SUBMISSION

Submission to the Department of Industry, Science and Resources

Submission to the National Robotics Strategy Discussion Paper Consultation

07 May 2023

The Australian Academy of Technological Sciences and Engineering (ATSE) is a Learned Academy of independent, non-political experts helping Australians understand and use technology to solve complex problems. Bringing together Australia's leading thinkers in applied science, technology and engineering, ATSE provides impartial, practical and evidence-based advice on how to achieve sustainable solutions and advance prosperity.

Emerging robotics technologies are already creating huge opportunities in agriculture, manufacturing, health, defence, mining and transportation, and the industries affected by robotics will contribute to expand as the technology continues to develop. The National Robotics Strategy is an opportunity for the government to adopt a unified and coordinated approach to robotics in Australia. This has the potential to help build Australian industry, improve productivity and improve health outcomes.

To seize this opportunity, the National Robotics Strategy will need to ensure that robots are designed and used ethically and effectively. Data privacy, data bias, design bias and cybersecurity will all need to be considered and managed to ensure that the use of robots meets community expectations. Robotic systems produced by different suppliers will need to be able to work with each other in an integrated manner that will allow for coordinated networks of robots to meet the needs of Australian industries. These systems will require trained and skilled professionals to develop, build and maintain, necessitating strong educational pipelines. This will include the need for operator training in industries outside of robotics, such a surgery and agriculture, to ensure their successful implementation.

ATSE makes the following recommendations for the National Robotics Strategy:

Recommendation 1: Amend the definitions of *Robots*, *Robotics*, *Cobotics* and *Drones* in the National Robotics Strategy such that:

a. The mention of "intelligence" in the definition of *Robots* is replaced with either "machine intelligence" or "advanced control";
b. The definition of *Robotics* describes it as "engineering, science and practice";
c. The definition of *Cobotics* include a mention of interaction in physical space; and
d. The definition of *Drones* be expanded to include uncrewed land and sea vehicles.

Recommendation 2: Develop an ethical code of conduct for responsible deployment of robots that leverages the ethics frameworks being developed for the models that may be deployed in robotics.

Recommendation 3: Prioritise cybersecurity in robotics systems, including appropriate regulation of minimum security standards.

Recommendation 4: Create programs to promote open access robotics software and establishes common standards for interoperability between robotics systems.

Recommendation 5: Implement government procurement policies that prioritise the purchase of open, interoperable systems.

Recommendation 6: Include a workforce recruitment and retraining plan that includes upskilling and reskilling of the current workforce to operate robotic systems, and support for more places in engineering and electrical trade courses.

Recommendation 7: Interface with the Diversity in STEM review to encourage inclusion of underrepresented groups in the robotics workforce.

Improving critical definitions of robotics

The Discussion Paper provides several definitions of robotics and related terms to help ensure consistency throughout the strategy. While ATSE agrees with most of the provided definitions, the definitions of *Robots*, *Robotics*, *Cobotics* and *Drones* should be amended to be more precise and better reflect the aims of the strategy. The current definition of "robotics" defines it as a "science and practice". This definition fails to reflect the significant role of engineers in the process of robotics. Moving forward, the growth of robotics in Australia will rely more heavily on the work of engineers than "bench scientists" and this should be reflected in the definition of robotics under the strategy. Also, there is some controversy over the exact definition of "intelligence", as used within the definition of *Robots*, and suggest the use of the terms "advanced control" or "machine intelligence" in place of "intelligence" to avoid these debates.

The field of *Cobotics* is defined by physical interactions between robotic systems and humans. The current definition provided in the Discussion Paper includes reference to the interaction between humans and robotic systems, but fails to specify that this interaction occurs in physical space. Humans regularly interact with robotic systems through programming and inputs. What makes cobotics unique within the field is that

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this interaction occurs in physical space. Amending the definition to refer to a “shared physical space” would make this clearer.

There is a wide range of robots not captured under the provided definition of *Drones*. While uncrewed aircraft systems make up a sizeable proportion of drone technologies, drones are not limited to aircraft systems. Land and water-based systems already fulfil critical roles. For example, the Royal Australian Navy is testing undersea drones developed by Anduril Australia (Chul, 2022). On land, a $3.3 million contract with Cyborg Dynamics Engineering will develop semi-autonomous ground vehicles for the Australian Army (Saballa, 2021), while XAG Australia offers land-based uncrewed vehicles for agricultural roles, including mowing, crop spraying and transportation of materials (XAG Australia, n.d.). Amending the definition of *Drones* to include land and sea vehicles will enable the National Robotics Strategy to account for these applications of robotics.

Recommendation 1: Amend the definitions of *Robots*, *Robotics*, *Cobotics* and *Drones* in the National Robotics Strategy such that:

e. The mention of “intelligence” in the definition of *Robots* is replaced with either “machine intelligence” or “advanced control”;
f. The definition of *Robotics* describes it as “engineering, science and practice”;
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h. The definition of *Drones* be expanded to include uncrewed land and sea vehicles.

