



National Robotics Strategy
Department of Industry, Science and Resources

7 May 2023

By email: robotics@industry.gov.au

Dear Department,

Submission in response to National Robotic Strategy

The Business Council for Sustainable Development Australia (**BCSD Australia**) welcomes the opportunity to make this submission to the Department.

The WBCSD is a global organization of over 200 leading businesses that work together to accelerate the transition to a sustainable world. While our primary focus is on sustainable business practices, climate change, circular economy, and other environmental and social issues, they do recognize the role of technology, including robotics, in achieving sustainable development.

Robotics is a subject within the context of broader discussions on Industry 4.0, digital transformation, and advanced technologies that can support sustainable business practices and contribute to achieving the United Nations Sustainable Development Goals (SDGs). Robotics and automation technologies can help companies and industries optimize resource use, minimize waste, reduce energy consumption, and improve overall sustainability.

Please see our **Summary** and detailed **Answers to the questions for response** below.

We would also welcome the opportunity to speak directly on these points at the appropriate time.

Yours faithfully,

A handwritten signature in black ink, appearing to read "Andrew Petersen", with a long horizontal line extending to the right.

Yours faithfully,

Andrew Petersen
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Summary

- **The United Nations Sustainable Development Goals (SDGs) are a set of 17 global goals designed to address various social, economic, and environmental challenges. Several SDGs are relevant to a country or company's robotics strategy, as robotics and automation technologies can contribute to achieving these goals:**

- **SDG 3: Good Health and Well-being:** Robotics can be used in healthcare to improve patient care, medical diagnostics, surgery, and rehabilitation. The use of robotics can help reduce human error, increase precision, and improve overall healthcare quality, accessibility, and affordability.
- **SDG 4: Quality Education:** Robotics can contribute to education by providing engaging, hands-on learning experiences for students of all ages. Robots can also be used in remote or under-resourced areas to increase access to quality education.
- **SDG 8: Decent Work and Economic Growth:** Robotics and automation can drive economic growth by increasing productivity, competitiveness, and innovation. By creating new jobs and industries, robotics can contribute to full and productive employment for all.
- **SDG 9: Industry, Innovation, and Infrastructure:** Robotics can play a vital role in the development of sustainable industrialization and innovation. By fostering cutting-edge research and development, robotics can help build resilient infrastructure, promote inclusive and sustainable industrialization, and facilitate innovation.
- **SDG 11: Sustainable Cities and Communities:** Robots can contribute to sustainable urban development by supporting the construction of eco-friendly buildings, improving waste management, and enhancing public transportation systems. Robotics can also assist in disaster response and recovery efforts, making cities and communities more resilient.
- **SDG 12: Responsible Consumption and Production:** Robotics can be used in manufacturing to optimize production processes, reduce waste, and minimize resource consumption. By improving efficiency and sustainability, robotics can help ensure responsible consumption and production patterns.
- **SDG 13: Climate Action:** Robotics technologies can support climate action by monitoring and collecting data on environmental conditions, reducing emissions in industrial processes, and contributing to clean energy production.
- **SDG 14: Life Below Water:** Underwater robotics can be used for ocean exploration, marine ecosystem monitoring, and pollution control. These technologies can help protect and preserve life below water and support sustainable use of marine resources.
- **SDG 15: Life on Land:** Robotics can be used in agriculture to increase crop yields, reduce resource consumption, and minimize the environmental impact of farming. Additionally, robotics can assist in wildlife monitoring, conservation efforts, and reforestation initiatives.

It is essential for countries and companies to consider the potential of robotics in addressing these SDGs when developing their robotics strategies. By aligning their objectives with the global goals, they can maximize the positive impact of robotics technologies on society and the environment.

