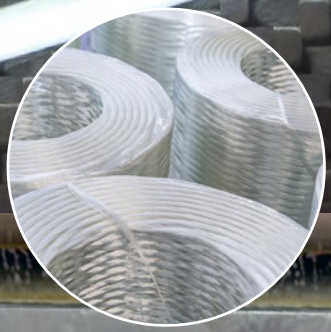

Composites Industry of Western Australia

SCOPING STUDY **2020**

RESOURCES INDUSTRY TRAINING COUNCIL

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CME

About this publication

Composites Industry of Western Australia: Scoping Study 2020

The primary objective of this scoping study was to identify issues, propose solutions, and recommend pathways for the development of skills and training within the Composites sector of WA in order to build resilience and adaptability.

This scoping study was initiated by The Resource Industry Training Council (RITC). The RITCWA is a state government funded joint venture between Chamber of Minerals and Energy (CME) and the Australian Petroleum Production and Exploration Association Ltd (APPEA), gathering industry intelligence, on current trends, skills gaps and training needs, which it provides to industry, the State Training Board (STB), Department of Training and Workforce Development (DTWD), the WA Government. RITC governance is facilitated through the RITC Advisory Board.

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This scoping study was conducted by Composites Australia Inc. (CA), the peak industry body for the composites sector in Australia – May 2020.

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1 Executive Summary

The objectives of the scoping study is to obtain a clear understanding of the impact of the composites industry in Western Australia as part of the state's economic base by mapping the key features of the industry, its existing labour force, skills and training provision, and future predicted needs.

Over a period of months the consultants held interviews with selected stakeholders, conducted an online survey and analysed data and industry reviews that have gone before this one. International and national case studies were also analysed for best practice and context. Enrolments and completions of AQF accredited courses were also reviewed.

The WA composite manufacturing industry has unique origins and a proud history of innovation. However, factors such as competition from imports, high wage costs, the 'boom and bust' economic cycle, and a constrained VET training sector have stymied its productive potential and the ability to ensure a skilled workforce.

The following data provides a snapshot of the current size, shape and value of the WA composites industry:

- Composites fabrication firms: > 80
- Workforce: ~ 1,200 people
- The top 12 firms employ a total of over 700 people
- Around 40 firms employ under 5 people
- Turnover: ~ A$300 million

There are five major market sectors: swimming pools and spas, marine craft, defence, transport (including a nascent advanced technology cluster), and industrial products (targeting the mining, oil and gas and agriculture industries). The vast majority of composites companies in WA operate from premises within the larger Perth metropolitan area, with a large cluster in the southern suburbs industrial zone. Companies are mostly privately owned SMEs, and only one listed company. Almost half are micro enterprises employing less than five employees.

It is clear that the industry has experienced a skills shortage for some time, the reasons for which are multifaceted. The resources boom and the subsequent economic decline in WA since 2015 and the ongoing changes to the VET sector has suppressed apprenticeship demand. As a result, the low enrolment and completion rate of apprentices has led to the parlous shortage of locally qualified and skilled labour. Until recently many employers sourced workers through the Skilled Migration Program which has now been curtailed.

Surprisingly, there is evidence that the industry is almost completely disconnected from the available employment services including government subsidies, information and support services and GTOs for labour sharing.

The research revealed an appetite for training within the industry. However, currently only the marine craft sector is employing apprentices. In other composites manufacturing sectors, skills training associated with composites fabrication is being done by the companies themselves, generally by experienced production managers using quality standards guidelines and operational manuals developed inhouse. This system of 100% on-the-job training is a heavy impost on employers and also means that workers are denied the opportunity to gain formal trade qualifications that will provide them a sustainable career path.

SMTAFE is the only WA training provider offering composites manufacturing skills training through its two apprenticeships (Marine Craft Construction and Composites Trade) and some customised fee-for-service training. Emerging from this consultation, attitudes

of the composites industry towards formal VET training can be summarised as "too slow, too rigid and too removed". Concerns relate to perceived deficiencies in training content, flexibility of delivery, and training facilities.

In addition, knowledge of the formal VET and higher education sector is limited, while there is a strong awareness of and commitment to inhouse/on-the-job skills training as well as licencing and standards certification requirements.

There is also little contact between the higher education sector and the composites manufacturing industry. Unlike the eastern states, there is no dedicated university-based collaborative research and development centre pertaining to composites.

Despite this, WA composites manufacturers are engaged users of computer-aided processes, such as CNC machines, Computer Aided Design (CAD), and 3D printing. However use of robotics processes associated with Industry 4.0 is limited and generally viewed as cost prohibitive.

Those who work within the sector are a resilient mob that have survived changing consumer trends and many 'boom and bust' economic cycles, as well as being marginalized in the procurement practices of government and the resources sector in recent times. Despite these headwinds, over 80 percent of those surveyed were optimistic about the future and 85 percent expected to increase their workforce in the next five years, including composite/fibreglass technicians. A rebound in the resources industries and government support for boosting local industrial capability has fuelled this optimism.

Section 7.2 outlines 28 potential solutions to address the key findings. Of particular importance is the need to tackle the skills shortage through improved VET training - by enabling cost effective and flexible training delivery that meets the skills needs of the industry.

A review of TAFE training services to the industry is timely, including the continuing viability of the existing two apprenticeship qualifications and consideration of other possible options. Also of importance is for the state government to leverage existing knowledge and WA-grown technologies, as well as cultivating and supporting advanced manufacturing start-ups through funding for R&D partnerships.

Kenwick Station composite roof 7Jun. A single piece sculptured monocoque canopy designed for durability and rapid overnight installation. Capital House Australasia Perth, made by Swarbrick Technologies. Image courtesy B Nelson

Western Australian Institute of Sport (WAIS) composites facade. Architects, Sandover Pinder with Melbourne partners dwp/suters architects, made by Swarbrick Technologies in Henderson and transported to site. Image courtesy WAIS

Left. Composite urban art 'Ascalon'. St George's Cathedral Sculpture 2009, International Design Competition. Capital House Australasia. Client: Marcus Canning and Christian Di Vietri. Sculpture made by Swarbrick Technologies. Image courtesy B Nelson

2 Introduction

The objectives of the scoping study is to obtain a clear understanding of the impact of the composites sector in WA and to explore the importance of the sector as part of the state's economic base by mapping the key features of the WA composites industry, its existing labour force and skills/training provision and future predicted needs. The report is designed to identify perceived gaps and problems and propose potential workforce training and skills development solutions.

2.1. WHAT ARE COMPOSITES?

Composites are Fibre-Reinforced Polymer (FRP or just 'composites') materials that are made from a polymer matrix reinforced with an engineered material, such as man-made or natural fibre. The matrix protects the fibres from environmental and external damage and transfers the load between the fibres. The fibres, in turn, provide strength and stiffness to reinforce the matrix. FRP composites may also contain fillers, additives, core materials or surface finishes designed to improve the manufacturing process, appearance and performance of the final product.

The most common form of composite is a polyester resin matrix combined with a glass fibre reinforcement which is known as GFRP. Carbon fibre composites are known as CFRP and are increasingly used for their strength and light weight. Aramid, Kevlar and even bamboo fibres can be used as reinforcement. The type of fibre and resins selected for each application is based on the manufacturing processes and equipment, and the end-use product.

The overall engineering performance characteristics of a finished composite far exceed those achievable from any of the individual components used in isolation. Fibre-reinforced composites typically result in lighter, stronger and more durable products.

Engineered advanced composites materials are used for their light weight, strength to weight characteristics together with corrosion resistance and lifelong performance and their ability to help protect people and assets from harm. As non-metallic materials, radio waves travel efficiently through most composites that can be embedded with technical functionality such as monitoring systems.

Global usage of composites is at its highest in North America, followed by Europe, as shown in the table below.

Measured as volume per head of population, North America uses 280% more composites than Australia. These figures suggest there is substantial room for growth in the Australian composites fabrication industry, to supply both the domestic and international markets.

Region	Volume per head of population
USA	2.20 kg
Europe	1.78 kg
Australia	0.78 kg
Asia	0.02 kg

Source: Owens Corning 2017

2.2. BACKGROUND TO THE SCOPING STUDY

A 2018 RITCWA paper, *Industry Developments and Workforce Challenges in the Manufacturing of Polymers, Chemicals, and Rubber & Cable-making*[1] sector identified the potential for growth in the composites sector to support the predicted expansion in Western Australia's resources industry, creating new opportunities and challenges.

One of the key challenges is the perceived shortage of the required skilled labour to meet production demands.

This finding is backed up by the IBSA Manufacturing and Engineering Industry Reference Committee *Skills Forecast Report* (April 2019)[2] which predicts imminent skills shortages in some trades and STEM occupations. The report also identified a number of workforce challenges and opportunities facing the manufacturing and engineering industry that have implications for skill development priorities. Push factors include:

- An ageing workforce
- Australian Defence Force projects that potentially will create many new jobs and demand for engineering skills over coming decades
- Changing technology driving the need for cross-disciplinary skills, and Post-mining boom migration of trades workers to the Eastern states.

As well as the above, additional workforce challenges were revealed during the scoping study:

- Tightening of the Federal government's Skilled Migration program[3]
- Low and declining apprentice numbers in many traditional trades.

2.3. GOVERNMENT POLICY FRAMEWORK INTRODUCTION

The policy framework at the State and National levels provide the environment through which opportunities to grow the composites sector exist.

WA State Government

- WA Jobs Act 2017, Diversify WA and 'buy local' procurement policy
- METRONET
- Defence contracts – shipbuilding, submarines, HMAS Stirling
- Space Strategy
- 50% discounted VET courses
- Tax incentives
- State Training Board
- Apprenticeship support system

Federal Government

- Australian Qualifications Framework
- National VET sector
- Apprenticeship incentives (for employers and apprentices) and support network
- Skilled Migration Program

[1] RITCWA (2018)
[2] https://ibsa.org.au/consultation-project/manufacturing-and-engineering-industry-skills-forecast-2019/
[3] See summary in Appendix 8.5

2.4. ABOUT THE RITCWA

The Resources Industry Training Council (RITC) is a joint venture between The Chamber of Minerals and Energy of WA (CMEWA) and The Australian Petroleum Production and Exploration Association (APPEA). The purpose of the RITC is to engage with the industry sectors it represents and gather intelligence on industry developments, workforce needs and strategies. The RITC uses this intelligence to advocate on behalf of industry and inform policy deliberations of the State Training Board and Department of Training and Workforce Development in Western Australia.

2.5. ABOUT COMPOSITES AUSTRALIA

This scoping study was conducted by Composites Australia Inc. (CA), the peak industry body for the composites sector in Australia. For over 40 years, CA has continued to represent hundreds of composite manufacturers, practitioners, suppliers, R&D agencies and education institutions. CA manages an annual program of industry development events, including conferences, international trade delegations, seminars and workshops. It participates in government and industry-driven committees and forums to formulate policy at state and federal levels. The association also implements government initiatives aiming to build capability and strengthen industry sectors and has conducted several industry scoping studies including the 2006 Composites Australia national composites manufacturing survey commissioned by Manufacturing Skills Australia[4].

CA Executive Director Kerryn Caulfield is a leader in advanced manufacturing and principal consultant on the study.

2.6. METHODOLOGY

For this scoping study, evidence has been collated from both primary and secondary sources to inform the findings and recommendations. The consultants worked with the RITCWA and the Board of Composites Australia to explore issues and ideas documented in this report.
The following research methods were used:

1. An online survey of WA composites manufacturing companies via Survey Monkey to elicit both quantitative and qualitative information on the state of the industry. Industry respondents to the study were overwhelmingly open and accommodating in sharing their knowledge, professional experience and perspectives on future industry directions.
2. Selected stakeholder interviews with:
   - WA composites manufacturing companies
   - WA TAFE training providers
   - East coast training providers – GOTAFE and Gordon TAFE
   - IBSA and other industry personnel
   - Government officers
3. Data analysis of employment figures, production growth, VET training data, etc. Data gathered in the survey was modelled and averaged to calculate the economic and employment dimensions of composites industry across the state.
4. Desktop literature review of key reports and research.
5. Use of international and national case studies for context, comparison and best practice examples.

[4] https://www.compositesaustralia.com.au/wp-content/uploads/2019/07/MASTER-COMPOSITES-INDUSTRY-SURVEY.pdf

3 An Overview of The WA Composites Industry

In WA, the composites manufacturing sector consists of an estimated 80 companies engaged in a range of production activities and supplying a myriad of industrial and retail end users, including the state's thriving resources industry. The composites manufacturing sector, as such, is not a significant direct employer and is dominated by small businesses.

Estimates from the survey data are that the WA industry consists of:

- Number of composites manufacturers: >80
- Workforce: ~1,200 people
- Turnover: ~ A$300 million

As an enabling technology, composites are used in an extensive range of applications across many industries; from utilities through to aerospace, construction, defence, marine, oil and gas, mining, rail and vehicle transport, renewables, medical and recreation products. Composite manufacturers may make an entire product, such as a boat, and/or produce components that are supplied to another fabricator to make a finished product.

While this study concentrates on composites manufacturers, the composites supply chain includes suppliers and manufacturers of material inputs such as chemicals, fibres and fabrics, as well as engineering, research, development and innovation (RDI), testing and software services.

3.1. INDUSTRY ORIGINS AND CULTURE

Composites companies in overseas markets are generally top tier, very large companies. In contrast, Australia's composites industry, like many manufacturing industries, is dominated by small to medium enterprises (SMEs) which predominately have entrepreneurial origins. This is particularly so for Western Australia, where a spirit of enterprise coupled with a sense of distance has fostered practical solutions and a diverse industrial sector.

WA's fibreglass surfcraft, sailboard and pool makers of the 1960s were pioneers fuelled by a sense of independence and 'can do' resourcefulness. At this time the eastern states seemed distant and irrelevant[5].

For example, Swarbrick Brothers built its first fibreglass yacht in 1967 at a time when traditional shipwrights were still loyal to timber. The company's first fibreglass sail craft was judged the perfect sail craft for the prevailing West Coast summer sea breeze. Fibreglass was also the enabling material to build transportable backyard swimming pools for families to escape the summer heat.

Western Australia has spawned a number of global step-change technologies such as the MacSurf[6] system software, which was originally developed in the 1980s at Windrush Yachts. This CAD/CAM application is used to design and manufacture windsurfers. MacSurf was renamed MaxSurf around 10 years later when it became available on multiple platforms. Another revolutionary WA invention is the Wintech 3 axis Hotwire foam cutting CNC machine developed by Wintech Engineering in Yangebup.

What was known as the 'fibreglass industry' has grown into a technical industrial sector in all states of Australia. In WA, the culture of the early adapters has provided a level of self-reliance and resilience in a slim and volatile market, qualities which are reflected in how composites companies in WA have approached training and skills development.. Companies that find ways to diversify and innovate are better equipped to weather the economic cycle.

[5]Interview quote: "[In the early days] there was a sense of isolation from information and materials but we weren't short on ideas. We'd just give-it-a-go, and if it didn't work, we'd have another go. It was creative and high risk – we loved it!"
[6]Macsurf an early NURB shiphull design system: A historical note. Mason Andrew 1/06/2002

3.2. THE COMPOSITES SUPPLY CHAIN

The supply chain that enables composite manufacturing/ fabricating operations to transform raw materials into final components and products includes manufacturers of material inputs such as chemicals, fibres, resins and fabrics as well as equipment, engineering, RDI, testing, and software services.

Raw material and equipment input suppliers

Various raw materials constitute the composite material such as fibreglass or other advanced fibres such as carbon fibre; plastic resins as well as pigment, catalysts and additives. There are a myriad of others inputs including, but not limited to mould release agents, adhesives and core materials for sandwich construction. Equipment required to manufacture composite components and products is also supplied by equipment input suppliers.

While these suppliers are recognised as part of the wider composites industry and some were consulted for this survey, their breadth and interrelationship with other industries made it difficult for all to be included in industry data. There is just one company (allnex) manufacturing resins in Australia, which has a large market share in WA. Other raw materials used in WA are imported from overseas or the eastern states.

Western Australian Institute of Sport (WAIS) composites facade. Architects, Sandover Pinder with Melbourne partners dwp/suters architects, made by Swarbrick Technologies in Henderson and transported to site. Image courtesy WAIS.

Manufacturers

WA composite manufacturers, often called fabricators[7] make an entire product such as a boat or a caravan - often under one brand. Others produce components that are commissioned by manufacturers closer to the end-user. The diversity in the manufacturing business models across a vast range of products covering industrial, defence and marine (to name a few) is a complication when profiling the industry.

With this breadth of end-use sectors and business models the WA industry remains highly independent from the Eastern states.

Engineering services

Composite manufacturers either employ qualified engineer/s or outsource external firms for specialist engineering services. Composite engineering is a broad discipline that can include civil, structural, mechanical, and chemical and materials engineering. Specialist areas can also include aerospace and automotive engineering. All require a deep understanding of the complexities of composite science when applied to the manufacture of commercial composite products. The discipline requires knowledge of the science of formulating material inputs; design and production techniques and an understanding of domestic and international standards and design codes and their application.

Repair and replacement of FRP products

There are a myriad of micro service companies repairing and replacing composite components and products across all sectors – such as aquatic, industrial, aerospace, mining, resources and marine.

Tanks West insulated tanks storing nickel sulphate solution made in Canning Vale. Image courtesy S Thompson

[7]The term manufacturer and fabricator are used interchangeably.

