Australian Institute for Machine Learning

THE UNIVERSITY of ADELAIDE

Committee Secretary
House Standing Committee on Industry, Science and Resources
PO Box 6021
Parliament House
Canberra ACT 2600

30 March 2023

Dear Committee Secretary,

Thank you for the opportunity to provide a submission to the House of Representatives Inquiry into developing advanced manufacturing in Australia.

The Australian Institute for Machine Learning (AIML) is recognised globally as one of the world's leading research groups in artificial intelligence (AI), computer vision, and machine learning. We work closely with a range of partners including government, industry, SMEs and defence to apply AI and machine learning technology to provide solutions to real world challenges.

We are a research-intensive institute at the University of Adelaide, with more than 170 members. AIML translates research into impact through:

- building sovereign capability in AI research and development
- collaborating with world-leading companies to develop high-tech products and solutions
- providing an interdisciplinary approach to research and consulting
- carrying out pure research to provide benefits to society
- raising the profile of South Australia as the place to be for innovation
- employing and training Australia's bright young minds.

AI is a disruptive technology that will impact virtually every sector of the economy, including manufacturing. The creation of new AI technology in Australia and the successful adoption of the technology by Australian manufacturing businesses will have a profound impact on the competitiveness of advanced manufacturing in Australia in the years to come.

However, in order for Australia to seize the opportunities of an AI future, we must be involved in technology creation, not just adoption of technology creation elsewhere, and ensure we have a sufficiently skilled workforce. In particular, sovereign AI capability enables us to deploy AI that addresses our needs as a country, protects our data, and is consistent with our values.

Once again I thank you for the opportunity to make a submission to this inquiry.

Yours sincerely,

[redacted]

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

Artificial intelligence (AI) is a disruptive technology with the potential to dramatically increase productivity and solve previously intractable problems across virtually every sector of the economy, including advanced manufacturing. AI systems will have a significant impact on manufacturing sectors, including optimisation of manufacturing processes, supporting the personalisation and customisation of products, predictive maintenance, quality control, supply-chain optimisation, and human-robot collaboration. The extent to which AI is successfully incorporated into manufacturing in Australia will be crucial to the long-term competitiveness of the sector.

AI will drive the creation of highly-skilled jobs and increase the productivity of manufacturing processes through greater automation. AI will also improve the capability of manufacturing processes improving the precision and consistency of high-quality products. Broadly, AI presents enormous opportunities for Australia, with the potential to increase productivity by 40% and add up to $315 billion to the national economy by 2028[1,2]. Moreover, Deloitte's *State of AI in the Enterprise in 2022* found businesses are increasingly adopting and / or experimenting with AI within their organisations and that early adopters are finding the payback period either meets or beats expectations[3]. As the deployment of AI into Australian businesses increases, the initial challenges of adopting AI will be increasingly easier to overcome, delivering greater returns for businesses, the economy and wider community.

But in order to seize the opportunities of advanced manufacturing for Australia it is essential that we increase our investment in building core Australian AI capability rather than simply relying on importing technology created elsewhere. Sovereign capability in AI is important to ensure Australia has the technology to commercialise into products, services and / or processes that address Australia's unique requirements and objectives, and is consistent with community expectations—safe, ethical, and responsible. The problem of falling behind in this regard, is that the first movers in AI technology gain a competitive advantage as they control the technology and the data that drives it, creating a significant barrier to entry for latecomers to the market.

International trends in advanced manufacturing;

Automation is having a significant impact on manufacturing around the world, making the costs of manufacturing processes more competitive in high-income economies. Productivity increases achieved through technology and automation have led to net increases in economic activity, jobs growth and productivity. The 2020 *US Robotics Roadmap* shows that increased automation

[1] (2017) *AI Sizing the prize: What's the real value of AI for your business and how can you capitalise?* PricewaterhouseCoopers report.
[2] (2019) *Australia's AI Roadmap*. CSIRO Data61 report.
[3] Mittal N. *et al*., (2022) *State of AI in the Enterprise*. Deloitte

between 2010 – 2020 was accompanied by a net increase in manufacturing jobs[4]. In fact, in the United States there is an active movement to leverage the benefits of automation to help re-balance labour costs and reshore manufacturing.