- **Several countries and regions have adopted national robotics strategies to harness the potential of robotics technology and maintain competitiveness in the global market.** Here are a few examples:
 - **United States:** The U.S. National Robotics Initiative (NRI) was established in 2011 to focus on the development and deployment of robotics technologies. The initiative aims to accelerate the development of next-generation robotics that can work cooperatively with humans, support the U.S. manufacturing sector, enhance healthcare and medical devices, provide emergency response and disaster recovery, and improve quality of life for people with disabilities.
 - **European Union:** The EU's SPARC Robotics program, launched in 2014, is a public-private partnership aimed at positioning Europe as a global leader in robotics innovation. The program focuses on:
 - Fostering research and development in robotics.
 - Enhancing the competitiveness of European robotics companies.
 - Encouraging the use of robotics across various sectors, including manufacturing, agriculture, healthcare, and transportation.
 - Developing ethical, legal, and societal guidelines for the responsible use of robotics.
 - **Japan:** Japan's New Robot Strategy, established in 2015, emphasizes the importance of robotics in addressing the country's aging population and labor shortage issues. The strategy aims to:
 - Increase the adoption of robots in industrial and service sectors.
 - Foster collaboration between industry, academia, and government to promote R&D and innovation.
 - Develop global standards for robotics and support the international expansion of Japanese robotics companies.
 - **South Korea:** The South Korean government's Intelligent Robot Development and Supply Promotion Act, enacted in 2008, focuses on promoting the robotics industry to enhance the country's global competitiveness. The strategy aims to:
 - Support the development of advanced robotics technologies and products.
 - Foster a skilled workforce in robotics through education and training programs.

- Promote the adoption of robotics in various industries, including manufacturing, healthcare, and entertainment.
 - China: China's Robotics Industry Development Plan (2016-2020) aims to make the country a global leader in the robotics sector. The plan focuses on:
 - Accelerating the development of core robotics technologies, such as sensing, control, and intelligent decision-making.
 - Promoting the application of robotics in industries like manufacturing, logistics, and services.
 - Encouraging innovation and collaboration between industry, academia, and research institutions.
 - Building a skilled workforce in robotics through education and training programs.

These strategies generally focus on research and development, commercialization, workforce development, and the responsible use of robotics across various sectors. While each country or region has its unique context and priorities, they all recognize the importance of robotics in driving innovation, economic growth, and societal well-being.

- **The Business for the role of advanced technologies to support sustainable business practice and contribute to the SDGs.** There are numerous examples of corporations leveraging advanced technologies, including robotics and automation, to support sustainable business practices and contribute to achieving the United Nations Sustainable Development Goals (SDGs). These technologies help companies optimize resource use, minimize waste, reduce energy consumption, and improve overall sustainability:
 - Siemens: Siemens has developed an automation and digitalization portfolio that supports energy efficiency, resource optimization, and sustainable production. By implementing their Digital Enterprise software suite, companies can create digital twins of their entire production process, allowing them to simulate, optimize, and manage resources more effectively. In the area of robotics, Siemens has also partnered with companies such as Comau to create more efficient robotic automation solutions for industries.
 - ABB: ABB, a global technology leader, offers numerous robotic and automation solutions to improve energy efficiency, reduce waste, and optimize resource use. One example is their collaborative robot, YuMi, designed to work alongside humans in manufacturing environments. ABB also provides industrial automation solutions that enable smart manufacturing, which can lead to more sustainable production processes.
 - IBM: IBM's Watson IoT platform has been utilized by various industries to optimize operations, reduce waste, and conserve resources. In agriculture, for example, IBM has partnered with Yara International to develop the Watson Decision Platform for Agriculture, which uses AI, IoT, and analytics to optimize water and fertilizer use, reduce waste, and improve overall crop yields.
 - Google: Google's DeepMind AI has been used to optimize the energy efficiency of Google's data centers, resulting in a 40% reduction in energy used for cooling and a 15% reduction in overall energy overhead. Google also invests in robotics and automation research, which has the potential to contribute to sustainable practices across various industries.
 - Amazon: Amazon uses robotics and automation in its warehouses to optimize logistics, reduce waste, and improve efficiency. They have also invested in drone technology for package delivery, which has the potential to reduce greenhouse gas emissions from traditional delivery vehicles. In addition, Amazon's sustainability initiatives include the Climate Pledge, which aims to reach net-zero carbon emissions by 2040.
 - John Deere: John Deere, an agricultural machinery manufacturer, has developed precision agriculture technologies that use AI, robotics, and IoT to optimize farming practices. These technologies help farmers manage resources more efficiently, reduce waste, and minimize the environmental impact of agriculture.