3.3. COMPOSITE MANUFACTURING PROCESS

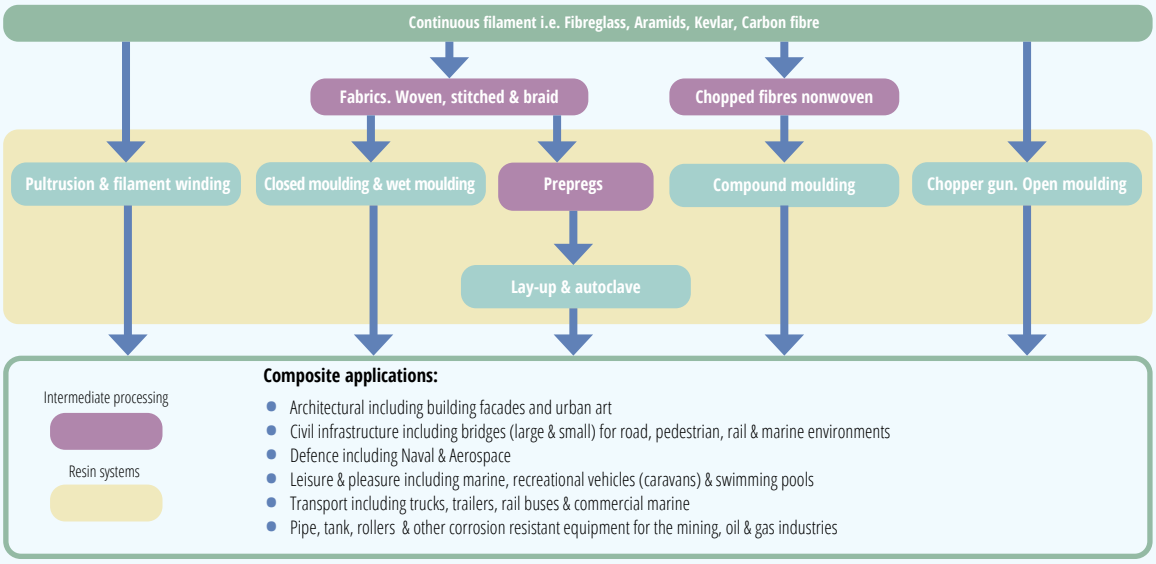
Raw material inputs move through a choice of stages to convert raw materials into a composite component. The stages are dependent on the chosen manufacturing technology, which in turn, is dictated by the required end-use, application or engineering specifications or standards.

Fibreglass rovings, carbon fibre tow and also chopped carbon fibre can be directly converted into a finished composite. This includes filament winding and pultrusion technologies.

Intermediate processing is when fibres or filaments are converted into semi-usable products such as textiles and prepregs. Additional mould processing is required to convert textiles and prepregs into a composite.

Another group of production processes convert the fibre and a resin matrix to a final composite. These can include, wet hand lay-up, vacuum bagging, resin transfer moulding, compression moulding and autoclave moulding.

The following depicts a simplified model of the composites manufacturing process routes and the relationship between fibre and fabric inputs. Several processes used elsewhere have been excluded from the diagram as they do not appear to be in common operation in WA.



3.4. MARKET SECTORS

Composite fabrication companies in WA can be divided into seven key market sectors, related to the products they manufacture. There is some level of double counting below, as many companies operate across more than one sector. The largest market sector are the pool and spa manufacturers, followed by marine craft (boat building and repairs), transport, industrial product manufacturers, and the multitude of smaller 'jobbing shops' for a wide range of product fabrication and repairs.

Some companies have evolved vertically to supply and identify with a single sector, such as the pools, transport, marine or infrastructure sectors. Others have thrived as generalist suppliers of fabricated components or composite repairs for a number of end markets.

Composites businesses that are oriented to the **local or national market** tend to be those manufacturing products that are large, bulky and costly to transport. This includes pools and spas, storage tanks,

and large bespoke structures for the resources industry. Few of these companies opt to source from offshore and appear to have fewer overseas competitors. There are also a number of companies producing one off bespoke composites parts, components and constructions including urban art and architectural installations.

Businesses selling to the **export market** tend to be focused on niche and/or high-end customised products, such as superyachts. In addition, pool and spa manufacturers are diversifying into the export market

	SECTOR	PRODUCT	% of WA companies (estimate)
1	Pools and spas (including repair)	Pools and spas	25%
2	Marine craft	Boats – canoes, dinghies, ferries, power boats, commercial vessels, yachts, superyachts Surfboards, windsurfers, canoes, etc.	34%
3	Defence	Decking, hatches, and component parts for aircraft, naval ships, and submarines Repairs and maintenance	2%
4	Transport: • Automotive • Public transport • Aviation	RVs, caravans, camper vans, bicycles, racing cars Trucks and trailers Trains, buses, trams Panels, wings, engine casings, blades, helicopters	5%
5	Industrial • Resources - mining, oil and gas, agriculture • Construction and infrastructure	Drills, pipes, storage tanks, equipment Grilles, walkways, handrails Architectural features - bridges, public art, cladding, etc.	27%

Matrix Composites and Engineering in Henderson manufacture buoyancy systems for deep sea drilling and other products.

3.4.1. POOLS AND SPAS

Australia has the highest rate of pools per capita in the world. Of the estimated 25,000 new in-ground pools built each year across Australia, **65 to 70 per cent** are now made of fibreglass, an increase from 5 percent during the 1980s when concrete and/or vinyl liner were the materials of choice. In WA, with Perth considered Australia's swimming-pool capital, the market share of fibreglass pools is even higher at an estimate of **up to 80 percent**[9].

Pool and spa shells are fabricated using composites open moulding where resin and reinforcements are sprayed onto a reusable mould using a 'chopper gun'. This process and related raw material volumes means that the pool sector consumes the most amounts of composite material inputs of any composites sector.

Australian fibreglass pools and spas are now the most technologically advanced in the world with competitors driving each other for new product improvements. Nonetheless, since the previous mining cycle in 2015, the industry has experienced a serious downturn (estimated at around 50%) due to subdued local consumer spending and the move to smaller residential blocks.

This situation has prompted pool companies to explore new markets in the eastern states and overseas, particularly North America. One manufacturer reported that the company's previous sales of 70% local WA sales, had reversed since 2015, with 65% of sales now outside the state.

Market share, quality and consumer confidence in the industry has advanced through collaboration with state governments and Standards Australia to develop a strict regulated framework for the construction, safety, installation and management of pools and spas. Over the last 40 years, fibreglass pool manufacturers have built a nationwide network through the Swimming Pool & Spa Association (SPASA), which has a comprehensive training and certification program for installation, inspection, repairs and maintenance, as well as landscaping and safety. In some states (excluding WA) pool installers and inspectors require a licence to operate.

Labour force and skills development

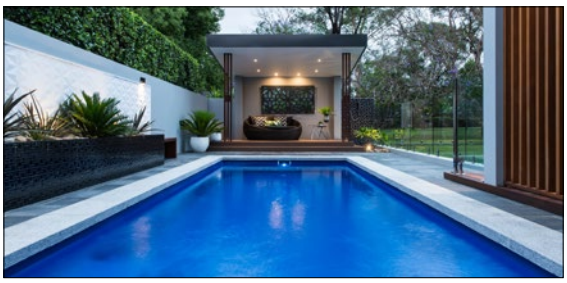
In WA, while there is a system of formal training for pools installation and maintenance, there is no equivalent system for skills development in the pools manufacturing process.

The five leading pool manufacturers[10] **are the largest employers in the entire WA composites industry** and report a serious shortage of skilled labour. In the past the industry was able to utilise the Skilled Migration Program to recruit experienced laminators and gel coat technicians, mainly from Asian countries such as the Philippines. But recent changes to the program have removed the category of 'fibreglass technician' from the list of priority occupations, thus severely restricting this avenue of recruitment. (See Appendix 8.5)

WA pool manufacturers have not adopted the MEM31119 Certificate III in Engineering -Composites Trades apprenticeship introduced in 2013. Several reasons were given during consultation for this study, including that the course was costly, did not accommodate onsite training, nor cover many of the skills required, such as relevant open moulding techniques (chopper gun). As a consequence, in the local fibreglass pools sector, all fabrication skills training for new recruits is done by inhouse technicians at the workplace.

Left. Aquatic Leisure Technologies Jandakot production site with staff and pool display.

Below. Aquatic Leisure Technologies swimming pool – Caprice made in Jandakot.



[9]SPLASH! Magazine, Dec2019/Jan2020 (p.44)
[10]The sector is currently rationalising: companies include Aquatic Leisure Technologies, Freedom Pools, Barrier Reef Pools, WA Fibreglass Pools & Billabong Pools (WA) Pty Ltd

3.4.2. MARINE CRAFT (OTHER THAN NAVAL)

The composites marine craft sector, as a subsector of the wider ship and boatbuilding industry, includes new vessel construction of small leisure craft, luxury yachts, pilot launches, commercial fishing boats, work boats, surfcraft, competitive craft and passenger vessels (ferries).

A 2017 KPMG report[11] identified almost 2,000 shipbuilding, boatbuilding and repair businesses operating across all Australian states and territories. In 2015, **Western Australia represents 18%** of this industry – including all material types (fibreglass, timber, aluminium, steel).

There are an estimated 10 marine craft manufacturers in WA that primarily or partly work with fibreglass, with the larger operators focussed on high-end custom builds, often for the export market. The largest marine craft companies are: Echo Yachts, Vikal and Dongara Marine.

The marine craft sector also features a plethora of support businesses dealing in boat and surfcraft repairs, modifications, maintenance, and chandlery that are found across the state, including in many coastal regions. A large number are micro-enterprises operating for lifestyle reasons as much as for commercial gain. Often called 'jobbing shops' and, while important, it is almost impossible to estimate the size and contribution of these marine craft repair businesses, which have not been surveyed in this study.

With 20,781 km of WA coastline, marine craft – both commercial and recreational vessels - are culturally and economically important to the state. Sensitive to global and domestic economic conditions, expansion and contraction of the sector is linked to consumer confidence and currency fluctuations that influence decisions on vessel purchases, upgrades or fitouts.

"The low Australian dollar is a catalyst for an increase in international demand for Australian boats, both commercial and pleasure. There has also been a significant increase in demand for commercial boats for the water police, border force and other government departments most of which are being built on the East Coast."

There are several marine craft clusters around state's coastline, including those in Fremantle and Dongara/Port Denison. The largest is the Henderson shipyards, which have been home to a number of world class composite, aluminium and hybrid builds, notably the 46-metre composite twin-hulled yacht "Charley". Launched in 2016, Charley remains one of the largest composite, resin-infused multi-hulls in the world. The 3D design and construction of the bespoke vessel took two and a half years (by Echo Yachts).

Labour force, skills and training

For large projects such as Charley, workers are often only engaged for the life of the project. Nonetheless, the skill sets developed by those working on such large projects are transferrable to other composites projects and sectors, such as pools and industrial manufacturing.

As a traditional trade, the marine craft sector has a culture of passing on skills and knowledge through both formal and non-formal education. Despite this, apprentice numbers are low in WA and have been in slow decline over the past decade, in line with the national trend. From a peak of 63 enrolments in 2007, in 2020 there are a meagre 10 marine craft apprentices in the state.

Vikal International luxury super yacht tender made in Bibra Lake. Image courtesy Lynden Vikingur.

[11] KPMG (July 2017) https://www.industry.gov.au/sites/default/files/July%202018/document/pdf/australias-marine-industry-capability_5.pdf?acsf_files_redirect

3.4.3. DEFENCE SECTOR

Composite materials are used for an increasing array of defence applications, ranging from naval vessels, aerial drones, armoured fighting vehicles, submarines, land systems, military aircraft, radomes[12] and communication dishes, weapons and body armour.

Supporting the Defence sector are a number of companies providing structural repair services. These are professional specialists guided by Australian and International standards including Australia's Civil Aviation Safety Regulations.

However, the size and scope of the defence sector is difficult to determine for a number of reasons, such as:

- The often-confidential nature of the supply relationships.
- Contracts for manufacture are likely to be protected by proprietary processes and technology.
- Companies supplying into or manufacturing for the sector may also supply the civilian market.

Nonetheless, a number of government documents give some indication of the dimensions involved. The Western Australian Defence and Defence Industries Strategic Plan released in October 2018, argues that WA's position as "an internationally recognised advanced manufacturing hub that is the pre-eminent base of operations for all Australian Defence Force (ADF) and Alliance operations in the Indian Ocean." The Plan aims to build on this existing capability in the defence industries by drawing on the State's expertise from the oil, gas, mining and other industry sectors.

Commissioned in 1978, the HMAS Stirling Naval Base on Garden Island plays a key role in the Defence Plan. Stationed at the Base are 12 Navy Fleet units including RAN's Anzac Class frigates and Collins Class submarines along with related operational support services.

On the mainland, the Australian Maritime Complex (AMC) is a cluster of government-owned and private industry infrastructure and facilities located in Henderson, 35km south-west of Perth. It is a leading naval shipbuilding and sustainment hub and includes manufacturing, fabrication, assembly, maintenance, technology and training and education operations servicing the defence, marine, oil and gas, and resource industries.

Companies based in the Henderson precinct include:

- Austal, the global shipbuilder, defence prime contractor and maritime technology company;
- ASC West's submarine support and repair facility; and
- Matrix Composites & Engineering which designs and manufactures proprietary
- composite and advanced material products for various end-uses.

In 2018, Defence West estimated that the AMC had "generated $2.5 billion for the local economy and created more than 40,000 jobs through 440 projects over the past 15 years."

For the future, the Australian and WA governments continue to invest heavily in the Henderson marine precinct. The Australian Defence two-year budget (2019-2021) totals more than $200 billion, of which over $2.2 billion will be spent in WA:

- $1.5 billion on infrastructure associated with our expanded maritime fleet and shipbuilding in Henderson:
  - $367 million to upgrade and extend HMAS Stirling facilities, and a further $670 million for new infrastructure for the Hunter class frigates.
  - $300 million for a centre to support training for the new Hunter class frigates and the Arafura class offshore patrol vessels.
- $200 million for infrastructure to support the Navy's new replenishment vessels.
- $718 million in the 2019-20 financial year for the ongoing upgrade and sustainment work for the existing maritime fleet of ANZAC class frigates and Collins class submarines at Henderson.
- Furthermore, to bolster Australia's national sovereign industrial capacity and security, the Federal government has committed well over $120 million nationally over two years towards grants and contracts for SMEs in the defence industries.

[12]A radome is a structural, weatherproof enclosure that protects a radar antenna.

3.4.3. DEFENCE SECTOR (continued)

The Henderson shipbuilding facility has been commissioned to construct the next generation of Australian submarines and patrol boats. While the focus is on heavy metals fabrication, the need for composites components and interiors is expected to benefit local composites suppliers.

If successful, the State government's campaign to relocate Australian submarine Full Cycle Docking to WA is also expected to create thousands of jobs and inject $600 million into the state's economy each year, again with potential flow-on for the composites manufacturing industry.

Growth opportunities in the Defence sector are reliant on the 'new defence procurement activities emerging in the 2020-2030 timeframe.'[13]

Airforce

Western Australia is home to three RAAF bases – Curtin in the Kimberley, Pearce in Bullsbrook near Perth, and Learmonth on the North West Cape peninsula – which support ADF operations, training and maintenance requirements, and the Special Air Service Regiment at Campbell Barracks.

An investigation of Australia's aircraft manufacturing and repair industry by KPMG[14] estimated that in 2016-17 the industry contributed $2 billion in Gross Value Added to the Australian economy, and another $0.9 billion annually in related flow-on effects and linkages.

The industry structure features distinct civil and defence operations, where only the largest prime contractors like BAE, Boeing and Airbus can operate in both segments. But there is a strong complementary and 'synergistic' relationship between civil and defence, including R&D and personnel transfer. Further discussion of the aviation sector is found in 2.4.5 of this report.

3.4.4. INDUSTRIAL SECTOR

The WA economy is dominated by its resources sector comprising mining, oil and gas, and agricultural commodities that relies on imported and locally engineered construction materials and auxiliary inputs.

Common composites products that are locally manufactured for these sectors are:

- Tanks for storage and transport (above and below ground, on and offshore)
- Pipes and fittings for a range of settings
- Water and wastewater treatment infrastructure
- Niche auxiliary items like gratings, caissons, walkways, handrails, ladders, odour control and manhole covers
- Repair of existing metallic structures.

However, as in other instances, there are some high volume composites industrial products, such as wind turbines, that are imported due to labour costs and procurement preference given to international supply chains.

Industrial composites also have application in civil engineering and construction, such as:

- Pedestrian and vehicle bridge construction
- Utility poles (including cross-arms),
- Pilings, gratings, catwalks, jetties, particularly in aquatic locations
- Cladding

Major WA manufacturers in this sector include:

- Matrix Composites and Engineering - the most technically advanced syntactic composites plant in the world, manufacturing buoyancy systems for deep sea drilling and other products.
- Tanks West – manufacturer of liquid storage and transport tanks for the agricultural, aquatic, industrial and mining sectors.
- GRP Tanks Solutions - manufacturer of above and below ground storage tanks for fuel, chemical, water, waste and sewerage.
- Prestige Fibreglass Products – operates the only automated filament winding machine in Western Australia manufacturing 25mm to 300mm FRP pipe
- CPS Conveyors – Develops, engineers and manufactures conveyor rollers from various composite materials including heavy duty, fibre-reinforced high-density polyethylene for the industrial conveyor industry.

[13]Western Australian Defence and Defence Industries Strategic Plan - Key strategy page 6
[14]KPMG (2019)

Most owner/operators of WA industrial composites firms have been in business for over 20 years, many having spent their working life in the sector.

Challenges

Regulations, standards and design guides play an important role in the choice and performance requirements of materials in the industrial sector. The composites sector recognises many are legacy standards written for concrete, wood or metals. The lack of design standards and guidelines is an impediment to the broader utilisation of fibre composites in civil engineering.

Growth opportunities

The industrial sector has possibly the greatest overall potential for growth in use of composites. The Diversify WA[15] policy document identified hydrogen as an emerging energy market in which WA has a competitive advantage. The report predicted the hydrogen market will grow substantially in coming years, with major export markets Japan and South Korea shifting towards a hydrogen economy. WA is well-positioned to be a major supplier of FRP composite pressure vessels for safe hydrogen storage.

Another emerging market for industrial composites, and where local manufacturers will have an advantage, is the expansion of lithium and rare earths in WA mines and processing plants.

Industrial infrastructure – a new industry:

Capital House

The Perth based engineering firm describes itself as the engineering interface between the composite and general construction industries and has designed major composite infrastructure projects and urban art installations both in Australia and overseas.

Capital House is utilising the attributes of FRP and has invested in designing, developing and patenting technology for cost effective, pre-engineered "flat packed mini bridges" which are compliant with Australian Bridge Design Code and Certified by Chartered Professional Engineer.

The Resin Transfer Moulded structures are approximately 85 percent lighter than conventional structures and are easily transported to and installed in remote and environmentally sensitive locations. The structures require no maintenance and can be fully pre-assembled off site and installed nominally within four hours.

Left. Capital House Australasia composite mini bridges in situ. Both Images courtesy B Nelson

Below. Capital House Australasia load testing for pultruded FRP beams for mini bridges.

[15]WA Government (2019)

3.4.5. TRANSPORT: TRUCKS, TRAINS, BUSES AND AVIATION

As Australia's largest state, the movement and management of freight and people is essential to Western Australia's economy. More than 60 million tonnes of freight move in and through the metropolitan area each year[16] and heavy vehicle road transport, regional rail and aircraft serve the resources and agriculture sectors.

