



Developing Advanced Manufacturing in Australia

Submission by Deakin University

March 2023

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Introduction

Deakin University is pleased to contribute to the House of Representatives Standing Committee on Industry, Science and Resources' Inquiry into developing advanced manufacturing in Australia. Deakin University, headquartered in Geelong, is one of the region's largest employers and, with almost 65,000 students, one of Australia's largest universities. In addition to Deakin's campuses in Burwood and On-Line, the University's regional footprint includes two campuses in Geelong, one at Warrnambool, research stations at Queenscliff and Griffith (NSW) and an office in Bendigo.

Deakin strongly supports the intent of the House of Representatives Standing Committee on Industry, Science and Resources to investigate developing advanced manufacturing in Australia.

Deakin has always had a strong interest in regional manufacturing driving sector leading initiatives. More recently the focus has shifted to a sovereign, advanced manufacturing capacity and capability. This is exemplified by Deakin's Australia-leading Geelong Future Economy Precinct, our work with the Geelong Manufacturing Council and Bendigo Manufacturing Group through Deakin's Manufutures initiative, the Deakin-led Recycling and Clean Energy Commercialisation Hub (REACH), supporting the Warrnambool region's transition to a Hydrogen economy (Hycel) and leading the bid for a regional advanced manufacturing cooperative research centre (RAMCRC).

Manufacturing remains a core activity within a modern economy and is the most innovation-intensive sector of the economy. The Australian manufacturing sector employs around 860,000 people, generates more than \$100 billion in economic value and over \$50 billion in exports. Nationally, regional manufacturers play an important role and contribute around one-third of the manufacturing economic and employment outcomes. Regional manufacturing plays a role in the local community and its resilience to major change and will be critical for the **green energy transition over the next decade**. Many Australian military bases are regionally based and rely on a strong local regional manufacturing industry to support their needs, reflecting the important role regional advanced manufacturing plays in the support of a cutting-edge defence industry and procurement sector.

Regional manufacturers are strongly connected to their communities. Regional areas need advanced and sustainable manufacturing to support economic growth, maintain broader economic competitiveness, attract highly skilled workers, limit volatility in employment and help bolster the multiplier effect of benefits to supporting businesses in their communities. The challenge is how to foster innovation given 85 per cent of regional manufacturing firms are SMEs.

Deakin continues to work with manufacturing groups in regional Australia to find solutions to these challenges.

Deakin's specific response to the inquiry terms of reference follow.

Deakin University makes the following recommendations to the committee:

- **Recommendation 1:** The Commonwealth Government established Regional Manufacturing Innovation Hubs (RMIHs) to support training and skills development, coordinate re-tooling of regional industry, green energy transition, deliver community transformation programs, defence establishments, and progress a culture of innovation in the regions.
- **Recommendation 2:** Regional manufacturing supports the re-tooling of factories to the next generation of adaptive/reconfigurable, transformable and intelligent factories. Speed of responsiveness to customers and markets is accelerating. There is a need to support manufacturers to build reconfigurable production facilities at reasonable cost.
- **Recommendation 3:** There is a focus on supporting the development of local manufacturing supply chains where Australia can take a lead role in translating local research excellence into globally leading manufacturing excellence.
- **Recommendation 4:** An increased focus on strengthening career pathways for international students into careers in advanced manufacturing and a stronger focus on expert support and financial development for companies to undertake both the digital and energy transition required to ensure they are resilient to market shocks and able to grow sustainably in their current locations.
- **Recommendation 5:** Government intervention and industry-government partnerships to strategically increase incentives and opportunities for female and other underrepresented groups in the advanced manufacturing sector, in particular to include incentivised online and flexible learning opportunities at a range of levels (microcredentials up to advanced apprenticeships, undergraduate and postgraduate degrees) that may better serve to overcome barriers to entry for these under-represented groups.
- **Recommendation 6:** The R&D tax incentive (R&DTI) system shift focus to explicitly incentivise research collaboration between industry and research providers.
- **Recommendation 7:** The Commonwealth Government support regional enhancement of the workforce at all levels, enabling upskilling of staff to utilise new technologies entering manufacturing. This would include a post-18 education system view, rather than siloed higher education, vocational etc. Specific focus should be on alignment between post-18 providers.

