Advanced Skills for Advanced Manufacturing:

Rebuilding Vocational Training in a Transforming Industry

By Dr. Tanya Carney and Dr. Jim Stanford
The Centre for Future Work at the Australia Institute

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Introduction and Summary

Australia's manufacturing industry is currently at a crossroads. After years of decline, the sector has finally found a more stable economic footing, and many indicators point to an expansion in domestic manufacturing in the coming years. However, one key factor that could constrain that recovery is the inability of Australia's present vocational education and training system, damaged by years of underfunding and failed policy experimentation, to meet the needs of manufacturing for highly-skilled workers. The skills challenge facing manufacturing is all the more acute because of the transformation of the sector toward more specialised and disaggregated advanced manufacturing processes: based on locating specified stages of production in Australia (rather than start-to-finish vertically integrated assembly), with corresponding demands for flexible, customisable production runs. The advanced manufacturing model naturally implies more intense demands for highly-trained workers, in all its occupations: production workers, licensed trades, technology specialists, and managers.

Employment in manufacturing has started to rebound, though is still much lower than a decade ago. Despite that downsizing, employers are already reporting difficulties in finding workers with the right mix of technical skills and employability, as well as relevant experience for their particular business or sector needs. During the years of manufacturing contraction, employers did not invest enough in an ongoing supply of skilled workers and apprentices. And Australia's VET system has been fragmented and undermined by years of spending cutbacks and failed experimentation with private delivery models. Hence the coming recovery in manufacturing could be cut short by inadequate availability of skilled labour.

To sustain the emerging turnaround in manufacturing, therefore, the sector has an urgent need for a concerted and cooperative effort to strengthen the sector's vocational education and training system. To succeed, this effort will require participation by all stakeholders: government, industry, educational institutions, and unions. This report aims to contribute to that process, by cataloguing the emerging skills challenges facing manufacturing, reviewing the failures of the existing approach to vocational education in this sector (and across Australia's economy as a whole), and proposing key principles for reform.

This report has been prepared by the Centre for Future Work at the Australia Institute, for the **Second Annual National Manufacturing Summit**. The Summit will gather leading representatives from all the major stakeholders in Australia's manufacturing

sector – business, unions, universities, the financial sector, suppliers and government – to consider the industry's prospects and identify promising, pragmatic policy measures to support a sustained industrial turnaround. It is a highly appropriate forum at which to begin a discussion about the necessary multi-partite approach to vocational education that will be required to address the looming skills challenges facing the sector.

The report contains three major sections. Part I outlines the features and capabilities of the current manufacturing workforce, and explores the emerging shortages of skilled workers that the sector will face in coming years. It may seem counter-intuitive that an industry that has lost over 100,000 positions in the past decade might experience a shortage of workers. But there are key factors behind the overall employment trend that are creating the conditions for potentially binding skills shortages. These include the rebound in total manufacturing employment (which has grown by almost 50,000 positions in the last year); the reorientation of production around more specialised and skills-intensive advanced manufacturing strategies; and the coming demographic transition within the workforce (as existing skilled workers, many of whom are approaching retirement age, begin to exit the industry). Moreover, the sectoral and occupational diversity of manufacturing jobs means that shortages can arise in specific fields, despite overall labour supply conditions that are relatively abundant.

Part II of the report then reviews the current operation of the VET system as experienced by Australian manufacturers, cataloguing its many shortcomings. According to interviews we conducted with multiple industry stakeholders, the current VET system is definitely not meeting the needs of the manufacturing industry for top-quality skilled workers – nor the needs of the wider community for access to high-quality training and corresponding opportunities for good work. At present, training delivery is largely oriented around competency-based, fragmented packages of knowledge. These may address narrow, enterprise-specific requirements, but typically do not permit workers to accumulate comprehensive, recognised, and portable qualifications. The focus on distinct units of competency has created a culture of "training for the enterprise," whereby employers primarily commission relatively narrow, firm-specific bits of knowledge rather than investing in comprehensive and flexibile capacities. This then inhibits the ability of the workforce to respond, adapt and redeploy in a variety of situations – such as redeployment within the enterprise, responding to personal circumstances of the workers, or responding to changes in wider economic conditions (Buchanan and Jakubauskas, 2010). The outsized role in the present VET structure played by private training providers, subsidised through poorly-supervised public payments, has also damaged the credibility and trust in the

value of vocational education that is so important in eliciting commitments (from both employers and students) to ongoing investments in skills acquisition. At the same time, the capacity of public "anchor" institutions (and the TAFE system in particular) has been eroded by funding cutbacks and the misplaced emphasis on market contestability in vocational education. For all these reasons, it is not an exaggeration to conclude that the vocational training system in Australia is in a full-blown crisis – affecting other sectors, too, not just manufacturing – that will significantly undermine future industrial and economic development if it is not quickly addressed and reversed.

In the face of these urgent concerns with the current status of vocational training in manufacturing, Part III of the report provides a series of specific recommendations for strengthening and reorienting the VET system in manufacturing. Of course, addressing the VET crisis in manufacturing can only occur in the context of broader efforts to reform vocational education more generally – since most of the problems (including the failure of subsidised market delivery of VET services) are system-wide in nature. So Part III affirms the necessity of moving ahead quickly with fundamental repair of the overall VET system in Australia. At the same time, however, there are important specific measures that must also be taken to address the particular skills challenges facing manufacturing, and the report makes several recommendations in this regard.

We make twelve recommendations for specific actions to resolve the skills crisis in manufacturing, and strengthen the overall VET system in Australia. They include:

1. Reestablish adequately funded and stable TAFEs as the centerpiece of vocational education.

2. Develop the capacities of TAFE teachers in manufacturing fields, and invest in modern capital equipment for training.

3. Encourage partnerships on customised joint training initiatives between specific TAFEs and firms or groups of firms.

4. Expand other forms of integrated training between VET providers and workplaces.

5. Begin working to develop and implement higher-level and multi-disciplinary qualifications reflecting emerging skills and composite capacities.

6. Shift emphasis in curricula and training programs toward comprehensive and complete qualifications, rather than micro-competencies.

7. Integrate basic literacy and numeracy training into VET offerings at all levels.

8. Support the expansion of apprenticeships in manufacturing with fiscal measures, instruction resources, and mentoring.

9. Implement provisions ensuring access to training opportunities, and fair employment conditions for trainees and apprentices, within modern awards and enterprise agreements.

10. Develop ambitious and better-resourced systems to support retraining and redeployment of displaced workers in declining manufacturing sectors.

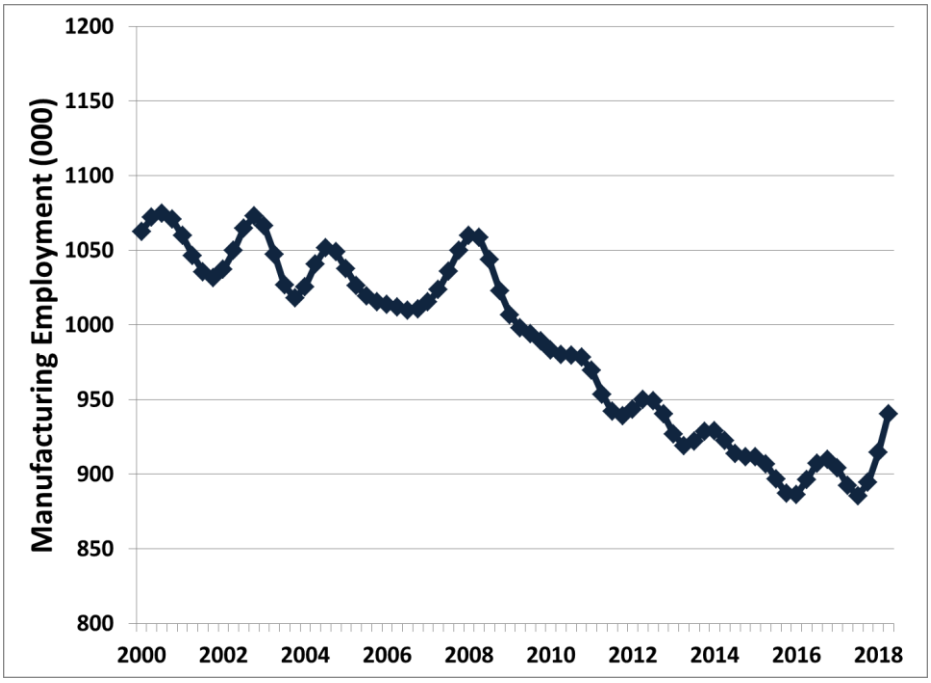
11. Develop new models for phased retirement to smooth the demographic transition facing skilled trade positions in manufacturing.

12. Establish a leadership-level Manufacturing VET Policy Board to coordinate VET initiatives in the sector, and represent the interests of manufacturing in broader VET processes and dialogues.

I: The Skills Challenge Facing Manufacturing

Australian manufacturing has survived a very challenging period, and is now poised for a more optimistic future (Swann and Stanford, 2017). Many indicators point to an improvement in the fundamental economic conditions of manufacturing. For example, the AiGroup's Performance of Manufacturing Index (PMI) has now signaled the sector's expansion for 20 consecutive months – the longest run of consecutive expanding conditions since 2005 (Australian Industry Group, 2018a). Most recent value-added data from the ABS indicates an expansion in the sector's real output of 4.5 percent over the past year.[1] Perhaps most encouragingly, the industry is now in hiring mode: trend total employment in manufacturing increased by almost 50,000 positions in the year ending in May 2018, making manufacturing one of the largest sources of new jobs in the entire economy (Figure 1).[2]