The transport industry can be broadly divided into trucks, buses (coaches), rail rolling stock and aircraft[17]. Aviation includes gliders, sport and general aircraft.

Trucks and buses

In Australia, both the truck and bus industries have been moderately high users of composites particularly for driver's cabins, and exterior and interior panels. Refrigerated trucks insulated with high density polymer foam are used extensively around the country.

The eastern states are home to the three major truck manufacturers, Paccar, Iveco and the Volvo Group. There are many smaller specialised truck and trailer manufacturers across the country, though WA appears to be home to only a few specialists that convert existing vehicles to refrigerated trucks as well as campervans.

There are six major bus manufacturers in Australia many of which subcontract the manufacture of composite components. Volgren, one of Australia's major bus manufacturers, has a manufacturing and sales site in Malaga. However, componentry is said to be mostly imported from Victoria and overseas, with 'a little composite repair being done onsite.'

There were no opportunities in manufacturing trucks or buses and associated training needs presented during research for this scoping study.

Rail

METRONET is Perth's biggest investment in public transport and rail projects to date. Stage one will deliver approximately 72 kilometres of new passenger rail and up to 18 new stations. The second stage is the build of 246 new C-series railcars over the next decade. Under the State Government's 2017 election commitment, 50 percent of the railcars must be made in WA, which is expected to create hundreds of jobs.[18] The deal returns local railcar manufacturing to WA, following the closure of the Midland Railway Workshops in 1994.

However, the messages around the use of composites and related training for the METRONET project are mixed. Because the railcars and cabins will be made of carbon steel, new apprenticeships and other training needs will be focused on the metal trades. While there is likely to be only limited use of composites in the production of rolling stock, there may be an opportunity for composite technology to replace timber sleepers and transoms which are subject to warping and rotting, and costly to repair. According to the University of Southern Queensland, "It is projected that in the next five years, Australian rail-track asset owners will move from a traditional timber-based system (with a limited lifespan of 15 years) to that of an engineered composites system (with a lifespan of 50 years)."[19] USQ claims that rail sleeper and timber transom replacement is a global industry worth over $1.3 billion per year. Despite this prediction, at this stage there is no evidence that locally sourced composites will be used for the METRONET rail tracks.

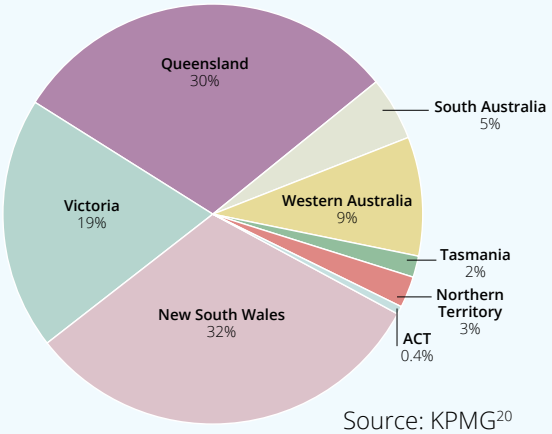
C-Series railcars METRONET

[16]https://www.transport.wa.gov.au/Freight-Ports/freight-information.asp
[17]Other than Defence
[18]Media statement 18/08/2019: Made in WA: METRONET railcars to be proudly built in WA
[19]https://www.usq.edu.au/news/2018/10/rail-technology

Aviation

Aviation plays a key role in the State's prosperity. Its network of air services, routes and airports connect communities and enable the tourism and resources sectors to function throughout the state. One of the industry's key capabilities is the manufacture of avionics, aircraft structures, airframes and parts, including the use of advanced composites, light-weight materials and 3D printing.

State distribution of Aircraft Manufacturing and Repair Services Businesses (Business count 2017-18)



Source: KPMG[20]

Employment

Nationally there are 937 registered businesses in this industry, 96% of which are SMEs employing fewer than 20 workers. It is estimated that 9-10% of businesses are based in Western Australia, mainly in Perth[21]. In 2016-17, the Aircraft Manufacturing and Repair Services industry accounted for nearly 1.5 per cent of total employment within the manufacturing sector in Australia, which was higher than the employment share of ship and boat building (0.9%) and motor vehicle manufacturing (1.1%).

Skills and training

The declining availability of skilled labour within the industry due to the fall in apprentices and trainees over the past decade was a critical concern. As well as university degrees, VET qualifications are considered vital to equip the workforce with the necessary skills for Aircraft Manufacturing and Repair Services. The MEA Aeroskills Training package provides qualifications at various levels in Avionics, Mechanical and Maintenance and other aeroskills for civil and military applications.

The KPMG report notes that: "Stakeholders indicate that it is getting increasingly difficult to attract and retain young apprentices in the (already limited) training and apprenticeship programs. It is also believed that current education and training for the new workforce could be better aligned to industry needs. A shortfall of skilled engineers and mechanics is a challenge for businesses. Concerted efforts in providing new and adequate facilities for skills training and STEM programs is imperative to sustain the industry in the long run. Also, there is a need to harmonise training and adopt international training standards to ensure recognition of domestic qualifications for overseas work."[22]

Trends in the transport sector:

R&D - The KPMG report noted that the Aircraft Manufacturing and Repair Services industry is technologically intensive. "The key drive to innovate … [is] to meet market demands and leverage new opportunities in niche markets, which can eventually be commercialized." (p.14) However, the nation's key aerospace R&D institutions, including the Advanced Manufacturing Growth Centre (AMGC) and the Defence Materials Technology Centre, are in the eastern states, mainly Victoria and New South Wales.

New industries and tech startups in transport - Despite the lack of key R&D centres in WA (see 5.1.2 Higher Education), there is a growing cluster of high-tech start-up companies based south of Perth, which point to a nascent advanced transport manufacturing hub. Though it is early days, three examples include Electro Aero, Warpforge and Carbon Art.

WARPFORGE

Despite being approached for this study, a WarpForge representative was unable to share any details on the company because of "confidentiality issues". However, the company would appear to

[21]KPMG (2019) *Australia's Aerospace Industry Capability, Research and Economic Modelling of the Aircraft Manufacturing and Repair Services Industry*
[22]KPMG (2019) See also Defence West (May 2018) p.30
[23]KPMG (2019) op.cit. p.21

have an interest in transport and defines itself on its website – www.warpforge.com - as "a manufacturer and IP owner of the most scalable, fastest and largest digital composite production technology in the world. We see a world where products enabled by advanced smart materials connected to platforms refine themselves using advanced AI."

CARBON FIBRE TECHNOLOGY (CARBON ART) – MINERAL RESOURCES

Composites technology is being deployed by Mineral Resources to reduce mining dump truck weight to increase payload using carbon fibre technology. As with WarpForge, a company representative is reticent to share information on the start-up "as the product is still in the R&D stage." However, its website - www.mineralresources.com.au/our-business/innovation/carbon-fibre-technology - states that "a carbon fibre manufacturing facility south of Perth has been established with the core focus of producing carbon fibre structural components for use in the mining industry. Our production prototype of a carbon fibre tray for Haulpak dump trucks has been completed and is undergoing extensive testing. Carbon fibre trays weigh substantially less than traditional steel trays increasing payload by at least 10%. The result is an equivalent reduction in the number of trucks required. 10% less trucks means 10% less fuel usage and 10% lower emissions. Also, with 10% fewer trucks, there will be fewer tyres required, creating less waste."

Prototype of a carbon fibre tray for 150 tonne Haulpak dump truck fitted with an MRL carbon fibre tray. *The West Australian* reported on April 14 'MinRes puts CarbonArt on ice amid coronavirus pandemic'

SPACE

A further area for innovation in Australia is the space sector. The Federal government recently commissioned the report 'Advancing Space - Australian Civil Space Strategy (2019-2028)' which forecast the space industry would grow to over $US1.1 trillion by 2040.1 from of value of US$350 billion today. The government's goal is to triple the sector's GDP contribution to $12 billion and to create an additional 20,000 jobs by 2030.

Advanced materials and processes – including GFRP and CFRP – have been fundamental in enabling space travel, making it more affordable and more feasible. Weight and cost-savings are critical for the space industry. Materials that can withstand the harsh conditions of space along with lightening the load for the long journey are essential.

While Queensland and South Australia are competing to attract the New Space Economy investment and manufacturing capability, a 2018 WA report[23], identified that 'there is no capability in launch facilities or design and manufacture of large satellites in WA'. The report identified a strong innovation pipeline in the four WA universities that were providing programs across all the disciplines that are essential to a sustainable space industry, including engineering, spatial sciences, computer science, astronomy, cyber security, mechatronics and material science.

For the VET sector, the report identified that SMTAFE has 'high quality existing programs and the ability to develop new programs in consultation with industries that integrate disciplines and address identified industry needs.'

Despite the positive reports on Space Technology capability, there is little evidence to date that local WA companies are developing manufacturing systems to service the space industry.

DRONES

UAVs or drones[24], which are used in both defence and civil situations, are a thriving new aviation application for composites. UAVs are transforming operations in conflict zones where they are increasingly used to perform hazardous work that was once performed by military personnel, including monitoring and aerial mapping, surveillance, and delivering supplies.

Drones are a worthy application for composite technologies, particularly carbon fibre, which has the strength-to-weight and stiffness-to-weight ratios to support large wing spans.

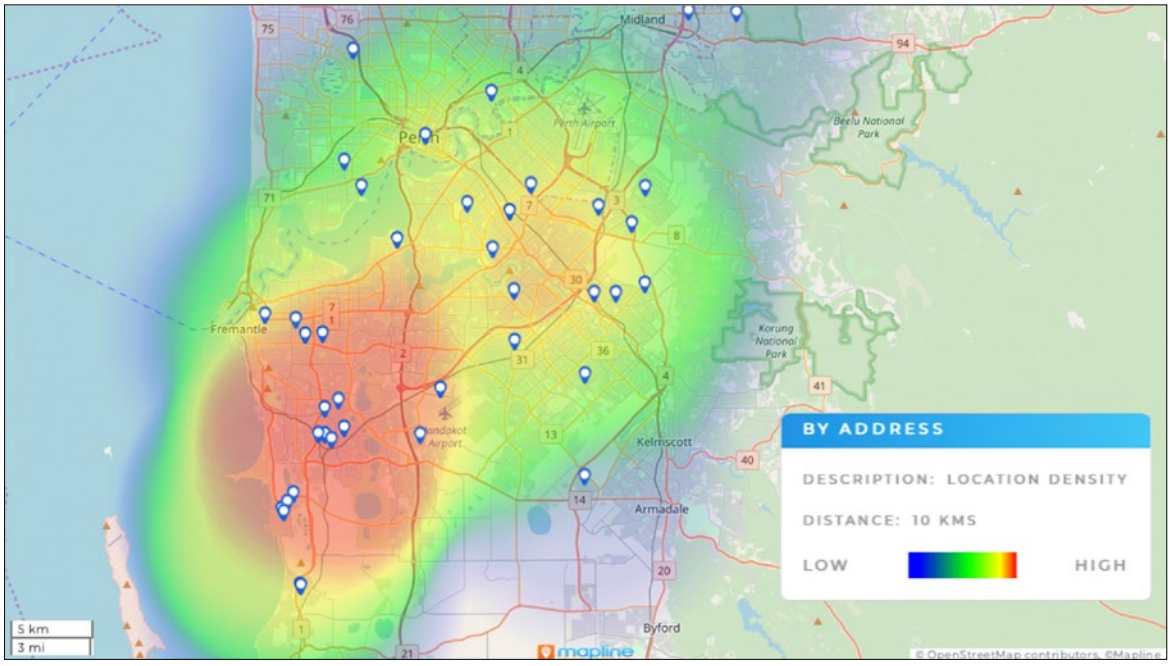
[23]ACIL Allen (2018) 'Space Industry Capability in Western Australia'

Electro Aero operating from Jandakot Airport is one such start-up working with drones. The company is pioneering the development of electric flight by focusing on the key enabling technology - the propulsion system. There have been discussions around trying to leverage the WA resources sector's remote operations capability to accelerate building space capability.

Growth opportunities

The Economic Development Framework outlined in the Diversify WA policy identified government procurement reform as a lever for economic outcomes, particularly by way of local industry participation. To that end, a growth opportunity in the transport sector is the unprecedented investment in transport infrastructure particularly rail.

3.5. LOCATION



Location density heat map by address around Perth

The vast majority of composites companies in WA operate from premises within the larger Perth metropolitan area, with a large cluster in the southern suburbs industrial zone.

There is also a large number of micro companies based in regional coastal towns engaged in composites boat and surfcraft manufacture and repairs. Boat builders and repair shops exist in Geraldton, Jurien, Dongara, Mandurah, Busselton, Rockingham, Bunbury, Augusta, Albany and Denmark, among others. These towns are important for regional employment and economic development, often supporting large commercial and recreational fishing industries as well as tourism.

Businesses operating in regional towns face specific challenges, including supply chain factors, including access to materials, skilled labour, and training, and product distribution, as well as fluctuating local demand.

[24]To the military, they are UAVs (Unmanned Aerial Vehicles) or RPAS (Remotely Piloted Aerial Systems). However, they are more commonly known as drones.

3.6. SIZE AND VALUE

Most composites companies are privately owned SMEs. There is only one listed composites company in Western Australia - Matrix Composites & Engineering.

Defining the value of the Australian composites sector according to existing statistical definition can be challenging as there is not a distinct civil subsector in the Australian standard industrial classifications (ANZSIC). ANZSIC **Code 1919 Other Polymer Product Manufacturing** is the closest, but it includes non-composites manufacturing sectors.

The best measure of the sector comes from raw material usage, particularly fibreglass, which is the essential work horse of the Australian composites sector. According to ABS data, raw material demand for fibreglass increased by 16 percent nationally in the 2018/19 financial year when compared to 2017/18 - the strongest growth rate in 14 years – as illustrated by the following graph.[26] This can be attributed to the use of fibreglass reinforced composites in infrastructure including piping systems and bridges as well as growth in the boat building sector.

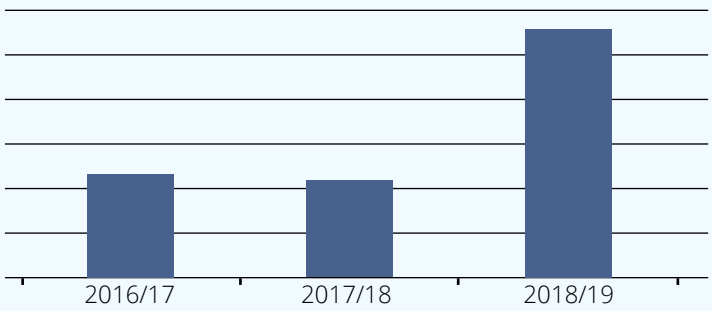
The use of **carbon fibre** in composites is also increasing – albeit from a small base - with entrepreneurial end-uses in automotive, industrial, marine and oil and gas sectors. While defence-related applications are also increasing, volumes are often confidential and difficult to measure.

Additional confidential data available to Composites Australia demonstrates, at the national level, there has been long term positive growth in the industry since the GFC of 2008-2009. Furthermore, productivity has been improving as a result of the industry-wide adoption of more efficient and enabling production technologies, engineering services and waste reduction programs that facilitate the production of "more with less".

Even so, information presented during the scoping study suggested that the national increase in composite materials usage was not applicable to WA and that business in this state has not recovered from the GFC to the same extent as elsewhere.

Innervations C-Force carbon fibre performance force platform – top. Prototype by Composites Components. Image courtesy G. Oldfield

Australian Glass Fibre Imports over Three Years



Source: ABS data - aggregate of chopped strand, rovings & mats

[26]Australian Bureau of Statistics 2019

4 Employment Profile

4.1. CURRENT EMPLOYMENT

Survey respondents reported a total of more than 606 employees at this time, but there is a wide disparity in workforce numbers between companies. The majority of companies employ less than 10 core team members, and very few employ over 100 core workers. The largest companies, such as Matrix, and the leading pool companies each employ between 120-160 people.

Ninety percent of employees are part of the companies' ongoing core team, and 10% are employed on temporary contracts as casuals, project workers, or contractors.

- Workforce: Approximately 1,200 people
- Number of companies: >80
- The top 12 firms employ a total of over 600 people

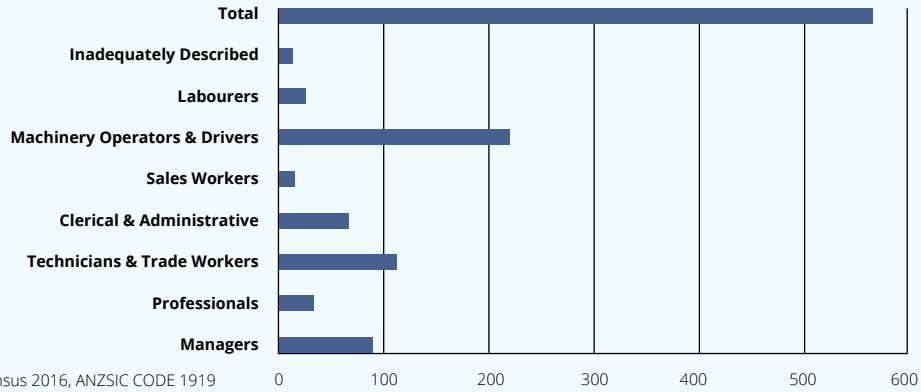
Extrapolating the above data across the sector provides the following estimates:

Approximately 40 firms employing less than 5 people

The Western Australian composites sector consists of >80 enterprises employing close to 1,200 people. Of these, around 50% are micro businesses and barely a dozen companies employ over 20 people. The value of the sector is close to A$300 million.