The US *Reshoring Initiative 1H* 2022 report estimates that 1.6 million jobs have been brought back to the United States by reshoring and inward-bound foreign direct investment since 2010[5]. While the leading factors driving this activity since the Covid-19 pandemic have been supply chain gaps and a growing need for greater self-sufficiency, automation-driven increases in domestic productivity have been among the leading factors every year since 2010. In Germany, manufacturers deploy three times more robots than US companies, but still employ more people. Relative to the size of its economy, the German manufacturing workforce is twice that of the United States[6].

There are also opportunities for Australia to leverage its trusted partner status through arrangements such as the AUKUS security pact, to build a local industrial base around exports to countries such as the United States and United Kingdom in more sensitive industries, such as autonomous vehicle and defence technology.

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

Future breakthroughs in AI research will very likely have a profound effect on multiple industry sectors, including advanced manufacturing. In recent months the release of ChatGPT has highlighted the ability of a single platform to make significant waves throughout the community. There will be many similar examples over the coming years and Australia has the opportunity to be part of this revolution and create opportunities and competitive advantages in our own industries.

The Kingston AI Group of Australia's leading AI professors has identified 'small data AI' as a problem Australia is well placed to help solve[7]. Global tech giants are developing better AI by training it on enormous datasets, using huge supercomputers and employing thousands of machine learning engineers. However, Australia does not have the human or financial resources to compete against this type of AI. Where we can compete, is in designing AI systems from small datasets where large datasets cannot be collected, or where the resources to build 'big AI' are not available. This type of AI is highly suited to solving Australian challenges and in building Australian security systems, where large datasets and resources are often not available. Moreover, there is research underway at AIML that is creating AI systems that are better able to overcome biases inherent in real-world datasets, and make decisions and predictions that are explainable. These responsible AI systems can be more reliably used in broader and more sensitive applications.

[4] Christensen H. I. *et al*. (2020) *A Roadmap for US Robotics – From Internet to Robotics 2020 Edition.*
[5] Moser, H. & Kelley, M. (2022) *Reshoring Initiative 1H 2022 Data report*. Reshoring Initiative.
[6] Graetz, G. & Michaels, G. (2018) *Robots at work*. The Review of Economics and Statistics. 100(5):753-768
[7] *Statement by the Kingston AI Group of University Professors*. 22 February 2023

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

A potentially significant barrier to growth of Australian advanced manufacturing is the reliance on AI technology created elsewhere, particularly for more sensitive applications. Companies that control AI systems end up learning a lot about their clients' data, and probably gain greater insight into Australian businesses and their customers than the businesses would know themselves. This presents sovereign risks when applied to sectors such as defence industry, mining, agriculture, health and energy. Therefore, in more sensitive sectors there is a strong case for insisting on Australian owned and controlled AI for the core functioning of related digital systems and datasets.

A key constraint on the adoption of AI in Australia, including to advanced manufacturing, is a shortage of the people with the appropriate skills. CSIRO estimates Australia will require as many as 161,000 people with specialist AI skills by 2030. However, Australia is on track to fall well short of this number. Access to talent is a barrier to AI adoption by businesses. While Deloitte's *State of AI in the Enterprise 2022* report indicates adoption of AI by Australian businesses is improving, many businesses experience challenges with implementation that could be better overcome by greater access to talent and programs that support the upskilling of workers[8].

Public concerns about the use of their personal data and a lack of trust in how corporations and governments use AI has the potential to create a serious barrier to AI adoption by businesses[9]. There are legitimate privacy and ethical issues that need to be managed in a way that is consistent with community expectations. Maintaining a social licence in this area is crucial to delivering good outcomes for industry and the community. Australia's National Artificial Intelligence Centre recently established the Responsible AI Network, which is a cross-ecosystem program to support Australian companies to use and create AI ethically and safely[10]. However, for Australian industries to adopt responsible AI practices, we need AI practitioners who can create responsible AI systems. Creating responsible AI systems that can overcome the biases that exist in real-world datasets, and make predictions and decisions that are explainable are key areas of fundamental research being pursued at AIML that will help address concerns about applying existing AI systems to many problems.

[8] Mittal N. *et al*., (2022) *State of AI in the Enterprise*. Deloitte
[9] Yigitcanlar, T., *et al.* (2022) *Drivers behind the public perceptions of artificial intelligence: insights from major Australian cities*. AI & Society.
[10] *National AI Centre's Responsible AI Network*. CSIRO. Accessed 23 March 2023.