Deakin University Responses to the Terms of Reference

1. The opportunities of advanced manufacturing for Australia – including in relation to job creation, productivity, and capability

Australia's significant potential to develop and grow the advanced manufacturing sector hinges on the nation's extraordinary capacity to produce cheap green energy. The challenge is to ensure that Australian regional manufacturing has access to this opportunity. Regional manufacturing faces challenges attracting skilled workers; whole of community approaches are needed to attract workers to regional areas. SMEs make up 85 per cent of the manufacturing companies in regional Australia, these companies need a way to re-tool for new technologies and new manufacturing needs/programs given their limited available capital. Developing resilience in local manufacturing communities for both supply chains and for short term demand shocks (both excessive demand as well as lack of demand) while maintaining long term capacity is vital.

Deakin University has significantly invested in recycling and clean energy advanced manufacturing, REACH (the Recycling and Clean Energy Commercialisation Hub) is Australia's largest ecosystem of clean energy advanced manufacturing. Likewise, with our partners (Commonwealth and Victorian Governments) we have invested significantly in developing a facility to support the introduction of new hydrogen technologies at Warrnambool (Hycel Technology Hub).

The above examples highlight a few opportunities across advanced manufacturing where Australia has grasped the future industry-base, and with that employment capacity and capability. Deakin's research points to particular opportunities, reflective of our work, in food and nutritional circular products; battery manufacturing; carbon fibre composite manufacturing; metal alloy development (mining); metal forming; additive manufacturing; nano-fibre textile manufacturing. There are many other opportunities on offer.

The importance of support for manufacturing in regional Australia is critical to the success of the industry. Deakin **recommends** the Commonwealth Government establishes a national network of regional manufacturing hubs as part of the National Reconstruction Fund. The Regional Manufacturing Innovation Hubs (RMIHs) would support training and skills development, coordinate re-tooling of regional industry, enable regional engagement in global supply chains, deliver community transformation programs, support defence establishments and embed a culture of innovation into the regions. It is critical these hubs connect with the sense of place and focus on the opportunities for each specific region to grow and thrive through local collaboration and capability.

2. International trends in advanced manufacturing

Deakin's breadth of exposure at the forefront of advanced manufacturing in key industrial hubs of Australia, international presence and engagement, as well as our strong global linkages via forums such as the Australian Technology Network, uniquely position us to forecast global trends in advanced manufacturing.

Considering the alignment to Australia's current industrial and economic environment and the University's research strengths, Deakin notes the following trends:

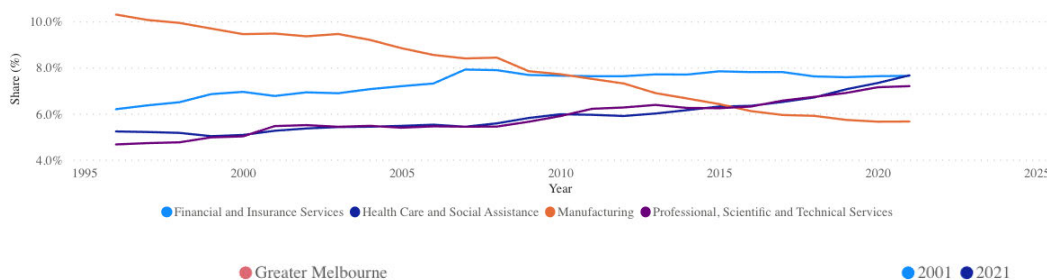
- New materials are being created that are more circular and sustainable.
- New processes are being created that are more flexible and bespoke to enable mass customisation.
- Mineral supply chain resilience and social risk analysis – countries are assessing the risks (technically, economically and socially) of their mineral supplies.
- Recycling of energy storage products to retain critical minerals in country.
- AR/VR/XR (i.e. augmented reality, virtual reality, mixed reality) assisting complex manufacturing and repair/maintenance.
- Industry 5.0 will holistically leverage the unique strengths of human and machines in centred manufacturing. Human creativity and problem solving will be enhanced by Artificial Intelligence, digital transformation, automation and robotics.
- IoT and sensors will drive the Industry 5.0 revolution that is overtaking Industry 4.0.
- Integration between manufacturing sectors to serve distinct consumer bases i.e. defence manufacturing influencing healthcare technology etc.
- People choosing to live regionally and wanting to build local manufacturing ecosystems that are connected to global networks.

- The need for energy transition both as a driver of new manufacturing opportunities (wind, solar, wave power, hydrogen and related systems) and as an enabler of globally competitive low carbon products and services.