Ensuring the ethical use of robotics

Prior to the deployment and widespread use of any emerging robotics technology, careful consideration must be given to the application and use of that technology for the benefit of Australian society. For example, in surgery, decisions must be made about who will receive robotics-assisted surgeries, and who will receive a traditional procedure. Robotic surgeries lead to improved surgical outcomes, including shorter lengths of stay in hospital, lower morbidity and faster patient recovery (Hussain et al., 2014). The lack of resources and trained surgeons, at least initially, will require strategic deployment of these resources where they can have the most positive impact. These decisions must be made in an evidence-based manner. The Government must ensure equality of access to care by making robotic surgeries available to patients in the public sector and in underserved populations, such as regional, rural and remote Australians.

For robots that collect data, particularly those in public space, considerations are needed regarding data privacy. These robots will need to capture, analyse and potentially store sound, images and other data in order to operate. We must ensure that this captured data is used ethically and in line with community expectations of privacy, and only stored where essential to do so. This technology may also prove to be a tempting target for misuse or malicious interference. We must ensure that these emerging technologies are developed with cybersecurity at the core, to ensure that mission critical systems and collected data are protected and cannot be used for malicious purposes.

In industry, such ethical considerations may be less obvious, but are nonetheless critical to ensuring a just uptake of robotic technologies. As technology develops, it is likely that much of the underlying code for many robotic systems will transition from human-written code to artificial intelligence (AI) models. AI models are dependent on their data inputs and biases in models on which the AI is based. There are already examples of AI-based systems showing racial and gender biases, particularly in facial imaging (Barbour, 2023), so the development of these technologies needs to be carefully managed to ensure that the inputs provided, both data and underlying code, facilitate the desired outcome and that these outcomes are ethical and meet community standards.

Recommendation 2: Develop an ethical code of conduct for responsible deployment of robots that leverages the ethics frameworks being developed for the models that may be deployed in robotics.

Recommendation 3: Prioritise cybersecurity in robotics systems, including appropriate regulation of minimum security standards.

Ensuring interoperability between systems

To get the most out of robotic systems, systems will need to be able to communicate with each other, to build fully networked robotic solutions. Presently, most large robotics providers utilise closed proprietary systems which helps to protect the intellectual property of these providers and ensure a return on investment in research and development. The use of these proprietary systems makes it difficult to build integrated robotics solutions that utilise components and robots from several providers. This also makes it harder for smaller suppliers to enter the market and for Australian research to develop into new industries within the market. Greater interoperability between systems and coordination will make it easier for researchers to produce advancements in robotics technology and will promote industry-academia collaborations. The Australian Government should work to support the development of open-source robotics and consortiums to enable an integrated robotic environment, and utilise its purchasing power to prioritise the purchase of open, interoperable systems.

Recommendation 4: Create programs to promote open access robotics software and establishes common standards for interoperability between robotics systems.

Recommendation 5: Implement government procurement policies that prioritise the purchase of open, interoperable systems.

Building a national robotics workforce

The growth of Australia's robotics industry, and the industries that robotics will support, will require a highly skilled workforce. Engineering skills in particular will be highly sought after, with Engineers Australia currently estimating a skills shortage of 60,000 engineers in Australia (Engineers Australia, 2022). The industry will also need a large number of skilled technicians, including those in electrical trades, to install and maintain robotic systems, as well as operators trained in their use. This will include training workers outside the robotics industry, like surgeons and their support staff, to incorporate robotics into their workflow to ensure that Australia can get the maximum benefit from a growing robotics industry. Successful and ethical implementation of the National Robotics Strategy will also require social sciences and other non-STEM professionals.

Part of this workforce strategy must be encouraging underrepresented groups in STEM (science, technology, engineering and mathematics) to consider a STEM pathway, particularly those in the robotics industry. Women, for example, make up only 27% of the workforce across all STEM industries and earn 18% less than their male colleagues (Department of Industry Science and Resources, 2022) Increasing the participation of women within the STEM workforce would go a long way to addressing the future skills needs within the robotics industry. Similarly, we must encourage individuals from culturally and linguistically diverse backgrounds, as well as Aboriginal and Torres Strait Islander people, to consider careers in STEM. This will not only help to fill skills shortages, but also allow for a greater diversity of experiences that can help industry to succeed. Initiatives such as ATSE's Diversity and Inclusion Toolkit (Australian Academy of Technological Sciences and Engineering, 2022) can be expanded to enable small and medium employers to create workplace cultures and policies requisite to attract and retain this workforce. The currently underway Diversity in STEM review – to which ATSE provided a submission – will also provide some guidance on successful programs that should be scaled up.

Recommendation 6: Include a workforce recruitment and retraining plan that includes upskilling and reskilling of the current workforce to operate robotic systems, and support for more places in engineering and electrical trade courses.

Recommendation 7: Interface with the Diversity in STEM review to encourage inclusion of underrepresented groups in the robotics workforce.

ATSE thanks the Department of Industry, Science and Resources for the opportunity to respond to the National Robotics Strategy Discussion Paper. For further information, please contact academypolicyteam@atse.org.au.

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