

# Reskilling the manufacturing workforce and developing capabilities for the future

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## CONTEXT

Innovative economies require a workforce with a high level of technical skills and scientific awareness, yet worldwide there is a decline in the number of students participating in pre university science, technology, engineering and mathematics (STEM). Australia's graduation rates in STEM fields are low by international comparison, providing challenges in meeting qualified workforce needs. Australia's future in the next three to five years depends on a stronger workforce with more qualified engineers and associated professionals with high level skills who are capable of meeting the needs of growing industries such as advanced manufacturing and the maritime sector.

## PURPOSE

This project identified the mismatch between current skills and future needs from a literature review and through interviews with Tasmanian industry stakeholders. It reflected on existing pathways and the changes required for ensuring that future skills needs are met.

## APPROACH

Qualitative data on current skills and future skill needs were collected through semi-structured interviews with individual companies in the manufacturing, advanced manufacturing and maritime/marine industries in Tasmania. The companies selected for interview were either members of the Tasmanian Maritime Network or considered to be in growth industries or industries of importance for Tasmania. Companies were selected to ensure a mix of size, age of company and diversity within the industry.

## RESULTS

A major learning from this project was that there are common needs amongst the manufacturing, advanced manufacturing and maritime/marine industries for future skills despite the diversity of industries. The fundamental skills identified by industry for continued growth and effective management included basic skills such as literacy and numeracy, problem-solving, work ethic, IT, leadership and management including the need for staff to be multi-skilled. Technology is ever-changing and technology based skills for specific industries will also drive training needs for the future. Issues raised by industry included: retirement of the ageing workforce in these industries which will create a skills gap if industry does not address training and progression of existing staff; training providers were not necessarily offering the required training and therefore all companies offered some form of in-house training for specialty skills; and that the lack of higher level Vocational Education and Training (VET) in manufacturing, advanced manufacturing and engineering has left a gap of skilled staff in Tasmania.

## DISCUSSION AND CONCLUSIONS

The results of this study clearly indicate that there is a need for VET and Higher Education (HE) to be flexible in their course offerings, and maintain a close relationship with industry (and with each other) to promote skills transfer between the sectors. This will ensure that the education and training sector remains relevant to meet the needs of employers, delivering consistent and quality learning outcomes. In addition, a close relationship will create a culture of communication and collaboration underpinned by mutual understanding of industry and education and training sector needs, possibilities and constraints.

## KEYWORDS

Future skills, skills gap, education and training, STEM, VET, HE.

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## Introduction

In Australia, manufacturing plays a major part in the economy at both national and local scales and extends through multiple industries (Manufacturing Skills Australia, 2014; Australian Government, 2013). Manufacturing produces approximately \$100 billion in output annually (Manufacturing Skills Australia, 2015), represents approximately eight percent of jobs and is the fourth largest employment sector in the nation (Australian Government, 2013). The flow-on effect of manufacturing jobs is large with every job creating another two and a half jobs in other sectors (Giffi, McNelly, Dollar, Carrick, Drew, & Gangula, 2015). These jobs are as diverse as the industry and span all education, qualification and skill levels. Low qualification rates are widespread across the manufacturing industry with 45.2 percent of the workforce without any post-secondary qualifications (Australian Government, 2013).

The industry has experienced significant change in the past five years from the onset of the Global Financial Crisis to the rapid developments in technology and the slowdown of the mining boom within Australia (Manufacturing Skills Australia, 2014, 2015; Australian Government, 2013) resulting in an industry decline over a number of years (Tasmanian Department of State Growth, 2014). This change has had far-reaching effects across the manufacturing sector and related industries on job availability, skills required and current training and education. Alongside the downturn in traditional manufacturing, advanced manufacturing and its related industries have been identified as growth industries not only in Tasmania (Beddie, Creaser, Hargreaves, & Ong, 2014) but also nationwide (Committee for Economic Development of Australia, 2015). In addition, there has been a shift from the manufacturing of goods to a service-based industry as part of a larger supply chain (Manufacturing Skills Australia, 2015).

The skills base needed in the 21<sup>st</sup> century is one that encompasses a mastery of core knowledge in a key field along with a number of well-developed workplace skills such as critical thinking, effective communication and willingness to engage in continued life-long learning (Business-Higher Education Forum, 2013). Multiple changes in career are likely and now expected in the workforce; having strong base knowledge to understand emerging digital technologies and new approaches to problem solving will be required (Deloitte Australia, 2014).