Figure 1. Total Manufacturing Employment, 2000-2018



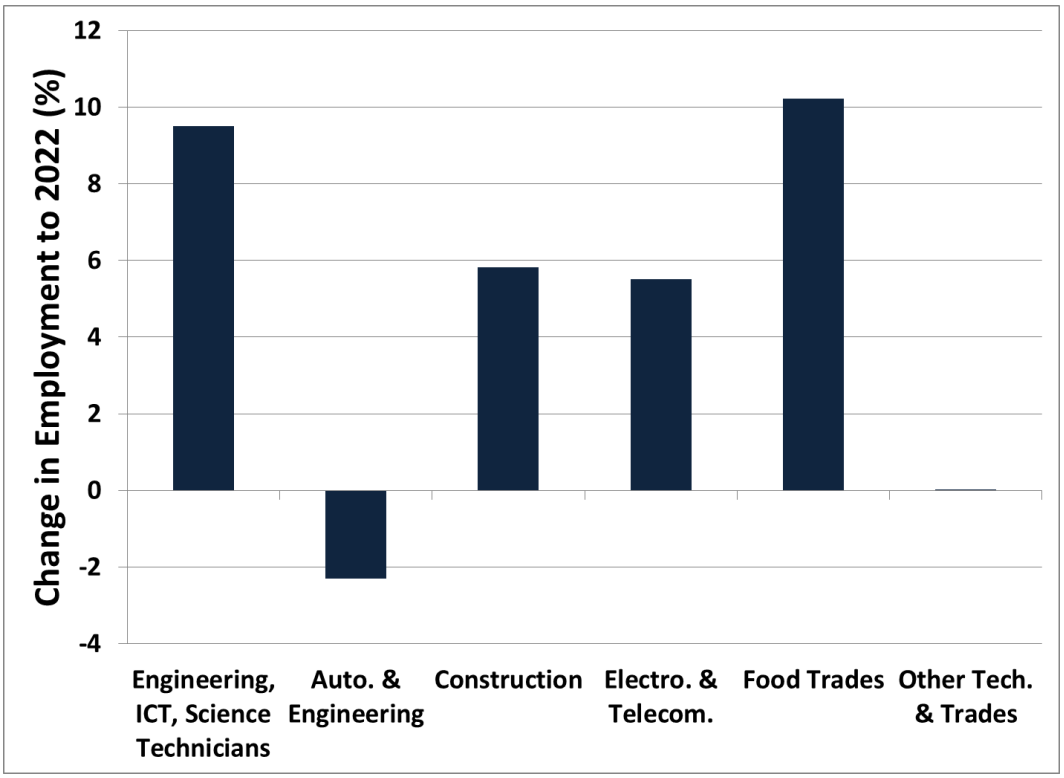
Source: ABS Catalogue, 6291.0.55.003, Table 4. Trend data.

[1] Authors' calculations from ABS Catalogue 5206.0, Table 6.

[2] Only health and social services (57,000 jobs) and construction (50,000) created more new jobs in the past year, on the basis of trend data.

The recovery in manufacturing reflects a reinvention, not just a rebound from previously depressed levels. The industry's decline over the decade up to 2016 reflected a “perfect storm” of several negative factors: including an overvalued Australian dollar, other cost constraints resulting from the resource boom, weak export demand, and an ambiguous and inconsistent domestic industrial policy stance. However, after 2016 growth in exports and profits, stronger business confidence, growing productivity, and employment growth marked the signs of an emerging turnaround. That this has occurred despite the heavy industrial blow associated with the closure of Australia’s passenger vehicle manufacturing industry, is all the more testimony to the resilience of the sector. Some of the success results from the industry’s shifting focus from mass production and complete assembly operations, toward advanced manufacturing, participation in discrete segments of global supply chains, and more specialised or “niche” production strategies. The industry is also increasingly reliant on digital and automated technologies to generate new, customised and innovative products for markets both in Australia and overseas.

Figure 2. New Demand for Technical & Trades Workers by Occupation, 2017-2022



Source: Department of Jobs and Small Business (2017b).

In the context of a general improvement in manufacturing employment, positions for technicians and recognised trades workers indicate some of the most promising future opportunities. For example, in its most recent five-year employment forecast, the Department of Jobs and Small Business (2018a) lists employment projections by

occupation. As indicated in Figure 2, they expect strong growth in employment in several technical and trades occupations in coming years, including 10 percent growth in food-processing trades and engineering and scientific technicians, and growth of over 5 percent in electrotechnical and telecommunications. Not all of these roles, of course, will be located in the manufacturing sector (since these occupations are also present in other sectors), but they further attest to the relatively vibrant labour demand for skilled technical and trades workers.

It may seem counter-intuitive that manufacturing could already be facing skills shortages, after a decade of substantial job losses. But our interviews with key informants from several different segments of Australian manufacturing, along with published research from other sources (including Australian Industry Group, 2018b; Department of Jobs and Small Business, 2018b; and Department of Industry, Innovation and Science, 2017) confirm that manufacturing employers are indeed facing growing challenges in meeting their requirements for skilled workers. Some surveys indicate that skills shortages are more acute in manufacturing than any other part of the economy (Patty, 2017).

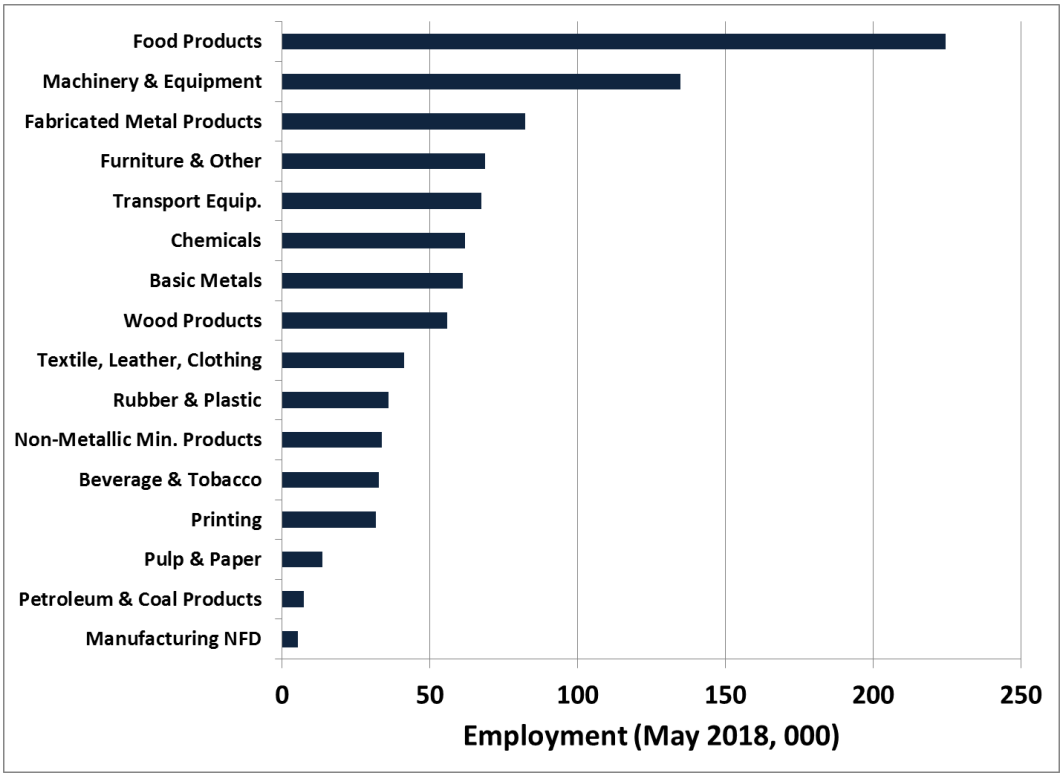
Why are skills shortages becoming so pressing, even relatively early in the industry's recovery? Several factors help to explain the fragility of the sector's overall skills pipeline:

SECTORAL DIVERSITY

Manufacturing is not a homogeneous undertaking: products and processes are very specialised across sub-sectors and occupations. This diversity can be a strength, of course: helping to stabilise the overall manufacturing sector against shocks or fluctuations in any particular market. But it complicates the challenge of skills development, since workers with particular qualifications or experience may not be able to transition as easily into alternative applications.

A perspective on this diversity of the sector can be gained by decomposing total manufacturing employment, and the recent change in employment, into the various sub-sectors that make up the overall manufacturing base. Figure 3 illustrates the segmentation of manufacturing employment according to sub-sector.

Figure 3. Manufacturing Employment by Sub-Sector, May 2018



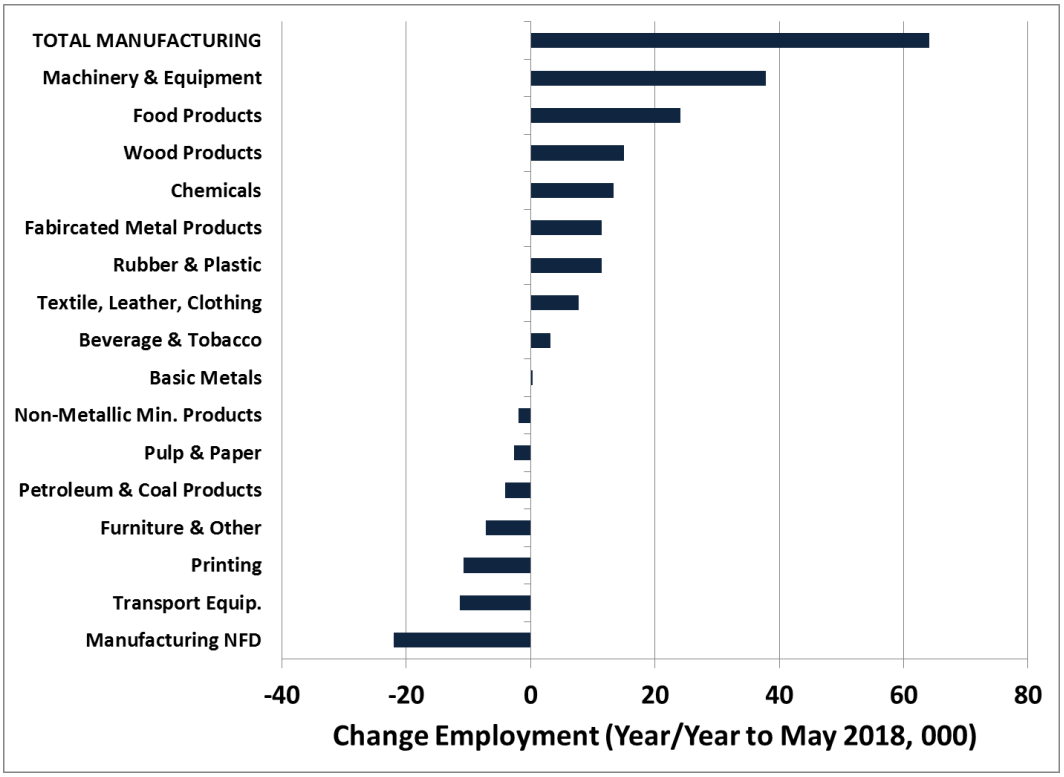
Source: ABS Catalogue 6291.0.55.003, Table 6.