These examples demonstrate how corporations are harnessing advanced technologies, including robotics and automation, to support sustainable business practices and contribute to achieving the United Nations Sustainable Development Goals. By integrating these technologies into their operations, companies can optimize resource use, minimize waste, reduce energy consumption, and improve overall sustainability.



Responses to specific questions

1. Do you agree with the definitions in the discussion paper? If not, what definitions do you prefer?

We appreciate the effort put into defining key terms in the discussion paper. It is essential to establish a common understanding of these terms as they are fundamental to shaping the National Robotics Strategy.

While we generally agree with the definitions provided, we suggest considering the following points to ensure they remain inclusive and adaptive to future technological advancements:

- In defining "robot," consider emphasizing the importance of autonomy and adaptability in addition to the physical and software components. This will help encompass a broader range of systems, including those that learn and evolve over time.
- For "robotics technology," we recommend expanding the definition to include not only the development and application of robots but also the integration of these systems within various industries and their impact on society, economy, and the environment.

By refining these definitions, we can better address the diverse range of technologies and applications relevant to the National Robotics Strategy.

2. What is your vision for the future of robotics and automation in Australia?

Are there any sectors or types of robotics that hold particular opportunities for our nation?

The future of robotics and automation in Australia should embrace innovation, foster sustainable development, and support the creation of high-quality jobs while enhancing the competitiveness of our industries. We envision a future where robotics and automation technologies contribute significantly to achieving the United Nations Sustainable Development Goals (SDGs) and promote the well-being of society, the environment, and the economy.

Development of robotics is essential for Australia's progress; however, its potential can be tripled if viewed from 'sustainability,' 'systems,' and 'eco-effectiveness' lenses.

Sustainability: It is a recognized fact that current production and consumption systems are resource-intensive and generate waste. A proactive acknowledgment of these issues will make Australia a leader in sustainable robotics as it develops the industry.

Systems: All domains of modern life, like the environment, society, economy, technology, and information, form a larger system. Introduction of robotics will be beneficial in one part of the system, but it might produce unintended effects in other parts. Therefore, a systems view of the industry should be adopted to strategically develop areas in robotics that produce positive synergies.

Eco-effectiveness: Robots will contribute to eco-efficiency, which is generally viewed as beneficial for resource utilization. However, eco-efficiency can produce reverse effects like rebound effects or Jevon's paradox. Robotics applications should also consider how they impact the environment and proactively reduce these negative impacts.

Several sectors in Australia hold particular opportunities for the integration of robotics and automation:

Agriculture: Robotics can revolutionize Australian agriculture by enhancing precision farming, optimizing resource use, minimizing waste, and reducing environmental impact. Examples include autonomous tractors, drones for crop monitoring, and robotic systems for harvesting and sorting produce.

Mining and resources: Robotics can help improve worker safety, increase operational efficiency, and reduce environmental impact in Australia's strong mining industry. Applications include autonomous vehicles for transportation, remote-controlled or autonomous drilling machines, and robotic systems for mine inspection and maintenance.

Manufacturing: Robotics and automation can help Australian manufacturers enhance productivity, improve product quality, and reduce waste. Collaborative robots (cobots) can work alongside human workers, while AI-driven systems can optimize production processes, reducing energy consumption and resource waste.

Healthcare and medical research: Robotics can play a crucial role in enhancing healthcare services, from remote surgeries and rehabilitation to advanced diagnostics and drug discovery. These technologies can help improve patient care, reduce healthcare costs, and increase accessibility.

3. How should we measure the growth and success of robotics in Australia? What methodologies would ensure robust and reproducible evidence?

We believe that measuring the growth and success of robotics in Australia requires a comprehensive and multi-dimensional approach, capturing not only the economic impact but also the social and environmental benefits. To ensure robust and reproducible evidence, we suggest considering the following methodologies and indicators:

Economic indicators:

- Number of robotics-related patents filed and granted.
- Investment in robotics research and development (public and private sectors).
- Market size and growth rate of the robotics industry in Australia.
- Number of robotics startups and established companies operating in Australia.
- Exports of robotics products and services.
- Job creation and workforce transformation in industries with a high adoption of robotics technologies.

