Australian Government

Department of Industry, Science, Energy and Resources

An AI Action Plan for all Australians

A call for views

DISCUSSION PAPER

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FOREWORD

This discussion paper is your opportunity to help shape Australia's vision for artificial intelligence (AI). AI has the potential to change our lives for the better. It can be a critical part of Australia's technology led recovery to the COVID-19 pandemic. The development of AI is accelerating at an incredible pace. Already, AI is being used to address national challenges—in new diagnostic tools for doctors, in computer models to predict bushfire spread and to better manage traffic flows. AI has sped up the development of COVID-19 testing kits and has been trialled in distinguishing between COVID-19 infections and other respiratory diseases.

Business adoption and adaption of AI will generate gains across the economy. It allows the same product or service to be delivered for less and for those products and services to be better tailored for consumer needs. In turn, this will drive productivity growth across a vast array of industries. This boost can help us recover from the unprecedented global slowdown in economic activity. AI presents opportunities to grow and scale our businesses. It will be a critical part of the Australian Government's Modern Manufacturing Strategy and can drive the modernisation of our manufacturers, boosting productivity and creating jobs.

AI promises to improve how Australia protects its interests and provides security to its citizens. AI is already helping to identify emerging threats and to protect against cyber-attacks. To continue to realise these benefits, Australia needs the right settings and policies in place to foster a global ecosystems of trustworthy AI firms.

As we have seen with all major technology changes, AI will change the nature of work. AI will reduce the demand for some skills while increasing the demand for others. For all Australians to benefit, we need to ensure Australians have or can develop the skills and capabilities needed as workforce demand changes. This includes building a workforce of skilled AI professionals. The Australian Government's JobMaker program is already ensuring government-backed training is focused on the skills our workers need for the future.

Australian researchers already lead the world in some applications of AI. We have an opportunity to strengthen Australia's research excellence by directing and coordinating efforts and ensuring research and development is accessible for small and medium enterprises.
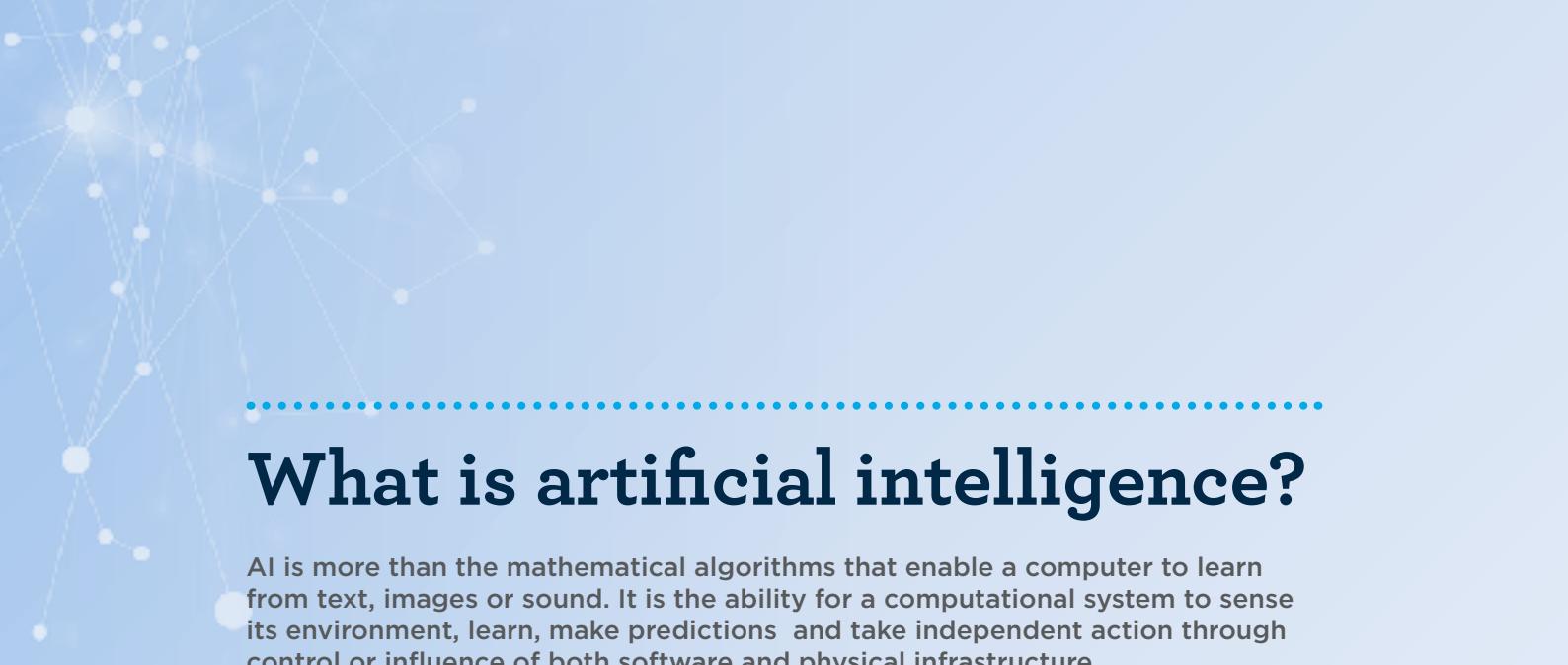
The economic potential is enormous. Digital innovation, including new AI technologies, is predicted to be worth $315 billion to the Australian economy by 2028. Australia can capture these benefits. But we need the right conditions and coordinated action by government, business, academia and the community.

Building on Australia's AI Ethics Framework, the Australian Government is developing an AI Action Plan. It is a key component of the government's vision to be a leading digital economy by 2030. It builds on almost $800 million invested in the 2020-21 Budget to enable businesses to take advantage of digital technologies to grow their businesses and create jobs. It is an opportunity to leverage AI as part of the Australian Government's economic recovery plan. We must work together to ensure all Australians can benefit from advances in AI.

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What is artificial intelligence?

AI is more than the mathematical algorithms that enable a computer to learn from text, images or sound. It is the ability for a computational system to sense its environment, learn, make predictions and take independent action through control or influence of both software and physical infrastructure.

This means AI enables a building owner to control access to an office autonomously based on facial recognition, or to optimise the air-conditioning in a block of apartments using weather forecasts. It means we can build systems that can predict energy demand and ramp up energy production in a system of both renewable and non renewable generators based on its prediction. AI allows us to predict the optimal route for a courier based on day of the year, current weather and the day's deliveries. It can identify the best time for maintenance for a bridge or piece of machinery. Each of these cases arise because AI lowers the cost of making accurate predictions.

In this discussion paper, we adopt CSIRO's Data61 description of AI: a collection of interrelated technologies used to solve problems autonomously, and perform tasks to achieve defined objectives, in some cases without explicit guidance from a human being.[1]

AI technologies include the various machine learning algorithms that form the basis of image and speech recognition models. They are also the sensors that collect data and the custom processors that enable computers to learn from existing datasets or real-time information. An AI system is the complete integration of sensors, learning and decision-making models, and connected software or hardware that can be influenced or controlled.