### Issues and needs of the current industry

The major industry skill concerns are focused on the inadequate fundamental numeracy and literacy skills of the workforce (Australian Government, 2013a; Business-Higher Education Forum, 2013), problem solving, critical thinking, and effective communication skills and engagement in learning (Business-Higher Education Forum, 2013). Other concerns are the ageing workforce (Australian Government, 2013a; Beddie et al., 2014), skill shortages, the level and importance of STEM skills in current training options (Australian Government, 2013a; Toner & Stilwell, 2014) and the ability of the workforce to adapt to the changing industry (Australian Government, 2014). The manufacturing and advanced manufacturing industries will be strengthened through improving skills which generate innovation (Parilla, Trujillo, & Berube, 2015). The workforce needs attributes such as team spirit, willingness to learn, commitment to the organisation, capacity to foster innovation and improve business performance (Mendes & Machado, 2015). Prinsley and Baranyai (2015) discovered that employers found their STEM-trained employees to be the most innovative and adaptable to change. They also found that the top four skills that were rated by employers as the most important were active learning, critical thinking, complex problem solving and creative problem solving.

The uptake of training and apprenticeships is not meeting the potential knowledge gap that will exist as the current workforce approaches retirement. A focus on training and education will need to occur in order to avoid significant skills gaps which will become more

pronounced as the technology and innovation in the manufacturing industry evolves (Manufacturing Skills Guidelines Australia, 2015). Manufacturing Skills Australia (MSA) (2015) predicts capacity will decline in the manufacturing industry as a result of the skills gap due to the ageing workforce.

Numerous reports on manufacturing in Tasmania identify the largest constraints in growing businesses and industry as being skills gaps, shortages and the small size of the skill base in Tasmania (Enterprise Connect Innovative Regions Centre, 2013; Allison et al., 2013). Developing skills and training for Tasmania’s North West manufacturing industry in particular is a key issue. A shortage of suitably qualified trade and professional staff is currently impacting growth of firms and has been identified as a critical issue for the future development of businesses located in that region of Tasmania (Enterprise Connect Innovative Regions Centre, 2013). The list of skills needed is extensive and has been covered in Table 1 of this paper. Enterprise Connect’s research highlighted the need for a whole-of-industry approach to skills development. Common issues are the basic mathematics knowledge of young people, practical knowledge or “nouse”, problem-solving skills, attitudes and willingness to work. The findings of this Tasmanian study reflect the issues reported in the manufacturing industry nationally and internationally (Manufacturing Skills 2014, 2015) with reports focusing on the importance of STEM to the growth and competitiveness of Australia on the world stage (Office of the Chief Scientist, 2012, 2014; Australian Government, 2013a; Manufacturing Skills Australia, 2015; Committee for Economic Development of Australia, 2015). The reports find that the need for STEM in industry is not being met and it is of concern that the current education and training will not meet this growing need for the workforce.

The skill needs of the Australian maritime and ports sector are similar. In 2014–2015 the sector had revenue of \$16.9 billion with added value of \$9.2 billion. It is expected to have a sector job growth of 4.7 percent from 2013 to 2018. Its workforce is one of the oldest in the country and is ageing 1.7 times faster than all industries (Transportation and Logistics Industry Skills Council, 2014). Due to limited ship-based training berths being available for incomers, there is a gap between the skills supply turned out by established training institutions and industry demands. There is also strong international competition for skilled port workers, with regional and remote ports facing the most difficulties in recruitment. The Transportation and Logistics Industry Skills Council has identified a skills gap in automated systems of work, electro-technical, dredging and offshore-specific requirements such as occupations of marine engineer and deck hand/integrated rating (Transportation and Logistics Industry Skills Council, 2014). This is consistent with the skills gap identified (Table 1) by the Tasmanian Maritime Network (2013).

STEM skills are the fundamental skills of the manufacturing/advanced manufacturing and maritime industries (Manufacturing Skills Australia, 2015) and having strong STEM understanding will create a workforce which will be able to address the changing needs of industries. Table 1 lists a wide range of skill shortages in areas such as oil and gas production workers, maintenance engineers and trade workers, fitter mechanics, pipe welders and coded welders and licensed aircraft mechanical engineers. These skills shortages are exacerbated when industries are located in regional areas (Manufacturing Skills Australia, 2015). The aim of this paper is to identify the current key skills in the Tasmanian manufacturing, advanced manufacturing and maritime/marine workforce; the future skill requirements for growth industries and any existing skills gaps between them.

Table 1. Summary of future skill requirements for the manufacturing, advanced manufacturing and related industries gathered from published reports and papers.