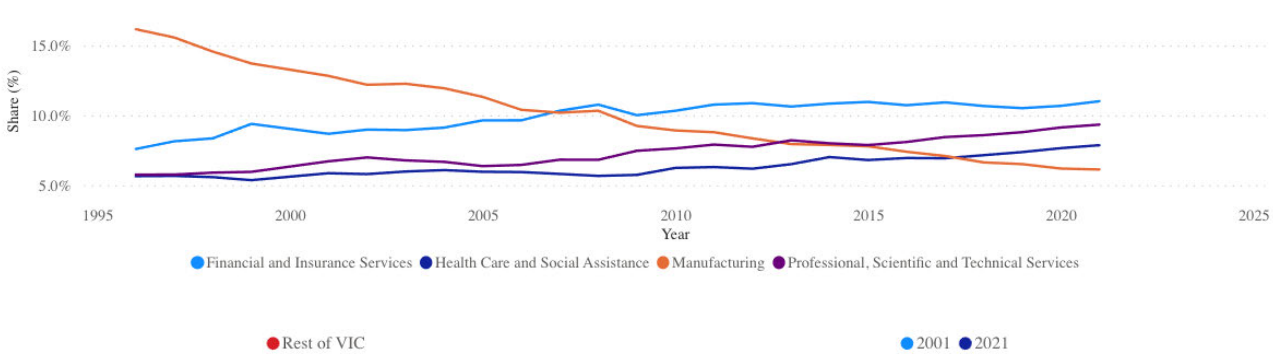
3. Competitive strengths and advantages of Australia in advanced manufacturing, including Australia's comparative international position in advanced manufacturing

Despite historic strengths as a manufacturing and industry-driven economy, at present Australia has a relatively weak international position in advanced manufacturing. Primarily, this is driven by our lack of scale in manufacturing to drive an advanced manufacturing sector. In stark contrast to our previous international position reflective of manufacturing as a major employer and economic participant (i.e. via the car industry, manufactured consumables etc), our current sectors fulfil more niche roles. For example, Australia’s capital cities have decreased their manufacturing sector to a historic low of 5 per cent of the economy. Regional and rural communities are facing a slow decline of their manufacturing sectors, with less alternative employment options available compared to metropolitan areas.

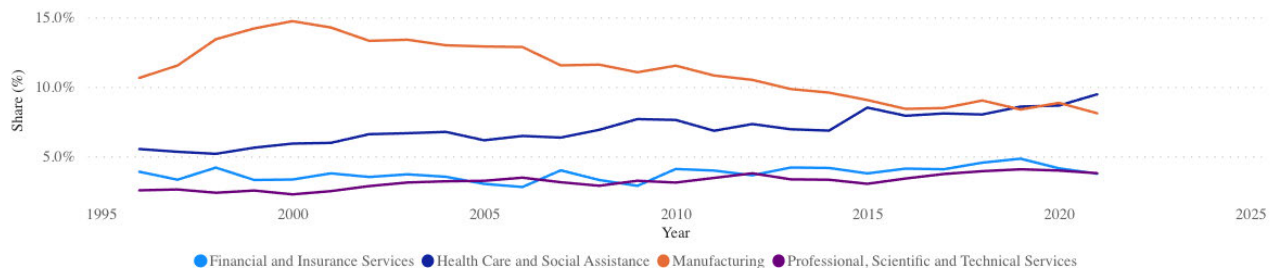
Industry Share '96 - '21



Industry Share '96 - '21



Industry Share '96 - '21



SGS Economics and Planning, Australia’s Economic Wellbeing, December 2021

In contrast, Australia’s status as an advanced, knowledge-driven economy, combined with early green shoots of a resurgence of advanced manufacturing across key portfolios speaks to potential opportunities. Likewise, the commitment of State and Federal Governments to the advanced manufacturing sector can positively impact these opportunities, to drive our relative international strengths and readiness. This is particularly the case with industries presenting advantage to intersect Australia’s research and development with industrial work – such as those outlined in the official priorities of current national strategy and policy.

Deakin **recommends** that there is a focus on supporting the development of local manufacturing supply chains where Australia can take a lead role in translating local research excellence into globally leading manufacturing excellence. This would include looking to ensure that there is a focus on completing supply chain gaps in areas including battery technologies (electrolyte, cathodes, anodes and testing), green composites (local bio-derived fibre precursors), wealth from waste (circular economy, high value end products, biomass to hard carbons, minerals processing, solar panel recycling) and low carbon production, processing and manufacturing via green energy transition strategies.