While the fundamental concepts underpinning AI have been discussed for over half a century, it has been decreases in the cost of graphics processors and storage, and the availability of data at scale that have enabled recent step-changes in the capability of AI. With these advances have come AI systems that undertake specific tasks with high levels of accuracy. For example, an image recognition model that can identify specific cancers with equal or greater accuracy than a radiologist. However, these systems can't be used outside of the task from which they were trained. This same image recognition model cannot be used for speech recognition. We're still a very long way from the "general" or "super" AI that can do all the things a human could do. Indeed, the development of such an AI may not even be possible.

INTRODUCTION

The Australian Government recognises that accelerating the development and use of AI will have profound social and economic outcomes for all Australians.

We have an opportunity and a responsibility to strive for a better future. A future where Australians develop and use AI to solve national problems, build competitive businesses and increase our collective wellbeing. Central to this vision is a commitment to develop and use AI responsibly, ethically and safely in ways that improve our lives and prosperity.

AI is a general purpose technology that can be used to increase the efficiency, safety and quality of production processes in almost every industry.

Given the profound reshaping of our economy brought on by the COVID-19 pandemic, we have the opportunity to use what AI technologies offer as a key plank of our recovery.

It is one of the key technologies that is driving the fourth industrial revolution (also known as Industry 4.0) that is affecting almost every industry worldwide. Industry 4.0 uses transformative technologies, like AI, advanced robotics and sensor technology, to connect the physical world with the digital world.

AI technologies will provide an opportunity for innovative Australian businesses to develop new revenue streams by building next generation products and services, and novel business models. For established businesses, these technologies will help to increase productivity through safer and more efficient workplaces. This will increase their international competitiveness when businesses across the globe are increasing their use of AI.

Australians are already using AI.

◉   We're organising our daily schedule using voice assistants and taking recommendations on the movies we should watch.

◉   Businesses are using AI to create safer workplaces using remotely-controlled robots.

◉   Banks are detecting anomalous transactions that may increase fraud and compliance risk.

◉   Business are making better decisions using insights from their customer data, such as using purchasing data to suggest other products customers may wish to buy.

◉   Hospitals are diagnosing diseases like cancer faster and more accurately using specialised medical imaging AI technologies.

◉   Doctors are selecting the most viable eggs for in-vitro fertilisation (IVF).

◉   Park rangers are using image-recognition combined with drones to identify invasive weeds across huge areas of land.

◉   Aged-care facilities are using sensors to quickly detect and alert if their residents have fallen.

◉   Transport agencies are using sensors to detect and optimise traffic flow.

These applications are just the beginning of what is possible as AI technologies evolve. AI will provide new opportunities to improve social inclusion and defend against emerging cyber threats. They will help us address critical environmental problems, and drive efficiencies and productivity across almost every industry sector.

AI will provide an opportunity for innovative Australian businesses to develop new revenue streams by building next generation products and services, and novel business models. For established businesses, these technologies will help to increase productivity through safer and more efficient workplaces. These technologies will enable manufacturing businesses to grow and scale. This will increase their international competitiveness when businesses across the globe are increasing their use of AI.

AI will also provide opportunities for governments. Government policy will be improved by better risk assessment and forecasting. Routine administrative tasks could be automated with more complex service delivery handled by people. This will reduce administrative costs for government and regulatory burden for businesses, while providing opportunities for more personalised service delivery.[2]

As great as the potential is, we must acknowledge and address the challenges these technologies present. That's why the Australian Government released Australia's AI ethics framework in November last year, to uphold trust in these technologies and to encourage them to be developed and used ethically, responsibly, and safely by both businesses and government.

Machine learning models derive from the data used to train it. This data will reflect both the current and historical values, norms and biases of our society. We recognise the impact that institutionalising the worst of our past could have on our future. To counter this, our AI workforce will need to be diverse and representative of our multicultural society. It will mean understanding what data is used to train an AI system and how this might shape its outputs.
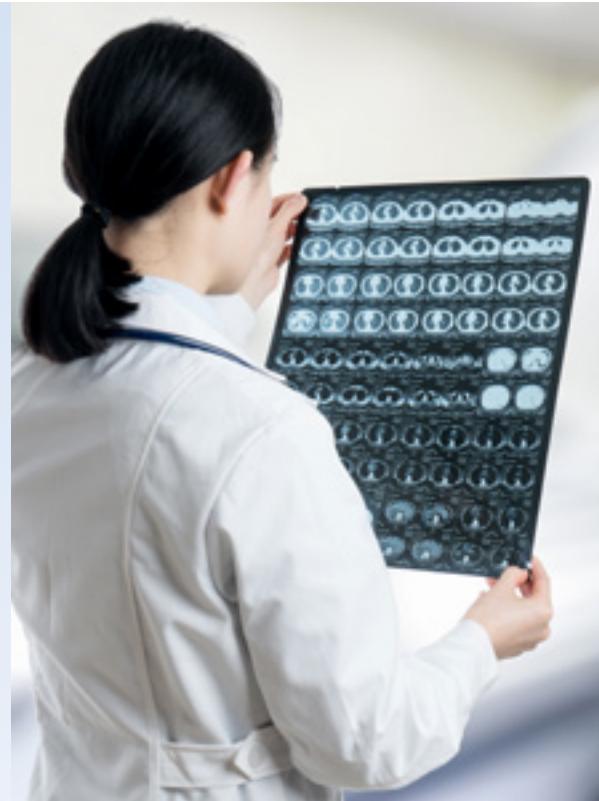
Shaping international standards in line with Australian values is also key. With the tremendous opportunity for new and higher paying jobs, our education and employment frameworks must continue to support workforce transition.

Improving diagnosis of COVID-19

AI is assisting in the fight against COVID-19 through better detection methods. Hospital staff around the world are now able to use an Australian-developed AI diagnosis tool to identify people who have coronavirus.

The technology, created by University of Sydney affiliated start-up DetectED-X, was originally developed to improve the accuracy of breast cancer detection. It has been quickly modified to detect COVID-19 using lung CT scans of patients from Italy and China. A study published in 2016 found radiologists using the Australian-designed diagnostic tool had "significant improvement" in their ability to accurately diagnose breast cancer.

AI has assisted in the development of COVID-19 vaccines. Google's Deepmind is creating predictions of protein structure of the COVID-19 virus. Furthermore, CSIRO's Australian e-Health Research Centre is using machine learning to identify possible strains of the virus on which to test vaccines.

2   Mehr, H. (2017). *Artificial Intelligence for Citizen Services and Government*.
    Retrieved from ash.harvard.edu/files/ash/files/artificial_intelligence_for_citizen_services.pdf

THE **JOURNEY** SO FAR

The Australian Government has long supported AI research and adoption. Around $10 billion is invested each financial year in science, research and innovation, helping to advancing our knowledge and capability in areas such as AI.

This complements action to build digital skills and improve trust and security in our digital economy through the $1.67 billion investment in the 2020 Cyber Security Strategy and investments in our online safety.

Investing in Australia's AI capability and Australia's digital future

The 2020-21 Budget has seen further investment from the Australian Government in Australia's digital future. This lays the groundwork for increasing the development and adoption of AI in Australia. It invests in the digital infrastructure, industry-research partnerships, business capability, individual skills development and diversity that will support the expansion and acceleration of Australia's AI ecosystem.

2020-21 Budget — building the foundations for AI development and adoption in Australia

In 2020-21, the Australian government is:

◉ Investing almost $800 million through the JobMaker Digital Business Plan to enable businesses to take advantage of digital technologies, to grow their business and create jobs as part of our economic recovery.

