

ADVANCED MANUFACTURING GROWTH CENTRE

INDUSTRY 4.0: AN OPPORTUNITY FOR EVERY AUSTRALIAN MANUFACTURER

SUBMISSION TO THE DEPARTMENT OF
INDUSTRY, INNOVATION AND SCIENCE

MARCH 2018



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Acknowledgements

The Advanced Manufacturing Growth Centre wishes to acknowledge the following organisations and their representatives who were invited to help develop this submission.

AMTIL

ANCA

B&R Enclosures

Chelgrave

Complete Lean Solutions

Composites Australia

Dassault Systèmes

Deakin University

Dresden Optics

Evolve Group

Foam Packing Australia

Freelance Robotics

Innovative Manufacturing CRC

Ipswich City Council

KPMG

Laser Central

Likatibro Consulting

Magnetica

Masters & Young

Monash University

Plastfix

QMI Solutions

Queensland University of Technology

Quickstep

Robert Bosch Australia

Russell Mineral Equipment

Siemens

Standards Australia

Sutton Tools

Swinburne University of Technology

Swisslog Australia

Technofast Industries

Thales Australia

Greg Chalker

Grant Anderson

Chris Bridges-Taylor

Ben Bridges

Mark Hale

Andy Kelsall

Peter Taylor

Kerryn Caulfield

Ravi Jain

Derek Buckmaster

Bruce Jeffreys

Ty Hermans

Phyl Montonya

William Pagnon

David Chuter

Tamanna Monem

Michael Alf

Rob Newton

Linsey Siede

Duncan Stovell

Rodney Young

Joseph Lawrence

Mario Dimovski

Mike Swart

Cori Stewart

Carl de Koning

Gavin Smith

David Pettigrew

Sue Carter

Dr Jed Horner

Peter Sutton

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Dr Steve Dowe

Matthew Leone

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Shanti Krishnan

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AMGC was formed in 2015 with a mandate from the Australian Government to connect local manufacturers into global supply chains, lift managerial and workforce skills, improve sector-wide collaboration and reduce red tape.

Introduction

Manufacturing is and remains essential to the prosperity of nations. Yet as traditional production methods and business models evolve in today's internet-driven world, Australia is locked in a global race with countries that understand the sector is profoundly changing. Embracing the digital transformation of manufacturing, referred to in this submission as Industry 4.0, is becoming crucial to a nation's competitive advantage. The stakes couldn't be higher. Nations that rest on their laurels risk squandering their market position. Those that successfully transition to the digital age will be the powerhouses of the future.

The Advanced Manufacturing Growth Centre (AMGC) welcomes the opportunity to advise the Australian Government on how more manufacturers can be activated as part of this urgent national challenge. This submission proposes exciting and achievable recommendations to help every Australian manufacturer adopt Industry 4.0 – from large businesses to the almost 95% of firms that employ 20 people or less – and in both city and regional areas around the country.

AMGC undertook comprehensive consultations with Australian manufacturing entrepreneurs and other industry experts. It held a series of leadership roundtables and interviews during the second half of 2017 in Brisbane, Canberra, Melbourne, Perth and Sydney. Key insights from these sessions are incorporated on a non-attributed basis. AMGC sincerely thanks all involved for their frank and constructive participation.

It is clear to AMGC that the main reason for the slow pace of Industry 4.0 adoption in Australia is not excessive regulation. Nonetheless, the Australian Government (and state governments) could better explain the opportunities provided by Industry 4.0; offer greater resources and support to firms; streamline and accelerate funding and grants structures; ensure the presence of a digitally skilled workforce; and be part of an international effort to create clear and consistent standards.

AMGC was formed in 2015 with a mandate from the Australian Government to connect local manufacturers into global supply chains, lift managerial and workforce skills, improve sector-wide collaboration and reduce red tape. AMGC now has more than 120 constituents and growing, including leading Australian and multinational firms and the nation's top research institutions. It plays a crucial role in incubating the latest manufacturing technologies as a member of the Industry 4.0 Forum (represented by its Managing Director Dr Jens Goennemann). It also sponsors the Industry 4.0 TestLab at Swinburne University of Technology's Manufacturing Futures Research Institute.

Overall, AMGC is convinced that embracing the digital transformation of manufacturing by implementing the recommendations in this submission will have a significant sector-wide impact. This is a race that Australia can enter and win. Embracing Industry 4.0 is the key to a competitive future, not only for manufacturing, but the entire economy.

Major recommendations

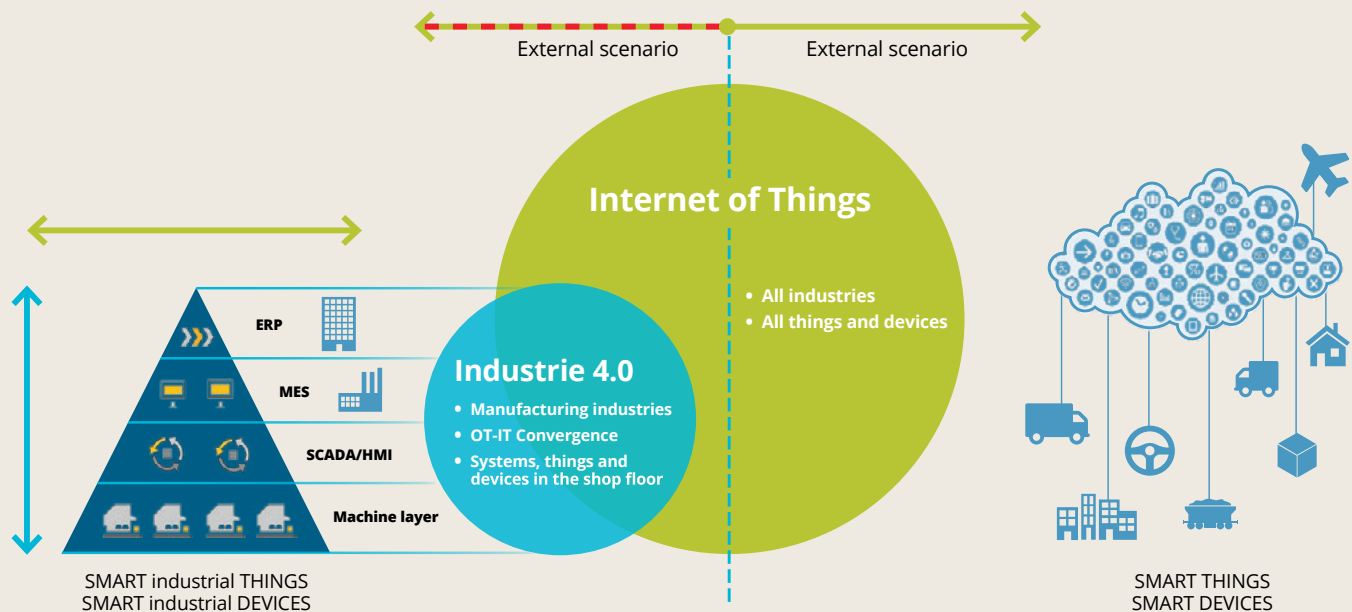
1. Make Industry 4.0 audits and self-assessment tools available to every Australian manufacturer. Having free or subsidised access to Industry 4.0-qualified advisers will help manufacturers reconsider their business models and learn how to integrate digital technology into their operations. Governments should also support a wider rollout of the Industry Capability Development Tool jointly delivered by AMGC, the Innovative Manufacturing Cooperative Research Centre and the Entrepreneurs' Programme.
2. Launch national network of Industry 4.0 collaboration hubs. Manufacturers deserve access to a central location, initially at no cost, where they can seek expert guidance, and test products and solutions. AMGC is eager to extend its current co-funding arrangements for projects conducted in Swinburne University's Industry 4.0 TestLab.
3. Fund Industry 4.0 innovation. Specific grants should be created to encourage manufacturers to adopt Industry 4.0 technologies, attend trade shows, and relocate some employees overseas to commercialise products and gain export traction. Federal and state grant schemes must be aligned and simplified to streamline the application processes.
4. Expand access to government-backed loans. Low-interest loans, backed by government guarantees, should be made available to manufacturers investing in Industry 4.0 upgrades. Lending criteria should also be relaxed by Austrade and the Export Finance and Insurance Corporation.
5. Establish an Australian manufacturing online business directory and sharing economy scheme. Working with the government, AMGC could offer its growing constituency a basic portal capability, enabling them to connect and explore business opportunities with potential customers and supply chain partners worldwide. Manufacturers could also loan and share equipment such as 3D printers that may be seasonally idle.
6. Reform education and on-the-job training to create an Industry 4.0-ready workforce. Vocational education and training should be liberalised so students can obtain shorter, job-relevant micro-credentials. Massive open online courses promoting digital skills should be supported by governments, irrespective of provider. New financial incentives would allow Industry 4.0 manufacturers to release workers to combine career and study.
7. Modernise awards schemes and visas affecting manufacturing workers Australian manufacturing workers should have the ability to embrace flexible schedules in keeping with the 24-hour Industry 4.0 business cycle. More workplace flexibility will allow people to move between roles requiring different skillsets, and for employers to plug skills gaps with a mix of local and international labour.
8. Lead in developing global Industry 4.0 standards. Through dialogue and partnerships, the Australian Government should spearhead international efforts to strengthen cybersecurity and facilitate easier electronic data exchange within manufacturing supply chains with compliant standards.