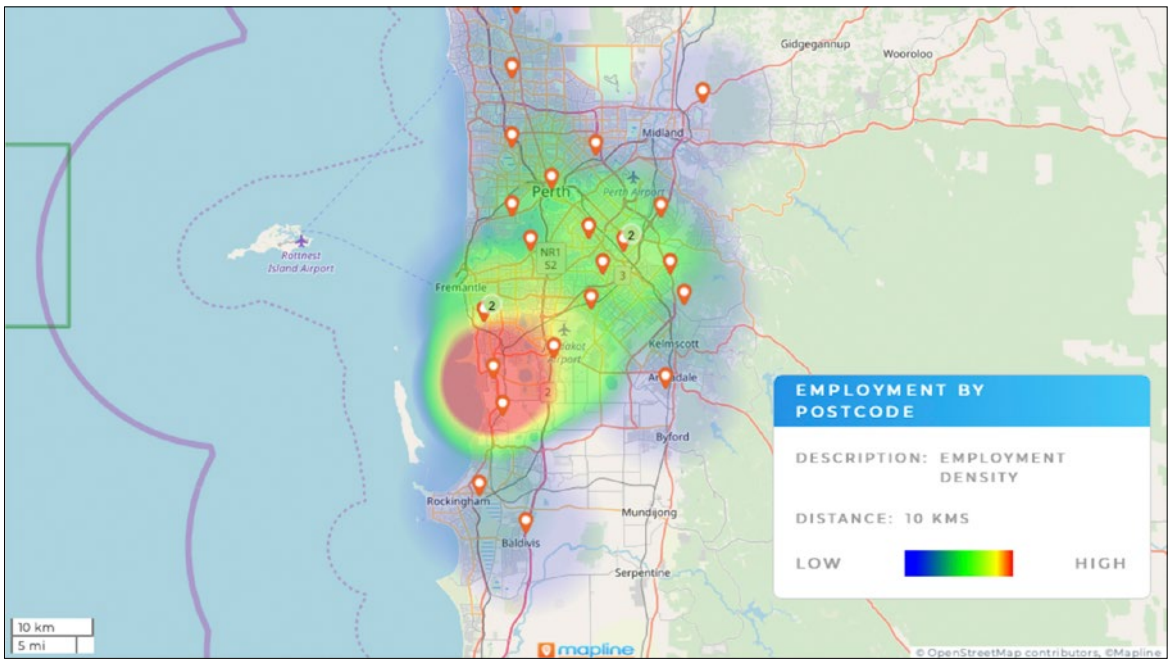
The table below applies the ABS 2016 Census and the ANZSIC industry classifications of Polymer Production Manufacturing, Synthetic Textile Manufacturing and Synthetic Resin and Synthetic Rubber. Using the Census data, the total workforce numbers for WA of 566 appear very small. The majority of workers were Machinery Operators and Drivers, followed by Technicians and Trades Workers. However, it should be noted that these figures are indicative only as they are based on Census self-reporting and may not capture composites workers that appear in other ANZSIC categories.

Number of Workers in the WA Composites Industry: 2016 Census



Source: ABS Census 2016, ANZSIC CODE 1919

Following is a map showing the employment sorted by postcode that illustrates the cluster in the south of Perth.



Employment by postcode - map focused on Perth CBD.

4.2. RECRUITMENT

Over 80 per cent of respondents have tried to recruit new employees/workers in the last year with 82 percent looking for "Qualified trades people". 60 per cent of employers are looking equally for apprentices and unskilled workers, and 20 percent have tried to employ engineering staff.

Employers are using a variety of methods to attract workers, in priority order:

- Word of mouth
- Advertising (including SEEK)
- Recruitment agency
- Local schools
- Government Skilled Migration Program
- Labour hire company

No companies reported using a Group Training Organisation to hire apprentices nor a Disability jobs provider.

Ninety percent used "Word of mouth" as the most common strategy to recruit and over 80 percent had advertised. Many expressed frustration at the ineffectiveness of advertising – be it due to a shallow pool, a reluctance to work in an industrial environment or simply reticence to commit to a job - and used word of mouth as an alternative.

This corresponds with the recent NCVER report of traditional trade apprenticeships that found: "Very few employers (especially of direct-indentured apprentices) had any luck with advertising in newspapers or online and were often frustrated by the low calibre of many of those who applied through these media." Family and friendship connections were said to be a key means of identifying potential apprentices, helping employers to know the background of the candidate.

Collectively the results confirm there is ongoing difficulty in finding suitable workers. As one interviewee said: "I'm happy if they have a pulse."

The Australian government's Skilled Migration Program was previously an option, but recent restrictions have largely closed off this portal for composites technicians. Although shipwrights and boat builders are still on the priority occupations list, the system has become too expensive and processing time too slow to be viable. Some marine craft companies expressed an interest in sourcing qualified workers from countries such as South Africa and the UK if these barriers were removed.

"The real impact [of skilled migrant restrictions] is not that a bunch of locals get jobs. The real impact is that a bunch of SMEs are without staff."

Some WA composites companies now employ other trades workers (shipwrights, plumbers, cabinet makers etc.), whose skills are seen as transferable to the manufacturing environment.

At least one employer has recruited from New Zealand, which has an integrated Composites and Marine Craft training pathway and a large pool of qualified technicians. However, most composite companies have been forced to hire unskilled labour and to train them on the job.

Surprisingly, there is evidence that the industry is almost completely disconnected from the available employment services:

- 75% of respondents had not accessed government employment subsidies in the last five years.
- None reported using the network of job providers to recruit, or GTOs for labour sharing.
- There was little (if any) use of employment and apprenticeship support services, such as the AASN and TAFE Jobs & Skills Centres.

4.3. FUTURE EMPLOYMENT TRENDS

4.3.1. SKILLED WORKERS

In the past year, 80% of respondents had tried to recruit workers in the following occupational categories (from most to least):

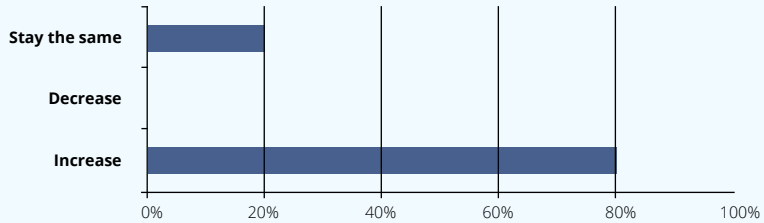
- Qualified trades
- Apprentices
- Unskilled
- Engineering
- Management

None of the respondents reported the need for workers with IT or design skills.

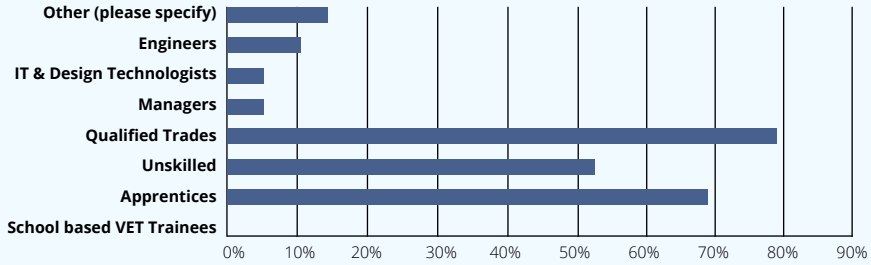
It is worth noting that, except for the largest enterprises such as Matrix, product and process engineering and design work is generally outsourced to specialist consultants. Very few companies employ inhouse engineers or designers.

For the next 5 years, 80 percent of respondents have plans to increase their workforce. None of the companies were planning to downsize.

Q9: What changes do you expect to make to your workforce over the next 1-5 years?



Q13: In the next 1-5 years, do you expect to employ more personnel in the following positions? (Multiple choice)



4.3.2. APPRENTICES

In the next five years, 85 percent are expecting to employ composite/fibreglass technicians, and 35 percent are likely to employ shipwrights or boat builders. The 25 percent who responded to "other" are hoping to employ CNC programmers and engineers.

As revealed by enrolment and completions data for the Certificate III in Marine Craft Construction, fibre-glass boat building is the only composites sector still employing apprentices to any extent. Still referred to as 'shipwrighting', the trade qualification has long history in a sector with a proud master/apprentice tradition. The Certificate III in Engineering – Composites Trade is less established and has not met the needs of the WA composites industry.

When asked if there are barriers to employing apprentices, 70 percent concurred, primarily due to a shortage of suitable applicants. Many lamented about issues associated with youth including reliability, self-management, planning and organising skills. Other key reasons were the direct and indirect costs to the business of an apprentice and problems with external training provision. Another perspective was provided by one employer, who said he did not employ apprentices due to the uncertainties of work continuity in his business and the lack of a career pathway in the industry.

The previous resources boom still casts a shadow across employers' and workers' attitudes alike. Manufacturers expressed reluctance to take on apprentices for fear they would leave for the more highly paid resources sector once qualified.

Proposed solutions to the barriers to employing apprentices, included:

- Expand the pool of applicants through a marketing campaign
- Improved government subsidies
- Improvements to formal training provision

There was some dismay expressed at the failure of the Certificate III in Engineering – Composite Trades introduced in 2013. The local industry had lobbied hard for the course, and many experienced technicians were awarded the qualification via RPL during the first two years, but support has since evaporated.

The economic decline in WA from 2015 is likely to have suppressed apprenticeship demand at that time, but employers in this survey focused on TAFE delivery as the main issue, as illustrated by the following quotes:

- "TAFE seemed to be content to let it 'wither on the vine' rather than put any investment into it. Everything was a barrier."
- "Acquiring equipment and materials seemed to be a big barrier" and the industry was asked to donate or help purchase them.
- "The pathways [within the MEM training package] don't exist, while they did in the PMB package".

The inability of the TAFE program to teach core composites skills, like chopper gun techniques, was repeatedly raised as a problem.

But – to quote one employer - if the TAFE course was properly resourced and equipped: "I'd start sending kids through there tomorrow because that's what we need."

Another interviewee: Boat builders are trained to think laterally. They are taught to understand complex shapes, torsional load, windage and the science of the materials with which they work. A qualified Shipwright has transferable skills that can more than adequately build structures and components other than boats.

5 Skills & Training Profile

5.1. TRAINING AND EDUCATION PATHWAYS

The pathways to becoming a skilled Composite Technician or Tradesperson (alternative titles can include Laminator, Composite Fabricator, Fibreglass Technician/Tradesperson, and Shipwright) are as follows:

- Formal VET qualifications – generally a four-year Certificate III apprenticeship
- On-the-job training combined with practical experience of up to 4 years

On-the-job-training was confirmed as the most used method for all types of skills development in WA's composites manufacturing firms:

- Over 70 percent of respondents frequently provide "On-the-job-training",
- 74 percent use "External short courses"

  and
- Over 68 percent use "Accredited qualifications", but only sometimes
- 90% of companies sponsor workers to obtain work tickets and licences either frequently or sometimes.

Top Left. Aquatic Leisure Technologies - Fit out bay
Left. Electrical engineer repairs a laser cutting head on large CNC computer numerical control printing and cutting machine
Above. Finishing a composite part.

5.1.1. VET QUALIFICATIONS

The AQF accredited courses most relevant to the composites industry are as follows:

MANUFACTURING AND ENGINEERING TRAINING PACKAGE

MEM31119 Certificate III in Engineering – Composites Trade

Developed by an industry-led national committee, this Certificate III qualification was released in March 2012 as MEM31112 and approved for inclusion in the AQF. The aim was to create a manufacturing trade qualification and a career pathway specifically for composites technicians working across a broad range of Manufacturing and Engineering industries.

In 2013 the new Composites qualification commenced delivery in WA at the former Challenger TAFE. In Victoria, it was launched by Kangan TAFE in the same year before being picked up by GOTAFE in October 2015. In mid-2019, the latest qualification update – MEM31119 – received approval by the Australian Industry and Skills Committee (AISC) for introduction in 2020.

Nationally, Certificate III in Engineering - Composites Trade is currently on scope as a four-year apprenticeship with two TAFE providers, GOTAFE (Vic) and SMTAFE (WA).

- Victoria: Since inception, around 25-30 apprentices have commenced with 14 completions to date[29]. There are 25 enrolments in 2020, some of which are NSW regional students receiving training via GOTAFE's flexible delivery. (See Case Study on Compass Pools).
- Western Australia: 15 apprentices have commenced since 2013, of which 4 have completed and one is still enrolled[30]. SMTAFE has also awarded the qualification to 13 industry members through an RPL process.
- Based on these statistics, the national total of technicians who have completed the MEM31112 Certificate III in Engineering - Composites Trades is now 31.

MEM30719 Certificate III in Marine Craft Construction[31]

The Marine Craft qualification is a traditional shipwrights course, which covers all aspects of boat building and surfcraft from design through to construction of plugs and composite moulds and products. There is a strong focus on fibreglass fabrication and many units are compatible with units in the Certificate III in Engineering – Composites Trade apprenticeship. This allows training providers to combine student cohorts and deliver both courses simultaneously.

The Marine Craft qualification is offered across Australia as a three-year (39 months) apprenticeship and is currently delivered by TAFE in four states: SMTAFE (WA), GOTAFE (Vic), TAFE Queensland (Coomera campus), and TAFE NSW. The course is also available for fee paying international students in some states (not represented in the data on page 32).

National enrolments peaked during the 'boom' years leading up to the GFC, reaching a high of 637 in 2008 before declining again post-GFC. In WA, Marine Craft apprentice enrolments have fallen steadily from 63 in 2007, down to 10 in 2020.

Enrolments MEM30603 & 30705 - Certificate III in Marine Craft Construction (Government-funded including ViS students.

The Berkeley Pilot Boat in action on its launch off the WA coast

[29] GOTAFE anecdotal
[30] NCVER VOCSTATS
[31] MEM30719 will be introduced in 2021. Earlier versions of the qualification were released in 2005 (MEM30705) and 2003 (MEM30603)

Enrolments MEM30603 & 30705 - Certificate III in Marine Craft Construction (Government-funded including ViS students)

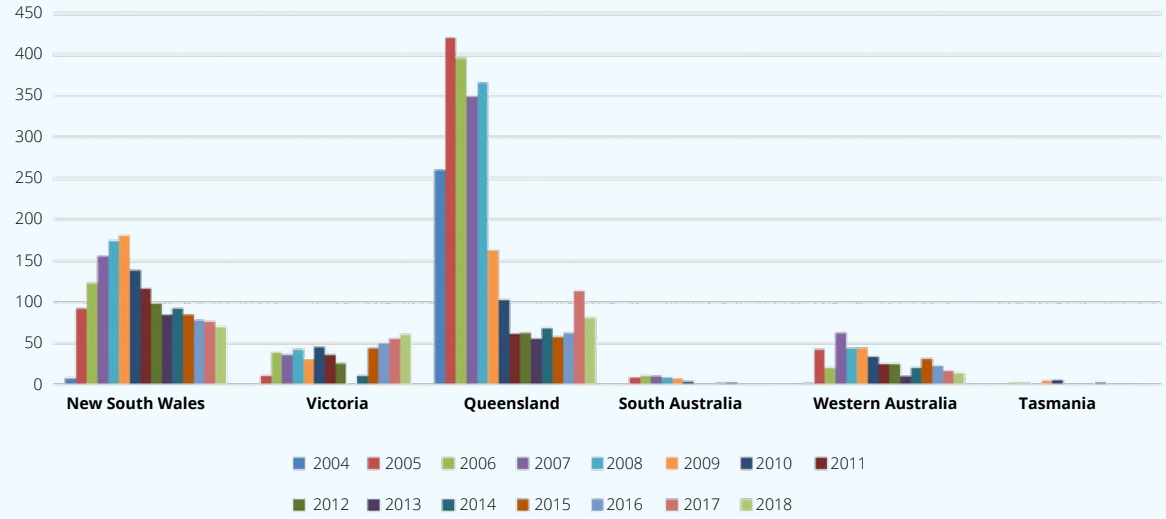
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
New South Wales	8	92	123	156	174	181	139	117	98	85	92	85	78	77	70
Victoria	0	11	39	36	43	31	46	36	26	0	11	44	50	56	61
Queensland	261	421	396	349	366	163	103	62	63	56	69	58	63	114	81
South Australia	0	9	11	10	9	8	4	1	1	2	3	0	0	0	0
Western Australia	2	43	21	63	44	45	34	25	25	10	21	32	23	17	14
Tasmania	0	0	3	2	1	5	6	0	0	1	3	1	1	0	0
Total	271	576	593	616	637	433	332	241	213	154	199	220	215	264	226

Source: NCVER VOCSTATS

Notes:

- Perturbation removed.
- State refers to the location of the RTO, not where the course was delivered, therefore some NSW students may be captured in the Victorian figures.
- From 2018, Non-nationally recognised training and training delivered by non-registered training organisations is excluded. This means 'Type of training' no longer presents data for 'locally developed courses' or 'locally developed skill sets'. Data has also been back-cast to 2015.

Enrolments: MEM30603 & 30705 Certificate III in Marine Craft Consruction (Government funded only)



Completions

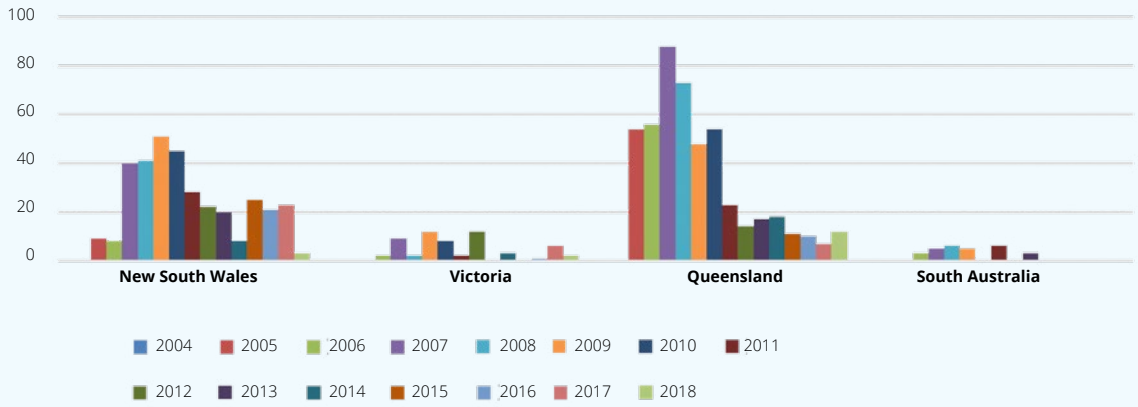
Marine Craft completions peaked nationally in 2007, before declining rapidly after 2010 (post-GFC).

Completions: MEM 30603 and 30705 Certificate III in Marine Craft Construction

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018 (prelim)
New South Wales	0	9	8	40	41	51	45	28	22	20	8	25	21	23	3
Victoria	0	0	2	9	2	12	8	2	12	0	3	0	1	6	2
Queensland	0	54	56	88	73	48	54	23	14	17	18	11	10	7	12
South Australia	0	0	3	5	6	5	0	6	0	3	0	0	0	0	0
Western Australia	1	0	0	3	8	9	21	9	5	0	9	1	0	9	6
Total	1	63	69	145	130	125	128	68	53	40	38	37	32	45	23

Source: NCVER VOCSTATS

Enrolments: MEM30603 & 30705 Certificate III in Marine Craft Consruction (Government funded only)



Western Australia

The 'thin market' for composites and marine craft technicians in WA is confirmed by the following enrolment and completion figures for the two apprenticeship courses (MEM31112/9 Certificate III in Engineering - Composites Trade and MEM30603 or 30705 Certificate III in Marine Craft Construction).