◉ Committing $1.5 billion through the Modern Manufacturing Strategy. Manufacturing is critical to a modern Australian economy, and has played a vital role in our response to the COVID-19 crisis. This strategy will help Australian manufacturers scale-up, improve their competiveness and build more resilient supply chains, including through the use of AI.

◉ Growing Australia's digital infrastructure. Initiatives, including the expansion of the NBN, the Regional Connectivity Program, Digital Identity, and 5G commercial trials lay the ground work for strong digital connectivity for all Australians. This is essential for the development and adoption of AI.

◉ Increasing the availability of public data and trust in its use through the Consumer Data Right, GeoScience Australia's Exploring for the Future initiative, and the National Road Safety Data Hub. These build on existing initiatives making government data open for industry, including through data.gov.au, Digital Earth Australia and the Geo-coded National Address File (GNAF).

◉ Supporting younger Australians to prepare for the digitally-enabled future through Commonwealth supported higher education, increasing the number of apprenticeships and traineeships and the businesses that employ them.

◉ Boosting research funding to universities, supports local university-industry partnerships along with the translation and commercialisation of university research. The University of Adelaide was provided $20 million to establish a Centre for Augmented Reasoning.

◉ Lifting gender diversity particularly in STEM careers through industry-sponsored advanced apprenticeship style courses.

The investment in Australia's digital future in 2020-21, builds on the 2018-19 Budget support package to develop Australia's AI capability as part of a broader $330 million allocation for new initiatives that support digital innovation. The package supported 14 industry-led research projects that focused on AI technologies through the Cooperative Research Centre Projects (CRC-P) program. Projects included:

- ◉ Automating data collection and analytics in underground mines using drones and AI.

- ◉ Transforming joint surgery rehabilitation with AI in telehealth.

- ◉ Using image recognition to detect brain aneurysms.

- ◉ Enabling real-time medical diagnostics using a digital stethoscope.

This package also included the curation and creation of online student and teacher resources to support teaching about emerging technologies and AI in schools, delivered through the Digital Technologies Hub.[3] It also supported a number of AI PhD scholarships through CSIRO's Data61.

Importantly, the package supported the development of three reports to inform government policy development.

- ◉ **Standards Australia** delivered *An Artificial Intelligence Standards Roadmap: Making Australia's Voice heard* to guide Australia's approach to standards development. In developing this roadmap, Standards Australia held workshops in capital cities across Australia and released a discussion paper for submissions.

- ◉ **CSIRO's Data61** delivered Australia's AI technology roadmap: *Artificial Intelligence: Solving problems, growing the economy and improving our quality of life*. CSIRO's Data61 and the Department of Industry, Innovation of Science (now the Department of Industry, Science, Energy and Resources) led workshops across Australia. This roadmap was released in November 2019 at Australia's national AI summit: Techtonic: Australia's AI Future, which hosted over 100 AI experts from across the nation.

- ◉ **CSIRO's Data61** also released a discussion paper Artificial Intelligence: *Australia's Ethics Framework*. Data61's AI ethics framework discussion paper gathered over 140 submissions. CSIRO's ethics framework discussion paper was central to the consultation that informed the development of Australia's AI Ethics Principles.

Australia's AI Ethics Principles were released in November 2019. In recent months, six organisations: National Australia Bank, Commonwealth Bank of Australia, Telstra, Microsoft, Flamingo AI and Insurance Australia Group have been piloting the AI ethics principles. The feedback from these trials is informing the development of guidance material to help organisations apply the AI ethics principles.

In addition, the Australian Human Rights Commission is developing a report on Human Rights and Technology which will make a number of recommendations on AI. They expect to release the report in early 2021. It will discuss safeguarding human rights and encouraging accessible, equitable and accountable use of new technology in Australia.

This recent activity builds on previous investments in research and development of AI. The Australian Research Council (ARC) has invested over $170 million over the past ten years, through the Discovery and Linkage Program, and through ARC Centres of Excellence for Robotic Vision, for Integrative Brain Function and for Automated Decision-Making and Society. The National Health and Medical Research Council (NHMRC) have also supported the development of AI and ML technologies in medical research projects; and CSIRO announced its $19 million Future Science Platform on Artificial Intelligence and Machine Learning in 2019.

Australian government departments are also investing in AI. The Department of Health, for example, is providing support through the Medical Research Future Fund to projects supporting the development of AI in health. The Department of Defence has established the Defence Cooperative Research Centre for Trusted Autonomous Systems through their Next Generation Technologies Fund.

State and territory governments are also deploying hubs of AI expertise. This includes the SA Government's support for the Australian Institute for Machine Learning (AIML) at the University of Adelaide, the QLD Government's support for the Brisbane based AI Hub, the WA Government's support for the WA Data Science Innovation Hub, and the VIC Government's contribution to establish the AI accelerator Boab AI.

The Australian Government has also been active in international fora like the OECD, G7 and G20. Australia has contributed to the development of frameworks underpinning international AI standards and norms. They support global efforts to ensure AI technologies are used for our collective wellbeing. Australia has been recognised for these efforts. In July this year, Australia became a founding member of the Global Partnership on AI. This forum was established to steward the responsible development and use of AI technologies.

The Global Partnership on AI (GPAI)

The GPAI is the world's first multilateral forum dedicated to AI. Australia's membership of the GPAI gives us a seat at the table guiding responsible development of AI internationally.

Australia joins other founding members of GPAI including: Canada, the European Union, Germany, France, India, Italy, Japan, New Zealand, the Republic of Korea, Singapore, Slovenia, the United Kingdom, and the United States of America.

Leading experts from industry, civil society, governments and academia will take part in working groups. They will focus on four key themes:

◉   Responsible AI

◉   Data governance

◉   The future of work

◉   Innovation and commercialisation

In the short term, the initiative will look into how to use AI to better respond to and recover from COVID-19. The GPAI working groups are providing collaboration opportunities for a broad range of experts from across Australian research and industry sectors. Professor Genevieve Bell, Professor Enrico Coiera, Professor Elanor Huntington, Professor Toby Walsh and Dr Paul Dalby have been selected as Australia's first nominations to GPAI.

THE **IMPERATIVE** FOR ACTION

Like other general purpose technologies before it, AI will reshape how we live, work and play.

The telephone and then the internet made communication easier and cheaper. Likewise, computers and the semi conductors that power them made calculations faster and more accurate. AI takes this a step further and will lower the cost of prediction.[4]

Prediction is the ability to process mass amounts of data to identify patterns that inform how future scenarios are likely to play out. It is key to how individuals, industry and governments make decisions. It is central to transportation, agriculture, healthcare, energy, manufacturing, and retail. AlphaBeta believe that digital innovation, including new AI technologies, could be worth up to $315 billion to the Australia economy by 2028.[5]

Action is needed now because the rate of AI development is accelerating. The past five years have seen considerable international interest and investment in AI. Fourteen of the world's most advanced economies have announced over $86 billion in focused AI programs and activities.[6] This has led to acceleration in the development of AI. This speed of development, and its wide application across every sector will reshape business competitiveness. In a globally connected market, it is not just domestic competition that will impact Australian businesses. As we rebuild from the COVID-19 pandemic, we cannot afford to fall behind. The benefits of a transition to AI are huge.