Social indicators:

- Workforce diversity in the robotics sector, including gender, age, and cultural backgrounds.
- Skill development and training opportunities in robotics-related fields.
- Public awareness and acceptance of robotics technologies.
- Impact on occupational health and safety, including the reduction of workplace accidents and injuries in industries adopting robotics.
- Access to robotics technologies for people with disabilities, enhancing social inclusion and independence.

Environmental indicators:

- Resource efficiency and waste reduction in industries adopting robotics and automation.
- Energy efficiency improvements due to the implementation of robotics technologies.
- Reduction in greenhouse gas emissions attributable to the use of robotics in various sectors, such as transportation and agriculture.
- Contribution of robotics to the development and maintenance of renewable energy infrastructure.

Alignment with the United Nations Sustainable Development Goals (SDGs):

- Assess the impact of robotics technologies on the progress towards achieving the SDGs in Australia, such as SDG 9 (Industry, Innovation, and Infrastructure) and SDG 12 (Responsible Consumption and Production).
- To ensure accurate and consistent measurement, it is essential to establish standardized methodologies and data collection procedures.

<p>4. Is there anything else we should consider for a shared vision to capture Australia's robotics opportunities</p>	<p>We believe that a shared vision for capturing Australia's robotics opportunities should consider the following additional aspects:</p> <p>Collaboration and knowledge sharing: Encourage collaboration among businesses, academia, government, and other stakeholders to foster innovation, share best practices, and accelerate the adoption of robotics and automation technologies across various sectors.</p> <p>Support for SMEs: Develop targeted programs and resources to assist small and medium-sized enterprises (SMEs) in understanding, adopting, and integrating robotics technologies, as they often face unique challenges compared to larger organizations.</p> <p>Regulatory framework and standards: Create a supportive and flexible regulatory environment that ensures the ethical and responsible development and use of robotics technologies while keeping pace with innovation. Develop and promote national and international standards to ensure interoperability, safety, and security.</p> <p>Education and workforce development: Invest in education and training programs that equip the current and future workforce with the necessary skills to succeed in a robotics-driven economy. Emphasize interdisciplinary learning, combining technical expertise with critical thinking, creativity, and communication skills.</p> <p>Focus on ethical, legal, and social implications: Address potential ethical, legal, and social issues related to the widespread adoption of robotics and automation, such as data privacy, cybersecurity, job displacement, and inequality.</p> <p>Inclusivity and accessibility: Ensure that the benefits of robotics and automation technologies are equitably distributed among all Australians, including those in remote and rural areas, and people with disabilities.</p> <p>Global competitiveness: Foster an innovation ecosystem that enables Australian robotics companies and researchers to compete on the global stage, attracting international talent, investment, and partnerships.</p>
<p>5. What are Australia's existing strengths in robotics and automation research, development and production? How can we build on these?</p>	<p>Australia has several existing strengths in robotics and automation research, development, and production, providing a solid foundation for the nation's future growth in the sector:</p> <p>World-class research institutions: Australia is home to an active robotics research community, including leading institutions such as the Australian Centre for Robotic Vision, the Centre for Autonomous Systems, and the Australian Robotics and Automation Association. These institutions drive cutting-edge research and produce highly skilled graduates in the field.</p> <p>Specialization in niche areas: Australia excels in specific areas of robotics and automation, such as mining automation, agricultural robotics, drone technology, and marine robotics. These specializations have garnered international recognition and provide a competitive advantage.</p> <p>Strong industry sectors: Established sectors, such as mining, agriculture, healthcare, and a strong medical technology industry, are already adopting robotics and automation technologies. These sectors have the potential to drive further innovation and create opportunities for collaboration between researchers and businesses.</p> <p>Supportive innovation ecosystem: Australia has a growing network of incubators, accelerators, and innovation hubs that support start-ups and SMEs in the robotics and automation sectors. These initiatives foster collaboration, knowledge-sharing, and access to resources.</p> <p>Government commitment: The National Robotics Roadmap demonstrates the government's strong commitment to robotics and paves the way for further investment and support in the sector.</p>