The food processing sector is the largest component of manufacturing work, accounting for almost 1 in 4 jobs in Australian manufacturing, or around 225,000 positions. Machinery and equipment manufacturing – itself an incredibly diverse category – is the next largest component, with 135,000 positions (14 percent of total manufacturing employment). Other large sub-sectors, each employing over 50,000 workers, include: fabricated metal products, furniture, transportation equipment (which has lost jobs with the automotive closures), chemicals, basic metals, and wood products. Eight smaller sub-sectors account for the remaining 200,000 workers in manufacturing.

Because of this diversity, and the particular economic conditions faced by each sub-sector, there is even greater variation in the patterns of employment change. The overall employment growth experienced recently in manufacturing has not been shared consistent by each sub-sector; some sub-sectors are still experiencing decline, while others are enjoying even stronger growth than the overall manufacturing trend. Figure 4 illustrates this wide variability in employment trajectories, based on the

change in employment in each sub-sector of manufacturing over the most recent 12-month period.[3]

Figure 4. Year/Year Change in Manufacturing Employment by Sub-Sector



Source: Authors' calculations from ABS Catalogue 6291.0.55.003, Table 6. Original unadjusted data.

The machinery and equipment sector has demonstrated the most impressive job growth over the past year, adding close to 40,000 new positions. Against a starting employment level of under 100,000 in mid-2017, that represents an expansion of almost 40 percent in one year; whether those reported gains reflect real sustained expansion, of course, will depend on future fluctuations in the ABS data. Nevertheless, an expansion of this pace in a sub-sector characterised by very specialised products and technologies will naturally create daunting challenges in recruiting, training, and retaining appropriately skilled workers. The food products industry was the second-largest source of new manufacturing jobs, adding 24,000 jobs in the year (for an expansion of around 12 percent). The slower relative pace of that expansion, and the somewhat more homogeneous nature of the work, suggest a less dramatic skills

[3] Figure 3 is based on the original quarterly data published by the ABS, rather than the seasonally adjusted or trend figures (which are not generated for manufacturing sub-sectors). The year-over-year change in total manufacturing employment indicated in Figure 3 (64,000 jobs) thus differs from that indicated in Figure 1 (which was based on trend data).

challenge – although food manufacturers will still be concerned with ensuring ongoing supply of suitable workers. Other industries which have added over 10,000 new jobs each in the last year include wood products, chemicals, fabricated metal products, and the rubber and plastic industries. Even the clothing, textile and footwear sector – which has experienced the most dramatic long-run contraction of any manufacturing sector – added a reported 7,700 new positions, attesting to the remarkable resilience of Australian manufacturing as it adapts to global pressures and reconfigures domestic production in line with the logic of flexible, niche production.

At the same time, some segments of manufacturing continue to shed labour. This includes, of course, transportation equipment manufacturing – which lost over 11,000 positions in the year to May 2018, mostly associated with the car assembly shutdowns and resulting ramifications through the supply chain. It makes obvious sense to address skills shortages in growing sub-sectors through the reallocation of workers who are still being shed from contracting sub-sectors; experience shows, however, that this important task is not easily accomplished, and requires detailed and active supports for affected workers to be matched with new opportunities in growing firms (including retraining and relocation supports).[4]

The uneven nature of job-creation, and its unpredictability (given continuing uncertainty affecting many sub-sectors of manufacturing regarding costs, exchange rates, export opportunities, and other core influences), make it difficult for employers to plan their skills development efforts. The continued downsizing experienced by some parts of manufacturing also reinforces the overall community misperception that manufacturing in general is bereft of economic opportunity – and hence would not be an attractive destination for new graduates. The closure of major automotive plants obviously reinforced this negative perception (generating headlines for months), while the smaller and more dispersed employment successes being recorded elsewhere in manufacturing are often overlooked.

OCCUPATIONAL DIVERSITY

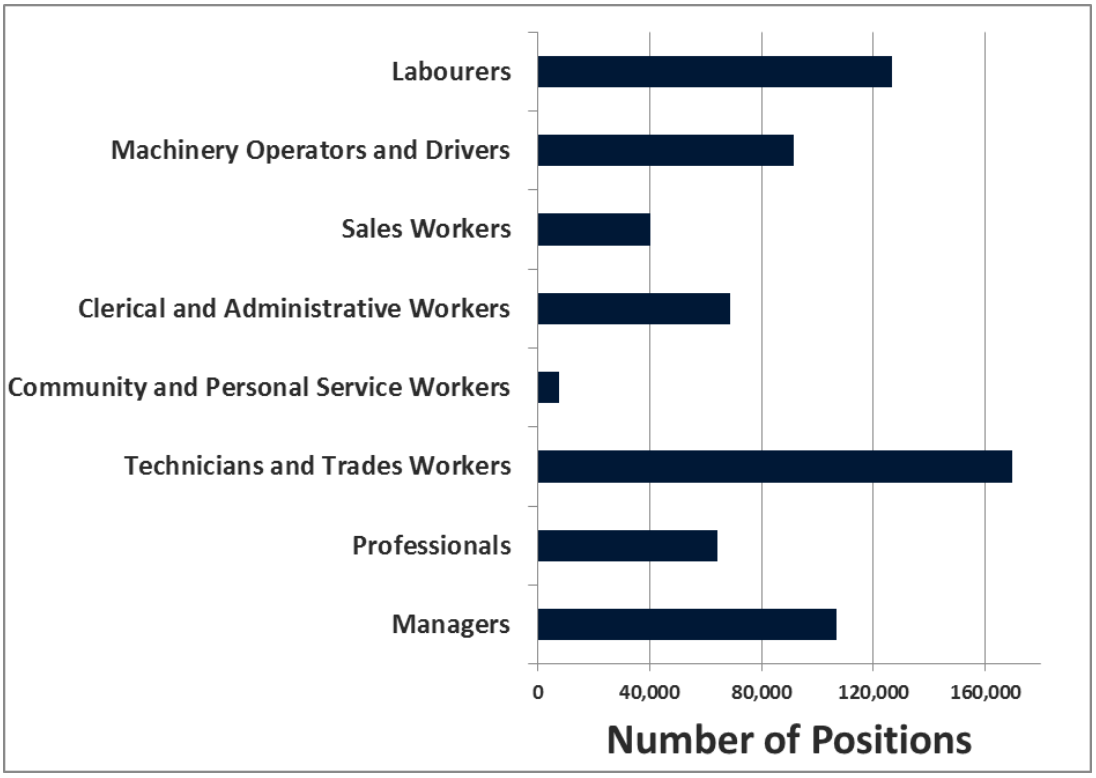
A parallel factor behind the emergence of skills shortages within manufacturing, despite the general downward trend of employment that until recently dominated the industry's trajectory, is the diverse make-up of the workforce with regard to specific

[4] Note that the largest reported decline in sub-sector employment was in the "not further defined" category, which is a residual category within the ABS data and tends to fluctuate dramatically from one quarter to another. For that reason, the year-over-year changes illustrated in Figure 4 must be interpreted with caution, as some of the apparent growth in expanding sectors may in fact reflect assignment of workers who were previously employed but misallocated in the statistics.

occupations. Like the sectoral diversity discussed above, this reality complicates the process of planning for future skills requirements, and redeploying labour from contracting to expanding sub-sectors and firms.

Figure 5 illustrates the occupational composition of overall manufacturing employment, on the basis of detailed survey data attained from the 2016 census.

Figure 5. Manufacturing Employment by Occupation



Source: ABS Census Data.

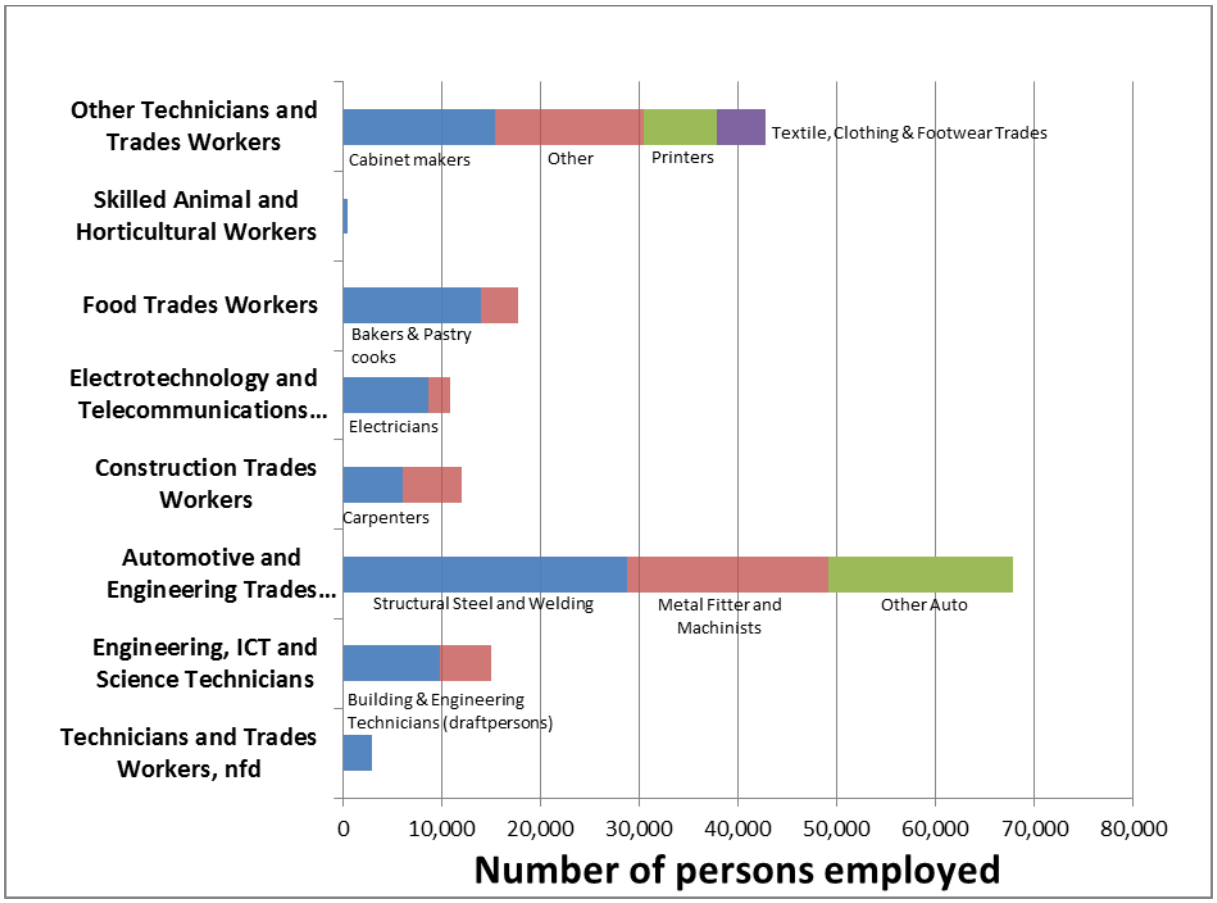
Manufacturing has a high demand for technicians and trades, followed by labourers. In theory workers in many of these occupations should have a degree of lateral movement between sectors of manufacturing, and even across industries. These types of lateral movements allow labour to flow towards areas of employment growth and away from areas of employment decline without intervening periods of unemployment, and with less costs for retraining. However, Australian manufacturing is currently experiencing skill shortages across a number of specific sub-sectors and occupations, despite continuing downsizing in some sectors – suggesting that this desired lateral movement of labour is not occurring.