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4   Ajay Agrawal, Joshua Gans, Avi Goldfarb (2016), *The Simple Economics of Machine Learning.*
    Accessed from: https://hbr.org/2016/11/the-simple-economics-of-machine-intelligence

5   The Automation Advantage: https://alphabeta.com/our-research/the-automation-advantage/

6   CSIRO Data61. (2019). *Artificial Intelligence: Solving problems, growing the economy and improve our quality of life.*
    Retrieved from: data61.csiro.au/en/our-research/our-work/AI-roadmap

In the last 18 months, through *Techtonic* and the public consultation held on the AI technology roadmap and AI ethics framework, a number of opportunities and challenges emerged, including:

Business

AI creates opportunities for our businesses: there are opportunities for most Australian businesses if they can adopt AI, but there are barriers to doing so. Common barriers include: awareness, capability, access to data and lack of relatable case studies. In addition, access to safe and trustworthy technologies is not assured. During government consultations, we also heard that there are significant economic opportunities for our leading AI businesses to continue to scale and export that could have flow on benefits.

Research

Cutting edge research and development can address national problems: Australia has world leading research in a range of AI fields. We cannot match the international investment in AI observed in recent years. However, there are opportunities to leverage and better coordinate our existing expertise to grow our areas of advantage, or to create new areas of competitive advantage. For example, areas focused on high quality, trustworthy AI. We need to ensure sufficient investment to drive industry growth and promote trusted partnerships.

People

AI skills and capability will strengthen our workforce: AI will create new highly paid jobs as well as change how we work and the skills required. We need to make sure our workforce is equipped to embrace the new opportunities presented by AI, have the skills to engage with AI, and is able to access support in managing periods of workplace or career transition.

Society

Human-centred AI will maximise the benefits of these technologies for all Australians: individuals, governments and businesses are already seeing greater convenience, cheaper products and more tailored services from technology. However, it is essential that the outcomes of AI are fair in order to maintain trust in AI. For example, the data AI technologies draw from must be free from bias and unwanted interference. Regulatory settings must balance innovation with safeguarding consumers and the broader community. Businesses have pointed to uncertainty around risks, ethics and potentially regulation of AI as barriers to adoption.

AN **AI ACTION PLAN** FOR ALL AUSTRALIANS

*The Australian Government is developing an AI action plan to maximise the benefits of AI for all Australians. The **AI Action Plan** will set a clear shared vision for AI in Australia.*

Australia develops and uses AI technologies responsibly to: address national problems, build competitive businesses, and increase our collective wellbeing.

Government, business and individual action over four streams will be needed to achieve this vision.

Business

Australians build competitive businesses that adopt, develop and export novel AI technologies. To achieve this, potential actions could focus on how to:

- Increase business adoption of AI.
- Enable businesses and government to develop, pilot and assess AI solutions.
- Ensure Australians have access to trusted and ethical AI.
- Accelerate the entry of our AI businesses into international markets.
- Enable better data sharing and increase the value of Australian data.

Research

Australians conduct cutting-edge cross-domain AI research and development and apply it to national problems. To achieve this, potential actions could focus on how to:

- Focus basic and applied research in areas of national priority.
- Build and expand our national data and digital infrastructure.
- Improve collaboration and support the diffusion of knowledge and experience.
- Increase commercialisation of Australian AI technology research.

People

Australians have the skills and capability to benefit from and participate in an AI-driven society. To achieve this, potential actions could focus on how to:

- Increase the diversity and number of talented AI researchers and engineers in Australia.
- Ensure Australians have foundational AI education and skills.
- Foster lifelong learning within our existing workforce.
- Improve business and government leaders' understanding of the use and impact of AI.

Society

Australians develop and adopt human-centred AI technologies that are trustworthy and steward their values globally. To achieve this, potential actions could focus on how to:

- Raise awareness and understanding of AI technologies in the community.
- Ensure our regulatory system keeps pace with advancing technologies.
- Champion Australian values and the responsible, ethical and safe use of AI globally.
- Encourage the responsible development and adoption of AI technologies that are safe, Australian-made, human-centred and trustworthy.
- Foster and participate in a global market of trusted suppliers of AI technologies.

This discussion paper seeks views on whether these potential action areas are the right ones, and whether there are existing programs or market solutions already addressing these objectives. Then, whether government, businesses or individuals are best placed to address any gaps.

We welcome your views on:

- ◉ **What is the role for government to support the uptake and use of AI technologies in Australia?**
- ◉ **What can be done to reduce barriers to AI adoption in Australia?**
- ◉ **Do we have the right vision for AI in Australia?**

BUSINESS – AI CREATES OPPORTUNITIES FOR OUR BUSINESSES

Increasing the capability of Australian businesses to develop, adopt, and adapt AI is critical to realising the opportunities on offer to diversify our industries and build economic resilience. AI is increasingly identified as a geostrategic imperative for economic prosperity and national security by Australia's international partners. It will be increasingly important for Australia to both maintain access to AI from trusted overseas suppliers or build sovereign capability in key areas.

For Australian manufacturers, the Modern Manufacturing Initiative (MMI) is helping to drive lasting change through the adoption and development of solutions powered by technology such as AI. Funding will support large business-to-business and business-to-research collaborations, as well as supporting manufacturers translate good ideas into commercial outcomes.

Uniquely Australian

Australia is a net intellectual property importer, but we are fast adopters of new technology. This has traditionally ensured that Australia has access to the latest technology while investing modestly in its early research and development. There is growing concern however, that AI may not follow this trend.

The availability of diverse and accurate datasets are the foundation of good AI. AI technologies like image recognition and speech recognition rely on large diverse training sets. This increases their accuracy and general applicability. While these datasets may be available for some applications, problems have arisen when models developed overseas have been used in Australia. For example:

⊙ When carmaker Volvo trialled their self-driving car in Australia, the unique hopping movement of kangaroos confused its large animal detection system.[10]

⊙ Carsales have applied machine learning to improve the customer experience of listing vehicles and to support the approval of listings by their staff. In doing this, they've needed to build a dataset of Australian vehicles.[11]

Ensuring AI technologies are accurate in the local context will be a clear challenge to their adoption in Australia. There will be times when Australian organisations will need to develop their own AI applications rather than import them from overseas. This should not be seen as a barrier to the adoption of AI technologies in Australia. There is a clear opportunity for Australia to celebrate uniquely Australian data. It's an opportunity to celebrate our diverse indigenous and multinational cultures. A starting point will be ensuring diversity is embedded in our AI workforce and the AI technologies we develop and use.

7   Productivity Commission. (2016). *Intellectual Property Arrangements (Inquiry Report no. 78)*. Canberra. Retrieved from: pc.gov.au/inquiries/completed/intellectual-property/report/intellectual-property-overview.pdf

8   https://www.theguardian.com/technology/2017/jul/01/volvo-admits-its-self-driving-cars-are-confused-by-kangaroos; https://www.bbc.com/news/technology-40416606; https://www.abc.net.au/news/2017-06-24/driverless-cars-in-australia-face-challenge-of-roo-problem/8574816

9   Silverpond. (2019). *Australia's AI Ecosystem 2019*. Melbourne: Silverpond Ltd. Available at: silverpond.com.au/ai-community/australian-ai-ecosystem-survey

Adoption

While COVID-19 has accelerated digital transformation of Australian businesses it has also highlighted some challenges.