KEY CONCEPTS

1. The digitalisation of manufacturing

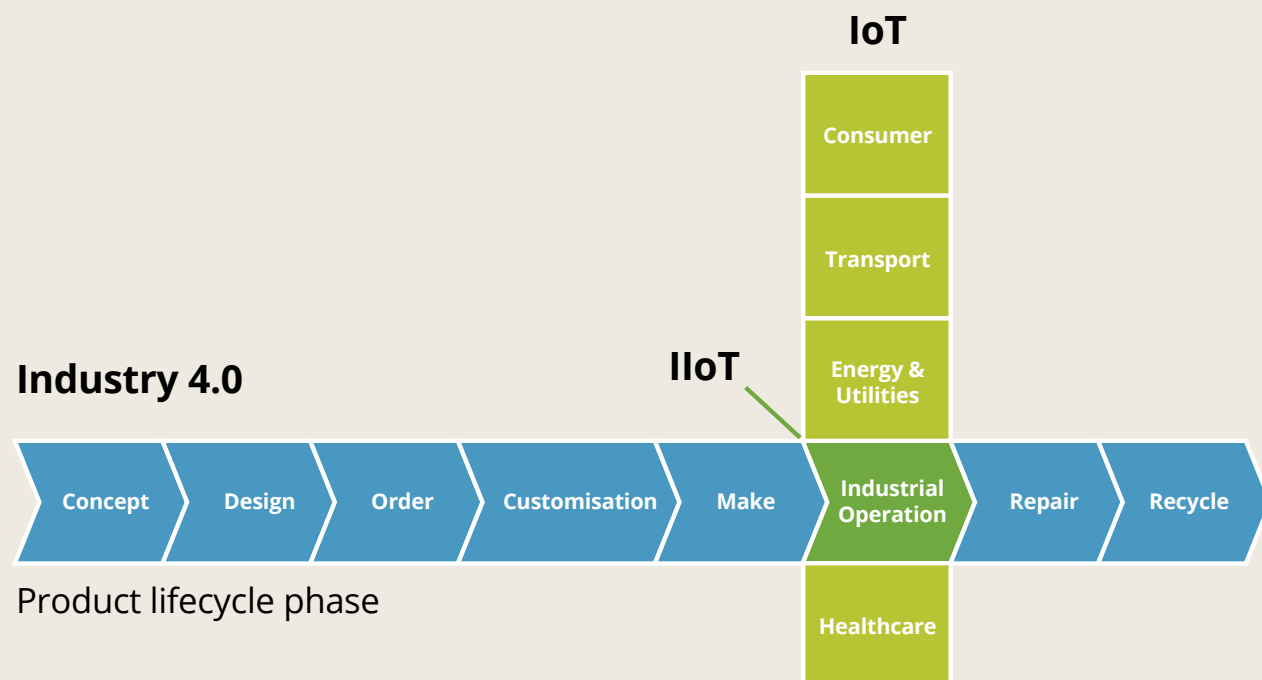
- 1.1** Manufacturing has progressed through three industrial revolutions. The advent of water and steam power mechanised production at the end of the 18th century. Electrical power created mass production in the late 19th century. Computing and electronics enabled production to be automated and optimised in the late 20th century.
- 1.2** The sector is now in the midst of a fourth industrial revolution. An unprecedented fusion of technologies is disrupting many traditional business models and creating opportunities for new ones. The key transition is from traditional factories and assembly lines to manufacturing settings, processes and supply chains that are linked by omnipresent connectivity. Just as the internet generated new value by linking people digitally, the Internet of Things will support automated systems in which products, machines, networks and systems communicate and cooperate independently. Artificial intelligence will augment this process, enabling machines to analyse vast tracts of data and learn through experience rather than relying completely on human instruction. For example, a sorting machine could learn whether unusually shaped product components are likely to be faulty or are just part of a custom design.
- 1.3** Even now, objects such as phones, cars and wearable health devices are being interconnected via embedded high-tech chips and sensors. According to one estimate, the world will have 20.4 billion connected devices by 2020 – a significant increase from 8.4 billion in 2017. As this connectivity extends to the manufacturing environment, it will create ubiquitous data relating to all aspects of a firm's operations. It will also unlock near-limitless value-creating potential.
- 1.4** 'Industry 4.0' is the term given to this new concept of manufacturing based on linking the physical and digital factory. In the words of Professor Bronwyn Fox from Swinburne University of Technology: "It refers to the digital transformation of the manufacturing process."
- 1.5** The Australian Government has adopted the language of Industry 4.0. This mirrors the situation in Europe, particularly Germany, where Industry 4.0 has become a whole-of-country strategy to strengthen the economy through manufacturing. Other countries have their own slogans – for example 'Smart China' – while GE calls it the 'Industrial Internet of Things'. There is further overlap with concepts such as 'smart manufacturing' and 'factories of the future'.
- 1.6** **“Stakeholders interviewed by AMGC emphasised that Industry 4.0 does not describe a single technological capability or achievement at a point in time. Rather, they see it as ‘a way of thinking’ or ‘a cultural journey that companies need to go on’.”**
A key part of that journey is to think in terms of tangible and intangible products and outputs, particularly the value that can be created in the digital realm. As one manufacturer said:
“It's not just the individual software or sensors; it's the collaboration of all these things.”
For many, the concept of Industry 4.0 is even broader and extends to manufacturers' fundamental business models. Some manufacturers criticised the terminology of Industry 4.0 as unhelpful and overly theoretical.