One quarter of all employment in manufacturing is for technicians and trades workers, while just under one fifth of employment is for labourers. It is the technicians and trades occupational grouping which is experiencing the greatest incidence of skill

shortages, with manufacturing reporting the greatest level of difficulty in sourcing skilled workers in those occupations (Australian Industry Group, 2017). The shortage in technicians and trades occupations is a national one; it is also experienced across a number of non-manufacturing industries, which also make use of these occupations (Department of Jobs and Small Business, 2018).

A further breakdown of occupational categories for technicians and trades workers in manufacturing is provided in Figure 6. Automotive and engineering trades make up the largest category of employment; over one-third of this group, in turn, are employed in structural steel and welding positions, with another third working as metal fitters and machinists. Other large categories of manufacturing technician and trades positions include bakers and pastry cooks, cabinet makers and building and engineering technicians; each of these categories accounts for at least 10,000 workers. In addition, clusters of over 5,000 workers are employed as printers; as textile, clothing and footwear workers; electricians; carpenters; and building and engineering technicians.

Figure 6. Distribution of Technical and Trades Occupations in Manufacturing, 2016



Source: ABS Census Data.

For some of these occupations, job opportunities exist outside of manufacturing as well. However, most of them depend on manufacturing as their primary source of employment. In those specific occupations which are most heavily dependent on manufacturing for employment, public perceptions of future employment prospects in manufacturing are an important factor in attracting and retaining labour; if negative perceptions regarding the future of manufacturing continue to dominate public attitudes (and in particular the perceptions of new graduates), then it will be all the more difficult to convince new workers to undertake investments in manufacturing-specific skills and training.

A number of these specific technical and trades occupations are reporting skill shortages. The latest Department of Jobs and Small Business report on skills shortages lists structural steel and welding trades workers; metal fitters and machinists; carpenters and joiners; a number of automotive and engineering trades (such as auto electricians and motor mechanics); cabinetmakers; bakers and pastry cooks; and telecommunications trades workers as all experiencing shortages of qualified workers (Department of Jobs and Small Business, 2018b). Unsurprisingly, employers report more difficulty recruiting workers for higher skilled occupations (especially technicians and trades occupations) than for occupations with less required qualifications.

MORE COMPLEX REQUIREMENTS

However, the character of skills shortages in manufacturing is more complex than simply a lack of workers with particular qualifications. The increasingly technology-intensive nature of work in manufacturing (especially in firms practicing advanced manufacturing techniques), and general requirements for numeracy and digital skills,[5] mean that even workers with a designated certification may not have the right combination of skills – including broader STEM skills, work experience, and "enterprise" skills or employability (like teamwork and communication skills; see Department of Jobs and Small Business, 2018a).

The increasing adoption of digitised manufacturing techniques, including the "internet of things," 3-D printing, and increasingly widespread robotics applications all require even production workers to demonstrate higher numerical and computer capacities. And employer surveys indicate that it is combinations of skills and attributes that are hardest to attain, more than any single specific qualification (Australian Industry Group, 2018b).

[5] A useful review of the increasingly complex nature of digital and computer skills required by manufacturing workers is provided by Innovation and Business Skills Australia (2017).

Accessing workers with the relevant STEM skills is compounded by deficiencies in other skill areas. Employers report that absence of STEM skills is often associated with a lack of employability and workplace experience, and/or a lack of business and management capacities. From this we can conclude that a reported shortage in STEM skills is not simply a shortage of workers with the relevant STEM knowledge – but also includes workers who can meet STEM requirements but lack other skills required for the job.

This paints a more nuanced picture of skills shortages in manufacturing. Employers commonly report a lack of suitable applicants, when they have disqualified candidates deemed unsuitable for a myriad of reasons – beyond whether they possess a particular required credential. This attests to the complex mixture of skills, attributes, and experience that many employers are seeking, when the work involves a more diverse set of knowledge and capacities. Where applicants have qualifications, there is often a lack of suitable experience relevant to the particular nature of the role, sector or industry in which the work is being undertaken.

For example, for job vacancies advertised in 2017 for sheet metal trades workers, welders, metal machinists or fitters, employers received an average of 7.6 applicants per vacancy (Department of Jobs and Small Business, 2017a). Yet only 1.2 applicants per vacancy were found suitable for consideration of hiring. 53 percent of applicants were formally qualified for the positions, but only 29 percent of qualified applicants were deemed suitable by the employers (that is, had sufficient experience working in the employer's sector or a similar work environment, were able to demonstrate necessary technical skills, attended a work trial or interview, and had a good work history).

Yet responsibility for attaining that experience clearly rests with employers, who need to invest in ongoing skills development rather than expecting ready-made candidates to suddenly appear whenever the firm decides to advertise for them. This failure to "fill the skills pipeline" on an ongoing basis was naturally exacerbated during the years of contraction which the manufacturing sector endured – when many firms had neither the financial resources nor enough certainty about their own futures to be able to invest in ongoing staff development and training programs. Now that manufacturing has stabilised, and most segments of the industry face a more promising future, it is incumbent on employers to step up their ongoing investments in skilled workers.

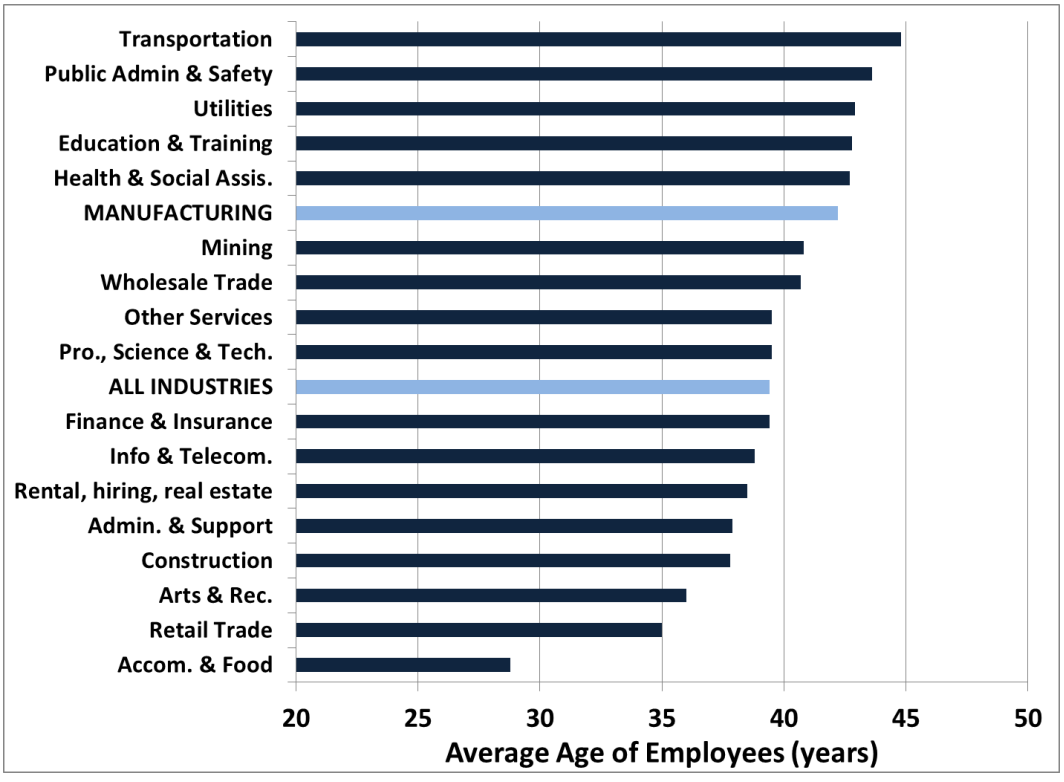
In sum, employers are looking to hire workers with a complex and complete package of skills and experience (including STEM and "soft" skills, in addition to relevant formal technical knowledge and qualifications). Potential new hires are often found to lack that full complement of knowledge and experience deemed necessary by employers.

But it is hard to imagine how future applicants will attain those requisite attributes, without pro-active efforts by employers to work closely with new workers (through apprenticeships, or other vehicles) to allow them to accumulate that broader desired experience and knowledge.

DEMOGRAPHIC SHIFTS

A final factor that helps to explain the increasing severity of skills shortages in manufacturing relates to the demographic transition which the industry is experiencing – especially the population of technicians and recognised trades workers. Many of today's experienced workers began their careers during more expansionary years (as far back as the 1980s in some cases), and now are approaching retirement age. As indicated in Figure 7, the average age of manufacturing workers is relatively old: over 42 years old on average in 2016, some 3 years older than the average for the entire workforce. This advanced average age also reflects the absence of major hiring during the last challenging decade.

Figure 7. Average Age of Employees by Sector, 2016



Source: ABS Catalogue 6306.0, Table 7.

Sub-sectors of manufacturing with especially old workforce profiles include petroleum and coal products; clothing, textile and leather; plastic and rubber products; printing; and paper products (Australian Workforce and Productivity Agency, 2014). Within the coming decade, therefore, a substantial portion of the sector's existing skilled workforce – as many as one-third – will be transitioning to retirement. This will compound the necessity of new hiring and skills development associated with the expected increases in overall employment levels.

EVIDENCE OF SKILLS SHORTAGES

We have identified several factors which are driving the skills challenge faced by many manufacturing firms, including:

- The rebound in total employment levels.
- The diversity of manufacturing employment across sectors and occupations, so that certain sub-sectors experience recruitment and training needs far more substantial than the overall pattern.
- The growing complexity of attributes (both formal technical qualifications, and broader experiential or employability attributes) sought by employers in light of shifting technologies and workplace practices.
- The demographic transition occurring as the cohort of older technicians and trades workers prepares to retire.