Many Australian businesses, especially small businesses, are just beginning their digital transformation journey and may not be aware of the existing AI-enabled technologies that could improve their operations. In addition, businesses may not know how to take full advantage of their data through the use of AI. Ensuring that we have the right security requirements and standards will be a key enabler in helping businesses confidently adopt AI solutions. This is important for AI solutions as these can be adopted and sold as a service, not just a product.

So far stakeholders and literature suggest that business and government decision makers may lack the necessary expertise to appreciate the impact that adopting emerging technologies like AI could have on customers and business operations. A report by the Australian Institute of Company Directors (AICD) indicated that Australian directors were struggling to drive innovation more than their international counterparts. Directors of Australian companies identified human talent shortages as the greatest barrier to innovation, and recommended action to lift directors' technology and digital literacy. The report noted that "all directors will need to think deeply about how they can better understand key technological developments facing their organisation and sector, including through targeted director education and drawing on external expertise where necessary". [10]

This points to communication barriers between AI professionals and domain experts. Business experts understand their data, but a data scientist may not. While a data scientist may identify correlation in a dataset, a domain expert will understand the cause. Constructive collaboration between both business experts and AI professions is a key requirement for greater AI adoption.

Helping small business owners to juggle their day to day demands

AI is helping business owners better understand their customers, supply chains and emerging opportunities for growth. There are already many Australian businesses (large and small) using predictive analytics and machine learning to analyse their sales data, potentially in combination with other data (e.g. census data). This analysis quickly informs how much of what products to order and when (days, weeks, months) based on seasonal demand. These tools can also:

◉ Help identify in-demand products for customers.

◉ Monitor stock inventories and production activity on the factory floor.

◉ Place automatic orders for new products or components when they're running short or demand is forecast to peak.

This can add up to major savings and new opportunities for our businesses to compete and thrive.

Development

There are clear reasons for Australia to maintain, and potentially grow, the number of firms that are developing AI in Australia. We already have some Australian businesses that are leaders in their field of AI, most notably in health, mining, space and infrastructure applications. These businesses are providing solutions tailored to uniquely Australian problems.

Similarly, stakeholders suggest that there are several areas where it is critical that Australia has a degree of sovereign capability in order to safeguard Australia's interests. Many of these are defence and national security applications. However, there may be other areas where sovereign capability and safeguarding critical technologies and research is essential given the increasing geostrategic importance of AI.

Supporting and growing the pool of leading Australian businesses who can translate Australian research will be a foundational element of Australia's future success. While Australia produces world-class research, research-business collaboration in Australia is below the OECD average. This presents a barrier to translating Australian research to commercial applications and limits the spillover benefits from R&D.

One specific barrier that was referenced in government consultations was access by Australian businesses to high quality, de-sensitised, ethically and legally sourced data sets. The development of AI technologies, in particular machine learning, requires large, high-quality datasets and digital infrastructure to collect, store, transmit and compute information. Government has been active in the field of data access already, for example, through reviews to the Privacy Act, implementation of the Consumer Data Right, establishment of the National Data Commissioner, and implementation of ACCC's Digital Platforms inquiry. Consideration is needed about whether more can be done, for example on issues like bias and accuracy, as well as governance issues like privacy and security.

At the same time, while there are amazing examples of successful Australian technology businesses expanding into international markets, Australia is ultimately a maturing start-up nation. There is evidence that venture capital funding is trending towards later stage start-ups. [11] This has been exacerbated by the COVID-19 crisis. This is limiting access to seed funding for early-stage businesses where early development and market testing would typically occur.

AI plays a critical role in Australia's growing space sector, with spill overs to other sectors and applications

AI has a range of functions in the space sector, from improving the use of space-enabled data through to enabling remote and autonomous operations in space. The resulting space-reliant products and services are used across other sectors and in our everyday lives, such as for navigation, weather reports and forecasts, and communicating across Australia's vast distances.

For example, Akin Australia is developing AI that can think and act like a human to help with complex tasks, such as improving space crew interactions with ship systems in space. GAIA Innovations (part of Consilium Technology) is using AI to analyse Earth imagery from satellites to map, monitor and optimise crop quality and yields, leading to increased profits. Fleet Space is using machine learning to connect a variety of sensors on Earth, through satellites, to your cloud computer. This enables a power company to immediately see when and exactly where a powerline is down, or identify an object that has entered the area surrounding a gas pipeline as either a car or a cow, and only sending an alert if it is a car.

Recognising the important role of space technology in supporting several areas of the economy and creating economic growth and jobs as part of Australia's economic recovery, the Australian Government is building common-use infrastructure, through the Australian Space Agency's Space Infrastructure Fund, to give Australian industry a foot-up in space—including in AI. For example Fugro Australia Marine is delivering the Australian Space Automation, AI and Robotics Control Complex (SpAARC), which will develop expertise in remote and autonomous operations in space using a $4.5 million grant. Back on Earth, a $1.5 million grant to the Pawsey Supercomputing Centre will give start-ups and SMEs access to fast processing on-the-ground to produce a range of space-based products and services.

We welcome your views on:

◉ **How can we identify and unlock the value of uniquely Australian datasets?**

◉ **How can we lower the barriers to entry for businesses and government developing, piloting or assessing the value of AI technologies while ensuring appropriate consumer safeguards?**

◉ **How can government help ensure that AI research, including international collaboration, is undertaken safely, ethically and responsibly?**

RESEARCH – CUTTING-EDGE AI RESEARCH AND DEVELOPMENT CAN ADDRESS NATIONAL PROBLEMS

Scientific breakthroughs in computer vision, natural language processing and machine learning have enabled the development and deployment of the AI systems we interact with every day. Examples range from the voice assistants on our phones to the fraud detection systems at our banks. However, we are only in the early stages of realising what may be possible to achieve with AI. New analytics and research tools are opening novel avenues of inquiry across a broad range of scientific domains. For example, unlocking insights in health data or monitoring cyber threats to our critical infrastructure.

In addition to both the direct and supporting investment in AI identified in "A journey so far", the Australian Government invests more $20 million per year (average) through the Australian Research Council (ARC) to support basic AI research and industry-research collaboration.[12] Australian state and territory governments are also making significant investments in AI-focused research precincts, hubs and accelerators.[13] Stakeholders have indicated that discoveries and advancements in fundamental and applied R&D have been essential in implementing AI technologies in existing business processes and value chains. However, stakeholder feedback indicates that our current science and technology priorities, framework and incentives may not adequately focus our AI capabilities on solving important problems. In Australia's AI Roadmap, Data61 highlighted the opportunity of leveraging our existing research and industry strengths to target our resources and investment.

Australia has developed world-leading capabilities in a number of core AI fields within our universities, research organisations and businesses. Over 550 researchers across 30 universities and institutions produced more than 11,000 research outputs in AI between 2011 and 2016.[14] Stakeholders have indicated the importance of fostering a pipeline of advanced AI

training and R&D to develop the next generation of AI experts and to attract top minds to Australia. There is an opportunity to ensure this pipeline reflects our evolving AI capability needs. This includes connecting capability across multidisciplinary fields; engaging with underrepresented and marginalised groups, such as women and Indigenous Australians; and preparing employment-ready graduates.

It will be essential to translate our research excellence into real-world outcomes to realise the benefits afforded by AI. Stakeholders have indicated the need to increase visibility of publically funded research and where our research strengths and capabilities in AI lie. However, collaboration between our public research organisations and businesses sits below the OECD average.[15] There is an opportunity to foster industry partnerships, including with small and medium businesses, by addressing barriers to research uptake by industry. Stakeholders have indicated that intellectual property issues and the siloing of data discourage collaboration. A higher emphasis on industry experience, placements and entrepreneurship could help reshape research culture.