Total Enrolments: Certificate III Composites Trade and Marine Craft qualifications (WA only)

	2013	2014	2015	2016	2017	2018	2019	2020
MEM31112/31119 – Composites Trade	4	14	9	1	0	2	1	1
MEM30603/30705 – Marine Craft	10	21	32	23	17	14	11	10
Total	14	35	41	24	17	16	12	11

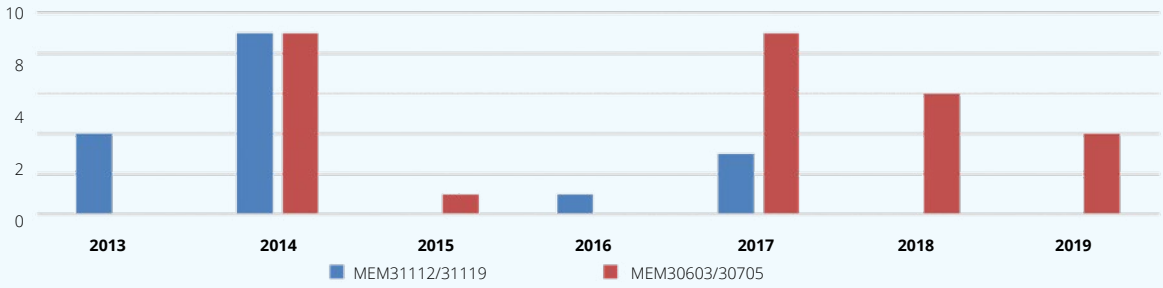
Total Completions: Certificate III Composites Trade and Marine Craft qualifications (WA only)

	2013	2014	2015	2016	2017	2018	2019	2020
MEM31112/31119 – Composites Trade	4	9	0	1	3	0	0	
MEM30603/30705 – Marine Craft	0	9	1	0	9	6	4	
Total	4	18	1	1	12	6	4	

Source: NCVER VOCSTATS and SMTAFE

Note:
Annual enrolments capture the same apprentice multiple times; therefore do not represent the true number of apprentices going through the system.
The Composites Trade enrolments and completions in 2013 and 2014 include 13 experienced composites technicians to qualify via an RPL process.

Combined completions: Composites Trade and MEM30603 and 30705 (WA)



PLASTICS, RUBBER AND CABLEMAKING TRAINING PACKAGE

The current Plastics, Rubber and Cablemaking training package[32] comprises the following five accredited qualifications:

PMB20116 Certificate II in Polymer Processing
PMB30116 Certificate III in Polymer Processing
PMB40116 Certificate IV in Polymer Technology
PMB50116 Diploma of Polymer Technology
PMB60116 Advanced Diploma of Polymer Technology

Across Australia, these qualifications are on scope for a total of **134 training providers**[33] including PARTEC[34] Queensland, many TAFE colleges, Universities and high schools, and a number of private and enterprise RTOs across several states. The states with the highest enrolments and completions for these qualifications are Queensland and Victoria.

While there are strong enrolments for the Certificate III and IV, the Certificate V and Diploma and Advanced Diploma courses are no longer on offer anywhere in Australia.

In WA, no TAFE colleges have these PMB qualifications on scope. Central TAFE did deliver some PMB training through its Subiaco facility (PARTEC), however when this campus was closed in 2014, equipment used in the facility was re-located to Central TAFE's main campus. It is understood this equipment was not re-commissioned in the new location and delivery capability was effectively lost.

PMB Certificates II and III[35] are offered exclusively in WA by several enterprise-based RTOs that specialise in rubber conveyor belt manufacture: namely, Fenner Dunlop in Kwinana, REMA Tip Top Academy, Bridgestone, and Australian Training Management in West Swan. These companies, and the training they provide, are specific to the conveyor belt market with few links to composites manufacturing and were not included in this scoping study.

The PMB20116 Certificate II and PMB30116 Certificate III also have school-based apprenticeships available in WA. However, because of the difficult assessment requirements for these courses, schools tend to opt for other qualifications.

The enrolment data for the PMB courses overall show a steady decline in activity after the mid-2000s.

Certificate II

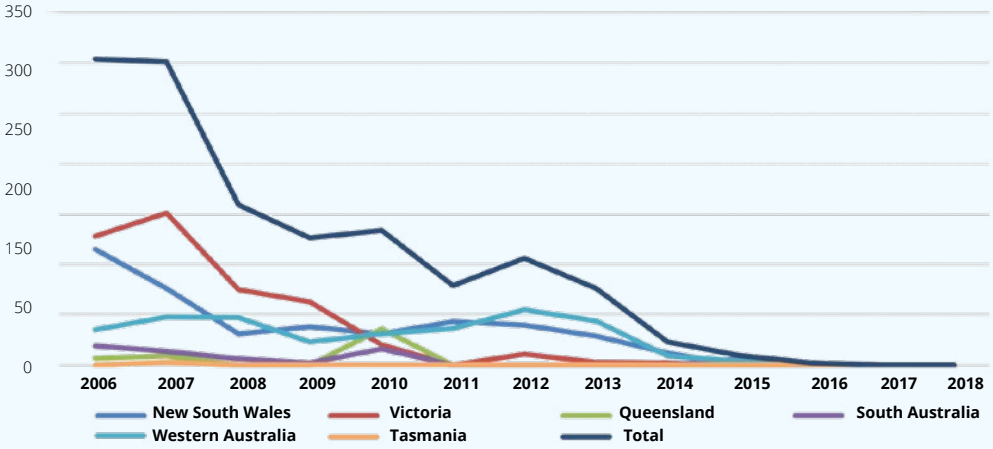
Total Enrolments: PMB20101, 20107 & 20116 Certificate II in Plastics/Polymer Processing (including ViS)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
New South Wales	115	76	31	38	31	43	40	29	12	0	0	0	0
Victoria	128	151	75	63	20	0	11	3	2	0	2	0	0
Queensland	7	9	0	0	36	0	0	0	0	0	0	0	0
South Australia	19	14	6	2	16	0	0	0	0	6	0	0	0
Western Australia	35	48	47	23	31	36	55	44	9	4	0	0	0
Tasmania	0	3	0	0	0	0	0	0	0	0	0	0	0
Total	304	301	159	126	134	79	106	76	23	10	2	0	0

Source: NCVER VOCSTATS

Notes: Perturbation removed
There were no enrolments recorded for PMB20116

Enrolments: PMB Certificate II in Plastics/Polymer Processing, All States (Including VIS)



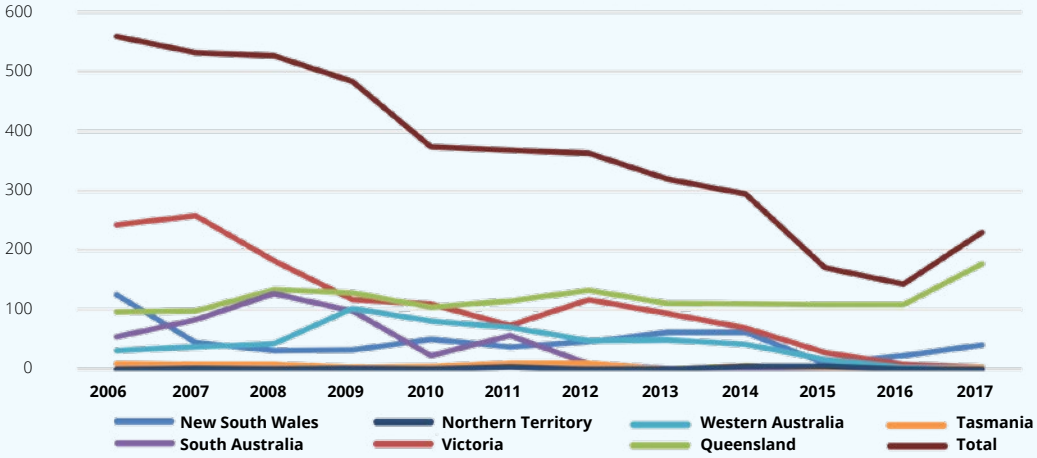
[32]Earlier versions of the PMB training package were released in 2001 and 2007.
[33]www.training.gov.au
[34]The Plastics and Rubber Technical Education Centre (PARTEC) has campuses in Brisbane and Townsville.
[35]The PMB Certificate IV was also offered in WA until 2018.

Certificate III

Total Enrolments PMB30101, 30107, 30116 Certificate III in Plastics/Polymer Processing

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
New South Wales	125	45	31	32	50	38	46	62	62	10	23	41	78
Victoria	243	258	182	117	109	74	117	94	69	28	8	4	0
Queensland	96	98	134	128	104	115	133	111	110	108	108	177	117
South Australia	55	83	127	98	23	57	9	2	0	0	0	0	0
Western Australia	31	38	43	102	81	70	48	49	42	17	3	4	3
Tasmania	9	8	8	4	5	10	10	1	6	3	0	4	5
Northern Territory	0	2	1	2	1	4	0	1	5	5	1	0	3
Total	559	532	526	483	373	368	363	320	294	171	143	230	206

Enrolments: PMB Certificate III in Polymer Processing, All States (Including VIS)



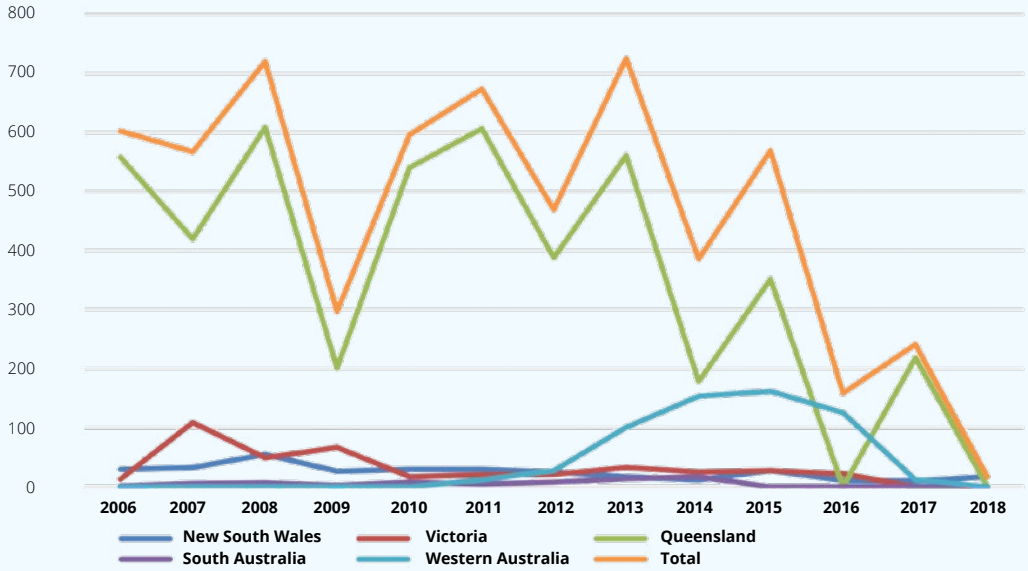
Certificate IV

Total Enrolments: PMB40101, 40107, 40116 Certificate IV in Polymer Technology

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
New South Wales	30	33	55	26	30	30	25	17	12	28	11	10	17
Victoria	13	109	49	67	17	20	21	33	25	28	22	0	0
Queensland	558	420	609	201	541	607	388	561	178	352	0	219	0
South Australia	2	6	7	3	8	5	8	14	17	0	0	0	0
Western Australia	0	0	0	0	0	12	28	101	154	162	126	12	0
Total	603	568	720	297	596	674	470	726	386	570	159	241	17

Note: The bubble of WA enrolments for the Certificate IV in Polymer Technology is most likely due to the introduction of the conveyor belt specialty qualification.

Enrolments: PMB Certificate III in Polymer Processing, All States (Including VIS)



Completions

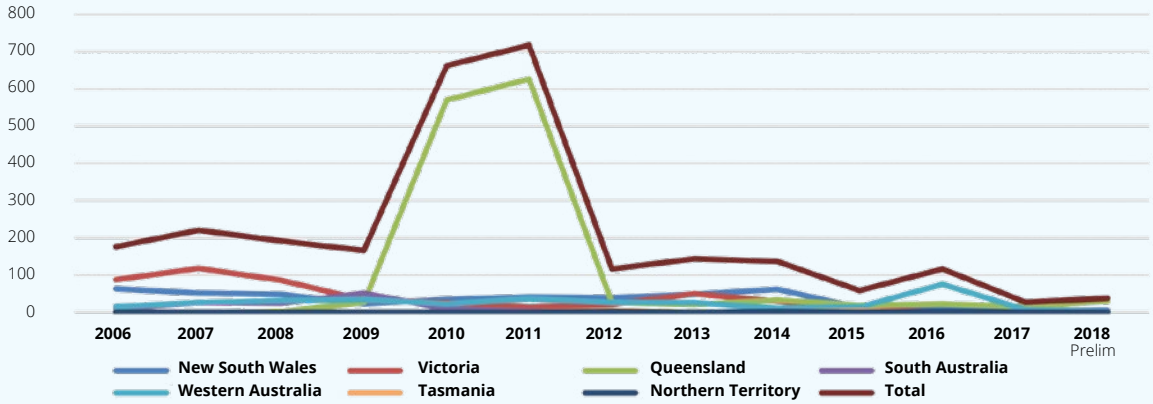
Statistics for completions in the three Polymer Processing Certificate courses (II, III and IV) have fluctuated, mainly in Queensland where there was a pronounced spike in 2010-2011.

These figures illustrate the strength, until recently, of this training package in the Eastern States, particularly Queensland where PARTEC has continued to tap the market for employer-sponsored traineeships and apprenticeships, as well as the open access short course market.

Total Completions: PMB Certificates II, III & IV - Polymer Processing/Technology

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018 (prelim)
New South Wales	63	51	48	23	34	41	39	48	61	12	17	5	6
Victoria	87	118	86	32	26	13	20	50	29	10	0	0	0
Queensland	0	0	2	25	571	627	26	21	33	19	22	15	30
South Australia	11	26	24	51	9	1	0	0	0	0	0	0	0
Western Australia	15	26	31	35	23	36	25	25	11	14	75	7	1
Tasmania	0	0	0	0	0	0	5	0	0	3	0	0	0
Northern Territory	0	0	0	0	0	0	2	0	2	0	2	0	0
Total	176	221	191	166	663	718	117	144	136	58	116	27	37

ECompletions: PMB Certificates II, III, IV - Polymer Processing/Technology



Composites in other qualifications

In addition to the Marine Craft and Composite Trades qualifications, a small amount of composites training is included in other courses, such as cabinet-making, panel beating and pipe-fitting.

An example is ISO 14692 D4 D5 D6 Petroleum and Natural Gas Certification for FRP pipe fitters, supervisors and inspectors, which is a requirement for working on many major WA resource projects. SMTAFE has partnered with Lloyds Register and local company ResiGlass to provide this training and ISO certification.

5.1.2. HIGHER EDUCATION

Increasingly engineers and architects are exploring the use of composite materials in building and construction, finding they have many advantages over traditional materials. Australian universities are responding to this trend by offering undergraduate courses or subjects in the use of composite materials in construction and design.

In Western Australia, four of the five universities (excluding Notre Dame University) offer units in the chemistry, design and application of composites and polymer materials for manufacturing, engineering, architecture and construction applications.

University academics across the sector are engaged in a range of research projects. Edith Cowan University, in particular, supports a Materials Research Group and a Design and Manufacturing Research Group, both of which are involved in composites projects. The University of Western Australia has undertaken a number of composite-related research projects through its School of Engineering.

The single-seat composites solar vehicle made by students of Western Sydney University - the first international and first Australia solar car to win the 2018 American Solar Challenge which is a nine day 2,800 kilometre race across four states, from Nebraska to Oregon.

Even so, Australian university-based collaborative research centres dedicated to fibre composites are all based on the east coast, and include the following:

- Institute for Frontier Materials (incorporating Carbon Nexus) at Deakin University
- Centre for Excellence in Engineered Fibre Composites at the University of Southern Queensland.
- ARC Training Centre - Chemical Industries, the University of New South Wales
- ARC Training Centre for Automated Manufacture of Advanced Composites, the University of New South Wales
- Manufacturing Futures Research Institute at Swinburne University of Technology.

CASE STUDY: The Geelong Future Economy

The Geelong Future Economy Precinct is an example of a successful public/private sector partnership to create an R&D, advanced manufacturing and education cluster[36] and was the catalyst for generating hundreds of new jobs in research and advanced manufacturing.

In 2010, Deakin University together with the Victorian State government, made an initial investment of $25 million to establish the Australian Carbon Fibre Research Facility on the Waurn Ponds Campus[37]. This was the first of a series of strategic investments by the Federal and State governments aimed at transforming the Geelong region into an advanced materials research and manufacturing technology precinct. The strategy was in response to the 2008-09 GFC and later the closure of the automotive industry that shut local plants and destroyed hundreds of jobs.

Now, after ten years and with a total investment of well over $100 million, the Geelong Future Economy Precinct has become a thriving collaborative venture with a grand vision and substantial success in leveraging research and other funding. The project has achieved the goal of supporting local manufacturing enterprise, generating jobs and contributing to the economic development of the entire region.

The precinct includes the world first Australian Future Fibres Research and Innovation Centre (now the Institute of Future Fibres) at Deakin, incorporating the University's carbon fibre and composite research facility Carbon Nexus. Carbon Nexus is an open-access plant designed to develop and produce carbon fibres, textile pre-forms and composites for new technologies, processes and products. The plant consists of a unique 55 tonne carbon fibre production line and R&D-scale single tow line scaled down from the pilot line[38].

To complement these research functions, the Geelong Manufacturing Council and a group of local companies received funding to set up the Geelong Advanced Fibre Manufacturing Cluster that aims to improve the competitiveness of member companies in manufacturing products for the marine, mining and infrastructure sectors. The Deakin campus cluster is also home to ManuFutures (a purpose-built centre for start-ups), CSIRO Manufacturing, and a clutch of SMEs and publicly-listed fabrication companies.

Carbon Nexus carbon fibre production facility.

[36]In Korea, collaborative projects between manufacturing, Universities and government are called "Golden Triangles".
[37]Senator Kim Carr, Media Release, 21 May 2010
[38]Former CN General Manager, Steve Atkiss

Carbon Revolution Pty Ltd

One of the start-ups operating from the precinct, Carbon Revolution has successfully developed and commercialised carbon fibre wheels for the global automotive industry. The company now supplies "the most technically advanced wheels on the planet" to car companies like Ford and Ferrari. Carbon Revolution has generated over 40 patents for its manufacturing processes and designs, which are potentially worth many millions of dollars in IP value. The company is in the process of a $100 million expansion of its Waurn Ponds plant that will add 500 workers to the payroll and increase output from 10,000 wheels per year to half a million wheels in the long term[39]. In November 2019, Carbon Revolution floated on the ASX.