4. Barriers to the growth of advanced manufacturing in Australia – including barriers to existing manufacturers, particularly small and medium enterprises, adopting advanced manufacturing technologies and processes such as AI and robotics

Deakin's regional and rural industry partners have stated the following barriers for manufacturing:

- Energy is not as available and often more expensive in regional and rural Australia – it's a bigger hurdle than for metropolitan companies.
- People, skills and talent are less available in our regions.
- The gap between regional and metropolitan competitiveness is widening.
- An absence of high value jobs and wages in regional settings.
- Regions are more susceptible to economic shocks as evidenced by the flow-on-impact of recent floods and fires.
- Metropolitan manufactures have greater density and therefore more options to diversify.

There are three main manufacturing sectors in regional Australia: **Food and Beverage** being the largest; followed by a combined **Mining/Agriculture/Transport/Defence equipment**; and **Fabrication and Regional Construction**. The first two groups were part of the Australian MMI priority areas, and the third group is a critical part of Australia's economy.

Australia's manufacturing sector is made up of a disproportionate number of small companies, with 87 per cent employing between one and 19 staff. Most SMEs are connected with their region and do not operate on a global scale, but many have the potential for expansion. Digital technologies are helping metropolitan companies produce customised products for consumers at scale. However, regional manufacturing is behind metropolitan manufacturing in making this shift to high-value production.

Seeking to address this Deakin University has implemented Manufutures, a unique advanced manufacturing innovation hub, located within the heart of Deakin's Future Economy Precinct in Waurm Ponds (Geelong, Victoria). Manufutures aims to accelerate success through its facilities, programs and services. The Manufutures approach is to address the industry challenge for the regions by developing a locally sustainable resilient advanced manufacturing ecosystem. The second challenge is how to take these companies (mostly SMEs) on a journey of innovation to become more agile to participate in future commercial opportunities.

Based on the feedback of our industry partners, as well as Deakin's expertise and experience, we **recommend** increased focus on strengthening career pathways for international students into careers in advanced manufacturing and a stronger focus on expert support and financial development for companies to undertake both the digital and energy transition required to ensure they are resilient to market shock and able to grow sustainably in their current locations.

Other Barriers for SME innovation:

IPA-Deakin SME Research Centre suggests that SMEs operating in or supplying to the advanced manufacturing sector in Australia are faced with a number of barriers to growth. For example, the IPA-Deakin SME Research Centre¹ reports in a small business white paper that Australia's private sector innovation and research has been **underperforming on almost every measure of innovation** and that **private sector R&D expenditure has been at or below**

¹ Tanewski, G., Kavourakis, J., Podolski, E., & Yusoff, I. (2021). "Post COVID Policy Options to Enhance Australia's Innovation Capabilities: Small Business White Paper 2021". The IPA-Deakin SME Research Centre, Deakin University.

OECD averages for most of the past two decades. Evidence in this white paper includes data from SMEs operating in or supplying to the advanced manufacturing sector.

Numerous government-commissioned-reviews of Australia’s innovation system over the past decade have consistently demonstrated that **lack of collaboration** between industry and the research community **impede** R&D activity, contributing to Australia’s under-performance in the innovation eco-system. Evidence from these reviews suggest that strong differences in culture and differing expectations affect the willingness of both parties to engage in common projects.

Business surveys conducted by the ABS identify numerous reasons for the lack of private sector collaboration on innovation. Both micro (i.e. 1-4 employees) and small businesses (i.e. 5-19 employees) cite **insufficient time** (a proxy measure for resources) and **insufficient funds** as primary reasons limiting collaboration on R&D (approximately 20 per cent of respondents cited both reasons) (see Table 1). These reasons are less frequently cited by larger companies. In contrast to cultural factors being cited as a primary reason for limited collaboration, the ABS data indicates that SMEs are deterred from collaboration by cost factors. This suggests government support for collaboration should address both cost barriers and cultural impediments. While cultural impediments are likely to be more important factors in larger businesses, cultural impediments are rarely cited in SME company responses, except so far that limited exposure to academics impede industry from identifying relevant researchers with whom to collaborate.