Substantial investments by governments and institutions over the past decade have positioned Australia with world-leading eResearch infrastructure.[16] Yet given the fast pace of technological development, the next decade may change our needs in relation to data and digital infrastructure. So it is important that Australia is responsive to such changes to ensure we can keep pace with AI development.

There is an opportunity to leverage our strong international partnerships with countries leading in AI R&D to collaborate and share knowledge. The diffusion of knowledge into Australia means we can better focus our limited research budget on the areas that have the greatest impacts for Australia.

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12   Australian Research Council. (2020). *National Competitive Grants Program* [Data Portal].
      Retrieved from: dataportal.arc.gov.au/NCGP/web/grant/grants. Project funding derived using the search term: "artificial intelligence" OR "machine learning" OR "neural net*" OR "deep learning".
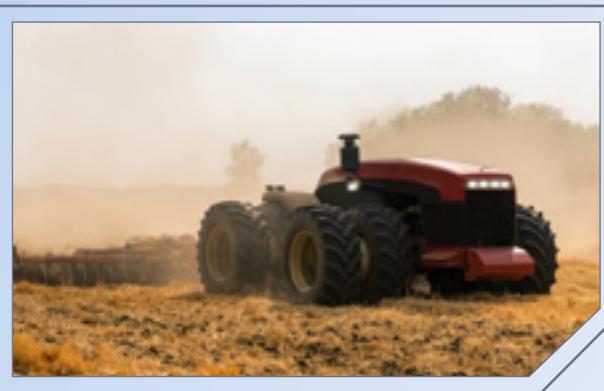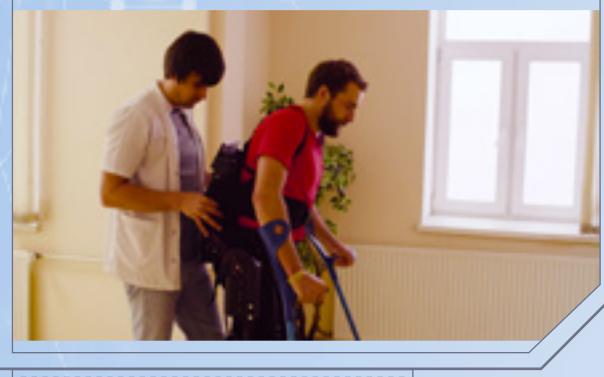
13   For example: the Queensland government have launched the *Artificial Intelligence Hub initiative*, the Victorian government have recently announced funding to support the accelerator *Boab AI*; the South Australia government invested in the *Australian Institute of Machine Learning (AIML)* at the University of Adelaide; and the New South Wales government are currently developing a *NSW AI Strategy*.

14   Australian Research Council. (2019). *State of Australian University Research 2018-19: ERA National Report*.
      Available at: dataportal.arc.gov.au/era/nationalreport/2018. Data provided under the Field of Research (FoR) code 0801 Artificial Intelligence and Image Processing.

15   OECD. (2017). *Collaboration on Innovation in OECD Science, Technology and Industry Scoreboard 2017: The digital transformation*. OECD Publishing: Paris. DOI: 10.1787/20725345.

16   For example: the Australia government made a strategic investment of over $2.8 billion, with over $1 billion co-investment from universities and state governments, between 2005 and 2016 under the National Collaborative Research Infrastructure Strategy (NCRIS).

Where does Australia have an AI advantage?

The quality and reputation of Australian research is one of our great strengths. However, as a nation our collective mass of diverse AI talent is dispersed and relatively isolated, across both geographic and thematic areas. We can make the most of our industry and research capabilities by clustering activity around our comparative strengths. In 2019, CSIRO Data61 published an AI technology roadmap that identified three high potential areas of specialisation for Australia. These specialisations would provide an opportunity to address significant national problems. They build on our existing strengths and have strong export potential. These areas are:

◉ **Health, Ageing and Disability:** AI for health, ageing and disability support to reduce costs, improve wellbeing and make quality care accessible for all Australians.

◉ **Cities, Towns and Infrastructure:** AI for better towns, cities and infrastructure to improve the safety, efficiency, cost-effectiveness and quality of the built environment.

◉ **Natural Resources and Environment:** AI for enhanced natural resource management to reduce the costs and improve the productivity of agriculture, mining, fisheries, forestry and environmental management.

Recent national emergencies have highlighted the potential of AI for natural disaster management and resilience. There are also opportunities for AI technologies to address critical challenges in cyber security and space.

We welcome your views on:

◉ What are the problems Australia is facing where the development and application of AI could provide long-term solutions and how could these be prioritised?

◉ How can Australia best coordinate its national research effort around areas of national priority?

◉ How can we better support industry-researcher engagement?

17 CSIRO Data61. (2019). *Artificial Intelligence: Solving problems, growing the economy and improve our quality of life.* Retrieved from data61.csiro.au/en/our-research/our-work/AI-roadmap

PEOPLE – AI SKILLS AND CAPABILITY WILL STRENGTHEN OUR WORKFORCE

As with other industrial transformations, AI will have a significant impact on the workforce. It will create new high paid jobs across many industries. It will augment the jobs of some, while displacing others.[18]

Australia is no stranger to changing workforce demands. Technology and market demands shift over time, increasing and decreasing the demand for particular skills and capabilities. These dynamics are a normal part of functioning economies but this does mean that continuing to invest in supporting people through quicker and smoother workforce transitions will be critical.

Developing AI skills and capabilities in the workforce requires government, business and individuals to adopt a flexible and multi-faceted approach. Experience from past industry and workforce transitions suggests that Australia's capability will be strengthened when it is underpinned by:

◎ Industry-led training.

◎ Promoting a culture of lifelong learning, which encourages individuals to continually develop skills throughout their career.

◎ Workforce investment by businesses to attract and maintain the best talent.

◎ Re-skilling workers from industries where there is decreasing demand for workers to meet labour market skill gaps.

◎ Generally encouraging greater labour mobility and flexibility.

Supporting this are the significant investments that the Australian Government continues to make in the vocational education and training (VET) sector. These investments increase the VET sector's capacity to respond to emerging job opportunities and provide Australian industries with access to a skilled workforce. For example, the Australian Government has partnered with states and territories to establish the $1 billion JobTrainer Fund to rapidly provide more Australians with access to free, or low cost, training places in areas of identified skills need, including in advanced digital skills. The Digital Skills Organisation (DSO) pilot was also established in June 2020 to develop innovative approaches to training and employing people in digital skills and to provide industry-led development of national digital training products.

To take advantage of emerging opportunities, especially in AI, it is also crucial that individuals can make informed career, education, and training related decisions. The National Careers Institute has recently been established to provide Australians with a single source of information on careers, including information on both vocational and higher education training. In partnership with the National Skills Commission, Australians now have access to comprehensive and up to date labour market information and skills matching assistance to help inform their study and job pathways.

Future changes within the labour market include that AI will decrease demand for more routine, physical work activities. However, we will likely see an increase in demand for other types of work, including: [19]

◎ Working with machines (technology skills).

◎ Applying specialised expertise (higher cognitive skills).

◎ Interacting with stakeholders (social skills).