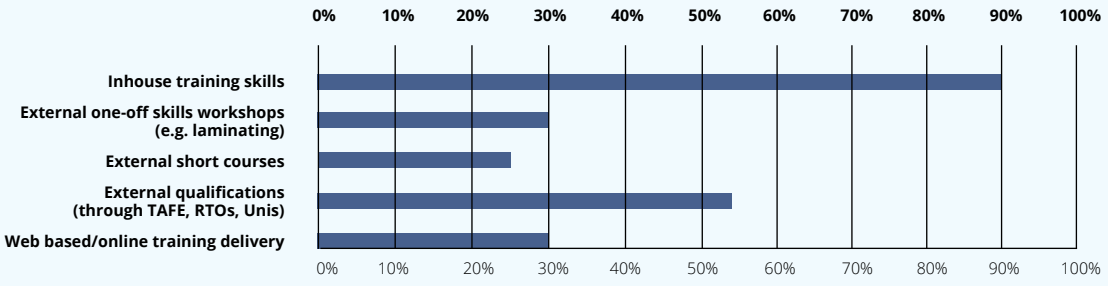
Carbon Revolution production facility (soon to be expanded) within the Geelong Future Economy Precinct in Victoria.

5.1.3. FEE-FOR-SERVICE COMPOSITES TRAINING

In this scoping study, WA composites companies across market sectors reported having a need for training in composites fabrication trade skills, such as: Open moulding – hand lay-up and spray up, Filament winding, and Chemical resins & catalysts.

The preferred mode of training was 'inhouse skills training' (90%), followed by 'external accredited qualifications' (55%), while offsite training was not favoured. This indicates that onsite training – as either fee-for-service, skills sets or flexible delivery of a qualification – is strongly supported by the industry.

Q28 What type of training is the most appropriate for your company needs?



[39]Sourced from AFR article, 25 October 2019

SMTAFE

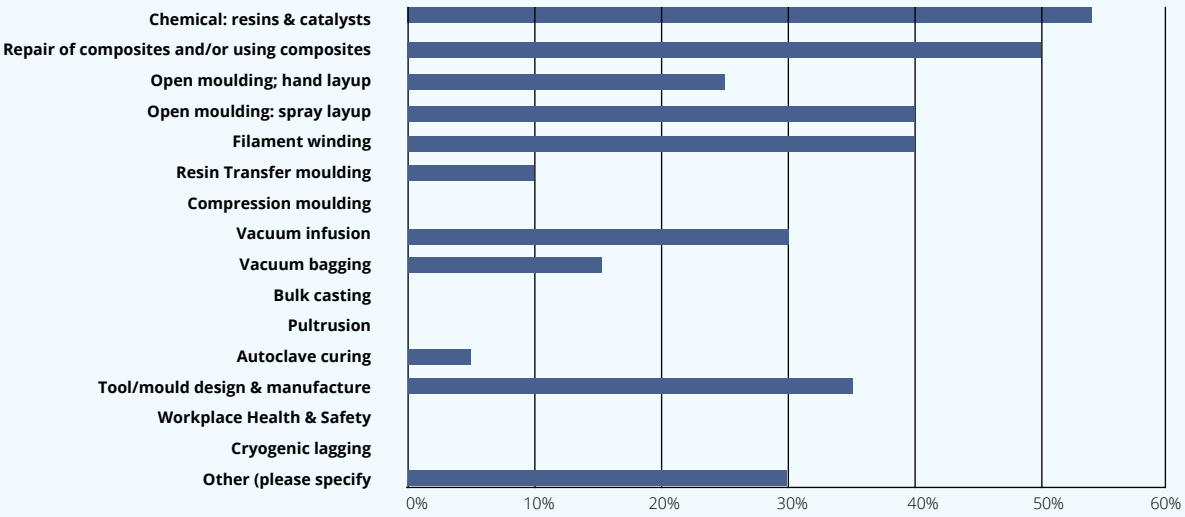
Demonstrating a market for customised fee-for-service training, recently SMTAFE was engaged by the Australian Navy to deliver training in composites hull repair and maintenance for workers at the HMAS Stirling naval base.The training involves two short courses, potentially up to 20 weeks per year:

- 1 week full-time gel coating skill set
- 6 week full-time Hull maintenance unit (from the Cert III & IV in Engineering Fabrication).

Survey results

As illustrated in the graph below, a majority of employers would be prepared to use affordable fee-for-service training in technical skills such as "Chemical: resins & catalysts". There is a need for workers to know the materials they are working with for reasons of safety and precision manufacturing.

Q24 In the future would your company use fee-for-service training in any of the following technical skills? (Multi choice)



Tanks West 2 x 60,000L tanks for raw water and delivered to mine site. Image courtesy S Thompson

5.1.4. SHORT COURSES

SMTAFE

While TAFE colleges in other states have found a market for fee-paying **direct entry short courses** relating to composites fabrication, such as described above, there are currently no RTOs in WA providing short courses of this nature.

SMTAFE reportedly attempted an open access Vacuum Infusion short course, which was offered over three nights for a fee of $600. The course did not attract the required minimum of six students and was abandoned. Even so, industry feedback and the buoyant market in Queensland (and previously in WA), suggests there is a potential market for short courses that offer a certificate.

Gordon TAFE (Victoria)

Gordon TAFE has developed several composites short courses that are approved by the Victorian government but are not part of an AQF qualification. These courses are delivered at the fully-equipped Advanced Manufacturing and Composite Centre (AMACC) opened in 2018 on the East Geelong Campus:

- **22312VIC Course in the Use of Carbon Fibre in Composite Manufacturing**
  Four units delivered over 2 days per week for 7 weeks. This a fee-paying course with conces sions available. The first intake was 20 students in 2017. While enrolments have since dwindled, the course is still on scope and the next intake is advertised for July 2020.
- **22470VIC Certificate in Engineering Studies "Mechanical, Fabrication and Composites"**
  A pre-apprenticeship course being offered free in 2020. Half-time for 6 months, with the next intake set for July 2020. The course covers seven core units and four electives, including a carbon fibre unit. It is delivered in three ways: as an open entry course to the public, as VET in Schools for Years 11 & 12, and as a special course for long-term disadvantaged.
- **25F01787 Hobby Composites course**
  One evening per week over 6 weeks, with the next intake scheduled for May 2020. Twelve places available and fees are $600 per student.

PARTEC (Queensland)

PARTEC[40] delivers a range of popular direct entry short courses, some of which (e.g.. vehicle plastics repairs) are not connected to the AQF. Other short courses comprise units of competency from the PMB Plastics Manufacturing or MEM Engineering training packages, such as composites spray moulding, hand lay-up, vacuum bagging/ resin infusion, plug-pattern and mould construction, injection moulding, and CNC moulding. In first semester 2020 the PARTEC website indicates there were 17 short courses on offer at PARTEC.

On completion, students receive a statement of Nationally Recognised Training competencies and may apply for credits toward a qualification. However, the enrolment and completions data would indicate that the majority of students who enrol in these short courses do so to improve their skills or learn new skills and have no intention of completing an award course[41].

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[40] https://www.partec.qld.edu.au

[41] PARTEC also provides Le Hunt Polytec® and Flexitec® accreditation training for Queensland and the Northern Territory, delivered at a PARTEC centre or at the workplace for groups of six and above.

5.1.5. LICENCES AND WORK TICKETS

The majority of companies are prepared to engage "private Registered Training Providers (RTOs)" and to sponsor workers to obtain relevant quality standards certification and licences, such as the following. Close to 80 percent are satisfied that this type of RTO training meets the needs of the company:

- First Aid
- Occupational Health and Safety
- Hazardous materials
- Working in Confined Spaces
- Forklift licences
- Working at Heights
- Lloyds certification training

5.2. INDUSTRY VIEWS ON SKILLS AND TRAINING

5.2.1. WA COMPOSITES MANUFACTURERS

Emerging from this consultation, attitudes of the composites industry towards formal VET training currently available can be summarised as "too slow, too rigid and too removed".
"Private is too expensive. TAFE is unapproachable – all too hard. Would love them to train onsite."
Many respondents called for the TAFE apprenticeship "training system" to step-up "for the good of industry, rather than profit." Key suggested improvements were:

- More flexible training delivery, such as workplace training and assessment
- Avoid scheduling off-the-job training during peak production periods
- Create a training pathway from 'taster' or introductory courses like pre-apprenticeships through to higher certificates that cover supervision and management skills

There was support for a career pathway for skilled composite technicians with transferable skills within the manufacturing and wider engineering industry. Ideas were linked to emerging sectors such as the automotive and aeronautical industry, and to technology advances like 3D Modelling and Analysis.

However, preferred methods to enable career pathways within the industry were not clearly defined in this survey. It is apparent that knowledge of the formal VET and higher education sector was limited, with uncertainty about the available options, the distinction between qualifications or their relevance to industry. In contrast, as mentioned above, there was a strong awareness of and commitment to inhouse/on-the-job skills training as well as licencing and standards certification requirements.

Flexible Delivery
For employers, the cost of training is an aggregate of the training fee, management time, and unproductive workers, as well as the diversion of labour to attend off-the-job training, often during peak times. All of which is weighed against productive outcomes and a backdrop of an uncertain industrial economy.

When asked about barriers or constraints to training, 60 percent of respondents selected "Insufficient financial incentives from government" and "Insufficient experienced people to act as in-house trainers." Close behind was the answer that "Training can't be accommodated around work demands."

When asked for possible solutions to these barriers and constraints, there was a clear preference for flexible, accessible on-the-job training.

It is worth noting that these results are no different to those from the 2006 Composites Australia Scoping Study, which found:
"The overwhelming attitude of industry to education and training is pragmatic. There is no doubt that any qualifications will be supported if they can be delivered in the workplace and subsequently enable employees to produce higher value-added products more efficiently and at a higher quality." [42]

In other Australian states, flexible TAFE training delivery has been found to be effective for regional manufacturers. Two case studies of Compass Pools and Steber International are included in this report.

CASE STUDY: Compass Pools

Compass Pools has been manufacturing fibreglass swimming pools in the regional town of Tomago NSW since 1980. A Workforce Skills Survey undertaken in 2019 by the state's peak business organisation, the NSW Business Chamber, found that over 64 per cent of Hunter Valley businesses were experiencing skill shortages - the second highest of all regions in NSW. Compass Pools was also affected by the shortage.

CEO Anthony Cross says: "We were facing a revolving door of short-term workers that seemed to have no end – so we decided to train up. Our options were limited as Hunter TAFE had ceased delivering training for boatbuilding and composites qualifications in 2013, so we decided to approach HunterNet for a solution."

HunterNet is a network of manufacturing, engineering and specialist service companies located in the Hunter and Central Coast regions of NSW. Through its Group Training operation, HunterNet[43] undertakes the attraction, interview and recruitment process for apprentices, as well as the induction, OH&S training and pastoral care. The apprentices are then placed with local businesses that provide the required on-the-job work experience.

"The first year we put on two composites apprentices and this year we are taking on another two. They are productive and adding to the capabilities of our workforce."

In the case of Compass Pools, the apprentices taken on will eventually qualify with a Certificate III in Engineering - Composites Trade (MEM31119), and at the end of their training contract will be employed as fulltime workers for the host company. Still, with no accredited composites course on offer in NSW, providing off-the-job training was a challenge. HunterNet struck on the idea to engage the services of GOTAFE (Goulburn Ovens Institute of TAFE), which has been training composites technicians in regional Victoria since 2015.

Seasoned composites lecturer Ross Mitchell, from Hunter Assessment and Training, was engaged by GOTAFE to deliver the apprenticeship training by distance education. Ross says that "There is a lot of flexibility in the model. Online distance education is a necessity in regional areas and is also efficient and student-centred." The training model involves online teaching, augmented with onsite tutorials and assessment. Ross visits each host employer regularly and is known to spend a day on the tools working side-by-side with his apprentices. He says that you lose students fast if they are expected to learn in isolation and regular follow up helps to maintain motivation.

Anthony Cross says the partnership with HunterNet and GOTAFE has exceeded all expectations: "The first year we put on two composites apprentices and this year we are taking on another two. They are productive and adding to the capabilities of our workforce."

Currently there are four composites apprentices employed through HunterNet's cooperative and flexible training and employment program. Using distance education delivery mode, GOTAFE's Ross Hunter is now training 11 Composites apprentices and six Boatbuilding apprentices across the Central Coast.

Compass Pools 8.2 metre slim line in-floor glass windowed pool made in Tomago in the Hunter region of NSW.

Compass Pools/GOTAFE/Hunternet
Compass Pools: compasspools.com.au
HunterNet: hunternet.com.au/about-us-gt/
GOTAFE: gotafe.vic.edu.au/
Ross Mitchell: Hunter Assessment and Training

[43]https://hunternet.com.au/hunternet-group-training/

CASE STUDY: Steber International

The fibreglass boat manufacturer Steber International operates from a four acre site in Taree, a regional town on the Mid North Coast of NSW, where it manufactures high quality boats for fishing, charter, patrol, sea rescue, medical support, surveillance and general boating use.

Managing Director Alan Steber says: "Being in a regional area, we've never been able to rely on trained people walking in the door. We've always had to look for ways to train up. Indeed, since the mid-1970s we've trained over 150 apprentices. I'm proud to say we currently have nine apprentice shipwrights on our books."

Government commissioned Naval boats and commercial vehicles are a large part of Steber's business, for which the tender process requires demonstration of a qualified workforce. The apprentices are employed directly by the company and enrol in a Certificate III in Marine Craft Construction (MEM30705) with NSW TAFE.

Located many hours from TAFE training facilities, the company prefers that the apprentices are trained

"I'm proud to say we currently have nine apprentice shipwrights on our books."

onsite. The apprentices, whether first, second or third year, attend weekly lessons which are delivered online using video conferencing and other media in the company's boardroom The TAFE lecturer is located over 300kms away at NSW TAFE's Ultimo Campus.

Alan says: "Though our training model was born out of circumstance, distance learning resonates with young people who find traditional learning tedious and uninspiring. They have left school for a reason and if the teaching mimics the school system they lose concentration."

Alan says that while the students never visit the TAFE College, the lecturer is available at any stage for "real-time learning" which is knowledge acquisition based on immediate needs. "The guys love making use of their mobile phones by taking photos and facetiming with the trainer as they use a piece of equipment – under supervision of course. The TAFE trainer also visits the factory for face-to-face teaching as well."

Alan believes that training in their place of work is ideal. "The apprentices get to do their practical assignments on the floor, using our equipment and our materials supervised by a co-worker - who we've also trained on the procedures. You'd be hard pressed to find a TAFE with the breadth and quality of equipment that we have. We find that quite often our guys are teaching the TAFE teacher. Having said that, we have a buddy system and it's all very collegiate."

Alan Steber Managing Director.
Steber International: steber.com.au/
NSW TAFE: tafensw.edu.au/

Steber International apprentices in their Taree workplace. Image taken by A. Steber.

On-the-job Training

Currently in WA, other than the marine craft sector, most skills training associated with fabricating composites is being done by the companies themselves, generally by experienced production managers using quality standards guidelines and/or operational manuals developed inhouse. Nearly 50 percent of survey respondents provide chopper gun training in the workplace as well as hand lay-up. A wide range of other fabricating skills also being taught inhouse and on-the-job include laminating, resin infusion, vacuum bagging, oven operation, CNC router operation, heated press operation, clean room practices, welding, carpentry, plug and mould making, moulding and demoulding, laminating, gel coating, filament winding, pipe and tank fabrication, pipe spooling, repair processes and material identification and characteristics.

For upskilling and professional development of experienced workers, one employer had utilised courses available in Singapore, where there is a thriving composites industry and high-quality training institutions.[44] Others mentioned New Zealand[45], the UK and the United States as destinations for professional skills development.

With the exception of the marine craft sector, it is evident that WA composite companies are bearing the full costs of providing inhouse supervision and training for the entire range of fabrication skills, and training both new recruits and existing workers. This is a major cost when it is considered that it takes one to three years to reskill or upskill new employees.

This system of 100% on-the-job training also means that most workers are denied the opportunity to gain formal trade qualifications that will provide them a sustainable career path.

CPS supplies BHP South Flank overland conveyors with Pilbara's first all-composite roller solution.

5.2.2. VET SECTOR

SMTAFE is the only WA training provider offering composites manufacturing skills training.
In the past, fibreglass and plastics training was delivered from a purpose-built centre based at Wembley TAFE but operated by PARTEC (Queensland). The centre enjoyed strong support from the industry and hobby markets alike, with a thriving suite of affordable short courses and traineeships.

After the WA PARTEC Centre closed in the mid-2000s, fibreglass/composites and Marine Craft Construction relocated to Challenger TAFE's Henderson campus.

After the Certificate III in Engineering - Composites Trade apprenticeship qualification was introduced in 2013, a decision was made to accommodate the two MEM apprenticeship courses (Composites Trade and Marine Craft Construction) in the same training facility. Workshop space at the new SMTAFE Naval Base campus was allocated and equipped, and training commenced at the location in April 2019. The facility, however, is considered by the lecturer in charge to be less than ideal, with functional deficits that constrain both the quality of training delivery and future expansion.

[44]For example, Singapore Institute of Manufacturing Technology.
[45]See 4.3

5.2.3. INNOVATION AND INDUSTRY 4.0

The disruptive effect on Australian manufacturing of innovations resulting from 'Industry 4.0' and the 'Industrial Internet of Things (IIOT)' has been predicted for some time and discussed in many high profile reports, including Diversify WA[46].

Industry 4.0 relates to a suite of emerging technologies, processes and machinery using artificial intelligence (AI), robotics and automation, digital data collection and analysis, and 3D printing (additive manufacturing).

The spread of Industry 4.0 developments throughout industry presents a major challenge to local manufacturers, especially SMEs that have little access to capital investment. However, while IIOT presents many opportunities (particularly through Smart City and environmental policies), the results of this scoping study show that company owners have mixed views on the potential benefits. (See Survey Results section below)

Training and education for Industry 4.0

The conclusion drawn by the authors of this growing body of research suggests the future will see a continuing decline of traditional trades qualifications in favour of more advanced qualifications focused on new Industry 4.0 technologies. The inference is that many manual trades skills will become redundant.