Industry	Future Skills	References
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Manufacturing, Advanced manufacturing	Balance of technical and theoretical skills, high-level application of STEM and literacy skills, personal values, skills in: interpersonal communication, problem solving, technology use, leadership and entrepreneurial and informational skills, business and workforce planning skills, developing global markets, lean and agile production management, customer service, management, intellectual property management, waste management, global supply chain management, creative thinking, and the ability to adapt	Beddie et al., 2014; Rasul, Rauf, & Nor, 2014; Manufacturing Skills Australia, 2014; Manufacturing Skills Australia, 2015; Prinsley & Baranyai, 2015
Engineering	Design/CAD, Drafting, lean manufacturing, customer service, CNC systems, automation/robotics, PLC programming, fitters, mechanics, mechanical, boiler makers, welders, sheet metal, metal fabrication, electrical and diesel technicians, marketing, business, administration and finance, accountancy, production management, quality assurance, leadership, supply chain management, surveying, engineering and geology	Enterprise Connect Innovative Regions Centre, 2013
Maritime	Problem solving, leadership and management, teaching and training, language literacy and numeracy, information technology and financial management, automated systems of work, electro-technical, dredging, and offshore-specific requirements such as occupations of marine engineer, deck hand/integrated rating, naval architects, design engineers, draftspersons	Tasmanian Maritime Network, 2013; Transportation and Logistics Industry Skills Council, 2014
Logistics	Supply chain management, business management, systems and technological skills, fleet management, safety management	Transportation and Logistics Industry Skills Council, 2014

## Approach

Qualitative data on current and future skills were collected through semi-structured interviews with individual businesses in the manufacturing and advanced manufacturing industries in Tasmania. The businesses selected to interview were either members of the Tasmanian Maritime Network or considered growth industries and industries of importance for Tasmania. A range of businesses was selected to ensure a mix of size, age of company and diversity within the industry. Purposeful sampling is an important part of the qualitative research design because it allows the research team to understand specific issues which are central to the research topic (Patton, 2015).

The project manager emailed 24 businesses to participate in the research, seven accepted, two declined and 15 did not reply. The sample was deemed representative of the future Tasmanian manufacturing industry in terms of size and diversity of production sectors. The participating businesses (n=7) ranged from small (<50 individuals) to large businesses with over 4,000 employees. There were three age categories for the participating businesses: three businesses were established more than 80 years ago, another three were established between 30–80 years ago and one company was less than 20 years old. They encompassed

the maritime/marine (n=3), advanced manufacturing (n=1), and renewable energy and engineering (n=3) industries. The businesses nominated an appropriate participant who was generally a human resources manager, training manager or similar. All interviewees had a good knowledge of the company's skills and developing needs for the future.

The semi-structured interview schedule comprised of open-ended questions in three categories: industry questions, current skills and future skills and developing needs. Interviews were conducted by members of the research team. Interviews were audio recorded with the participant's permission and transcribed verbatim for analysis.

Transcripts were coded thematically (Creswell, 2014) and themes were generated from the data, consistent with an inductive analytic approach (Ryan & Bernard, 2000). The themes were then combined into a smaller number of overarching categories that became the framework for the major findings.

This section describes the themes which emerged from the semi-structured interviews with the individual businesses.

## Employees

### *Future staff needs*

Staff needs for the future are changing in the range of businesses interviewed. Technology is driving the needs for the future and businesses which are involved in production are indicating that with changes in technology, they will have staff reductions generally at the lower skills level. Businesses will be looking for a more skilled workforce and, as indicated by company F, "the role will change from one of hands-on to technology-based, focused, and skilled, in every way... leadership; IT skills are what we need for the future". When company F was asked what their staff needs would be in 3–5 years, they replied, "Less at the lower level". Technology will increase the productivity and efficiency and company C expects it will "improve efficiencies and speed up the [production] process, cut down the number of workforce, you know, people cost money to employ, unfortunately".

Other businesses were experiencing a period of growth and indicated that they would be hiring staff (in relatively large numbers) currently and in the near (1–2) to medium future (3–5 years). These businesses have implied they will be increasing their staff by 15 percent in some cases and more in others. Some of these employees will be temporary in order to meet immediate staffing demands but all staff will be retrained for the specific industries. For a few businesses, the staff demands will be met through multi-skilling their current employees.