Industry 4.0 vs Internet of Things



Source: Industry 4.0 Testlab paper, courtesy of Swinburne University of Technology <https://industry.gov.au/industry/Industry-4-0/Documents/Industry-4.0-Testlabs-Report.pdf>

Industry 4.0 vs Industrial Internet of Things (IIoT)



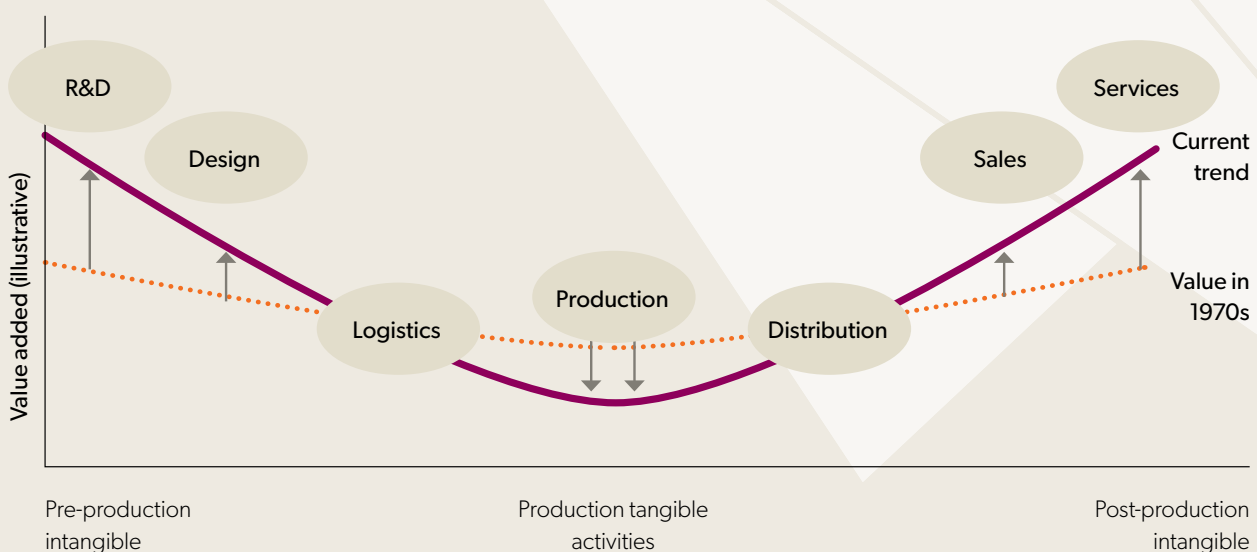
Source: Industry 4.0 Testlab paper, courtesy of Swinburne University of Technology <https://industry.gov.au/industry/Industry-4-0/Documents/Industry-4.0-Testlabs-Report.pdf>

- 1.7** The rise of Industry 4.0 is occurring as manufacturing undergoes a historic transformation. As depicted in the so-called 'smiley curve', the sector in many countries is moving away from the production of finished goods and towards other activities along the value chain such as research and development, design, logistics, packaging, distribution and after-sales customer service. The internet is amplifying this disaggregation, creating a distinction between physical jobs – which involve making something, or delivering services that require the provider to be present – and digital jobs, where the service can be provided anywhere.
- 1.8** All of this means that the manufacturing output of tomorrow is not necessarily a commodifiable object like an electrical appliance or a car. This is particularly the case for industrialised nations such as Australia where labour costs are less competitive. Instead, it might be a customised component, software solution or service delivered over the internet. An example would be a virtual product template that is shared simultaneously between different members of a supply chain.
- 1.9** To embrace Industry 4.0, manufacturers commit to connect all the 'digital fingers' of their business. This means gradually digitalising, automating and interconnecting all machines and processes. Adoption then extends from production activities to the entire

value chain, including functions such as design, engineering, procurement, marketing and finance, and final customer engagement. This allows business owners to enjoy real-time visibility into the entire network of value creation, and to make decisions based on intelligence and data. For example, customer feedback might flow from social media back to the original product designers. Alternatively, a manufacturer may analyse thousands of hours of equipment time to calculate the optimum time of day to conduct maintenance or minimise electricity costs.

- 1.10** Key Industry 4.0 building blocks include cloud-based enterprise resource planning (ERP) software; cyber-physical assets such as sensors and scanners attached to machines; mobile interfaces for workers, such as smartphones, tablets and wearable devices (like connected helmets); and platforms that original equipment manufacturer or suppliers can use to connect these disparate systems. Manufacturers can purchase software off the shelf and customise it, as is possible with Salesforce or fieldworker management solutions such as Hellotracks. Alternatively, software developers may develop solutions specifically for each different customer. The goal is for manufacturers to manage business relationships, and track the functionality of every staff member, project, process and piece of equipment – all using simple dashboards and management reports.

Figure 1: the new manufacturing value chain¹



¹ Advanced Manufacturing Growth Centre, *Sector Competitiveness Plan 2017*, p. 8. Source: https://www.amgc.org.au/Attachment?Action=Download&Attachment_id=15

2. Connecting the customer

- 2.1** Industry 4.0 enables special collaborations between manufacturers and customers. This allows precisely tailored products, from sports shoes to industrial components, to be built and delivered just in time. As digital technology creates greater expectations of instant gratification and personalised service, the customer is in the driver's seat. Radically redesigning business processes to please the customer is therefore becoming an essential part of manufacturers' ability to compete.
- 2.2** One manufacturing stakeholder interviewed by AMGC summarised this landmark evolution as follows: "At the moment, manufacturers operate a 'business-to-customer' (B2C) model; this is rapidly going to change to a 'customer-to-business' (C2B) model through the connectivity that each one of us has."
- 2.3** At American electric-car manufacturer Tesla, for example, a purchaser might walk into a virtual showroom in Los Angeles and customise their own car. Tesla then sends these requirements straight to the factory, and the car is built on a modularised assembly line. Quickstep is an example of an Australian manufacturer pursuing a similar approach. Each solution is designed cooperatively with the customer and integrated into the manufacturing process. This includes everything from delivery logistics to sustaining products throughout their potentially 40-year life cycle.

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3. Radical supply chain transparency

3.1 Radical transparency is integral to Industry 4.0 business models. Today's customers want to know where a product has been made – as well as how and by whom. For example, at advanced Australian eyewear-manufacturer Dresden Optics, customers may purchase frames made from recycled plastic landmine casing discovered on a beach in Southeast Asia. Another Australian manufacturer, which supplies parts to Boeing, is moving to digitalise its quality assurance systems so that it can easily track down the source of faults and assess risks to other units. This involves transitioning from using paper documentation and Excel spreadsheets to collate serial numbers of different parts. As noted by Anton S. Huber, former Chief Executive Officer of the Siemens Digital Factory Division: "In the future, every manufacturer will know exactly which component has been installed, with which characteristics in which of its products, and will thus be able to respond to problems in a targeted manner."

