MONASH University

Faculty of Engineering

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Driving the uptake of Advanced Manufacturing in Australia: opinion paper

Introduction

Monash University is pleased to respond to the inquiry the House of Representatives Standing Committee on Industry, Science and Resources is conducting on developing advanced Manufacturing in Australia.

Our response is based upon our work to drive innovation and a talent stream into advanced manufacturing through the new Monash Smart Manufacturing Hub which will open this year. We draw from scientific expertise in the areas of AI and machine learning, advanced robotics, additive manufacturing, process digitisation and product full life cycle.

On the following pages, we offer feedback in response to some of the main points raised within the terms of reference of the inquiry. We look forward to working with government, research and industry partners in a national approach to achieving advances in manufacturing and supporting the competitive future of the sector.

For more information on any aspect of our response, please contact Professor Adrian Neild, Director of the Monash Smart Manufacturing Hub. adrian.neild@monash.edu

Feedback on Points raised in the Terms of Reference

1. **Opportunities for advanced manufacturing for Australia – including in relation to job creation, productivity and capability**

The adoption of advanced manufacturing techniques can offer significant opportunities for Australia in terms of job creation, productivity, value-add. It propagates, protects, and preserves sovereign manufacturing capability. Such techniques provide a route to improved productivity, faster production time, and reduced resource usage and waste. The automation of repetitive tasks by robots collaborating with workers allows improved efficiency and quality while reducing costs. At the same time the use of real-time data and analytics can also provide valuable insights into production processes, allowing manufacturers to make informed decisions in order to optimise production and become more sustainable.

Already Australia has had considerable success in its active approach to building capabilities in advanced manufacturing; this includes:

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- *Additive manufacturing (3D printing): Australia has a burgeoning 3D printing industry, with companies specializing in sectors such as aerospace, medical device, and automotive manufacturing.*
- *Robotics and automation: Australian companies are developing advanced robotics and automation technologies for use in industries such as mining, agriculture, and manufacturing*
- *Digital manufacturing: Australia has been working to build its capability in digital manufacturing, which involves the integration of digital technologies such as the Internet of Things (IoT), big data analytics, and artificial intelligence across the manufacturing process, from design to production to delivery. Digital manufacturing enables manufacturers to improve efficiency, flexibility, and quality while reducing costs.*

In the university sector there is considerable expertise in these areas, Monash, for example, has the Monash Centre for Additive Manufacturing, Monash Data Futures Institute, and Monash Robotics. A challenge is to ensure there are suitable routes for industry to easily access such capability and either start or further their journey towards efficient digital manufacturing. To this end, the new Monash Smart Manufacturing Hub will act as a portal to industry to better access this capability, and focus on partnering with industry to translating cutting edge techniques into workflows, advancing competitiveness and sovereign capability. The Monash Smart Manufacturing Hub will also foster and facilitate start-ups in manufacturing underpinned by our own innovation and research.

To drive innovation in the manufacturing sector and to encourage uptake in as broad a cross section as possible we recommend that university and industry partnerships are supported at both a project and programmatic level.

2. International trends in advanced manufacturing;

Advanced manufacturing is a rapidly evolving field, and there are several international trends that are shaping its development. Key trends in advanced manufacturing include:

- Additive manufacturing. Creating complex shapes and designs with a high degree of accuracy, while reducing waste and cost, and allowing just in time delivery of parts. The qualification and approval process for various industrial sectors to adopt this technology is currently predominant in US, Europe and China.

- Smart manufacturing: digital sensors providing real time data for process optimisation, improved quality, increased sustainability and maintenance schedules that can be optimised.

- Digital twins: virtual replicas of physical products or processes, used to optimise design and production processes, and monitor and improve the performance of their physical counterparts.

- Sustainability: using digital processes to reduce waste and energy consumption, through real time quality control and quantifying inefficiencies.

Many of Australia's manufacturers are highly advanced in their uptake of these techniques, others are at an earlier stage of their journey. For the latter, with the technology existing, the challenge is often ascribed to lack of skills within existing workforce and finding the starting point for upfront investment. The challenge for the University sector is to support upskilling and enabling improved translation of capability into industry, especially SMEs.

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As an exemplar, the Monash Smart Manufacturing Hub will provide a test bed for manufacturing innovation and modernization, supporting industry-led collaborations between industry, students, researchers and the wider community. It will have a state-of-the-art digital laboratory covering production, processing and the build environment. This facility will create new solutions, but importantly, it will allow access to future graduates who have been trained in advanced manufacturing techniques. In partnership with technology providers, the facility will act as a showcase to industry on digital techniques, and provide project capability on delivering solutions and the talent to implement them within the partners organisation.

We recommend that university research into innovative practices is supported as are the frameworks put in place to translate them out of the research domain.

3. **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**

In establishing the Monash Smart Manufacturing Hub we sought, from potential partners and technology providers, a better understanding of these barriers. The following are the two key themes:

-   Uncertainty around the return on investment. Technological benefits are well articulated; however, businesses often lack confidence in the cost savings and benefits. This is especially true for SMEs facing tight budgets and running at full capacity on existing production lines.
-   Skills shortage. Some SMEs point to a lack of skills within their existing workforce to drive new uptake of digital techniques. At the same time technology providers point to a need to run extensive training whilst selling automation products.

To address this issue, advanced manufacturing technology testbeds (such as MSMH) can play an important role. The provision of both physical and digital infrastructure for companies to test advanced manufacturing ideas in the earlier stage can reduce upfront costs, limit down time on existing production lines and demonstrate the return which can be expected. Through the use of such facilities as a training ground for undergraduates, universities can start to offer solutions to companies along with the future graduates who can be hired to implement them. For example, the MSMH is working on a model in which a trained pool of undergraduates is available for internships to deliver solutions, followed by employment to implement them. At the doctoral level, Monash's new Industry Doctoral Program also allows for existing employees to work for their employer within the MSMH to create specific solutions, and to be assessed on the industry relevant outcomes rather than a traditional thesis.

We recommend that investment is made into programs aiming at reducing skills shortages, and that this be aimed at multiple levels of education or experience.

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4. 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;

The concept of "Industry 5.0" represents a significant shift in the way humans and machines can collaborate to improve the efficiency and productivity of manufacturing production. Rather than simply replacing human labour with machines, the goal is to create a digital environment that facilitates the "age of augmentation," in which humans and machines work together to enhance productivity and creativity.

With the help of digital twin enabled human-machine collaboration technologies such as Augmented Reality, Virtual Reality and Mixed Reality, humans will no longer be required to perform heavy physical labour during the manufacturing process. Instead, they will supervise and control the machines, freeing them up to focus on more creative and sophisticated tasks. With the help of advanced AI technologies, training and using machines will become much more intuitive and user-friendly. Interacting with machines will become more natural, with humans able to use gestures, eye movements, and other forms of communication to control and direct machines to complete required tasks.

This shift has the potential to significantly increase the participation and retention of historically underrepresented groups, such as women, in the manufacturing sector. By reducing the physical workload and providing opportunities for more creative and fulfilling work, workers will experience greater happiness and a sense of accomplishment, leading to improved retention rates and a more diverse and inclusive workforce.

We recommend that research and development of emerging technologies utilising robot/human interactions be supported through the creation of a national centre.

In summary, we believe that our universities can play a pivotal role in both technology development and translation, and in solving the skills shortfall. We have drawn from our experiences in establishing the MSMH, but we note that there are multiple university facilities across the country, each have differences in their approach but share a common goal of assisting the manufacturing industry through its digital transition. Finding ways to support and encourage companies to interact with these facilities will expedite the uptake of advanced manufacturing techniques.