	<p>These strengths, when combined, offer a robust foundation for Australia to become a global leader in robotics and automation, driving innovation, economic growth, and societal benefits.</p>
<p>6. In what related areas could Australia develop world-leading expertise?</p>	<p>Australia has the potential to develop world-leading expertise in several robotics and automation areas, leveraging its existing strengths and addressing emerging global challenges:</p> <p>Environmental and conservation robotics: Australia's unique biodiversity and ecosystems provide opportunities to develop robotics technologies for environmental monitoring, wildlife conservation, and habitat restoration. Examples include drones for monitoring wildlife populations, robotic systems for reforestation, and autonomous marine robots for oceanographic research and monitoring.</p> <p>Disaster response and resilience: Given Australia's exposure to natural disasters, there is an opportunity to develop advanced robotics and automation technologies for disaster response, recovery, and mitigation. This could include autonomous systems for search and rescue, debris removal, damage assessment, reconnaissance in dangerous or inaccessible areas, and early warning and monitoring systems.</p> <p>Remote and teleoperated robotics: Australia's vast and remote areas create opportunities to develop remote and teleoperated robotic systems for various applications, such as mining, agriculture, infrastructure maintenance (e.g., inspecting and maintaining critical infrastructure like bridges, tunnels, and pipelines), and healthcare. These systems can help address challenges posed by distance, accessibility, and workforce limitations in remote areas.</p> <p>Human-robot collaboration: As collaborative robots (cobots) become more prevalent, Australia can develop expertise in designing and integrating systems that enable safe, efficient, and effective human-robot collaboration in various industries, such as manufacturing, logistics, and healthcare.</p> <p>Special needs education: Robots can also be used to assist with special needs education, such as autism, providing tailored support and innovative learning experiences for students with diverse needs.</p>

7. How can Australia improve its investment environment and access to capital to support Australian robotics companies?

We recognize the importance of a supportive investment environment and access to capital for the growth and success of Australian robotics companies. Here are some strategies that can help improve these aspects:

Government funding and incentives: Increase government funding for robotics research, development, and commercialization through grants, tax incentives, and subsidies. This support can help reduce the financial risks associated with developing new technologies and make it easier for startups and SMEs to access capital.

Public-private partnerships: Encourage public-private partnerships (PPPs) to support the development and adoption of robotics technologies. PPPs can help share risks, pool resources, and facilitate collaboration between the public sector, private sector, and research institutions.

Attract venture capital and private investment: Promote Australia's robotics sector to domestic and international venture capital firms, angel investors, and other private investors to attract additional funding. This can be achieved through networking events, conferences, and showcasing success stories in the industry.

Establish robotics-focused investment funds: Create dedicated investment funds or incubators that specifically target robotics and automation start-ups and companies. These funds can provide targeted financial support and mentorship, helping companies grow and scale.

Streamline regulations and remove barriers: Review and streamline regulations that may hinder investment in the robotics sector. This includes addressing any legal, financial, or administrative barriers that could discourage investors or slow down the commercialization process.

Enhance collaboration with research institutions: Strengthen the ties between industry and research institutions to facilitate knowledge transfer, co-development, and commercialization of robotics technologies. This can increase the attractiveness of Australian robotics companies to investors and improve their access to capital.

Educate investors on the potential of robotics: Raise awareness among the investment community about the potential growth and benefits of the robotics sector, as well as the opportunities for long-term returns on investment.

Support for SMEs: Develop targeted programs and resources to help SMEs navigate the investment landscape and access capital. This could include training on pitch development, financial planning, and investment readiness.

8. How can Australia improve its robotics supply chain?

we understand the importance of a robust and efficient robotics supply chain for the growth and success of the sector. Here are some strategies to improve Australia's robotics supply chain:

Strengthen domestic manufacturing capabilities: Invest in advanced manufacturing technologies and infrastructure to support the local production of high-quality, cost-effective robotics components and systems. This includes promoting the adoption of Industry 4.0 practices, such as additive manufacturing, digital twins, and the Industrial Internet of Things (IIoT).

Encourage local sourcing: Support the development of a strong domestic supply base for robotics components and materials, encouraging local sourcing and reducing reliance on international suppliers. This can be achieved through targeted incentives, support programs, and public-private partnerships.

Enhance supply chain resilience: Identify and address potential vulnerabilities in the robotics supply chain, such as single points of failure, limited supplier diversity, and geopolitical risks. Develop contingency plans and risk mitigation strategies to ensure supply chain resilience.