*"Well, one thing that we've tried to do over the years is to multi-skill our workforce and why we've done that is because we go through these peaks and troughs, to try and maintain all the different trade groups in the numbers we need is where we become very inefficient. So we have spent a lot of time and effort trying to multi-skill our trade group..." [company I]*

## Skills

### *Reskilling and up-skilling staff*

All the businesses that were interviewed, with the exception of one, had established training programs for reskilling and up-skilling their staff. These varied from fully funded programs including time off for attending training to retrospective payments on completion with the employee responsible for the time needed to attend. "We're offering it to you, we're going to pay for it, the rest is up to you." [company F]

There was variation to these programs and often what was made available depended upon the level of the employee. Generally, lower-level employees who required specific training for their position were catered for. The one company [company C] which did not have an established training program had a culture where if they needed a specific skill or

qualification they would “go and employ someone that’s already done that on their own behalf”. The attitude in this company at the time of interview was beginning to shift, with management pushing for support of a few employees to be retrained. “We’re trying to push for the betterment of the worker, you know, these people and we think they’ve got potential.” [company C]

Amongst the businesses there was a general culture about up-skilling and re-skilling that was very positive. The businesses in this study all require a high level of technical skill and will reskill employees to meet their needs.

*“Regardless of what level they come in we’ll always up-skill. So regardless if you came to us with all the qualifications relevant to your role we would still...the application into our industry will be slightly different, so we’ll up-skill you into power processes, we’ll up-skill you onto our best practice because being an industry leader we want you to that level.” [company T]*

Many of the businesses emphasised the benefit of multi-skilling their staff, and this provided the opportunity for employees to move within the company and “come up through the system” [company C] in the larger businesses. Another company said that “multi-skilling is going to help people going forward” [company I].

#### *Core/fundamental skills*

An issue that was alluded to in the interviews from several of the businesses was the literacy and numeracy skills of staff. These businesses had a large number of staff currently in non-skilled labour jobs.

*“...we do generally have a literacy problem..., and I see that in the manner that our boys complete basic forms, where some of them can’t adequately construct a sentence. So if you throw them into a certificate course, how much are they going to get out of it? [company F]*

As mentioned in this quote, inadequate literacy and numeracy becomes a major issue for training, reskilling and multi-skilling of staff members. Company F spoke in more detail about training assessments for staff with literacy issues and the need not to alienate them but develop the internal training to be “as coherent as possible..., deliver it verbally, and any assessments to be done on the day with the assessor or the facilitator, otherwise it won’t work”.

#### *Skills gaps and future needs*

A major need identified by the interviews was in leadership. Half the businesses were investing in leadership training for their staff as this was an identified need for continued company growth and effective staff management.

*“...this is an area that we all need to hone in, leadership...we are focusing heavily on a leadership program.” [company F]*

*“...frontline leadership training...how to be an effective leader, and the skills we look for with those that are leading teams or influencing the business.” [company T]*

These businesses were either contracting businesses from mainland Australia to train in-house to provide specialised leadership training customised for their specific industry or sending employees out of the state for the training. Other gaps in skills identified were focused on changing technology, and mentoring for staff. Changing technology will be discussed below.

With the focus on technology and its strong influence on the future, the point has been made about retaining those basic core skills in engineering and ensuring that they are not lost in

the trades but also teaching the trades so as to develop a real understanding of the skills and knowledge needed for flexible, critical thinking and decision making.

*“I think they’ll need to have a lot of the traditional skills, and they’ll still be very much valued. A good understanding of it, of how it works, why it works, all those sorts of things and it’s the same with the trade skills. I think that’s probably where we’ve missed the boat. We don’t teach the tradesmen the basic skills, we probably teach them a whole lot about...business and economics and marketing,...how to balance their budgets..., but if they don’t have the basic skills it’s very hard for them to apply those things... But it’s the broadening of those skills and the adding on of those skills so that they can take those...take that core base, understand how things work, but then...be much more capable of reacting and understanding the business world, the market, what’s driving change and be a lot more flexible.” [company H]*

## Training

### *VET providers meeting the needs of industry*

The businesses interviewed utilise both the TAFE and private registered training organisations (RTOs) for training their staff. There was an overwhelming level of dissatisfaction with the training options available, however, with these specialised manufacturing and advanced manufacturing industries much of the training required is highly specialised. Nonetheless, it is clear that there are issues between industry needs and the training providers (both the TAFE and private RTOs). In Tasmania, the TAFE is aware of these issues and has engaged with industry to improve the relationship between student outcomes and industry needs. In 2013, the advanced diploma qualification delivery was cancelled in Tasmania but the need for it still exists in the manufacturing and engineering industries.

*“...18 months ago [TAFE] taught out that final year of advanced diploma subjects...it creates a massive gap, like, were looking to put a cadet on, but there’s no pool to pick from...there’s nobody with those skills that we actually require, because being paid employment, you need to put them on the floor and they need to become useful as quick as possible, so there is currently no engineering course that gives them that skillset.” [company G]*

Most interviewees indicated that the skills of the students graduating with a VET qualification were lower than expected. “We are finding skills, hand skills, trade skills, basic practical skills lacking in a lot of apprentices coming to us from well, TasTAFE and things like that” [company H]. Another company stated that in “a whole range of areas we just didn’t feel that the modules had kept step with our industry” [company T] and that there was a “...down skilling of the trades...They’ve got a really good solid base in theory and all the rest but their practical skills are very, very minimal” [company C].