The combined effect of these factors is undeniable evidence that employers will face greater challenges in coming years in identifying and recruiting skilled workers who can meet the needs of this transforming industry. A growing proportion of firms has identified skills shortages as a major constraint on their future expansion. For example, recent survey data from NAB Australian Economics (2018) indicates that skills shortages are now identified by 60 percent of employers, and constitute the largest single constraint on firm expansion. The Australian Industry Group (2018b) indicates that the proportion of firms reporting that skills shortages are inhibiting their expansion has doubled in the last year; over half of responding firms reported skills shortages in the previous year, and a similar proportion expected those shortages to continue moving forward. Shortages of technicians and trades workers were clearly the most acute.

Table 1 is based on surveys of employers conducted by the Department of Jobs and Small Business as part of its ongoing skills shortage research. In several critical manufacturing-related trades categories (grouped within the general engineering trades composite), national-level shortages have arisen in the last year. Overall,

shortages in this field are the most acute at any time since before the advent of the Global Financial Crisis in 2008.

Table 1. Growing Shortages of Engineering Trades

ANZSCO Code	Occupation	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
3222-11	Sheetmetal Trades Worker										
3223-11	Metal Fabricator										
3223-13	Welder (First Class)										
3231	Aircraft Maintenance Engineer*										
3232-11,12,13	Fitter										
3232-14	Metal Machinist (First Class)										
3233-13	Locksmith										

Legend: *Not assessed* *S Shortage* *Regional shortages* *Recruitment difficulty* *No shortage*

Source: Department of Jobs and Small Business (2017a).

Self-reporting by employers regarding perceived shortages of labour must always be considered with a degree of critical perspective. After several years of excess labour supply in the overall economy, most employers have become accustomed to being readily able to recruit incremental labour needs from a perpetual pool of unemployed or underemployed workers without difficulty. They may therefore experience any diminishment in that pool of available labour as an emerging "shortage." So these reported shortages do not indicate that the labour market is nearing capacity, nor that labour is scarce in any fundamental way; to the contrary, when pools of underutilised labour (including underemployed, discouraged and marginally attached workers) are considered, labour market slack is still at double-digit levels.[6] And it certainly should not be interpreted as evidence that government should further relax restrictions on importation of temporary migrant labour (through programs like the Temporary Skills Shortage program); to the contrary, the fact that employers in previous years could easily "solve" their skills shortage problems by recourse to foreign migrant labour

[6] See ACTU (2018), pp. 12-15, for a detailed breakdown of the components of underutilised labour in Australia today, which they estimate total over 3 million workers.

actually undermined the pressure to address skills development needs in a more systematic and sustainable manner.

Instead, the evidence of emerging skills shortages in manufacturing should be interpreted as evidence of a profound failure in labour force development planning by both employers and government. There are millions of unemployed and underemployed Australians, many of whom would relish the opportunity for the high-quality, decently-paid work associated with skilled manufacturing jobs. The fact that they are not able to attain those jobs, even as labour shortages seem to become more intense, is testimony to the failure of the vocational training system – not a statement on the lack of capacities of Australian workers. The next section of this report will now turn to considering the dimensions of that failure, and its potential solutions.

II. The Failure of Vocational Training in Australian Manufacturing

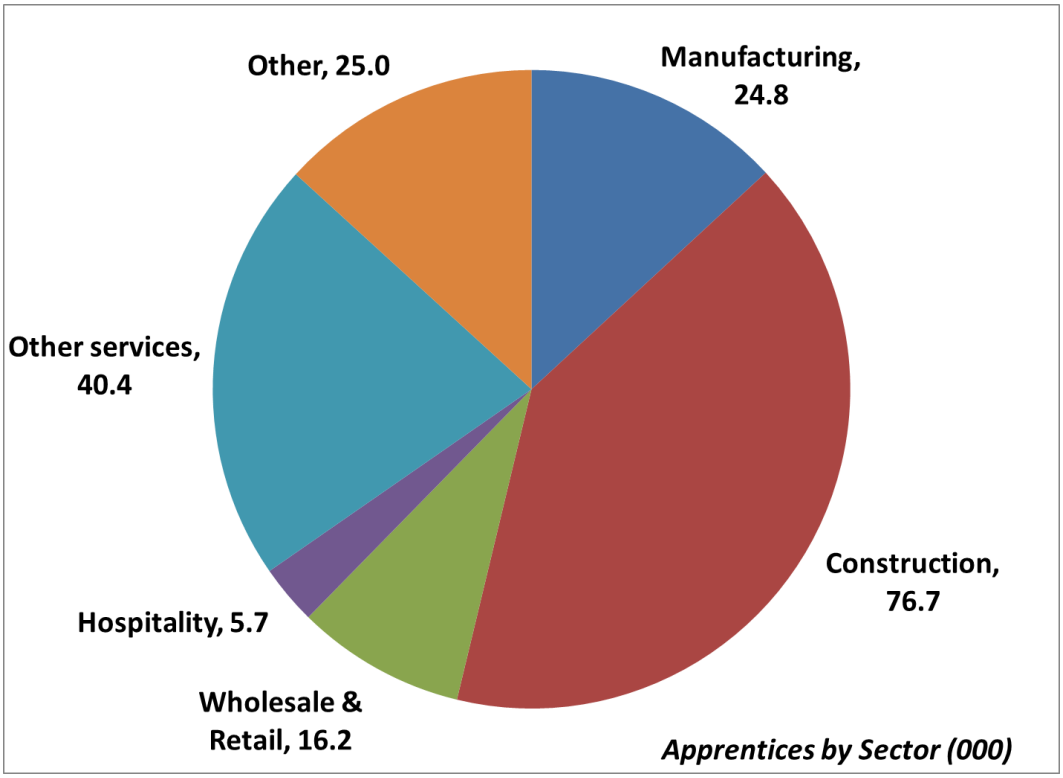
It is difficult to exaggerate the extent to which the supply of skilled workers to Australia's manufacturing sector has been hampered by a profound and multidimensional crisis in the national vocational education and training (VET) system. That system has been wracked by a devastating combination of policy errors and fiscal mismanagement, including:

- A long-term decline in fiscal support, from both state and Commonwealth levels of government, for vocational training, with government post-secondary education expenditures increasingly concentrated instead in the university sector.
- A devastating and failed policy experiment with the marketisation of vocational education services (Braithwaite, 2016), whereby control over course offerings, course delivery, and student recruitment was decentralised to a supposed "market" dominated by for-profit training providers. As Quiggin (2018) bluntly puts it, "Worthless qualifications have proliferated, driven by incentives and exploited by fraudulent for-profit enterprises."
- Despite the language of "market accountability" used to describe this experiment, the private provision of VET services was enormously subsidised through a poorly-controlled subsidy (VET FEE-HELP) that clearly wasted public resources and fostered unethical and unproductive practices throughout the for-profit VET system.[7]
- Another consequence of this experiment in marketisation has been the near-collapse of TAFEs as a reliable, quality, publicly-accountable core provider of vocational education. Forced to compete for students and funds against for-profit providers, the important "anchor" function that should be played by high-quality public institutions has been lost, and TAFEs struggle to clarify their mandate and maintain a critical mass.

[7] Forward (2015) reports that the cost of the subsidy exploded more than 50-fold between its introduction in 2009 and its peak in 2014, to over $1.3 billion per year. Billions of dollars of those payments are now unrecoverable because of the failure of private providers and the uselessness of credentials which students obtained.

These factors have devastated the vocational training system in all parts of Australia's economy, but manufacturing has been one of the hardest-hit sectors – by virtue of its particular reliance on technicians and trades workers, and its rapidly-evolving requirements for skilled labour. As indicated in Figure 8, for example, manufacturing is the second-largest single destination for apprentices (after construction) of any other sector in the economy. Any problem besetting the general VET system, therefore, will impact manufacturing in a magnified manner.

Figure 8. Apprentices by Sector, 2017



Source: ABS Catalogue 6227.0, Table 21.

This section of the report will catalogue several dimensions of Australia's VET crisis as experienced in the manufacturing sector:

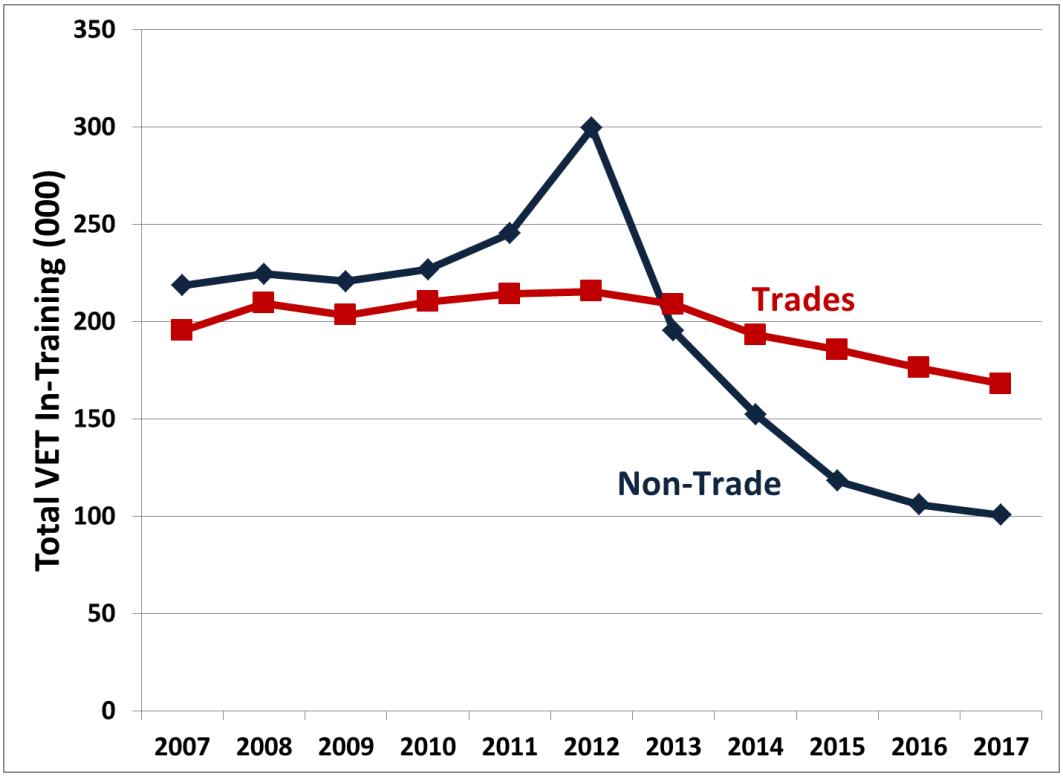
REDUCED ENROLMENTS

The marketisation of vocational education reached its crux in the early years of the present decade (following the extension of VET FEE-HELP payments to the sector). After a short-lived surge in enrolments, especially in non-trades training programs, total participation in vocational training programs (including both apprenticeships and traineeships) has fallen sharply. The belated restrictions on the FEE-HELP program imposed in the wake of numerous scandals with the program reinforced that decline –

but unfortunately there was no commitment of resources to support more genuine VET streams as alternatives to dodgy for-profit providers.