3.2 Industry 4.0 enables procurement departments and suppliers to enjoy fully transparent supply chains, as well as real-time data and feedback. As one manufacturer said: *"The design is connected to my client in Germany who sends the purchase order to me in Australia, which automatically forces a material request on my supplier."* Of course, every business in the supply chain requires the same level of digital integration otherwise all slow down. One manufacturer told AMGC that his company was looking to create 'system-agnostic' digital interfaces with customers and suppliers, that allow any ERP system to talk to another.

“Suppliers will see our inventory and our orders exchanged digitally in real time,” he said. “If we have three-month visibility of planned orders, we can also take a risk on buying longer-lead capital items.”

3.3 Cybersecurity is increasingly important as customer information becomes transparent across the firms that make up the manufacturing supply chain, each of which may have different protocols and standards. As one contributor to this report noted:

“Cybersecurity must be a whole-of-business approach for Industry 4.0; it requires a thorough analysis of all strengths and weaknesses internally and across the entire supply chain and operating environment.”

For example, if a manufacturer builds a computer chip or any form of communications capability into a product, they must ensure it is impervious to manipulation by hackers in ways that could compromise customer information. As discussed in section 4, this is particularly vital for those supplying the defence industry.

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MOVING TOWARDS INDUSTRY 4.0

4. Recognising the opportunity

- 4.1** AMGC is committed to helping Australian manufacturers understand what a massive opportunity Industry 4.0 represents. For a nation with a relatively small domestic market, it makes sense to develop an export-oriented manufacturing industry that taps into a pool of 7 billion potential worldwide customers. This is particularly important as manufacturing enters the digital age, making Australia's geographic distance from world markets less relevant. Of course, the reduction in the 'tyranny of distance' also cuts two ways, with foreign competitors now more able to provide value within Australia from afar.
- 4.2** Unfortunately, too many Australian manufacturers are still exclusively domestically focused. As one manufacturer told AMGC: *"There is very little capability in Australia about taking a mass consumer product overseas; we have a massive global market with limited expertise in Australia about accessing that market."*
- 4.3** The sector has a choice: retreat and wait until it is surpassed by international competitors, or do what is necessary to become innovative, export-oriented and world-leading. The latter is the only way to ensure that manufacturing continues to support Australia's economic prosperity and standard of living. In its Sector Competitiveness Plan 2017, AMGC estimated that the 'size of the prize' from improving Australia's manufacturing competitiveness could be an additional 25–35% of national output, worth \$36 billion by 2026. Some experts consulted by AMGC further suggested that a realistic target should be to lift the manufacturing sector's contribution to 25% of gross domestic product (GDP). This would help Australia move into the top 15 on the Global Manufacturing Index, up from its current position of 21st.
- 4.4** Creating a local manufacturing base that is agile and digitally integrated will bring considerable opportunities for Australian firms. Local manufacturers will gain the means to scale their innovations worldwide and contribute to lucrative global supply chains. Several manufacturers told AMGC that building relationships with global systems integrators or primes was worth the cost of investing in new equipment or becoming compatible with the latter's business software (including complying with cybersecurity requirements). As one interviewee said: *"If you're connected to a prime, it pulls you up". Another agreed, saying that "you're dragged on the journey if you're with a prime".*
- 4.5** By embracing Industry 4.0, Australia can even begin to 're-shore' some production from countries with low labour and electricity costs, such as China. This will help bring back jobs to regional areas such as Far North Queensland, the Hunter Valley in New South Wales, and Geelong in Victoria. In particular, capabilities such as 3D printing – in which physical objects are created using digital designs – have the potential to help Australian manufacturers meet demand for highly customised products and materials that can be quickly replicated anywhere in the world. According to one local manufacturing expert: *"Whereas previously you may have been a manufacturer of toys, bikes or weapons, 3D printing capabilities will mean that on Monday you print toys, on Tuesday it's bikes and on Wednesday it's weapons."*

5. Getting started

- 5.1** The first step towards Industry 4.0 is for the leaders of manufacturing businesses to consider their fundamental business model and approach to market. They should set an overall direction by identifying the business opportunity or problem they are seeking to solve, and how leveraging the latest digital technologies could enhance their value proposition. Rather than providing value through products, they must think more about delivering services that people will access using various modes of connectivity. They must also be prepared to transform their workforce – both by upskilling existing workers and hiring new recruits to fill skills gaps.
- 5.2** This is a journey that every Australian manufacturer can embrace. Indeed, it is strongly in their interest to do so in a world where digital integration is becoming a basic requirement. Fortunately, the cost is not as large as firms might think – and accordingly the risk of failure is not as great. As one manufacturer observed: *“It’s just computers, Wi-Fi, big data; the hardware is very cheap, and the software is not overly complex. The real issue is coming up with the ideas of how to use it.”* Another agreed, adding: *“Everyone thinks tech is expensive – but a new website is only \$1,500, it doesn’t cost \$10,000. You’re linked into so much technology just by having a phone.”* A simple example might involve attaching sensors to filtration equipment in a factory. Instead of a maintenance worker conducting a time-consuming physical inspection every month, he or she only receives an SMS alert when the filters need to be changed.
- 5.3** The transition to Industry 4.0 cannot happen overnight and there is no one-size-fits-all approach. Each manufacturer will have different needs, circumstances and capabilities. Experts interviewed by AMGC emphasised that it would be a mistake to assume the German experience of Industry 4.0 can be fitted into the Australian context. Germany has a greater share of large manufacturing companies than Australia, and deeper integration between industry and the education system. As one manufacturer said: *“The problems are shared, but the solutions are not; they are local and based on our capability.”* He suggested that creating a nation of smart factories begins with creating ‘smart enough’ factories (or ‘minimum viable smart factories’). Other experts emphasised the notion of aspiring to a sensible level of automation, commenting that even in Germany, only about 50% of manufacturing processes are automated.

6. Investing to win new work

- 6.1** Today, many Australian manufacturers are grappling with how to create game-changing efficiencies and cost savings in their businesses. These investments tend to fall into four categories: robotics and automation; new, energy-efficient equipment; cloud-based ERP and material requirements planning systems; and lean methodology. Overall, the necessary transition requires moving to fully automated digital platforms. In the words of one manufacturer: *"We need to become an efficient, high-quality business buying new digital machines that can be programmed, come with robotics arms and interface with back-end systems so we know what orders need to be fulfilled. This will go live to our factory and be communicated right across our supply chain. At the moment, all we have is paper – and doing manual checks."*
- 6.2** Manufacturers that automate some processes may strip out labour costs from their businesses. At the same time, they create the potential to win new work and grow higher-value jobs over the medium term – not just in production, but across the manufacturing value chain. As one manufacturer told AMGC: *"Every single person on this floor understands that we're in an industry where we have everything stacked against us. Especially if you're a manufacturer with an offshore headquarters, all you need is one line through your budget from overseas, and you're done."* He added that SMEs need to adopt innovative technologies and processes to gain every efficiency they possibly can. *"If we're not, then we're falling behind because they're doing it in Germany and China."*
- 6.3** Automation is cost-saving rather than directly money-making, so the return on investment is often harder to demonstrate. For one manufacturer aspiring to remotely control and monitor equipment using radio frequency identification (RFID) tags and barcode scanners, the critical task is weighing the level of investment compared to the return for a given amount of product. *"At the moment we do things manually, but there will come a point where it's automated,"* the manufacturer told AMGC. *"It goes to an ERP system, it's all visible very quickly, and management gets real-time reports on which to base operational decisions rather than out-of-date information. All of those things I can see coming in the future. Deploying sensors that enable everything will give us a leg up to be more competitive in the global environment."*
- 6.4** Other firms emphasised that making production processes more efficient was crucial to their very existence in Australia. One interviewee said: *"I want to stay onshore for manufacturing, but it can't be done at any cost. That's why I want our systems automated – so we're delivering 'repeatable' good-quality products; our results are recorded in databases and ERP systems; and we run lean and mean."* Another agreed, adding: *"If I had to bring in 10 people at market rates, I'd have to go offshore. I can't keep employing Australian workers at Australian wages. Going through a level of automation, I only need five new people not 10. At least those five have a job – and I'm helping to keep our manufacturing onshore and our exports going."*
- 6.5** Overall, Australian manufacturers understand that Industry 4.0 will have an impact on jobs. Automation will replace some manual roles, but firms will also need more engineers, software experts and people to oversee the technology. Many manufacturers commented to AMGC that it will be vital to help workers make this transition and expand their career horizons, often through flexible qualifications and on-the-job training.