In readiness for this perceived transformation, collaborations between governments, industry and the vocational and higher education sectors are creating new training products and pathways. For example, one major study of the potential for new Industry 4.0 training and education, was released by the AiGroup in 2018[47]. The report proposed a form of advanced (or Higher) apprenticeship involving employment contracts and new VET/University hybrid pathways.

The NCVER also released a report in 2019 on this topic, which concluded that: "[I]t is unlikely that a 'standard' higher apprenticeship model can be developed and successfully implemented. A more likely scenario is a variety of higher apprenticeships and apprenticeship-like models of learning within the constraints of the current system."[48]

In WA, SMTAFE recently announced it will be piloting several new courses related to Industry 4.0 and relevant to the composites industry, namely:

- **22460VIC Diploma of Applied Technologies** developed at Swinburne in Victoria, and
- Two new automation courses targeting trades-qualified manufacturing workers and apprentices - Certificate II in Autonomous Workplace Operations, and a micro-credential *Working Effectively in an Automation Workplace*.

Automation, Industry 4.0 and Composites Manufacturing

This scoping study revealed that WA composites manufacturers are engaged users of computer-aided processes that enhance quality and productivity, such as CNC machines, Computer Aided Design (CAD), 3D printing and similar enabling technologies. For companies producing repeatable componentry/products, robotic cells could include water-jet cutters, robotic gelcoaters and chopper guns and automated cutting equipment complete with PLCs (Program Logic Controls). However, except for the largest operators the opportunities presented by Industry 4.0 appear to have not yet penetrated the WA industry. (See Survey Results section below)

The SME manufacturers surveyed in this scoping study said they were reluctant to invest in the next generation of technology in the current uncertain economic climate. (See Survey Results section below) Since the survey, the economic landscape across the world has been transformed by the COVID-19 pandemic and the future is even more uncertain. As in previous economic crises, it is likely that parts of the composites industry will experience restructure, and many companies will face loss of business, hardship and closure. Conversely, it is likely that some firms may grasp the opportunity to develop new products and new markets presented by an increasing national focus on industrial sovereign capability for essential items.

Survey results

When asked whether they foresee any major changes in their training or skilling requirement as a direct result of Industry 4.0 technology, 55 percent answered in the negative with the exception of CNC (computer numerical control) machine, which

[46]See references section
[47]AiGroup (2018)

has become the preferred choice for precision mould making for some components.

Those with a positive view of the technology still saw robotics processes as "cost prohibitive" – in that the required capital investment would not achieve sufficient productivity returns. The habitual concern about "uncertain market conditions" was cited as a reason for prudence in expenditure.

One manufacturer said that "I lose sleep for three months over changing my supplier for adhesive systems. Product failure is a liability that costs both money, reputation and puts the public at risk. Changing systems, material inputs and processes for existing products will take years of modifying, testing, reworking and more testing. It's not just as simple as buying a new robot and getting a young buck to run it."

In fact, only 10 percent of respondents expected to 'invest in robotics' over the next few years.

As WA composite manufacturers are small and focused on niche markets or customised products, there is less need for automation and AI than in mass produced manufacturing or process industries such as mining.

Respondents generally remain unconvinced of the potential uptake of Robotics and Industry 4.0, which some see as more relevant to product design than to fabrication processes. There is also uncertainty around the interface between the Australian (AS/NZS) and international standards and Industry 4.0 production equipment and methods.

A Group of Operators (Students) are Taking PLC Course for Industry 4.0 preparation in a automation education center.

5.3. INTERNATIONAL EXAMPLES

Respondents in this scoping study pointed to examples of international composites training systems that could be applied in Western Australia. The Boating Industry of Australia (WA) is looking at the New Zealand system of a combined marine craft and composites pathway as a model for the future. Another option is an occupational licensing or certification system for composites technicians, as applies in the United States.

While problematic within the context of AQF, ANZSCO and the modern award system, these training ideas are worth considering.

New Zealand

New Zealand has developed a comprehensive training package and career pathway for composites and marine craft trades workers. The three qualifications are the Certificates in Composites Level 3 (entry level), 4 (apprenticeship course) and 6 (advanced level). The training package is developed and delivered by NZ Marine & Composites Industry Training Organisation (NZMACITO). Graduates are recognised as fully qualified trades persons by the Composites Association of New Zealand (CANZ).

Singapore

Singapore has a thriving composites industry and world-class training institutions. The Singapore Institute of Manufacturing Technology (SIT) offers a range of composites modules, courses and master classes. Singapore Polytechnic has short courses in composite repairs.

North America

The American Composites Manufacturers Association (ACMA) delivers certified composites manufacturing training. The Certified Composites Technician (CCT) program instructs on a wide range of processes and products, including advanced composites, compression moulding, corrosion, light resin transfer moulding, open moulding, vacuum infusion, and wind blade repair. The certification program is valued and widely recognised. It is a self-study program whereby materials and references are 'shipped' to learners. The CCT program is also supported by an advanced version as well as CCT trainer training. All Certified technicians require recertification every three years to keep their national credential active.

[48]NCVER (2019) Higher Apprenticeships in Australia. What are we talking about? p.3

6 The Future of The WA Composites Industry

6.1. GROWTH OPPORTUNITIES

Seventy-five per cent of survey respondents were generally positive about the potential for business growth overall, subject to the fortunes and purchasing practices of the WA resources industry and State government procurement and support measures.

Over half of survey respondents considered that, due to the technical advantages of composites over other materials, the likely rebound in the resources and industrial sectors offer the best opportunities over the next five years.

Companies that manufacture for the consumer market such as the pool and pleasure craft sector also connect domestic consumer demand with the fortunes of the resources sector.

There is also a perceived opportunity in the repair of composite products in the domestic industrial, mining resources and marine sectors. This is particularly so for imported fibreglass products that aren't built for the harsh high UV environment of WA.

Expansion in composites is also predicted for a range of products and markets including:

- Architectural features (bridges, durable canopies, cladding etc.)
- Aerospace and defence
- Water and waste-water engineering, such as desalination plants
- Commercial vessels, as AMSA (Australian Marine Safety Authority) further regulates the industry
- Storage tanks and pipes for new mining ventures, such as lithium and rare earths, and industries such as hydrogen energy Exotic materials linked to the growing aerospace industry.

Several companies mentioned good prospects in export, particularly for R&D and products with built-in AI, but also traditional industrial items like storage tanks and automotive and transport components.

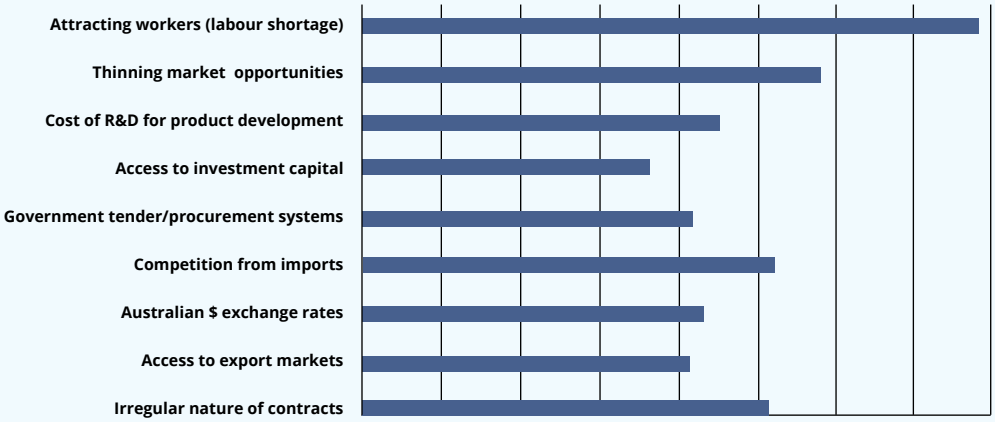
Due to the high cost of labour, the strong domestic market in previous years for mass produced products (such as 'surfcats' and ute canopies) were not expected to revive. Successful local manufacturers are now focussed primarily on niche markets and customised products that require agile 'just-in-time' production lines.

Some companies have survived changing consumer trends and the 'boom and bust' economic cycle, by repurposing machinery to diversify their product range. For example, Vikal uses its CNC machine for making transportables and now ventilators, and Swarbrick has moved into sculptures and fibreglass cladding. Others, such as Tanks West have developed bespoke machinery to manufacture innovative industrial products.

(L) Kerryn Caulfield, Composites Australia with (R) Lynden Vikingur, Director Vikal International in front of an in-house 4x4m 5-Axis gantry-based CNC machine said to be the biggest in WA.

6.2. CHALLENGES

Q5: Please rank (in order of priority 1 being most profound) what you see are the challenges facing WA composites manufacturing companies and supplies



95% of survey respondents acknowledged there was a labour shortage in the composites industry, which was nominated as the biggest challenge for future growth. The ongoing shortage, particularly for trades workers and technicians, is a persistent problem for Australian manufacturing, as highlighted in multiple reports[53].

The WA State Training Board in 2018 released a paper based on State-wide industry consultation on apprenticeship and traineeships in WA.[54] The report identified that after reaching a peak in 2011-12, apprenticeship and traineeship commencements in WA had been in long term decline.

As a result of the report, the State government has instituted several positive reforms. However, based the inadequacies in VET training identified in the survey for this scoping study, more could be done (see Section 7).

Notwithstanding a positive future outlook discussed in 6.1 above, the second biggest challenge identified by the industry has been the thinning market for products, which has occurred across different market sectors over a number of years. Companies have adopted innovative solutions to weather the tight conditions, such as diversifying products, finding new markets and/or downsizing.

The irregular nature of work orders, and competition from imports were seen as equally important in third place. Some companies also mentioned competition from eastern states companies as a major threat.

Government tender and procurement processes were also recognised as a serious challenge, as well as other government policies. Constant changes to incentives and support mechanisms were seen to elevate business uncertainty and could seriously damage many companies. Examples provided were:

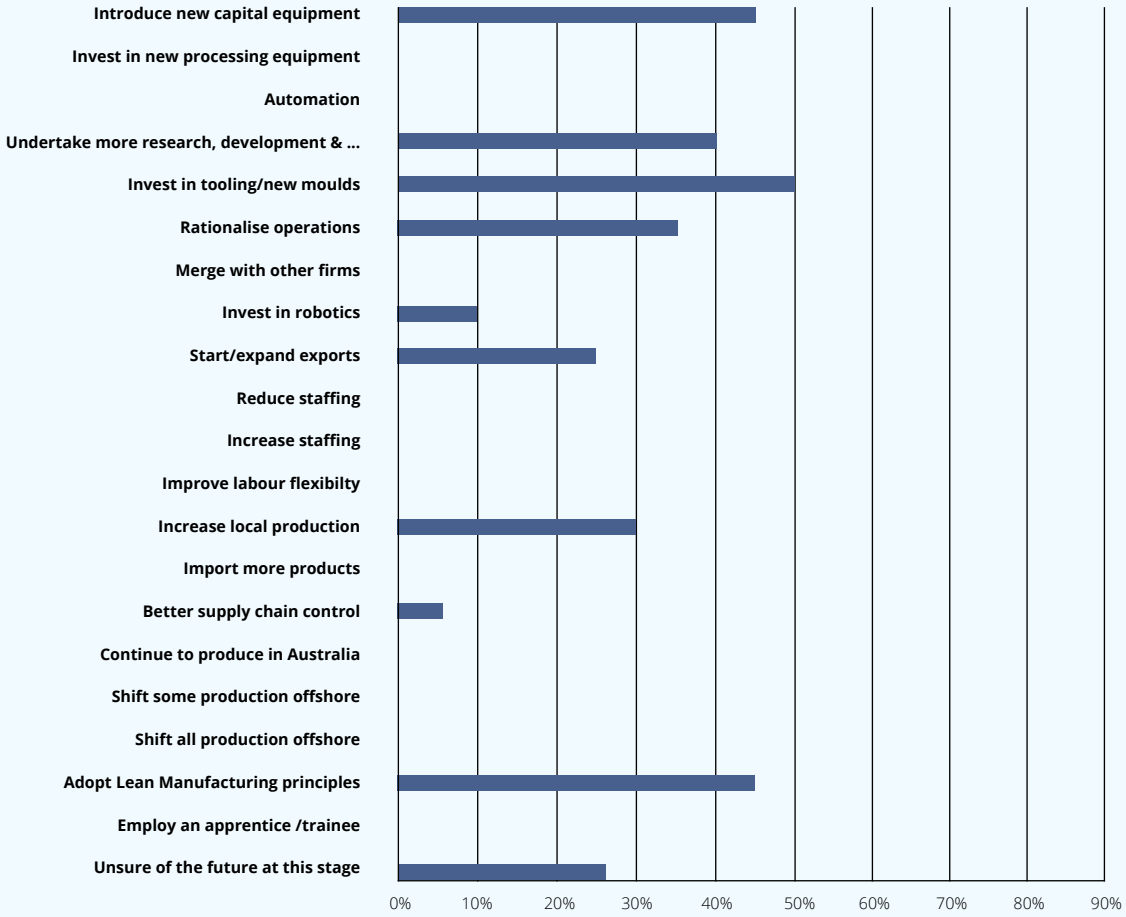
- Skilled Migration Program
- Tax rebates for skills training
- R&D tax offset program
- TAFE training fees
- Government procurement policies
- Apprentice wage subsidies and 'Tools for Trades' grants

[53]The Joyce Review (2019)
- KPMG (2019) Australia's Aerospace Industry Capability, Research and Economic Modelling of the Aircraft Manufacturing and Repair Services Industry
- NCVER research – see Appendix 8.3
- Australian Industry Group (2018) Skilling: A National Imperative
- IBSA Manufacturing (April 2019) Skills Forecast and Proposed Schedule of Work 2019-2023
- Food, Fibre & Timber Industries Training Council WA Inc. (2019) Employer Perceptions of the Apprenticeship System
- Australian Government (2018)

[54]State Training Board (2018)

6.3. SURVEY RESULTS

Q31: Please indicate what your company plans to do over the next few years: (Multiple choice)



Industry stakeholders were invited to look forward and indicate company plans for the next few years. Over 80 per cent responded optimistically with intentions to "continue to produce in Australia", 50 percent intend to "invest in tooling/ new moulds" and 45 percent intend to invest in "new capital equipment". Thirty per cent plan to "increase local production".

There was no indication of future plans to import more products, shift production offshore, or to automate. Finally, industry respondents clearly demonstrated a commitment to 'lean manufacturing' principles of continuous improvement and efficiency ("doing more with less") - while 45 percent expect to "adopt lean manufacturing principles" and 35% will "rationalise operations".

Stakeholders were also asked to suggest initiatives, strategies and/or actions that would most benefit the composites industry and their companies in the next 1 to 5 years. Responses to this question favoured two clear themes:

- Over 55 percent were skills and training related and
- 30 percent were calling for government procurement, at all levels, to support local manufacture. The view was that current procurement practices, particularly for large projects, tend to be driven by cost factors without real regard for value, quality or local content. As well as government procurement, the purchasing decisions of the large resources companies also came under fire.

Both themes – skills training and local procurement practices - featured in the Economic Development Framework outlined in the State government's *Diversify WA Report*[55] which described the policy levers for economic and jobs growth:

- Promoting increased apprenticeship, training and job opportunities in Western Australia.
- Promoting the diversification and growth of the Western Australian economy by targeting supply opportunities for local industry.
- Promoting a full, fair and reasonable opportunity for local industry to compete against other suppliers of goods or services.

Jobs growth and training are also explicitly linked to local industry expansion and supply chain security in the Western Australian Jobs Act 2017[56].

In this survey, when asked to describe three potential strategies or actions which would most benefit the composites industry and individual companies in the next 1-5 years, the responses echoed the objectives of the above mentioned state government objectives and reinforced the recurring themes mentioned throughout this report. The priority strategies mentioned are:

- Ramping up education and training in composites by:
  - Increasing government support for local industry and TAFE
  - Providing flexible and relevant training
  - Offering short courses on materials and other inputs
- Developing certification qualifications recognised by industry bodies and insurance companies for manufacture and repairs (see CCT course section 5.3)
- Government and the resources sector to "buy WA"
- Protecting industry by more robust regulatory controls on imported products.
- The addition of Composite Technician to the Occupation List for regional work visas in the (skilled migration program)

A particularly salient concept was to develop an Australian Composites Industry Strategic Plan.

Vikal International luxury super yacht tender made in Bibra Lake. Image courtesy Lynden Vikingur

[55]https://www.wa.gov.au/sites/default/files/2019-07/DiversifyWA_0.pdf
[56]Clause 7 https://www.legislation.wa.gov.au/legislation/prod/filestore.nsf/FileURL/mrdoc_41345.pdf/$FILE/Western%20Australian%20Jobs%20Act%202017%20-%20%5B00-b0-00%5D.pdf?OpenElement

7 Key Findings & Solutions

During this scoping study, many suggestions and strategies emerged on how to address the severe skills and labour shortage and training needs in the composites industry, as well as other challenges facing the industry. The list of strategies below is grouped according to the responsible agency and is in no particular priority order. It is acknowledged that some potential solutions may be more affordable and achievable than others.

7.1. KEY FINDINGS

7.1.1. COMPOSITES INDUSTRY PROFILE

The employment figures provided by respondents were extrapolated across the sector to achieve the following estimates of the size and value of the WA composites industry:

- Workforce: ~ 1,200 people
- Composites fabrication firms: >80
- The top 12 firms employ a total of over 700 people
- Approximately 40 firms employ less than 5 people
- Turnover: ~A$300 million

There is clear evidence that the industry has contracted since the initial Composites Australia national study in 2006. The number of companies has dropped by almost one-third to approximately 82. This is confirmed by some suppliers who report a decline in raw material inputs. However, there are companies manufacturing for the industrial sector that have grown since the national study and there is a growing cluster of high-tech start-up companies based south of Perth, which point to a nascent advanced transport manufacturing hub.

The five main market sectors in the composites industry are:

- Pools and spas – by far the largest user of raw materials inputs
- Marine craft
- Defence
- Transport
- Industrial (including mining, oil and gas)

Launched in 2016, the 46-metre composite twin-hulled yacht 'Charley' remains one of the largest composite, resin-infused multi-hulls in the world. The 3D design and construction of the bespoke vessel took two and a half years (by Echo Yachts). Notably, these projects are important for employment and skills.