Since peaking in 2012 (at over 500,000 people in training), enrolments have since plunged by almost half. By 2017, just 269,000 Australians were in VET training programs (NCVER, 2017c). As illustrated in Figure 9, the steepest decline in enrolments was experienced in non-trades programs – which were the programs most vulnerable to unacceptable marketing practices from for-profit providers. But the reputational damage to the entire VET system from this experience has also damaged trades enrolments, which have also declined markedly since 2012.

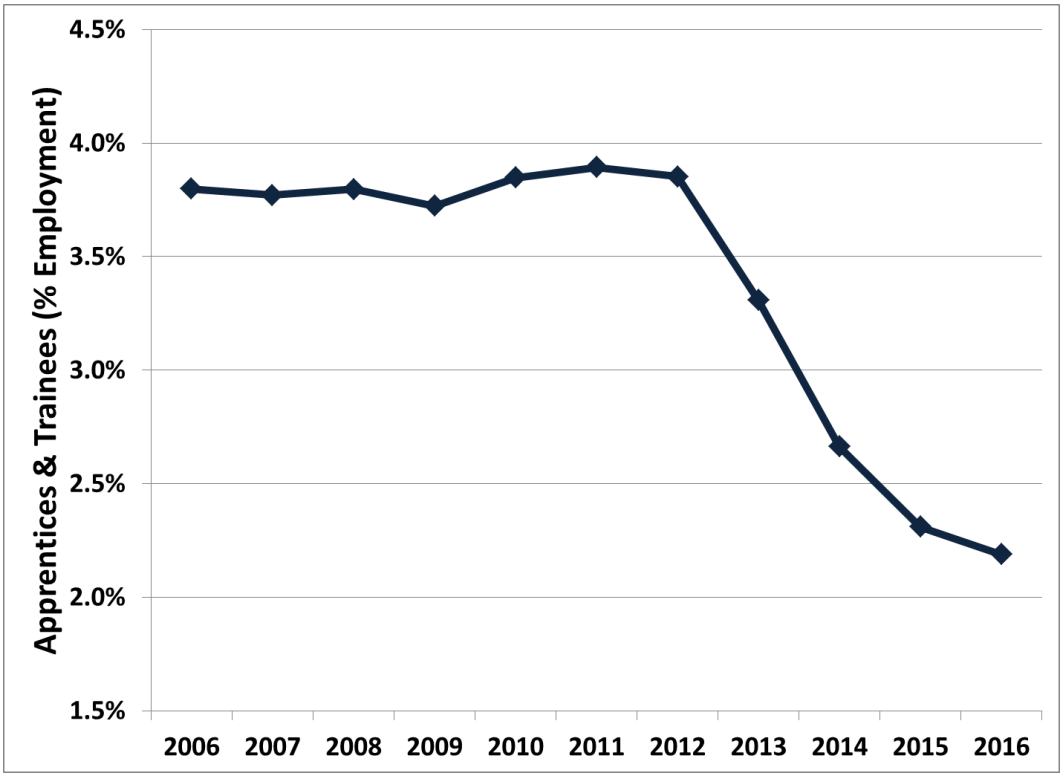
Figure 9. Declining Enrolment in VET Programs



Source: NCVER (2017c). In-training as of June 30.

The decline in participation in vocational training programs has occurred alongside continued growth in the total workforce – and corresponding expansion of the need for training. Expressed as a share of total employment, therefore, the decline in training participation has been even more severe. Figure 10 illustrates the shocking decline in the overall rate of vocational training in Australia's economy since 2012. In 2017, total participation in apprenticeships and traineeships represented barely 2 percent of Australian employment. That constitutes one of the weakest rates of vocational education participation of any industrial country.

Figure 10. Apprentice and Trainee Training Rate, 2006-2016

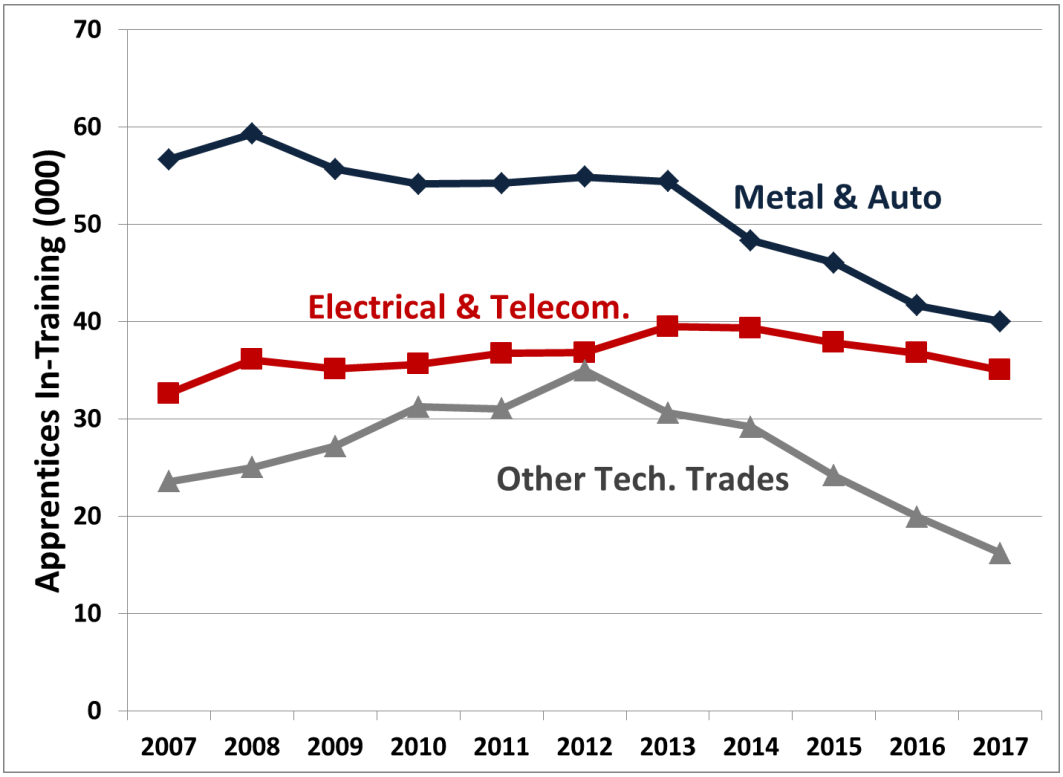


Source: Authors' calculations from NCVER (2017c). Apprentices and trainees as share of total employment, December each year.

Manufacturing-related training has suffered along with the general erosion of participation in vocational education. Figure 11 illustrates the decline in the number of apprentices in-training in three of the trades categories most relevant to the manufacturing sector. Metal and automotive trades apprentices have experienced a significant decline, falling by one-third since 2008. Electrotechnical and telecommunication trades apprenticeships have been broadly stable. The other technicians and trades category has plunged by over one-half since peaking in 2012.[8]

[8] The "Other Trades" category includes cabinet-makers, carpenters and joiners, electricians, and several other occupations widely employed in manufacturing.

Figure 11. Declining Apprenticeships in Manufacturing-Related Trades



Source: NCVER (2017c). In-training as of June 30.

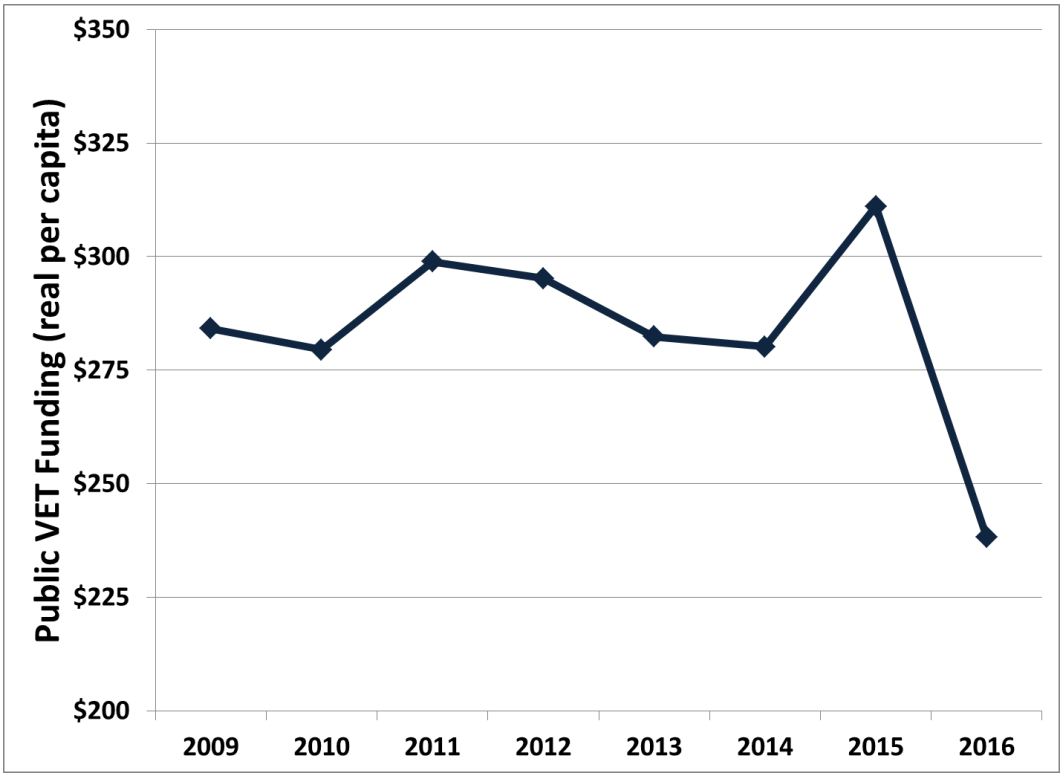
REDUCED FUNDING

Reductions in funding for vocational education are both a cause and a consequence of the decline in participation in programs, contributing to a damaging cycle of cumulative causation: reduced enrolments allow governments to further cut funding, but that further damages the quality of vocational training, further reducing the incentive for students to enroll (and undermining the confidence of employers in the whole system). Pilcher and Torii (2017, Figure 1) report that total public expenditure on VET in Australia (including both state and Commonwealth spending) has been cut by almost 20 percent in real terms between 2011-12 and 2015-16, to levels equivalent to total spending back in 2005-06. Subsequent budget announcements (including a $177 million cut in vocational education spending in the 2017 Commonwealth budget, through the cancellation of the National Partnership Agreement for Skills Reform) mean this decline in financial support has continued in subsequent years.