One interviewee was previously a teacher at a VET training organisation and “the lack of ability of the people coming out of the Polytech is why I got into teaching at the Polytech.” “I can teach them what they’re doing, but they need a core skill which is why we’re reliant on the VET courses. The problem is the VET courses are not necessarily up to speed” [company G]. The same interviewee also said that “the course deliverers were not maintaining their skill base, and some of them have the right knowledge and the right understanding of things but they aren’t able to deliver it in a way that helps people actually educate themselves, or they rely on people educating themselves other than delivering it well” [company G].

All of the businesses had developed some level of in-house training to cover their needs. Some businesses use the VET system for some levels of training and provide the rest through in-house training as demonstrated by the following examples:

*“TasTAFE mainly for the technical skills and then internal training for the industry specific skills.” [company H]*

*“So we’re an industry leader on our safety systems, and we expect the staff that attend the training with a third party to receive the same level of health and safety training as we present. We’re finding that that’s falling behind...There is also the core modules within the Cert III...not in line with current legislation or what we would deem is best practice for our industry.” [company T]*

*“...we do all that in-house now, where once upon a time we went through TAFE.” [company I]*

*“...we just believe that we have more skill in-house to teach.” [company W]*

One interviewee highlighted that direct communication with the VET providers and building a strong relationship with them was the way to overcome/meet their training needs:

*“We have developed a close relationship over the last two years given that, for the last 10 or 15 years, the education that was provided wasn’t very specific to what we needed. So we sat with them and pretty much told them that, ‘It needs to be more specific, your teachers need to deliver the content in a manner that is attractive and coherent to our [staff], who, the last thing they want is to sit in a classroom setting and write notes’.” [company F]*

### *Information Technology*

An area of constant change and increasing importance for the manufacturing, advanced manufacturing and engineering industries is technology. All businesses interviewed mentioned technology in some way, but IT skills, data collection and changing technology as important areas for skills development was highlighted in nearly all the interviews. This is demonstrated by the examples below:

*“...because we’re a pioneering industry, the machinery, the equipment that we use is always developing so fast, so we’re going to need skilled operators to use that.” [company T]*

*“...we are identifying at all levels, IT skills are so, so important and are so lacking...this is not an isolated problem, it’s company-wide. From top to bottom, we have to be IT-savvy.” [company F]*

## **Discussion and conclusions**

The objectives of this project were to identify the skills needed for the future for the manufacturing, advanced manufacturing, maritime/marine and related industries in Tasmania, as well as identify any mismatch between the current workforce skills and future needs. Several of these industries require employees who have skills across two or more disciplines and/or span several AQF levels. This need is being addressed in Tasmania through pathways projects (Symes et al., 2014; Penesis et al., 2015) and in particular the development of a new associate degree at University of Tasmania, developed based on industry consultation. The new associate degree is a partnership between VET, higher education and industry which will improve industry-valued outcomes.

The results of this study clearly indicate that there is a need for VET and higher education to be flexible in their course offerings, maintaining a close relationship with industry (and with each other) to promote skills transfer between the sectors. There is an identified need for up-skilling and reskilling within the education and training sectors in order to remain current and meet the learning outcome needs of employers for STEM-based technical and generic skills, supporting lifelong learning and career changes (Business-Higher Education Forum, 2013; Deloitte Australia, 2014). This will ensure consistency and quality in education and training that remains industry relevant, especially where higher-level skills needs are emerging related to STEM industries. Interviews conducted with the manufacturing and maritime industries identified the need to improve the partnership between the trainers and employers and the necessary inclusion of industry-expert teachers in VET-delivered programs to ensure the demand for the future skills is met. While this study is limited to Tasmania and the results are not necessarily generalisable to other places, the similarities between skills needs in Tasmania and those reported nationally and internationally in Table 1 suggest similar needs may apply elsewhere, including the need for education and training in both technical STEM-based and generic skills such as for literacy and leadership (Beddie et al., 2014; Rasul, Rauf, & Nor, 2014; Manufacturing Skills Australia, 2014; Manufacturing Skills Australia, 2015; Prinsley & Baranyai, 2015). Additional research is needed to understand how best education and training providers can work effectively with industry to address the skills needs of niche businesses in thin education and training markets.

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