OVERCOMING BARRIERS TO ADOPTION

7. Explaining the opportunity

- 7.1** Many Australian manufacturers demonstrate strong leadership and are driven by innovation, always looking to find a better way of solving a problem. Eager to compete globally, they have the confidence to invest in doing things differently. Then there is the broad mass of firms choosing to stay where they are. As one manufacturer told AMGC: *"There are still people living under a rock and I see a couple of reasons. They say, 'I'm doing OK so what's the big deal?'. They don't see the disruptor coming, and they won't because the barriers to entry are lower now. It's like a frog that's in the water. The temperature is increasing slowly, so by the time they boil, they will not realise it, and they will disappear from the market."*
- 7.2** From AMGC's consultations, it is clear that the main reason for the relative lack of Industry 4.0 adoption in Australia is not excessive regulation or red tape. It begins with a resistance to change, particularly among middle management. In the words of one manufacturer:
“The leadership needs to drive it, otherwise it won't happen. However, tempting it may be to do things the way they've always been done, you don't try and hold back the tide – you learn to surf.”
- 7.3** Lack of understanding of the possibilities is another reason for slow adoption. As one manufacturer told AMGC: *"You go to most businesses about Industry 4.0 – 'it's going to change your world, we'll put in sensors' – their heads will blow. It simply won't compute."*
- 7.4** Many Australian manufacturers seem to feel that Industry 4.0 is more hype than real; an obscure concept being pushed from Germany. Part of the problem is the language of Industry 4.0 itself. According to one manufacturer: *"Industry 4.0 is an umbrella term; it takes the conversation to a theoretical level that people are uncomfortable with."* This manufacturer went on to say that business owners are practical people who want to hear about specific technologies rather than listening to 'consultant speak'.
- 7.5** There is a misperception that Industry 4.0 is an all-or-nothing proposition and that it is not possible to transition gradually. *"If you're a manufacturer who's got old machines, you won't engage at the moment because you go to the conferences, you hear the hype and everyone on the supply side is selling the dream,"* one manufacturer told AMGC. *"You know, everything's connected, collecting data, flashing lights, self-configuring machines, that's utopia. For 99.99% of all manufacturers, utopia will never exist."* He recommended that proponents of Industry 4.0 help firms understand they can digitise one process at a time.
“You've got to paint the big picture and then you've got to paint me in it,” he said. “Don't make the dream too big.”
- 7.6** There is a strong desire in the sector for clear, authoritative information. As one manufacturer remarked: *"If the government can provide an avenue for unbiased education of what Industry 4.0 is about – if we can just understand what it is – I'm more likely to take up some portions, if not all of it. Who are the unbiased bodies that can help educate the manufacturing industry and then incentivise businesses to take it up?"*

8. Providing assessment support

- 8.1** Many manufacturers are interested in Industry 4.0 but unable to explore it because they are fully occupied keeping the everyday business running. One interviewee explained: *"We get busy with the day to day; we haven't got time to lift our gaze and look at the opportunity."* In the words of another: *"Satisfying customers today takes time, so how do we find time to think about the future? When an order comes in, you need to extricate yourself from the planning and immediately execute to deliver that order."*
- 8.2** This leaves time-poor business owners unable to conduct detailed evaluations into whether investing in Industry 4.0 is worth it. As one manufacturer said: *"We all want a return on our investment of less than two years. Unfortunately, many of us haven't the time or the wherewithal to do the proper analysis in the first place."*
- 8.3** One option for firms is to spend tens of thousands of dollars hiring external consultants to walk the factory floors and work out which processes can be digitalised and automated. As one manufacturer observed: *"I'd like the ability to access consultants at a sensible price that can come in and provide advice on that."* Another suggested: *"You could get a small grant of \$5,000 to \$10,000 from the government that could support a consultant coming in to move to a state of consciousness. There's usually some low-hanging fruit in terms of automation."*
- 8.4** Some manufacturers report feeling daunted about where to start – or who to call. AMGC heard numerous stories of people getting discouraged by universities not replying to emails asking for assistance. In the words of one manufacturer: *"Who do I go talk to? I've got this amazing idea, it's going to change the face of my industry. Who do I talk to that I can trust who won't pinch it?"*
- 8.5** Others felt that embracing Industry 4.0 involved something of a Catch-22. Firms can't simply decide to embark on the digital transformation journey. Rather, they need to invest upfront in assets such as sensors, and in solutions that gather and analyse data. They do so as the cost of going on that journey, without any sense of what the payoff will be.
- 8.6** One manufacturer suggested that organisations needed to conduct proper 'digital maturity assessments'. This would help determine whether they could actually benefit from adding sensors, connecting devices, accumulating data and analysing the results to deliver process improvements. *"Lots of them won't do the assessment – because they are not already at optimum batch sizes,"* the manufacturer told AMGC. *"They haven't done bottleneck analysis; they haven't got just-in-time manufacturing. The reason why implementing technology is 98% of times a failure is because people buy it and don't know what to do with it. In our factory, there are a lot of automated processes and data being collected. How much of it do we actually do anything with? Probably about 10% of it. The last thing I need is more data, because I'm not even using what I've got. So, what we need to work out is what we can do with the data, and what data we should collect."*

8.7 Recommendations

8.7.1 Industry 4.0 audits and assessments

AMGC recommends:

- ▶ Australian manufacturers receive direct support to help them reconsider their business models, positions within local and global supply chains, partnerships, workforce composition and other strategic and operational elements, as manufacturing shifts to Industry 4.0.
- ▶ Every firm be given access to a government-subsidised Industry 4.0 audit, similar to a sustainability audit. Experts would help determine the manufacturer's readiness to integrate digital technology into their operations, which would in turn help them collect and analyse data, and create process efficiencies.
- ▶ Existing business grants schemes be extended to give more manufacturers access to digital transformation consultants.