◎ Managing, teaching and developing people (emotional skills).

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18 Modelling by Faethm and the *Australian Computer Society* (ACS) predicts that over the next 15 years, an additional 5.3 million new jobs could be created. Around 22 per cent (1.2 million) of these are technology jobs required to support the adoption and implementation of technologies like AI. However, automation could also displace 2.7 million workers. This accounts for 21 per cent of the Australian workforce. The impact will vary by industry. *Australian Computer Society*. (2020). *Technology Impacts on the Australia Workforce* (report prepared by Faethm). Available at: acs.org.au/content/dam/acs/acs-publications/Technology-impacts-on-the-australian-workforce.pdf

19 McKinsey & Company. (2019). *Australia's automation opportunity: Reigniting productivity and inclusive income growth*. Available at: mckinsey.com/featured-insights/future-of-work/australias-automation-opportunity-reigniting-productivity-and-inclusive-income-growth

What skills are businesses looking for?

Australian businesses have indicated there is already high demand for people with the right skills in AI-related fields, particularly technical and business management skills. However, it is difficult for businesses to find people with that expertise in Australia. CSIRO's Data61 estimates that Australian industry will require a workforce of between 32,000 to 161,000 AI professionals by 2030. This includes professionals in computer vision, robotics, human language technologies, data science and other AI related fields.[20]

To realise the opportunity of advances in these technologies, Australia will need to improve its business management capability. Australia's business management capability trails behind comparable OECD nations, particularly the USA. Business management capability accounts for up to half the productivity gap between Australia and the USA.[21]

ACS research estimates that by 2034 the change in workforce may result in labour force gaps. In the short-term, the *narrow* AI technologies being developed are less likely to replace entire jobs. These technologies are task specific. They focus on more efficiently completing repetitive, mundane or dangerous tasks. This allows people to focus on safer, higher-value and more meaningful tasks.

Taken together, further action will be needed by government, businesses and individuals to ensure all Australians benefit from advances in AI technology. The themes identified above can be drawn into three major areas of focus:

◉ Building capability in our existing workers—Educating and up-skilling our workforce can help ensure displaced workers transition to different jobs and industries. Given the fast-pace of technological advancement, it will be important to foster lifelong learning. Businesses take a proactive role in this area by supporting their existing employees to upskill and retrain.

◉ Building capability in our future workers—Our tertiary education and training systems need to remain responsive and flexible to the current and future needs of industry. This will help build a critical mass of skilled AI professionals in Australia. Providing foundational AI skills and education through the STEM curriculum in Australian primary and secondary schools can assist in equipping and inspiring our students to engage with AI. Early engagement with AI by students is necessary to help build Australia's next generation of AI adopters and experts.

◉ Attracting foreign talent—Skilled migration could help to fill the short-term labour force gaps in our domestic supply of skilled AI professionals. These specialists provide a critical source of knowledge transfer to Australia. Businesses need experienced specialists to help them adopt technologies like AI and transform their operations. Skilled migrants are important source of such AI specialists and can also contribute to education through mentoring and growing Australian expertise, like our next generation of graduates.

We welcome your views on:

◉ **What is the best way to ensure Australians have the skills and capabilities they will need for an AI enabled future?**

◉ **What is the best way to ensure Australian businesses have access to the AI workforce they need for an AI enabled future?**

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20 CSIRO Data61. (2019). *Artificial Intelligence: Solving problems, growing the economy and improve our quality of life*. Retrieved from: data61.csiro.au/en/our-research/our-work/AI-roadmap

21 Australian Government Department of Industry, Science, Energy and Resources. (2018). *Industry Insights: 3/2018 Future productivity*. Available at: https://publications.industry.gov.au/publications/industryinsightsjune2018/future-productivity.html

SOCIETY – HUMAN-CENTRED AI WILL MAXIMISE THE BENEFITS OF THESE TECHNOLOGIES FOR ALL AUSTRALIANS

In order to spur broader adoption of AI in ways which contribute to Australia's economic prosperity, security and unique way of life, we need to maintain public trust in AI. Businesses have also expressed a desire for clearer guide rails on how AI can be used before making bigger investments in AI.

Technological advances have always come with questions about their impact on society. The adoption of AI, particularly AI developed with Australian datasets, can help to ensure greater inclusion and fairness, particularly for Australia's most vulnerable communities. It can be used to decrease bias and discrimination in decision making and enable access to new services in regional and remote communities that have faced a tyranny of distance. It will be important to ensure that advances in AI embody our values as a society.

While we have seen rapid advances in AI, some Australians worry that AI could be used for malicious purposes, or the use of AI could have unintended effects. In developing the AI ethics principles, we heard that individuals and businesses are wary of algorithmic decision-making. In particular, where the owner and operator of AI enabled systems might not be able to assure, analyse or explain the functions being performed. This is especially important in relation to safety, for example, in the context of things like self-driving cars and public transport. Many have indicated that to address this, it is vital that AI systems respect human rights and diversity, are explainable, enable human oversight and have clear accountability.

The type of data used to drive AI will shape the outcomes an AI algorithm produces. This means values become a key part of the conversation around data for AI. For example, we have seen examples where data sets used to power AI have institutionalised historical norms leading to unfair discrimination. To avoid this, AI systems need a strong focus on transparency, accountability and appropriate recourse. Australia's AI ethics principles set this expectation, as does the OECD Council Recommendation on AI.

Australia also has established legislative frameworks for how personal information is handled and administrative decisions are made. These already guide how and where AI technologies can be developed and applied. For example, the *Privacy Act 1998 (Cth)* was introduced to promote and protect the privacy of individuals. It regulates how Australian Government agencies and other covered organisations handle personal information. Automated systems must also comply with administrative law principles of legality, fairness, rationality and transparency, in addition to privacy requirements and human rights obligations.

Within this legislative environment, there have been requests from businesses for clearer guidance on how these legislative frameworks and ethics frameworks apply to their development and use of AI. Businesses have highlighted the impact of regulation on innovation, and sought to ensure that the compliance burden of regulation is proportionate and specific to the risks associated with particular AI applications. Public-private partnerships are one way to help develop the strong guidance and standards needed to support the future of AI technologies.

Global approaches to responsible AI

◉ **Australia: In November 2019, The Australian Government released a voluntary set of AI Ethics Principles. These are to assist government and businesses achieve better outcomes, reduce the risk of negative impacts, and practice the highest standards of ethical business and good governance practices. The Australian Human Rights Commission will release a report in early 2021 on safeguarding human rights and encouraging accessible, equitable and accountable use of new technology.**

◉ **Canada: In April 2019, Canada introduced a mandatory directive on automated decision-making, with Canadian government departments required to comply by 1 April 2020.**

◉ **European Union: In February 2020, the European Union released a white paper on an AI-specific policy framework. The framework proposes significant regulatory requirements on AI deemed as high-risk. For example, those in high-risk sectors and those used in ways that result in significant risks. The regulatory requirements include processes to allow algorithms and data sets to be tested, inspected and certified during development with ongoing monitoring where needed.**

◉ **Singapore: In January 2019, Singapore released its Model AI Governance Framework. It provides guidance to enable organisations on how to responsibly deploy AI solutions at scale.[22]**

◉ **United States of America: In January 2020, the United States White House Office of Science and Technology Policy released a draft memorandum for government agencies when proposing new AI regulations. It outlined ten principles, including: public trust; public participation; scientific integrity; risk management; benefits and costs; flexibility; fairness; transparency; and safety.**

Perhaps more so than other technologies, AI systems are embedded with the values and norms of their creator. Australia, as a net importer of technology, cannot be a passive importer. We will need to ensure Australians can source AI systems from trusted suppliers. Suppliers that develop AI technologies transparently, responsibly and ethically. The alternative is the potential for Australians to inadvertently adopt technologies that are counter to our values or local regulation and laws. Some AI systems could even threaten our sovereignty. Australia must ensure that our own regulatory approaches align with countries where our AI imports are likely to come from. This will ensure that Australian businesses can both adopt or export AI technologies easily and responsibly.