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

Computation infrastructure is a key capability required for the successful development of AI, which will be a key driver of advanced manufacturing. Training AI and machine learning systems requires very high levels of processing power that are costly to purchase and maintain. This phenomenon increasingly benefits the largest corporations with the most data and enormous resources thus creating an access divide. In recent years most major breakthroughs in the AI field have come from large companies, such as Amazon, Meta and Google, due primarily to their access to computing power[11]. This access divide has been recognised in the United States by the recently released final report of the National AI Research Resource Task Force that recommends $2.6 billion be spent on national AI infrastructure to help democratise AI research and diversify the approaches and applications of AI[12]. The governments of the United Kingdom and Canada have also recognised the importance of computation infrastructure to the development of AI and the flow-on impacts of these technologies to diverse sectors including advanced manufacturing[13,14].

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

The United States has seen an increased number of workers in its manufacturing sectors as automation has been more broadly deployed throughout the economy[15]. These findings in other countries demonstrate the benefit of Australia leveraging technology, such as AI, to make manufacturing more competitive compared to lower-wage economies.

Women are underrepresented in the workforces of technology-related areas, such as the computer sciences, AI, and advanced manufacturing. Measures that help celebrate the success of women in these fields plays an important role in demonstrating pathways for women at earlier stages of their career, particularly while still making decisions about what career to pursue.

AIML has identified improving the representation of women in the AI field as a key priority. The Australian Government-funded Centre for Augmented Reasoning, headquartered within AIML, has core targets for the number of women commencing a PhD in the program, and the hosting of events to promote AI research as an attractive career for women. The centre has also

[11] (2023) *The race of the AI labs heats up*. The Economist
[12] Panchanathan S. and Prabhakar A. (2023) *Strengthening and Democratizing the U.S. Artificial Intelligence Innovation Ecosystem: an implementation plan of the national artificial intelligence research resource*. National Artificial Intelligence Research Resource Task Force.
[13] Milmo D. and Hern A. (2023) *UK to invest £900m in supercomputer in bid to build own 'BritGPT'.* The Guardian. 16 March.
[14] *Government of Canada launches second phase of the Pan-Canadian Artificial Intelligence Strategy*. Government of Canada. 22 June, 2022.
[15] Christensen H. I. *et al*. (2020) *A Roadmap for US Robotics – From Internet to Robotics 2020 Edition.*

exceeded its target for the number of women appointed as postdoctoral research fellows under the program. More broadly AIML regularly hosts events that showcase the contribution that women scientists are making in the field of AI, but also by strives to ensure gender balance among presenters at events more broadly.

AIML has, albeit from a low base, seen a significant increase in the number of women appointed as postdoctoral research fellows and postgraduate students. While this progress demonstrates the success of the measures employed to increase participation by women, there is nonetheless a long way to go to achieve gender parity.

Skills needs in advanced manufacturing.

A key constraint on the development and application of AI in Australia is a shortage of people with relevant skills. CSIRO estimates Australia will require 161,000 people with specialist AI skills by 2030[16], and at present we are on track to fall well short. University research is a critical pathway for growing advanced skills. However, the need for more skills is across the board from the postgraduate level through to upskilling workers within industry, and the Tech Council of Australia, supported by the Australian Government, has a target of 1.2 million workers in technology by 2030[17].

As a founding tenant of the Lot Fourteen innovation district in Adelaide, AIML hosts many school tours promoting the opportunities for young people to pursue careers in science and technology, and in particular AI. Moreover, AIML frequently holds events including panel discussions, information sessions and open days to encourage undergraduate students to pursue postgraduate studies in AI and the opportunities for exciting, impactful careers in AI.

The current international environment presents opportunities to recruit highly-skilled people from overseas to help address our local skills gap. Tech giants in the United States such as Google, Meta, Amazon and Twitter have been shedding significant numbers of staff from their operations, providing an opportunity to help fill the skills gap in Australia. However, the length of time it takes to process visa applications is, in our experience, a significant barrier to attracting internationally competitive talent to Australia. A pathway to permanent residency is a highly attractive proposition when attempting to entice talent to Australia, but application processing times that can be as long as 6 to 12 months can often lead to applicants deciding not to come to Australia.

[16] Hajkowicz S.A., *et al*., (2019) *Artificial intelligence: Solving problems, growing the economy and improving our quality of life*. CSIRO Data61, Australia
[17] (2022) Getting to 1.2 million: Our roadmap to create a thriving Australian tech workforce. Tech Council of Australia.