Table 1. Reasons for Not Collaborating on Innovation Activity by Size of Business

	0-4 employees Micro %	5-19 employees Small %	20-199 employees Medium %	200+ employees Large %	Total %
Company Reasons					
No expected benefit	11	8.8	9.8	9.1	10
Unable to find a suitable collaboration partner	8.3	6.2	5.6	6.3	7.2
Lack of access to knowledge or advice about collaborative arrangements	6.4	4.9	4.6	4.9	5.6
Lack of skills within the business	4.9	4.2	7	6.4	4.8
Insufficient time	19.7	20	14.5	13.5	19.3
Insufficient funds	22	19.1	14.6	10	20.1
Government regulations or compliance	4.8	4.1	4.5	10.1	4.6
Reasons relating to collaboration partner(s):					
Differences in priorities or outcomes sought	2.4	1.7	2.9	2.5	2.2
Different work practices	1.8	1.6	1.5	2.1	1.7
Confidentiality or trust concerns	3.2	2.4	3	4	2.9
No factors	56.1	59.8	63.2	66.2	58.3

Source: ABS BLADE Integrated Data 2012-2018

Australia also lacks government investment in knowledge-sharing centres and infrastructure, adding to the difficulty of finding relevant researchers with whom to collaborate. The lack of investment in knowledge-sharing infrastructure also compounds skills shortages seen throughout industry. Table 2 shows data related to skills shortages in companies performing R&D. The shortages vary considerably by industry and by company size. Among smaller companies, most common skills shortages are in business-related fields such as the trades, transport and machinery operation and business management. Among larger companies, skills shortages are common in technical fields such as engineering, science, information technology and finance. With both limited experience in finding research partners and no centralised location to seek research partners, companies are required to navigate sometimes complex university or research-centre collaboration requirements. The complexity of these arrangements further limits collaboration.

Table 2. Skills shortages in private companies conducting R&D by size of business

	Small (< \$20m turnover) %	Large (≥ \$20m turnover) %
Skills shortage or deficiency to develop or implement innovation		
Engineering	35.46	64.54
Scientific and research	43.04	59.96
Information technology	40.83	59.17
Trades	60.03	39.97
Transport, plant and machinery operation	60.55	39.45
Marketing	65.29	34.71
Project management	33.33	66.67
Business management	55.36	44.64
Financial	39.72	60.28
None of the above	56.78	43.22

Source: ABS BLADE Integrated Data 2012-2018

Accordingly, Deakin University makes several recommendations explicitly focused on collaboration between advanced manufacturing companies and Australia’s universities and research institutions. Universities Australia (2020) suggests that benefits of private sector collaboration brings a return of \$4.47 per dollar invested. The Department of Education’s Review of Research Policy and Funding Arrangements (2015) suggests that the potential increases in business efficiency from collaborative research, relative to uncollaborative research, increases by a factor of three. Similarly, Deakin’s analysis provides evidence consistent with the notion that collaborative research produces more successful patent and innovation outcomes.

Consistent with the stated objectives of Australia’s innovation tax system, Deakin **recommends** that the R&D tax incentive (R&DTI) system shift focus to explicitly incentivise research collaboration. The current R&DTI scheme provides preferential treatment to collaborative research, permitting claims of less than \$20,000. We support previous reviews calling for additional support for collaboration (Ferris et al. 2016) and recommend extending the preferential status of collaboration with research institutions to include a premium of 20 per cent to the relief provided by the R&DTI, reflecting the additional non-private benefits derived from collaboration.

Further, additional incentives and systems can complement the R&DTI and aid in addressing the limited access to capital of SMEs and overcome any perceived cultural barriers that restrict collaboration. One such effective tool is the provision of innovation vouchers – an approach for which there is strong causal evidence supporting additionality and collaboration outcomes. Innovation vouchers provide conditional access to capital for use in R&D – redeemable only on presentation for research collaboration with a university or other publicly-funded research institution. Hence, the vouchers explicitly require industry to partner with research institutions to extract value from the grant. Evidence from several overseas applications of innovation vouchers shows improvements in additionality and spillovers.

5. Financial and non-financial investment opportunities or possible reforms to support the growth of advanced manufacturing in Australia in: renewables and low emission technology; medical and health technologies; transport; value adding in agriculture, forestry and fisheries; value adding in resources; defence; and enabling capabilities

Australian Manufacturing employs over 860,000 people and it typically contributes 45 per cent of Australia’s R&D spend. Regional manufacturing will play a vital role in employment as the fossil fuel industries decrease their footprints in regional Australia over the next 10 years. Over the next decade regional Australia will need to expand food and beverage manufacturing and defence, energy and transport equipment manufacturing.