These funding cuts have occurred, even as the size of the workforce (and associated training needs) have steadily expanded. Expressed in real per capita terms, therefore, the decline in funding has been even worse. Based on funding data to 2016 (most recent reported), Figure 12 suggests that real per capita VET funding from

governments had declined 25 percent by 2016 – and further reductions have occurred since.

Figure 12. Public VET Funding, 2009-2016.



Source: Authors' calculations from NCVER**,** *Government Funding of VET: Financial Information* (various years), and ABS Catalogues 3301.0 and 6401.0.

TAFE DECIMATED

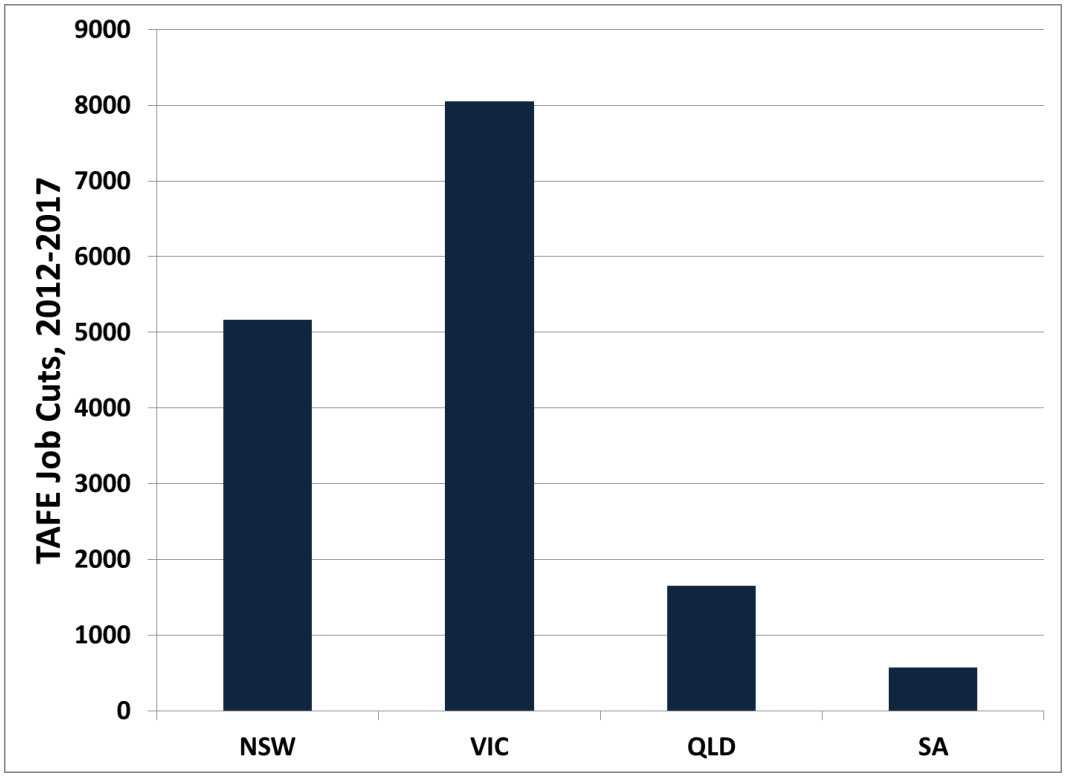
No segment of the vocational training system has been damaged more by failed policy experimentation over the past decade than the TAFE institutions. They once functioned as the "anchors" of the VET system: a network of stable, well-funded, publicly accountable and trusted institutions that provided the full range of core vocational courses, oversaw most apprenticeships, and innovated new curricula and teaching methods. Private providers were welcome to offer specialist and ancillary training programs. But the TAFE system undertook a public policy function as a trusted and permanent source of most vocational education.

Under the marketised delivery system, TAFEs were meant to compete on the "same ground" as private providers for (publicly subsidised) student dollars. Private providers did not face the same infrastructure requirements or costs, and could entice students with often-misleading promises, gimmicks, and incentives. TAFEs were stranded by

the steady shift of resources to private VET provision, and this also created a vicious circle of cumulative causation – whereby cash-strapped TAFEs had to pare back their own offerings, further undermining their reputation with students and employers alike.

Wheelahan (2018) reports that total hours of training offered by TAFEs in Australia declined by 30 percent from 2009 through 2016 under the marketisation experiment, in contrast to a near-doubling of privately provided hours over the same period. This decline was exacerbated by a simultaneous 10 percent decline in real funding from government for each hour of training. TAFE staffing levels have also been decimated in line with falling enrolments and budgets. As illustrated in Figure 13, over 15,000 TAFE positions were cut over the last 5 years in just 4 states – with Victorian TAFEs being the worst-hit.

Figure 13. Reductions in TAFE Staff Levels, 2012-2017



Source: Australian Education Union (2017).

TECHNOLOGY AND CURRICULA

In the context of chronic underfunding and the misallocation of resources through the failed experiment with marketisation, the need for VET providers to continually upgrade and modernise their course offerings, and to develop entire new

qualifications in line with the emerging needs of advanced manufacturing, has largely gone unmet. As described above, the most intense skills shortages experienced by manufacturing employers are more complex than simply a shortage of suitable applicants with a particular qualification. Rather, employers are seeking a more comprehensive set of qualifications and attributes, reflecting the more challenging, judgment-based, and technology-intensive nature of manufacturing work. In this regard, important attention must be paid to the reform and modernisation of curricula, skill sets, and entire qualifications.

An example of the importance and complexity of this task is provided by the "Digital Skills Cross Sector Project" undertaken by Innovation and Business Skills Australia (2017), the skills service organisation (SSO) responsible for most manufacturing-related VET in Australia. This project began to identify the cross-cutting nature of digital competencies that are required in modern manufacturing (and related) applications, identifying 211 distinct units of competency that needed updating in light of new digital and computer-related aspects of current and expected manufacturing work. The project's recommendations are now being considered through a process overseen by the Australian Industry and Skills Committee (AISC). However, without energetic leadership and adequate resources to implement reforms in the content and structure of VET offerings, it is not clear that changes like these will be realised in a sufficiently timely and effective manner to meet the evolving needs of manufacturers for technology-intensive trades qualifications.

FRAGMENTATION OF CURRICULA

A related problem in the current VET model is the increasing concentration of training around small, more fragmented units. The marketised user-pay delivery model for VET in Australia contributes to this problem, since it is less expensive for students to enroll in narrower, "bite-size" subjects – as compared to undertaking full qualifications (Ross, 2018). Employers may also be more willing to fund employees to attain micro-competencies that meet immediate practical needs within their workplaces, rather than support them to attain broader, more complete qualifications, certificates, and diplomas.

Competency-based, fragmented packages of knowledge address narrow, enterprise-specific requirements; they generally do not allow workers to accumulate comprehensive, recognised, and portable qualifications. In the resulting culture of "training for the enterprise," employers commission relatively narrow, firm-specific capacities, not comprehensive and flexible qualifications. This inhibits the ability of the

workforce to respond, adapt and redeploy in the face of changes in product demand, technology, and personal circumstances (Buchanan and Jakubauskas, 2010).

Our interviews with key informants from various segments of manufacturing confirm widespread concern with this fragmented vision of VET provision. The approach runs counter to the identified need of skilled manufacturing workers to possess a range of skills and competencies which can be flexibly applied to evolving and complex problems. And the greater the extent to which training is focused on employer-specific micro-competencies, the less will workers be able to transfer their skills to other firms or sub-sectors; this further reduces the capacity of the sector to respond to the changes in sectoral and occupational composition that were described above.

POOR COMPLETION RATES

The decline in the number of new workers commencing apprenticeships and other forms of vocational education is both striking and worrisome. However, this problem is compounded by low completion rates for those who commence their programs. Only about half of those who commence vocational placements (including both apprenticeships and traineeships) complete their programs (Bednarz, 2014). Surveys have identified that poor satisfaction with employment conditions (including, but not limited to, poor wages[9]) are the major reason for participants to withdraw from their programs. Apprentices are more likely to finish their programs than trainees (Oliver, 2008). Larger workplaces, with more experienced managers (who better understand the requirements of successful apprenticeship and traineeships, and who typically have access to more resources to support higher-quality experience for participants) are more likely to attain high completion rates.

PRECARIOUS WORK AND ACCESS TO TRAINING

A final factor that has clearly contributed to the failure of vocational training in manufacturing is the visible shift in most parts of the economy, including manufacturing, toward more precarious forms of employment. This includes a growing incidence of part-time work (which now accounts for 16 percent of all manufacturing employment, up significantly over the past decade[10]), the more widespread use of temporary jobs and labour hire firms, and the contracting out of

[9] The Fair Work Commission significantly increased minimum wages for apprentices in an important 2013 ruling, so concerns about low pay for apprentices have abated somewhat (Schneiders and Lucas, 2013).

[10] Authors' calculations from ABS Catalogue 6291.0.55.003, Table 6.

many functions to independent operators who are nominally self-employed but still heavily reliant on income from a particular dominant “customer” (which would be their employer under a more traditional employment relationship). Across Australia’s economy as a whole, the share of employment which reflects one or more of these dimensions of insecurity now exceeds 50 percent (Carney and Stanford, 2018). That ratio is somewhat lower in the manufacturing sector, where traditional full-time paid positions still account for a majority of employment; but the growth of precarious work within manufacturing nevertheless affects access to ongoing training opportunities. Very few temporary, labour hire, or contract workers would have access to any forms of support for acquiring vocational skills. Ironically, these are the same workers who would benefit most from the more secure and permanent forms of employment that good VET could help them attain.

III. Policies to Rebuild Vocational Training in Manufacturing

This report has highlighted the positive potential for manufacturing to create thousands of high-quality jobs in the coming years. Already, the sector has become one of the most important sources of new work in the whole economy. However, we have also indicated that this positive trajectory could be needlessly constrained by the failure of Australia's existing VET system to provide a steady flow of skilled workers, possessing modern and flexible qualifications and capacities that are consistent with the expansion of more specialised, advanced manufacturing business models. In this section we will catalogue several of the more promising strategies for ameliorating these failures. We stress that responsibility for improving the performance of the VET system must be shared between all stakeholders in the sector: including government, employers, educational institutions and training organisations, and trade unions. All have a stake in building a modern and effective vocational training model, which can meet the future skills needs of this vital sector, and ensure that it can live up to its full potential as a source of valuable, productive work for Australians.