Foster collaboration and partnerships: Encourage collaboration and partnerships among Australian robotics companies, suppliers, research institutions, and government agencies to facilitate knowledge-sharing, innovation, and access to resources.

Support for SMEs: Provide targeted support to SMEs in the robotics supply chain, helping them overcome barriers to entry, scale their operations, and access new markets. This could include technical assistance, financial support, and networking opportunities.

Streamline regulations and standards: Review and harmonize regulations and standards related to the robotics supply chain, ensuring they are supportive, transparent, and keep pace with technological advancements. This can help reduce compliance costs and encourage innovation.

Develop a skilled workforce: Invest in education and training programs to develop a skilled workforce capable of supporting the robotics supply chain. This includes promoting STEM education, vocational training, and upskilling initiatives focused on robotics and related fields.

Promote sustainable and ethical practices: Encourage the adoption of sustainable and ethical practices throughout the robotics supply chain, such as resource efficiency, waste reduction, and fair labour practices. This can enhance the reputation and competitiveness of the Australian robotics sector.

9. How can we make it easier to commercialise Australian research and development?

we recognize the importance of commercializing Australian research and development (R&D) for the growth and success of the nation's technology sectors, including robotics. Here are some strategies to facilitate the commercialization process:

Enhance collaboration between academia and industry: Strengthen ties between universities, research institutions, and industry to foster knowledge transfer, joint research projects, and the development of market-ready solutions. Initiatives such as industry-sponsored research programs, joint research centres, and innovation hubs can help facilitate collaboration.

Support technology transfer: Establish technology transfer offices within research institutions to assist with the identification, protection, and commercialization of intellectual property (IP). These offices can provide guidance on IP strategies, licensing, and partnership opportunities.

Streamline funding and grant programs: Simplify and streamline the process for accessing public funding and grants for R&D commercialization. This includes reducing bureaucratic hurdles, increasing transparency, and providing clear guidelines on eligibility and application requirements.

Develop incubators and accelerators: Support the establishment of incubators and accelerators that focus on helping startups and SMEs in technology sectors, including robotics, bring their innovations to market. These programs can provide resources, mentorship, and networking opportunities to help entrepreneurs scale their businesses.

Encourage public-private partnerships: Promote public-private partnerships (PPPs) that facilitate the commercialization of research by sharing risks, resources, and expertise. PPPs can help bring together researchers, businesses, and government agencies to address market needs and develop innovative solutions.

Create targeted tax incentives: Develop tax incentives for businesses that invest in commercializing Australian R&D, such as R&D tax credits, deductions for IP licensing, or tax breaks for start-ups and SMEs engaged in technology commercialization.

Foster a culture of entrepreneurship: Encourage a culture of entrepreneurship within research institutions by providing training, resources, and support for researchers interested in commercializing their innovations. This includes promoting entrepreneurial education, mentorship programs, and access to resources such as office space and seed funding.

Build a skilled workforce: Invest in education and training programs that equip graduates and professionals with the skills needed to support R&D commercialization, such as business development, project management, and IP management.

10. How can we encourage more collaboration between industry and research?

Fostering collaboration between industry and research is critical for driving innovation, commercialization, and economic growth. Here are some strategies to encourage greater collaboration:

Establish collaborative platforms: Create innovation hubs, research parks, and industry clusters that facilitate collaboration between researchers, businesses, and government agencies. These platforms can provide shared resources, networking opportunities, and a collaborative environment to foster partnerships and joint projects.

Develop industry-focused research programs: Encourage research institutions to develop industry-focused research programs that address market needs and challenges. These programs can be supported by industry partnerships, sponsorships, or co-funding arrangements, ensuring research outcomes have practical applications and commercial potential.

Facilitate knowledge exchange: Organize regular events, such as workshops, conferences, and webinars, to facilitate knowledge exchange and networking between industry and research communities. These events can help identify collaboration opportunities, showcase research achievements, and build relationships among stakeholders.

Support collaborative research grants: Offer grants and funding opportunities that specifically encourage collaborative research projects between industry and research institutions. These grants can help share risks, pool resources, and facilitate the development of market-driven innovations.