8.7.2 Better resources and self-assessment tools

AMGC recommends:

- ▶ The Australian Government develop a low-cost teaching tool – such as the 'factory in a box' described below – for Australian manufacturers. This would demonstrate relevant technologies and allow companies to discover Industry 4.0 for themselves.
- ▶ The Australian Government develop recommended Industry 4.0 templates or pathways for manufacturers. These would educate firms about each step of the digital transformation process and could be tailored to different categories. Examples could include different templates for bespoke manufacturers versus primes, and for firms looking to automate a single process, as well as those re-examining their entire value chain.
- ▶ Firms be given free access to authoritative and unbiased educational resources about the potential of Industry 4.0, which have not been developed by suppliers. These materials should include compelling success stories and proof points, explaining how technologies such as sensors and robots have increased productivity in Australian manufacturing companies.
- ▶ Regular government-sponsored industry sessions on Industry 4.0 be held in major cities and regional population centres.

Teaching with a factory in a box

The Australian Government will soon be able to see the 'factory in a box' teaching tool in action. In January 2018, Sutton Tools began working with RMIT, The University of Queensland and AMGC to develop a model of the next-generation factory. SMEs around Australia will be able to review this model and download related educational materials to better understand how they can apply the latest digital technologies and other innovations at their sites. The initiative is being funded by the Defence Materials Technology Centre.

9. Improving collaboration

9.1 Australia's manufacturing sector badly lags behind the rest of the world in terms of innovation-related collaboration. For example, the Organisation for Economic Co-operation and Development (OECD) found that for 2012–14, Australia ranked third last out of 28 for big business collaboration with universities and public research bodies.¹ In developing its Sector Competitiveness Plan, AMGC found that 78 of 80 surveyed manufacturing companies had given up trying to partner with research organisations and had brought their R&D activities in-house.

9.2 AMGC is taking important steps to nurture collaboration with respect to technologies that offer strong export potential. One of AMGC's major initiatives involves partnering with the Manufacturing Futures Research Institute at Swinburne University of Technology to develop the next generation of Industry 4.0 initiatives. This includes a contribution of \$250,000 towards an Industry 4.0 TestLab, which will become one of many in a nationwide network. These TestLabs will give SMEs around Australia a readily accessible way to learn more about Industry 4.0 principles, gain hands-on experience, share learnings and access resources.

9.3 Other encouraging examples of Industry 4.0 collaboration in Australia include partnerships between GE and Monash University in the area of digital energy (deploying the Internet of Things in the electricity sector), and between Quickstep and Deakin University.

9.4 Many manufacturers told AMGC there should be more opportunities for Australian manufacturing SMEs to cluster around hubs and experiment with new technologies. In the words of one interviewee:

“**Manufacturers like to have things tangible. And this whole Internet of Things and Industry 4.0 and data digitisation is fundamentally intangible unless you can actually go and see it in practice.**” **Giving manufacturing SMEs access to universities – that is, inviting them to ‘come and play at Swinburne’ – would help get them thinking about the minimal viable smart factory in their area of specialisation.**”

As another manufacturer pointed out: “*Collaboration also has the benefit of demonstrating to universities and TAFE the skills in demand. Teachers get to stand there and see what the businesses need.*” Ideally, firms that are advanced along the Industry 4.0 journey would mentor those in the initial stages. A culture of ‘show and tell’ will be needed to create a pool of active demonstrators and accomplished winners.

9.5 International trade shows are another opportunity for Australian manufacturers. Companies such as Sutton Tools have made it a priority to benchmark themselves against the world's best tool companies. Staff members head overseas to gain inspiration and incorporate the best new ideas into the business. In the words of CEO Peter Sutton, their approach is to ‘steal with pride’ – not just matching but surpassing competitors. However, for many Australian manufacturing SMEs, attending trade shows is a huge expense. As one interviewee observed: “*Australia is a small market; companies need the international exposure, but it's hard. Trying to get a stand at Automechanika, you wouldn't get change on \$10,000. It's a juggernaut, dog-eat-dog world for someone who's never had international exposure.*”

9.6 Other manufacturers commented on the expense of joining industry associations and the difficulty of engaging with other firms in related supply chains. While some areas of the sector are very competitive and work against a culture of sharing insights, manufacturers in niche fields are yearning to cross-pollinate. “*There's not enough of it,*” one told AMGC. “*There should be more events, once every quarter. So many people are doing so much exciting stuff; you see it on LinkedIn. Even if the government were to fund some nibbles or drinks, wherever it is, you get people in a room and allow them to network. The value is in mixing with people; connecting with the professionals that are advancing in that area.*”

9.7 Recommendations

9.7.1 Expanded access to Industry 4.0 collaboration hubs

AMGC recommends:

- ▶ Additional funding and capacity for a national network of Industry 4.0 TestLabs. These would bring in manufacturing SMEs from metropolitan and regional areas to participate in collaboration opportunities, enabling them to gain expert advice, and to test products and solutions.
- ▶ Firms initially be invited into these facilities at no cost, and thereafter be charged a small fee.

9.7.2 Online business directory and sharing schemes

AMGC recommends:

- ▶ An online business directory be created, allowing customers from anywhere in the world to connect with Australian manufacturers, find out information about products, and obtain real-time quotes and feedback. Manufacturers would also be able to connect with others in related supply chains. AMGC could offer this directory as a basic portal capability for its members.
- ▶ A new 'sharing economy' be established for the industry, allowing manufacturers to loan and share equipment such as 3D printers and other physical infrastructure that may be seasonally idle.

9.7.3 Other collaboration incentives

AMGC recommends:

- ▶ The Australian Government subsidise membership of manufacturing industry associations – or make it tax-deductible – encouraging networking and collaboration, and relieving SMEs of significant annual costs.
- ▶ Funding be extended and disbursed through Austrade, allowing more Australian manufacturers to attend domestic and international trade shows, and conferences such as Hannover Messe in Germany.
- ▶ Funding be extended to help Australian manufacturers relocate some employees overseas to help commercialise products and support retailers on the ground in key export markets.

10. Securing critical investment

- 10.1** The cost of piloting Industry 4.0 initiatives using basic building blocks such as mobile devices, Wi-Fi and sensors is lower than commonly understood (see 5.2). Digital technology has the potential to lower the cost to companies of keeping high-tech equipment in Australia. The ability to predict maintenance requirements using analytics means fewer malfunctions and periods when machines are sitting idle. In addition, cloud-based software and new collaboration tools such as videoconferencing make remote IT servicing more feasible.
- 10.2** Nonetheless, manufacturers that are keen to integrate more complex technologies such as robotics and additive manufacturing face a challenge in accessing capital. As one business owner observed: *"We have got so many things we want to design and build ourselves. I've got projects I would start, but we haven't followed through. You can put that down to funding – I have to prioritise."* Another manufacturer with an entrenched 'anchor customer' has developed an innovative funding model: the customer partly funds the manufacturer's purchase of advanced robotics equipment to complete tasks such as drilling and riveting. The manufacturer then pays the customer back through price reductions over time. But as this manufacturer told AMGC, *"not all customers will allow you to do that"*.
- 10.3** Generally, Australian manufacturers have access to two main sources of funding for capital investments: government grants or commercial loans. Commonwealth grants schemes include the R&D tax incentive, Accelerating Commercialisation, the Entrepreneurs' Programme, Innovation Connections, the Industry Skills Fund, Cooperative Research Centres Projects (CRC-P) grants and venture capital grants. Examples of state-based commercialisation schemes include Queensland's Ignite Ideas Fund.
- 10.4** Almost every manufacturer AMGC consulted criticised the complexity of accessing federal and state government grants to pursue Industry 4.0 projects or upgrade from old to new technology. Several expressed confusion and lack of awareness about key initiatives. One manufacturer noted that applying for grants was a full-time job in itself. *"Everything is a slow process,"* they said. *"You'll get the money in the end, but can you survive the process? I was out for two months on a CRC-P application – that's why we were apprehensive if you don't get it. It's very binary; there's an opportunity cost to applying for this stuff."* Another said it was obvious that the application forms had been written by public servants rather than people with practical knowledge of industry. *"Ignite was asking for a ridiculous amount of paperwork. Nonetheless, it's money that you would otherwise not be getting and we're happy to jump through the hoops."*
- 10.5** Manufacturers criticised the restrictive criteria for government grants. One felt that it was arbitrary to set funding eligibility limits based on a company's turnover: *"I've got a company turnover of \$4 million to \$5 million – that puts us outside the range. But when you have 15 to 20 people, the overheads are a lot more than if you have 12. You do need the extra help."* Another argued that it was unrealistic to expect firms to prove how many additional jobs they are going to create from a project, when sometimes it is an achievement to simply sustain a business and keep going in the face of competitive pressures. This manufacturer's application for a new laser machine was rejected because it wasn't going to increase the size of the workforce. From their perspective: *"There needs to be a wider definition of success. If a manufacturer can get capital investment into a plant, they can keep the same people but just skill them differently – but in doing so, change the plant's entire direction."*