TWELVE RECOMMENDATIONS

Below we present a list of twelve recommendations, addressing many of the challenges and failures described above. These recommendations are informed by our interviews with key informants from various segments of manufacturing, other published literature, and our own analysis and judgments. Given the broader challenges facing the national VET system, the training crisis in manufacturing clearly cannot be addressed in isolation from efforts to repair the general vocational system in Australia. But while participating in that crucial effort to repair the national VET system, manufacturing stakeholders can also undertake some direct manufacturing-specific initiatives to improve VET outcomes in their own sector.

Of course, given the complexity and multi-dimensional nature of the vocational training crisis in manufacturing, these recommendations are not the final word on the subject. Rather, they represent our effort to start an ambitious dialogue among all manufacturing stakeholders, and begin to marshal the attention and resources necessary to seriously tackle the problem.

1. ***Reestablish adequately funded and stable TAFEs as the centerpiece of vocational education***. The evidence from Australia and other countries (Wheelahan, 2016) is clear that stable, well-resourced, and publicly-accountable institutions must serve as "anchors" at the core of the VET system, to enhance the quality and scope of training, and underpin confidence (on the part of both employers and students) in the quality of training on offer. TAFEs must be rebuilt as the major provider of core VET services; a healthy balance would see 70 percent of public VET funding delivered through TAFEs, rather than through private providers. Community colleges can also play an important role as anchor institutions.

2. ***Develop the capacities of TAFE teachers in manufacturing fields, and invest in modern capital equipment for training.*** Skills and technologies are constantly changing in real-world manufacturing, and to ensure that apprentices and graduates are capable of working with those technologies will require ongoing investments in both teacher resources and tools and capital equipment used in TAFE training. Only large public institutions have the capacity to invest in modern capital equipment, and utilise those resources effectively in large-scale teaching; smaller private training organisations possess neither the financial resources nor the enrolment size to justify such investments. Teachers in manufacturing-related subjects must be provided with ample opportunities for continuous upgrading, working closely with manufacturing firms to ensure that their curriculum and pedagogy reflect state-of-the-art methods and skills.

3. ***Encourage partnerships on customised joint training initiatives between specific TAFEs and firms or groups of firms.*** TAFEs should have the flexibility and resources required to enter into specialised partnerships with specific firms, groups of firms, or peak bodies to offer tailored vocational programs designed to meet emerging needs in the industry.

4. ***Expand other forms of integrated training between VET providers and workplaces.*** Employers uniformly report that VET graduates would benefit from enhanced opportunities for on-the-job experience. All VET providers (including private RTOs) should be directed to develop further opportunities for work placements, exchanges, co-op opportunities, and similar initiatives.

5. ***Begin working to develop and implement higher-level and multi-disciplinary qualifications reflecting emerging skills and composite capacities.*** The growing complexity and multi-dimensionality of manufacturing work, especially given the adoption of advanced manufacturing strategies by enterprises, requires manufacturing workers to be equipped with more overarching and flexible sets of skills – including technical, problem-solving, and enterprise skills. The roster of qualifications (including higher-level diploma and post-diploma certifications)

needs to be expanded to reflect this trend, and the content of those offerings updated accordingly.

6. ***Shift emphasis in curricula and training programs toward comprehensive and complete qualifications, rather than micro-competencies.*** The undue emphasis in VET in recent years on provision of narrow, enterprise-specific micro-credentials was reinforced by the funding constraints and market-based delivery approach of Australian VET policy. Under a repaired and refunded system, main priority should be placed once again on offering complete and comprehensive qualifications, including full certificates, diplomas, and post-diplomas that permit graduates to perform the full range of tasks associated with their chosen trade or profession, and adapt flexibly to evolving requirements of modern manufacturing work.

7. ***Integrate basic literacy and numeracy training into VET offerings at all levels***. Many employers report the absence of core literacy and numeracy skills to be a barrier to the employment of potential workers who otherwise possess necessary technical qualifications. Access to these foundational programs should be universally provided for those students that require them.

8. ***Support the expansion of apprenticeships in manufacturing with fiscal measures, instruction resources, and mentoring***. The number of apprentices commencing positions in Australian firms, including in manufacturing, has experienced a worrisome decline. Fiscal supports for both employers and apprentices need to be expanded. Apprenticeships would be more successful, and completion rates higher, if both students and their managers/employers were supported with more intense supervision and mentoring. Group-based apprenticeship programs (to coordinate training and apprenticeships across several firms at once) would assist smaller firms in bringing on apprentices.

9. ***Implement provisions ensuring access to training opportunities, and fair employment conditions for trainees and apprentices, within modern awards and enterprise agreements***. Oliver (2008) found that completion rates for apprentices are much higher in workplaces where decent terms and conditions for vocational education (including pay, training time, mentoring and supervision, and working hours flexibility) were specified in relevant industrial awards. Modern awards and enterprise agreements should, wherever possible, incorporate high-quality provisions and rights for workers to access VET opportunities, and combine them successfully with their continuing work responsibilities.

10. ***Develop ambitious and better-resourced systems to support retraining and redeployment of displaced workers in declining manufacturing sectors***. The employment outlook for the overall manufacturing sector is brighter than it has

been for over a decade. But there are still some parts of the industry experiencing downsizing and job losses. A first step in addressing emerging skills shortages in growing sub-sectors and occupations should surely be to maximise the potential for redeploying displaced skilled workers from other segments of manufacturing. Those workers could make a substantial contribution to other growing sectors, but only if their transitions are supported with consideration and resources. At present restructuring and transition assistance is typically provided in a piecemeal and ad-hoc manner (Nowell, 2015; Callan and Bowman, 2015). With due attention, advance planning in cases of looming retrenchments, and adequate resources to support retraining and relocation, the value embodied in the skills and experience of displaced workers could be retained within manufacturing.

11. ***Develop new models for phased retirement to smooth the demographic transition facing skilled trade positions in manufacturing***. Another important source of potential skilled labour to help address skills shortages in certain sub-sectors and occupations is the large number of skilled workers poised for retirement in coming years. While retirement can and should be accessible to them, in many cases senior workers may be interested in phasing in their retirement – thus allowing their skills to continue to be partially enlisted, during the transition period when scarce new workers are being trained. Similarly, senior workers could be recruited to provide ongoing mentorship and supervision roles with new apprentices, in order to improve the quality of their experience and boost completion rates (as discussed under point 8 above). Flexible experiments with these phased-in strategies should be undertaken wherever appropriate.

12. ***Establish a leadership-level Manufacturing VET Policy Board to coordinate VET initiatives in the sector, and represent the interests of manufacturing in broader VET processes and dialogues.*** Australia will undertake important national-level dialogues in coming years regarding the direction of VET policy, given the widespread recognition that the current model is deeply flawed and failing to meet the needs of all sectors for skilled labour.[11] The particular and acute needs of the manufacturing sector for skilled labour must be communicated forcefully into those fora. At the same time, manufacturing stakeholders themselves need an effective and influential meeting place where their common interest in a well-resourced and more effective VET system can be defined and pursued. Existing sector-wide committees fulfil important specific functions within the operation of the current VET system.[12] But their ability to define and advocate for an

[11] Examples of these dialogues include the current review of the Australian Qualifications Framework, IBSA's digital cross-sector project, and the comprehensive review of VET policy that has been promised by the Labor Party if it wins government.

[12] For example, a Manufacturing and Engineering Industry Reference Committee advises the work of Innovation and Business Skills Australia, the relevant SSO covering manufacturing.

overarching VET policy approach to better meet the needs of manufacturing is constrained by their limited mandates and lack of resources. A leadership-level policy board, incorporating all major stakeholders with an interest in manufacturing VET (including individual businesses, peak bodies, trade unions, TAFEs, other VET providers, and state and Commonwealth governments) should be established to commission further research and policy development, canvas the views of stakeholders, define a common agenda for reform – and most importantly, advocate for that agenda backed by the combined voices and influence of all participating stakeholders.

Conclusion

Manufacturing fulfils a vital strategic role in Australia's economy. Apart from directly constituting one of the country's largest sources of employment and income, manufacturing generates broader, spill-over benefits that support production and employment in other sectors. Its strong input-output and supply chain linkages; its strong productivity levels; its orientation toward export markets; and its innovation intensity all mean that manufacturing will continue to make an important and unique contribution to Australia's economic development. Particularly in the wake of the slowdown in resource-based industries in recent years, manufacturing takes on renewed importance as a source of high-value-added tradable output. Recent indicators of expansion and job-creation in manufacturing are a welcome contrast to the stereotypical impressions of decline and backwardness that characterised many Australians' attitudes toward manufacturing in previous years.

While the fundamental economic conditions facing domestic manufacturing have improved significantly in recent years, an important constraint on future recovery is posed by the sector's ability to recruit and retain the skilled workers who will be required to fulfil manufacturing's renewed potential. Already there are clear indications of emerging skills shortages in several sub-sectoral and occupational job categories. These shortages do not at all imply that Australia is "running out of workers" – far from it. Continued high levels of unemployment and underemployment confirm that there are large numbers of Australians who want and need secure, well-paying work, such as the jobs that are filled by skilled manufacturing workers. Reported shortages, rather, are evidence of a long-term failure in Australia's system of vocational education. For numerous reasons, employers and governments have failed to take the measures necessary to ensure a steady supply of new, well-qualified graduates to help meet the future staffing needs of the sector.

Manufacturing is not unique in suffering the consequences of Australia's badly-managed VET system; all parts of the economy are harmed by the underfunding, policy inconsistency, and misplaced reliance on market forces that characterise the national approach to vocational education. But given its heavy reliance on skilled labour inputs – a reliance that will only grow in coming years with the shift toward more specialised, flexible, and technology-intensive models of advanced manufacturing – the manufacturing sector is particularly hampered by the failure of our national skills system.

On the basis of interviews with key manufacturing stakeholders, findings in the published literature, and our own judgment and analysis, we have proposed an agenda of twelve concrete initiatives that would help to address the looming skills crisis that will needlessly hold back our long-awaited industrial recovery. We hope, at a minimum, that this list spurs further dialogue and cooperative action to help repair the flaws in the existing VET system in manufacturing, and ensure that the sector has access to the skilled workers it needs to make the most of its coming opportunities.

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