Create industry liaison roles: Establish industry liaison roles within research institutions to help identify collaboration opportunities, facilitate partnerships, and support the commercialization of research outcomes. These roles can act as a bridge between the academic and business communities, ensuring research activities align with industry needs.

Encourage secondments and internships: Promote secondments and internships that enable researchers to work within industry settings and industry professionals to engage with research institutions. These opportunities can help build understanding, trust, and relationships between the two sectors.

Streamline intellectual property (IP) policies: Review and streamline IP policies to ensure they are supportive of collaborative research activities, addressing issues such as ownership, licensing, and revenue-sharing. Clear and transparent IP policies can help reduce barriers to collaboration and promote innovation.

Enhance skills development: Invest in education and training programs that equip researchers and industry professionals with the skills needed to engage in collaborative research activities, such as project management, communication, and problem-solving.

11. What are the barriers and enablers to international cooperation and exporting Australian robotics and automation technologies?

International cooperation and exporting Australian robotics and automation technologies are essential for the sector's growth and global competitiveness. Here are some barriers and enablers to consider:

Barriers:

Limited brand recognition: Australian robotics and automation companies may face limited brand recognition in the global market, making it challenging to establish partnerships, access customers, and secure international contracts.

Access to global supply chains: Integrating into global supply chains can be difficult due to established competitors, strict quality requirements, and logistical challenges.

Regulatory differences: Differences in regulations, standards, and certifications between countries can create barriers to market entry and increase compliance costs for Australian companies.

Intellectual property protection: Ensuring adequate IP protection in international markets can be challenging, as IP regulations and enforcement may vary between countries.

Access to financing: Securing financing to support international expansion and export activities can be difficult, particularly for SMEs and start-ups with limited financial resources.

Skills gap: Australian companies may face a skills gap when entering new markets, as local talent may not possess the necessary knowledge and expertise to navigate the complexities of international business.

Enablers:

Government support: Government initiatives such as export grants, trade missions, and bilateral agreements can help Australian robotics companies access international markets and establish partnerships.

Industry associations and networks: Industry associations and networks can facilitate connections and collaboration with international partners, providing access to resources, knowledge, and opportunities.

International standards and certifications: Adopting international standards and certifications can help Australian companies meet global market requirements and demonstrate the quality and reliability of their products.

Technology showcasing: Participating in international trade shows, conferences, and events can help Australian companies showcase their technologies, establish brand recognition, and build relationships with potential customers and partners.

R&D collaboration: Collaborating with international research institutions and organizations can help Australian companies access new ideas, expertise, and resources, driving innovation and global competitiveness.

Skilled workforce: Developing a skilled workforce with international business experience and language capabilities can help Australian companies navigate the complexities of international markets and establish successful export activities.

12. What do you think are the impacts and opportunities of robotics and automation in Australia?

The impacts and opportunities of robotics and automation in Australia are significant, with the potential to transform various sectors of the economy and society. Here are some key impacts and opportunities:

Impacts:

Productivity improvements: Robotics and automation can lead to substantial productivity gains by streamlining processes, reducing manual labour, and optimizing resource utilization. This can enhance the competitiveness of Australian businesses in the global market.

Job displacement and creation: While robotics and automation may displace some jobs, especially those involving repetitive tasks, they can also create new job opportunities in fields such as programming, engineering, maintenance, and data analysis. Upskilling and reskilling programs will be crucial to address this transition.

Changes in work patterns: The introduction of robotics and automation may lead to changes in work patterns, with an increased focus on collaboration, problem-solving, and creativity. Workers will need to adapt to working alongside robots and automated systems.

Opportunities:

Growth in key sectors: Robotics and automation can drive growth in sectors such as agriculture, mining, manufacturing, healthcare, logistics, and renewable energy. By automating processes, improving efficiency, and reducing costs, these industries can become more competitive and sustainable.

Enhanced safety and working conditions: Robotics and automation can improve safety and working conditions by performing hazardous tasks, reducing workplace injuries, and minimizing exposure to harmful environments.

Sustainable resource management: Robotics and automation technologies can contribute to more sustainable resource management practices, including optimizing energy and water usage, reducing waste, and promoting recycling and circular economy initiatives.