10.6 🗨️ Manufacturers felt it would be extremely helpful for the Australian Government to make more loans available at reduced interest rates. 🗨️

This would encourage companies to invest more in digital technologies, so they can operate more efficiently and bid for new orders. Many emphasised they were not asking for 'free money'; they were confident that the projects they were interested in would deliver a commercial return. This meant they would be prepared to pay back a discounted loan over a five-or 10-year horizon, bearing in mind that machines last as long as 20 years. As one interview said: "It's not a grant, it's an investment. Companies would be happy to accept a loan at 1% or 5%. Give me access to money that the banks don't."

10.7 In the words of another manufacturer: *"If the Government wants a silver bullet, give us the ability to access capital equipment to re-shore projects from China. I'm talking about advanced manufacturing equipment, state-of-the-art injection moulding machines, the fastest and most cost-effective machines to produce a plastic part. I need more advanced quality than what China is using – machines that are faster, use less electricity and are more reliable. There's my first competitive advantage and I need access to that quickly. I could replace my entire fleet on the ground for \$5 million."*

10.8 Governments need to pay greater attention to this area as Australian banks are too often unwilling to loan to manufacturers because of perceived risk. One manufacturer regarded lenders of last resort such as the Export Finance and Insurance Corporation (EFIC) as *"exhausting to get funding out of"*. Another mentioned that his business was exploring growth opportunities in Canada where it had received two lines of finance from Canadian banks – a start-up loan of more than \$300,000 and further assistance from the Business Development Bank of Canada. The Canadian Government is acting as guarantor for 90% of the loan amount. As the manufacturer told AMGC: *"Our business in Toronto has banks chasing them; the actual lender knocking on the door saying, 'how can we help?'. In Australia, that is unheard of. We will grow in Canada faster than in Australia."*

10.9 Recommendations

10.9.1 Funding innovation models

AMGC recommends:

- ▶ The Australian Government streamline and simplify all federal grants programs that are available to manufacturers. The Government should establish clear, reasonable and commercially practical guidelines and eligibility criteria to make it easier for firms to apply. It should also make it easier for companies to find appropriate grants.
- ▶ All federal and state government manufacturer grants schemes be aligned to avoid confusion and duplication, and establish clear, reasonable and commercially practical guidelines.
- ▶ Specific additional grants assistance be offered to encourage firms to adopt Industry 4.0 technologies such as sensors for legacy equipment, upgraded cybersecurity measures and trial innovations.
- ▶ Any government agency involved in providing grants review the length of the application and funding cycle, and consider whether it is fast enough to be effective for recipients as they seek to meet their competitive objectives.

10.9.2 Expanded access to government-backed loans

AMGC recommends:

- ▶ The Australian Government make low-interest loans available to manufacturers investing in Industry 4.0 upgrades, backed by government guarantees.
- ▶ EFIC and Austrade lending standards be relaxed.

11. Creating a skilled workforce

- 11.1** Workforce transformation is essential for Australia to make the transition to Industry 4.0. There is a growing need for skilled workers in areas such as electronics, engineering, software development and production technology. To operate efficiently and better understand customers – in short, to compete – firms must be able to analyse large datasets generated by sensors and machines. As one business owner observed: *“There will be a wealth of data and we will need to crunch that data. So yes, people will move into roles that currently don’t exist.”*
- 11.2** Another manufacturer pointed to the tightness of the current labour market and workers constantly job-hopping to gain salary increases, taking their intellectual property knowledge with them. The manufacturer told AMGC: *“It’s become something of a platitude but it’s always a challenge to find skilled engineers. The country has a massive skills gap, particularly in certain areas such as building submarines and frigates. We have to rely on a migrant workforce for those programs.”* One manufacturer said that as many as seven of his 20 staff members were qualified engineers.
- 11.3** Another interesting trend is the increased frequency of manufacturing managers completing Master of Business Administration (MBA) degrees, broadening their focus so they can contribute value across the manufacturing value chain. This reflects the urgent need to ensure that managers and even owners are equipped with the skills required to lead in today’s increasingly digital and globalised manufacturing market.
- 11.4** Manufacturers have to play a ‘double game’ as they constantly seek to onboard skilled workers who can help them adapt to Industry 4.0. They need to compete in today’s business market and also build for the future. This involves anticipating the need for technical skills and filling vacancies for future positions even though this may be more expensive for the business. In the words of one manufacturer:
“There is a period where your workforce’s skills are in advance of what you need. However, if you don’t bring in these workers until you actually need them, they won’t have developed the necessary understanding of your business. For SMEs, that is a barrier, even though those workers will deliver in future.”
- 11.5** There was widespread agreement that Australia’s education system is failing to deliver the skills and competencies to help manufacturers digitally transform. One interviewee commented that universities are not providing students with enough job-relevant skills; that the system is creating great ‘pen pushers’ for government, but not adaptable workers for business. As they put it: *“Our education system is producing people who are unemployable and need to be retrained. You can study for 18 years and come out of it knowing virtually nothing. We are educating people based on a template that is 50 years out of date; that doesn’t work in the digital economy. It’s a pre-internet education system.”*

1.6 At the same time, the perceived prestige of university has led to vocational education and training being treated as a second-tier option. One manufacturer told AMGC: *"The school and university system is massively ramming this stigma around vocational education. They're snobby about anything applied."* Another agreed, saying: *"We haven't got the skilled people here. Everyone wants to be a white-collar IT guru. They're telling everyone to go to university, saying 'don't get a trade'."* The industry needs to be proactive and change perceptions. Everyone thinks panel-beating involves working in some dusty shop, but they're ultimately million-dollar facilities with state-of-the-art equipment."

11.7 Australia's vocational education and training system was also criticised for offering 'clunky' degree structures that don't deliver graduates trained in the combination of modules manufacturers need. Currently, TAFE institutes only receive government funding if they teach to a particular qualification. This forces students to sit all the way through multi-year Certificate 3 or Certificate 4 courses. Furthermore, Australia's federal and state governments do not fund massive open online courses (MOOCs) run by private providers. By contrast, New Zealand has reformed its vocational education and training system to create a new breed of open online polytechnic courses that allow students to mix and match different Industry 4.0 modules.