7.1.2. EMPLOYMENT

- There continues to be a severe shortage in WA of skilled composite technicians. Employers report they are unable to recruit experienced workers in the local labour market which severely affects productivity[57]. Firms are con strained in what work they can accept or are putting pressure on a depleted workforce to complete orders.
- Composite manufacturers in WA are attempting to solve the skills and labour shortage by sourcing workers in different ways:
  - Where possible, recruiting qualified tradespeople from countries with comparable qualifications; such as the UK, South Africa and New Zealand.
  - Hiring unskilled local workers or those with other trades qualifications and applying specific on-the-job training relevant to the worksite. This initiative provides an opportunity for post-COVID-19 recruitment into the sector.
  - Currently the only WA composites sector to employ apprentices is the marine craft and aviation sectors. In all other industry sectors, formal apprenticeships have largely evaporated.
- The reason given by employers for this situation are:
  - Shortage of suitable apprentice applicants
  - Cost factors (direct and indirect) of employing apprentices
  - Perceived deficiencies in off-the-job training provision. (See section 7.1.3. below)

7.1.3. SKILLS AND TRAINING

- The bulk of fabrication skills training in WA composites companies is delivered in the workplace by experienced company personnel and is not accredited or regulated.
- New technologies (e.g. robotics, automation, 3D) and materials (e.g. carbon fibre) will be embraced by the composites industry for specific processes based on market demand, business conditions and affordability. *However, companies foresee that traditional composite manufacturing techniques will continue to be used by the local WA industry and require traditional composites fabrication skills training for sometime.*
- In relation to formal VET, marine craft apprenticeships have dwindled in the past 10 years. The composites trade apprenticeship qualification (Certificate III in Engineering – Composites Trade) was initially embraced by the WA industry, but interest declined due to a lack of alignment between industry need and TAFE provider capability. Concerns relate to perceived deficiencies in training content, flexibility of delivery, and training facilities.
- While the VET system does not allow these methods at present, the clear preference by employers is for:
  - More flexible training delivery, including workplace based where possible.
  - Skill sets or micro-credentials leading to a formal qualification.
- There are no RTOs in WA offering direct entry short courses in composites fabrication skills, such as those that exist in other states (e.g. Gordon TAFE and PARTEC)

[57]Interview quote: "I believe when business picks up and we need composites people, it will happen quickly and catch us by surprise – and we'll be in an even worse skills shortage."

7.2. POTENTIAL SOLUTIONS

7.2.1. WA GOVERNMENT

PS1: Develop a WA composites industry strategic plan that includes an advanced manufacturing, R&D and education cluster, designed to promote industrial sovereign capability as outlined in Diversify WA and the Western Australian Jobs Act.[58]

PS2: Invest in upgrades for the composites training centre at SMTAFE Naval Base campus:

- Suitable temperature control in the infusion room
- Workshop air conditioning or ventilation
- Spray booth for chopper gun training
- Classroom sound proofing
- Separation between the composites and metal fabrication zones (to reduce noise and improve safety.)

PS3: Extend 50% TAFE course fees discount to cover Certificate III in Engineering – Composite Trades apprenticeship (MEM31119) to incentivise industry participation.[59]

PS4: Ensure the State's 'buy local' procurement policy applies to the local composites industry and is implemented effectively.

PS5: Develop an industry strategy for Western Australia's composites industry to promote established local capability and attract industrial start-ups to WA. In this context, explore options to incentivise training and reduce business costs for composite manufacturers – for example, wage and training subsidies, utility discounts or payroll tax relief.[60]

7.2.2. FEDERAL GOVERNMENT

PS6: Improve apprenticeship wage subsidies for employers and communication of these incentives to employers and industry groups. Note: The current Covid-19 policy for a 50% wage subsidy for 9 months could be extended beyond this period to stimulate the local industry.

PS7: Reinstate 'tools for the trade' grants program to assist apprentices to purchase a set of tools and to alleviate some of the costs to employers.

PS8: Reinstate composites and fibreglass technicians on the Skilled Migration Program priority occupations list (See Appendix 8.2.3 and 8.5).

7.2.3. TAFE

PS9: Appoint a representative from the composites and boatbuilding industry to SMTAFE's relevant Portfolio Industry Advisory Group, nominated by Composites Australia.[61]

PS10: Develop ways to communicate with the composites industry to educate, consult and build awareness and demand for formal composites training.

PS11: Continue to offer RPL (Recognition of Prior Learning) of accredited units and qualifications for experienced composites technicians, at an affordable price. This may help to build a culture of support for the available qualifications and encourage apprenticeships.

PS12: In consultation with industry, develop short courses, skill sets / micro-credentials and fee-for-service options for composites training, possibly delivered in the workplace. Skills training required relates to the following processes:

[58]See references
[59]The Certificate III in Marine Craft Construction (MEM30719) is already covered by the discounted fees policy.
[60]As part of the COVID-19 support package, the WA government has waived payroll tax for 3 months (March-June 2020) for all employers with Australian-taxed wages of less than $7.5million.
[61]A TAFE industry reference group for the composites and marine craft industry existed previously but has been disbanded and replaced by an industry advisory group representing a broader range of manufacturing trades.

- Chopper gun
- Hand lay-up
- Laminating
- Gel coat spraying
- FRP repairs and maintenance
- Vacuum bagging
- Resin infusion
- Mould creation
- Moulding & demoulding
- Oven operation
- CMC router operations
- Heated press operation
- Clean room practices
- Material identification & characteristics
- Welding, carpentry, painting
- Safety issues in dealing with composites – handling hazardous material

PS13: Develop more flexible learning options for apprenticeship training, particularly training and assessment in the workplace, off-the-job training schedules, and distance learning technologies (See Case Studies on Compass Pools and Steber International)

PS14: Seek advice, training products and materials from best-practice international composites training providers, such as:

- New Zealand Marine and Composites Training package (NZ-MACITO)
- Singapore Institute of Manufacturing Technology
- American Composites Manufacturing Association (ACMA)

PS15: Explore a Certificate II option as a stand-alone qualification or pathway into the current Certificates III in Composites and Marine Craft. Delivery options could be via traineeship, on-campus pre-apprenticeship or VET delivery in secondary schools. This could be done by:

- Reintroducing Certificate II in Polymer Processing,
- Purchasing an 'off the shelf' course from New Zealand, or
- Developing a new Introduction to Composites qualification.

PS16: Investigate potential for the Marine Craft qualification (MEM30719) to be offered to fee-paying international students (non-apprenticeship), some of whom may decide to stay in Australia.

PS17: Explore delivering the Course in the Use of Carbon Fibre in Composite Manufacturing (22312VIC) developed by Gordon TAFE, particularly learning resources.

Students working in a robotics lab

7.2.4. INDUSTRY BODIES - CA, BIAWA AND SPASA

PS18: Employment: Investigate using a Group Training Organisation (GTO) for employing apprentices, similar to the HunterNet GTO in NSW. Options could be:

- Existing GTOs – MEGT or the Apprenticeship and Traineeship Company etc.
- Establish a new GTO to service all sectors of the composites industry

PS19: Certification: Explore the potential for developing certification for composites technicians, similar to the SPASA pool installer and inspector system based on OHS issues.

PS20: Training: Advocate for micro-credentials to be adopted by the VET system, and partner with TAFE in developing micro-credentials and skill sets for composites fabrication training, building towards a full qualification.

PS21: Promotion: Develop a marketing strategy to promote the industry and improve its image. Potential targets are schools and apprenticeship/training advisors. Possibly partner with TAFE Marketing or Jobs and Skills Centres.

7.2.5. RITCWA

PS22: Work with the composites industry and apprenticeship agencies to inform employers of existing government incentives and benefits to support employment of apprentices and trainees.

PS23: Potential role to identify the best training model for the future - e.g. apprenticeship or traineeship or alternative, and what changes need to be made to make the National System more attractive to the industry. Such as introducing skill sets and micro-credentials so they can be utilised to build towards a full qualification – either development of a traineeship or incorporated into a new apprenticeship model.

PS24: Explore pre-apprenticeship (e.g. Certificate II) qualification through direct entry. Post-COVID it is anticipated that young people will be looking for further study options to improve their personal career prospects and could be attracted to a qualification leading to a manufacturing career.

7.2.6. IBSA - MANUFACTURING & ENGINEERING INDUSTRY REFERENCE COMMITTEE

PS25: Consult with employers and training providers (SMTAFE and GOTAFE) to review the success and long-term viability of the apprenticeship Certificate III in Engineering – Composites Trade (MEM31119).

PS26: In the short-term, consider ways to improve the current apprenticeship version , such as:

- Number of prerequisites
- Compulsory workplace hours for some competencies
- Remove mistakes and improve unit descriptors

PS27: Explore the option to combine the two MEM apprenticeships – Composites Trade and Marine Craft Construction – similar to the NZ Composites and Marine Craft program.

7.2.7. THE WA GOVERNMENT, RITCWA AND COMPOSITES AUSTRALIA

PS 28: The state government, RITCWA and Composites Australia to collaborate with local universities, to leverage existing knowledge and WA-grown technologies, as well as cultivating, nurturing and supporting advanced manufacturing start-ups through funding for R&D partnerships .

8 Appendices

8.1. ACRONYMS

ABS	Australian Bureau of Statistics
ACMA	American Composites Manufacturing Association
AISC	Australian Industry & Skills Committee
ANZSCO	Australian New Zealand Standard Classification of Occupations
ANZSIC	Australian and New Zealand Standard Industrial Classification
AQF	Australian Qualifications Framework
ASQA	Australian Skills Quality Authority
IBSA	Innovation and Business Skills Australia
GOTAFE	Goulburn Ovens Institute of TAFE, Victoria
NCVER	National Council of Vocational Education Research
NZMACITO	New Zealand Marine & Composites Industry Training Organisation
PARTEC	Plastics and Rubber Technical Education Centre, Queensland
RITCWA	Resources Industry Training Council of Western Australia
RPL	Recognition of Prior Learning or Skills Recognition
RTO	Registered Training Organisation
SMTAFE	South Metropolitan College of TAFE, Western Australia
TAFE	Technical and Further Education
VET	Vocational Education and training

8.2. GLOSSARY

Industry 4.0
"The world of the fourth industrial revolution includes automation, machine learning and networked cognition where technologies link the physical, digital and biological spheres. The term Industry 4.0 encompasses the digitalisation of production processes based on devices autonomously communicating with each other along a value chain." AiGroup Workforce Development (July 2018)

SMEs
Small to Medium Enterprises are organisations with fewer than 20 employees. The Australian and West Australian manufacturing industry, including composites manufacturing, has an overwhelming number of SMEs.

8.2.1. TRAINING TERMINOLOGY

Australian Apprenticeships Incentive Program (AAIP)

The Australian Apprenticeships Incentives Program provides employers with incentives to employ an apprentice.

Australian Apprenticeship Support Network

From the 1 July 2020, the AAIP will be replaced with a new, simplified and streamlined incentives program for employers of apprentices and trainees, the Incentives for Australian Apprenticeships (IAA). The program is funded by the Federal government and covers a set of wage subsidies for employers to assist in the costs of employing an apprentice.

Australian Qualifications Framework (AQF)

First introduced in 1995, the Australian Qualifications Framework (AQF) is the policy for regulated qualifications in the Australian education and training system encompassing schools, vocational education and training (VET), and higher education.

Training package qualifications

Qualifications that are within the AQF from Certificates I, II, III, IV, Diploma, Advanced Diploma, Graduate Certificate and Graduate Diploma.

Accredited courses

Courses that have been assessed by a VET regulator as compliant with the Standards for VET accredited courses 2012 and lead to a nationally recognised qualification.

Licenses and work tickets

These are short courses connected to legislation or regulation where a licence or work ticket is required to perform certain tasks, particularly those which are hazardous or dangerous, including forklift driving, working at heights, health and safety. Training is delivered by a multitude of public and private RTOs that are often geared towards specific industries.

Training packages

The package of units of competency that can be offered in a nationally recognised qualification within or aligned with the Australian Qualifications Framework

Skill sets and micro-credentials

Skill sets are single units of competency, or combinations of units, which teach a specific workplace skill or meet a licensing requirement. Micro-credentials are skill sets that are a one-off qualification or part of a formal pathway leading to an accredited qualification.

Short courses

Short courses are related to specific tasks, competencies or skill sets. They may connect to a nationally accredited qualification. Others are non-accredited courses where participants receive a Statement of Attendance or Attainment. In some states, short courses may be approved by the State Training authority rather than the AISC.

Australian Qualifications Framework

APPRENTICESHIP support AUSTRALIA

8.2.2. ANZSIC AUSTRALIAN & NEW ZEALAND STANDARD INDUSTRIAL CLASSIFICATION

Code 1919 - Other Polymer Product Manufacturing is the most relevant to the composites industry, as follows:

1919, Awning, fibreglass, manufacturing

1919, Conveyor belt, plastic or composite, manufacturing

1919, Cutting plastic to size

1919, Disposable plastic gloves manufacturing

1919, Enamel printed felt base floor covering manufacturing

1919, Extruded plastic sections manufacturing (except rigid or semi-rigid)

1919, Fibre reinforced plastic automotive components manufacturing

1919, Fibreglass awnings manufacturing

1919, Fibreglass boat components manufacturing

1919, Fibreglass products manufacturing (except furniture)

1919, Fibreglass reinforced plastic swimming pool shell manufacturing

1919, Fibreglass reinforced plastic tank manufacturing

1919, Fibreglass shower base manufacturing

1919, Floor covering, resilient polymer, manufacturing

1919, Garbage bin, plastic, manufacturing

1919, Garden hose, plastic or composite, manufacturing

1919, Gloves, plastic, manufacturing

1919, Hard surface floor covering manufacturing

1919, High-density safety equipment manufacturing (e.g. military helmets)

1919, Hose, plastic or composite, manufacturing

1919, Hull, boat building, manufacturing

1919, Lino tiles manufacturing

1919, Motor vehicle and boat parts, fibreglass, manufacturing

1919, Plastic conveyor belting manufacturing

1919, Plastic extruded product manufacturing (except rigid or semi-rigid)

1919, Plastic garden hose manufacturing

1919, Plastic hose manufacturing - including reinforced

1919, Plastic linoleum or plastic floor coverings manufacturing

1919, Plastic tiles manufacturing

1919, Plastic wall coverings manufacturing

1919, Radiator and heating hose, plastic or composite, manufacturing

1919, Refrigeration container insulation sheet manufacturing

1919, Rigid fibreglass reinforced plastic sheet manufacturing

1919, Synthetic rubber gloves manufacturing

1919, Synthetic rubber motor vehicle parts manufacturing

1919, Synthetic rubber products manufacturing

1919, Transmission belt, plastic or composite, manufacturing

1919, V-belt, plastic or composite, manufacturing

1919, Vacuum cleaner belt, plastic or composite, manufacturing

1919, Welding services - plastic

8.2.3. ANZSCO AUSTRALIAN & NEW ZEALAND STANDARDS CLASSIFICATION OF OCCUPATIONS

Major Group Code	Minor/Unit Group Code	Occupation title	Skill level
3. Technicians and Trades Workers	3991 Miscellaneous Technicians & Trades Workers	399100 Boat Builders and Shipwrights nfd 399111 Boat Builder and Repairer 399112 Shipwright	3
	3999 Other Miscellaneous Technicians and Trade Workers nfd	399916 Plastics Technician 399999 Various including Fibre Composite Technician and Surfboard Maker	3
7. Machinery Operators and Drivers	7115 Plastics & Rubber Production Machine Operators nfd*	Seven occupation titles* (see below)	4

*711500	Plastics and Rubber Production Machine Operators nfd	711514	Plastics Production Machine Operator (General)
711511	Plastic Cablemaking Machine Operator	711515	Reinforced Plastic and Composite Production Worker
711512	Plastic Compounding and Reclamation Machine Operator	711516	Rubber Production Machine Operator
711513	Plastics Fabricator or Welder	711599	Plastics and Rubber Production Machine Operators nec

8.3. REFERENCES

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8.4. ONLINE SURVEY FORM

The survey included four sets of questions. Feedback was confidential and aggregated into this report. Following is the link for the survey: https://www.surveymonkey.com/r/HH9P9KC

8.5. AUSTRALIAN SKILLED MIGRATION PROGRAM

https://immi.homeaffairs.gov.au/what-we-do/skilled-migration-program

The Skilled Migration stream comprises almost 70% of the entire Australian Migration Program intake in 2019/20. It is designed to improve the productive capacity of the economy and fill skill shortages in the labour market, including in regional areas where skilled labour cannot be sourced locally.

The size and composition of the Migration Program is set each year through the Australian Government's Budget process. It is informed by broad consultation with state and territory governments, business and community groups and the wider public. Community views, economic and labour force forecasts, international research, net overseas migration and economic and fiscal modelling are all taken into account when planning the program.

Currently there are 10 types of visas for temporary skilled worker visas, which are shown on the Department of Home Affairs website.

8.5.1. SKILLED OCCUPATIONS LIST

Related to the Migration Program, the Federal government maintains a Skilled Occupations List which is regularly reviewed to ensure it is responsive to genuine skill needs across Australia. This List specifies the Australian and New Zealand Standard Classification of Occupations (ANZSCO) code for each occupation, including the required skill level, qualifications and/or experience.

The Skilled Occupations List is divided into three sub-sections:

- Short-Term Skilled Occupation List (STSOL);
- Medium and Long-Term Strategic Skills List (MLTSSL); and,
- Regional Occupation List (ROL).

Boat builders and shipwrights (classified under the ANZSCO codes as Code 3991 - Technicians and Trades Workers Major Group 3) are identified in the Skilled Occupations List and are eligible for Skilled Migrant visas.

In contrast, Fibre Composite Technicians, which are included in the ANZSCO Code 399999 Technicians or Trades Workers NEC (not elsewhere classified), do not appear in the current Skilled Occupations List and are not eligible for a Skilled Migrant Visa. This severely limits the ability of the Australian composites industry to fill positions for experienced workers.

8.5.2. 457 VISAS

Prior to its abolition in March 2018, the Temporary Work (Skilled) Sub-class 457 Visa was the most common visa used by employers to sponsor skilled overseas workers to work temporarily in Australia. Holders of a 457 visa could be employed for a period of up to four years and be accompanied by eligible family members.

457 visa applicants had to meet minimum levels of skill and English language requirements, in addition to character and health checks. Some trades occupations and nationals from certain countries could be required to do a skills assessment. It was (and is) common for workers on a temporary work visa to apply for permanent residency with a view to settling in Australia.

In April 2017, the Turnbull Government introduced a number of new visa eligibility criteria, including a one-third reduction in the number of eligible occupations and regions. Finally, on 1 March 2018, the 457 visa was abolished and replaced by two new visa temporary work categories (short term and medium term). Since then, several changes have been made, particularly aimed at attracting skilled workers to regional areas.