Deakin has leveraged Commonwealth funds by matching it with a combination of industry and Deakin’s own investment in regional infrastructure for training and innovation. Hycel Hydrogen Hub (\$2 million in Commonwealth

funds) has over \$20 million worth of infrastructure to enable the training of the future hydrogen workforce (vocational and university level). Hycel has research infrastructure to attract green energy manufacturing companies to Warrnambool. Deakin's REACH (Recycling and Clean Energy Commercialisation Hub) has leveraged \$50 million of Commonwealth funds with industry and Deakin funds to create a total Hub value of \$380 million.

One-off capital funding opportunities can assist but to drive change they need to be embedded into the local communities in the longer term so that employers know these resources are there to support their future development. Often funding is given to a new initiative or infrastructure build with an expectation that it will rapidly become self sufficient, yet few are, due in part to the overheads for operating open access capabilities, but also due to need to regularly update technology. There is a need for these initiatives to have an opportunity to apply for (competitive) co-support funding beyond an initial establishment phase to keep key staff and support new programs that adapt to local needs.

The nexus between research and vocational education needs to be strengthened to ensure training is agile and focused on local needs for access to technology ahead of when it may be implemented in industry. There is a need to upskill the workplace, with small, tailored training opportunities and ongoing learning embedded into employment. This is in addition to the training of new workers from across the globe and enabling them to bring their skills and work in the regions. Digital training tools and systems for short-form training is a skill Deakin could significantly contribute to as a leader in on-line learning and skill development. The funding model for this type of educational service provision needs to be established to ensure the system is sustainable for providers, connected to physical training infrastructure and able to be accessed by companies no matter the scale of their workforce or their location.

6. The opportunities to increase the number of workers employed in advanced manufacturing, including consideration of ways to increase the participation and retention of women and other historically underrepresented groups

Improving diversity of the workforce is critical to enhancing any workplace. Prior to the COVID-19 pandemic, The School Engineering at Deakin University, implemented a strategy to employ more female academics. This work was based on experience from a range of sectors, effectively 'you cannot be what you cannot see'. As such, increasing the employment numbers of women and other underrepresented groups in advanced manufacturing will be accelerated as future participants start to see greater numbers of individuals like them in those roles.

Based on this learned experience, Deakin **recommends** government intervention and industry-government partnerships to strategically increase incentives and opportunities for female and other underrepresented groups into the advanced manufacturing sector, in particular to include incentivised on-line and flexible learning opportunities at a range of levels (microcredentials up to advanced apprenticeships, undergraduate and postgraduate degrees) that may better serve to overcome barriers to entry for these underrepresented groups.

We also recommend continued partnership with the university and vocational sector to increase academic career pathways for women and underrepresented groups as role models and exemplars for future generations of the opportunities advanced manufacturing holds.

7. Skills needs in advanced manufacturing

Development of the regional workforce capacity is critical. The COVID-19 pandemic exposed the issue of skilled labour supply shortages to meet industrial demand. Deakin's Manufutures initiative is committed to enhancing regional workforce resilience by providing a cohesive framework for advanced manufacturing industries, associated services and supply chains to access a skilled regional workforce and providing coherent pathways for individuals to obtain skills for sustainable careers in regional advanced manufacturing from vocational to tertiary routes.

Deakin aims to contribute its experiences in workforce development to state/territory governments to inform education, employment and skills policies and skills service organisations to inform reviews of existing standards and to develop new standards based on new technologies being developed with Deakin (such as REACH or Hycel). Deakin with the Royal Australian Air Force (RAAF) developed a competency framework called the 'Virtual Trade' to upskill technical and maintenance aviators on the latest technologies, starting with Additive Manufacturing (AM) otherwise known as 3D printing. The Virtual Trade process can be rolled out to industry and implemented through local vocational education providers. This is a new short term pathway to better enable new technology knowledge to flow from research at a university level through to vocational education providers that can improve the associated

workforce, while appropriate trade certifications are created in the background to be taught at TAFE. This upskilling of the vocational workforce is critical for regional Australia, where it is difficult to attract new workers.

Deakin University works with regional schools, TAFEs and other regional university partners to deliver integrated, authentic learning outcomes and with DESE Local Jobs Taskforces and state skills and employment bodies to join the dots between employment and skills initiatives.

It is critical to highlight that skills needs in advanced manufacturing will often be region-specific, reflective of the industrial opportunities and relative profile of the manufacturing-base of the region. As such, any response by government, industry, and key skills partners such as universities, must remain flexible and responsive to changing needs, requirements, and drivers.

Deakin **recommends** that the Commonwealth Government support regional enhancement of the workforce at all levels, enabling training for new technologies entering manufacturing. This must facilitate an entire post-18 education view, rather than just universities.