One way of achieving this is through participation in international standards development. Standards Australia's AI Standards Roadmap provides recommendations to guide Australia's approach to standards development. [23] These recommendations were grouped under four goals:

◉ Ensure Australia can effectively influence AI standards development globally.

◉ Increase Australian businesses' international competitiveness in relation to responsible AI and streamline requirements in areas like privacy risk management.

◉ Ensure AI-related standards are developed in a way that take into account diversity and inclusion, ensure fairness, and build social trust.

◉ Grow Australia's capacity to develop and share best practice in the design, deployment and evaluation of AI systems.

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22 Singapore Digital, Info-communications Media Development Authority (IMDA) and Personal Data Protection Commission (PDPC) (2020), *Model Artificial Intelligence Governance Framework: Second Edition*.
Accessed from: https://www.pdpc.gov.sg/-/media/Files/PDPC/PDF-Files/Resource-for-Organisation/AI/SGModelAIGovFramework2.pdf
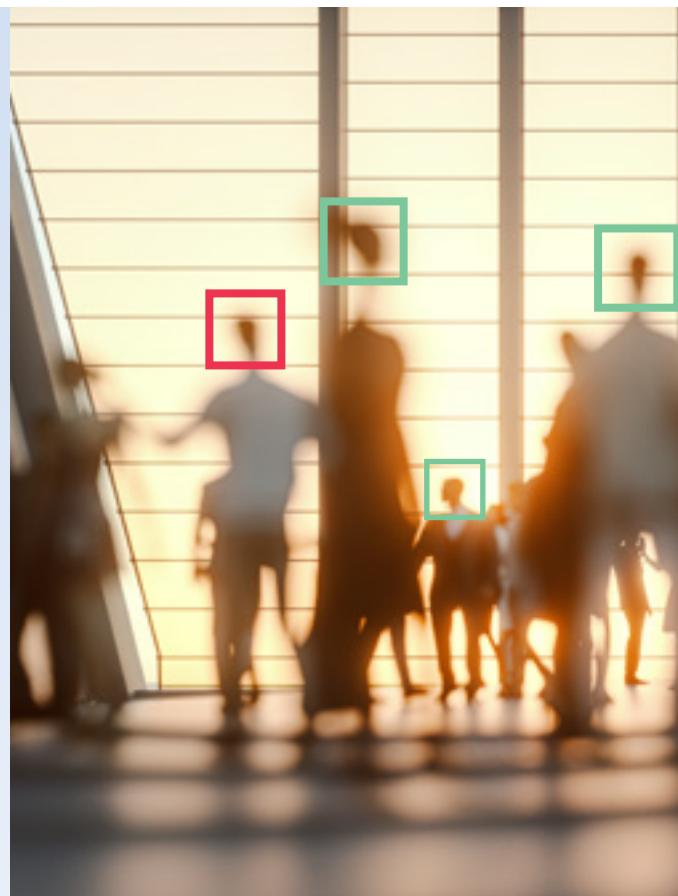
23 Standard's Australia (2020), *An Artificial Intelligence Standards Roadmap: Making Australia's voice heard*.
Accessed from: https://www.standards.org.au/news/standards-australia-sets-priorities-for-artificial-intelligence

Australia has already been active in working internationally to build consensus around the rules and norms for AI. For example, we are a founding partner of the Global Partnership in AI. This forum brings together likeminded members including Canada, the European Union, Germany, India, France, Italy, Japan, New Zealand, the Republic of Korea, Singapore, Slovenia, the United Kingdom, and the United States of America. We have also committed to the OECD AI ethics principles, and we continue to engage bilaterally with our likeminded partners on AI. Collaboration with likeminded partners could allow us to shape international standards and work collaboratively on shared safety outcomes.

Improving border security

The Department of Home Affairs and the Australian Border Force use AI to assist with the identification of risks and threats to Australia's visa programs and its border security. Officers use AI-assisted tools built to identify patterns of high-risk behaviour or attempts to circumvent Australia's visa and entry requirements.

The technology is predominantly used to surface actionable information on a small cohort that alerts officers to potential risks, while minimising interruptions and streamlining processing for the majority of legitimate visa applicants and travellers to Australia. Big data and AI technologies are used to augment evidence-based decision making against legislative criteria. Australia also abides by the 'golden rule' that any adverse decision, such as the refusal of a visa, are made by a human and not by a computer.

We welcome your views on:

- ◎ **Is there more the government can do to support responsible and human centred development and use of AI in Australia?**

- ◎ **What approach should Australia take internationally to steward its values and commitment to the responsible and ethical use of the AI? How can Australia support its partners and neighbours in their efforts to make the most of AI?**

- ◎ **What security issues associated with AI systems should be considered?**

HOW TO GET **INVOLVED**

We want to test and refine the high-level ideas presented in this paper. This will ensure we have identified the right problems and the right solutions. It is your opportunity to shape the vision for Australia's AI future.

To join the discussion visit: https://consult.industry.gov.au/digital-economy/ai-action-plan

We welcome your views on:

An AI Action Plan for All Australians

⦿ What is the role for government to support the uptake and use of AI technologies in Australia?

⦿ What can be done to reduce barriers to AI adoption in Australia?

⦿ Do we have the right vision for AI in Australia?

Business

⦿ How can we identify and unlock the value of uniquely Australian datasets?

⦿ How can we lower the barriers to entry for businesses and government developing, piloting or assessing the value of AI while ensuring appropriate consumer safeguards?

⦿ How can government help ensure that AI research, including international collaboration, is undertaken safely, ethically and responsibly?

Research

⦿ What are the problems Australia is facing where the development and application of AI could provide long-term solutions and how could these be prioritised?

⦿ How can Australia best coordinate its national research effort around areas of national priority?

⦿ How can we better support industry-researcher engagement?

People

⦿ What is the best way to ensure Australians have the skills and capabilities they will need for an AI enabled future?

⦿ What is the best way to ensure Australian businesses have access to the AI workforce they need for an AI enable future?

Society

⦿ Is there more the government can do to support responsible and human centred development and use of AI in Australia?

⦿ What approach should Australia take internationally to steward its values and commitment to the responsible and ethical use of the AI? How can Australia support its partners and neighbours in their efforts to make the most of AI?

⦿ What security issues associated with AI systems should be considered?

NEXT STEPS

Using your input we will set out clear objectives and develop the actions needed to deliver on these and achieve our vision for AI in Australia.

To stay informed on our progress subscribe to our AI in Australia updates at:
https://www.industry.gov.au/strategies-for-the-future/artificial-intelligence-in-australia-updates

For more information on our AI initiatives and activities visit:
https://www.industry.gov.au/strategies-for-the-future/artificial-intelligence