11.8 Employers seek greater involvement in Australia's vocational education and training system. As one manufacturer told AMGC:

“We want to tailor the training schemes for us; to cherry-pick what we want.”

Another said: *"The education system doesn't need to be reorganised around Industry 4.0. What needs to take place is the development of the little modules so that a manufacturer can come along and say 'I want that piece'."* Another recommended that industry representatives should come into TAFE institutes and provide the training: *"Companies like Bosch should be assisted to come in and do something specific with Commonwealth money."* One interviewee also highlighted the importance of mentoring graduates, as a way to ensure training is relevant to the workplace. As they see it: *"Just because you can give a guy a Certificate 4 in problem-solving doesn't mean he's going to solve my problems."*

The industry needs to be proactive and change perceptions. Everyone thinks panel-beating involves working in some dusty shop, but they're ultimately million-dollar facilities with state-of-the-art equipment.

11.9 Recommendations

11.9.1 Assess workforce development requirements

AMGC recommends:

- › The Australian Government helps companies develop workforce development plans to identify training, retraining and upskilling requirements, and which specific employees should be trained in new technologies.

11.9.2 Reform educational approaches

AMGC recommends:

- › Australian federal and state governments commit to overhauling the nation's education system, to create an Industry 4.0-ready workforce. This could include making work placements and 'earn and learn' apprenticeships a compulsory part of university and TAFE programs. Curriculum reforms should also be initiated to encourage greater participation in science, technology, engineering and maths (STEM) disciplines throughout the education cycle.
- › Specific training be developed to help manufacturing business owners and other leaders develop the management skills and strategic thinking required to operate effectively in the current environment, and to reform business models.
- › Vocational education and training degree structures be liberalised, allowing students to obtain shorter and more job-relevant micro-credentials sought by manufacturing employers.
- › Governments should 'teach the teachers' by providing targeted Industry 4.0-related upskilling for relevant university, TAFE and other instructors.

- › MOOCs related to Industry 4.0 capabilities receive funding, irrespective of provider.
- › New financial incentives be created so Industry 4.0 manufacturers can release their workers to study and upgrade their skills.
- › Governments work with employers and educational institutions to increase manufacturing workers' comfort using digital devices, overcoming any underlying fear of technology.

11.9.3 Recruit skilled workers from overseas

AMGC recommends:

- › The Australian Government reverse policies – such as recent restrictions imposed on 457 visas – that reduce manufacturers' flexibility to hire a mix of local and international labour to address skills gaps, and in doing so harm Australia's global competitiveness.

11.9.4 Update industry awards

AMGC recommends:

- › The Australian Government review how it can introduce more flexibility into manufacturing workplace awards.
- › The Government focus on making it easier:
 - for workers to move between roles that require different skillsets
 - for employers to offer more flexible schedules – in keeping with the realities of the 24-hour Industry 4.0 business cycle – without triggering overtime and penalty rate payments.

12. Promoting software interoperability

- 12.1** Industry 4.0 involves digitally managing the entire manufacturing value chain across international borders. This requires seamless transactions between entities such as suppliers, component manufacturers and global primes – all linked to the customer via a real-time feedback loop. It also relies on unprecedented IT system integration across the product cycle. Consensus-based standards are an important way to achieve this. Standards Australia recently observed that establishing agreed international standards for products and services could encourage interoperability and reduce barriers to trade. As such, it represents an essential driver of growth, competitiveness and innovation.
- 12.2** The first challenge for Australian manufacturers is to integrate Industry 4.0 technologies with existing software. Cloud-based ERP systems need to be configured for the individual manufacturer, yet compatible with those used by other members of the supply chain. This facilitates electronic data interchange and visibility of everything from inventory levels to customer orders. As one manufacturer noted: *“There is a need for agnostic software that can talk to other systems.”* Firms will lose business opportunities if they cannot overcome software integration challenges. Fortunately, a range of industry standards, ‘middleware’ solutions and advances in the use of application programming interfaces (APIs) are making it easier to interconnect systems.
- 12.3** Digital compatibility is a particular problem for Australian manufacturers that are supplying components to the supply chains of primes like General Motors and Boeing. Local firms must ensure their technology systems and quality processes align with those used by larger global organisations. For example, many international manufacturers are certified to the international ISO 9001 quality management standard. Implementing the systems necessary to meet this standard is an expensive process for Australian firms, yet doing so is essential to unlock business opportunities.
- 12.4** Cybersecurity requirements when dealing with primes are especially stringent. Manufacturers wanting to be part of global supply chains have to operate under strict rules of confidentiality and information assurance. Unless the whole chain has the same level of cybersecurity, there will be gaps in the system that are easy to hack into. One manufacturer told AMGC: *“It’s a very expensive exercise for SMEs to operate at that level.”*
- 12.5** Cybersecurity is a key requirement for Australian defence SMEs seeking to supply products and services to US-based primes. A major barrier to trade is the difficulty of achieving compliance with the best-practice NIST Cybersecurity Framework. Originally developed by the US National Institute of Standards and Technology in 2014, the framework offers guidance on how firms can prevent, detect and respond to cyber attacks. AMGC has heard that the standard is likely to become pervasive across the international defence industry. This will push high compliance costs and change management requirements onto Australian businesses, even for businesses that already comply with similar but not identical cybersecurity standards. Nonetheless, one manufacturer told AMGC that barriers to entry are inherent in being a defence supplier. *“If an SME is complaining, they should go and work in a different sector,”* this manufacturer said. *“They have to decide: ‘Do I want to play in the defence market?’. And if so, they have to invest. It’s hard work; if it was easy everyone would play, but there are long contracts once you’re in.”*

12.6 Recommendations

12.6.1 Leadership on Industry 4.0 standards

AMGC recommends:

- › The Australian Government play a leading role in achieving global Industry 4.0 standards that promote easier exchange of electronic data within manufacturing supply chains.
- › In doing so, the Government increase support and resourcing for Standards Australia, as the national standards body representing Australia on the International Organization for Standardization.
- › Renewed efforts be made to deepen partnerships with Industry 4.0 standardisation initiatives such as Germany's Plattform Industrie 4.0 and the Industrial Internet Consortium.

- › The Australian Government assist local manufacturing SMEs to comply with global standards and improve their ability to interface with primes, including by boosting their level of cybersecurity awareness and capabilities.

12.6.2 Increase cybersecurity awareness and skills

AMGC recommends:

- › The Australian Government promotes and supports the delivery of industry-based cybersecurity awareness and training, and provides support for the implementation of manufacturing-related cybersecurity measures.

Online cybersecurity training for SMEs



Deakin University is demonstrating how universities can leverage their expertise to play a cost-effective role in building cybersecurity awareness among Australian manufacturing businesses. Anyone can sign up to the University's two-week, free online 'Cyber Security for Small and Medium Enterprises: Identifying Threats and Preventing Attacks' course to learn about common threats, the implications of a cyber-attack, and the practical tools and strategies they can put in place to prevent them.

See: <https://www.futurelearn.com/courses/cyber-security-business#section-overview>

Key recommendations



Contact information

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