Increased innovation: The adoption of robotics and automation can spur innovation across various industries, as businesses seek to develop new products, services, and processes to remain competitive in the evolving market landscape.

Improved quality of life: Robotics and automation can improve the quality of life by enhancing healthcare services, assisting with elder care, and enabling smarter, more efficient cities.

Global leadership: By developing and adopting cutting-edge robotics and automation technologies, Australia can position itself as a global leader in the sector, attracting investment, talent, and fostering international collaboration.

13. What would increase trust and approval of robotics and automation?

Building trust and approval for robotics and automation is essential for their successful adoption and integration into society. Here are some strategies to increase trust and approval:

Transparent communication: Open and transparent communication about the benefits, risks, and potential impacts of robotics and automation can help build public understanding and trust. Companies and policymakers should engage in dialogue with stakeholders, address concerns, and provide clear information about the technology.

Education and awareness: Raising awareness and promoting education about robotics and automation can help the public understand the technology's capabilities, limitations, and potential applications. Initiatives such as public demonstrations, workshops, and educational programs can help demystify the technology and foster acceptance.

Ethical considerations: Ensuring the ethical development and use of robotics and automation is critical to gain public trust. This includes addressing concerns related to privacy, data security, and human-robot interaction. Establishing ethical guidelines and best practices can help guide responsible technology deployment.

Regulatory frameworks and standards: Developing and implementing robust regulatory frameworks and standards can help ensure the safe, responsible, and compliant use of robotics and automation. These frameworks should address potential risks and challenges, such as safety, security, and liability, and be adaptable to evolving technology advancements.

Inclusive design: Involving end-users, communities, and other stakeholders in the design and development process can help ensure that robotics and automation technologies meet diverse needs, preferences, and values. Inclusive design can lead to more user-friendly and socially acceptable solutions.

Demonstrating benefits: Showcasing real-life examples of how robotics and automation improve efficiency, safety, sustainability, and overall quality of life can help build public trust and approval. Sharing success stories and case studies can provide tangible evidence of the technology's potential.

Public-private partnerships: Encouraging collaboration between public and private sectors can help align technology development with societal needs, ensure responsible deployment, and build public trust.

14. How can Australia ensure robotics and automation are developed and adopted lawfully, responsibly and in a way that improves the lives of Australians?

Ensuring the lawful, responsible, and beneficial development and adoption of robotics and automation in Australia requires a comprehensive approach that involves various stakeholders. Here are some key strategies to achieve this:

Robust regulatory frameworks: Establishing clear, adaptable, and future-proof regulatory frameworks that address safety, privacy, data security, and ethical concerns is crucial. These frameworks should be regularly reviewed and updated to accommodate technological advancements and emerging challenges.

Industry standards and best practices: Developing and promoting industry standards and best practices for the responsible development and deployment of robotics and automation can help ensure consistency, safety, and ethical considerations across various sectors.

Public-private partnerships: Encouraging collaboration between public and private sectors can help align technology development with societal needs and ensure responsible deployment. This collaboration can facilitate knowledge exchange, risk-sharing, and the development of innovative solutions that improve the lives of Australians.

Education and training: Investing in education and training programs to develop a skilled workforce capable of designing, deploying, and maintaining robotics and automation systems responsibly is essential. This includes upskilling and reskilling programs for workers impacted by automation to ensure a smooth transition into new job opportunities.

Inclusive design: Engaging end-users, communities, and other stakeholders in the design and development process can help ensure that robotics and automation technologies are developed with diverse needs, preferences, and values in mind. Inclusive design can lead to more user-friendly and socially acceptable solutions.

Ethical considerations: Emphasizing ethical considerations throughout the development and deployment of robotics and automation is critical. This includes addressing concerns related to privacy, data security, and human-robot interaction. Establishing ethical guidelines and best practices can help guide responsible technology deployment.

Monitoring and evaluation: Regular monitoring and evaluation of the impacts of robotics and automation on society, the economy, and the environment are essential. This data can help inform policy adjustments, identify areas for improvement, and ensure that the technology continues to benefit Australians.

Several countries have addressed similar issues in their robotics strategies, focusing on the responsible and beneficial development and adoption of robotics and automation technologies. Here are a few examples:

Germany: Germany's High-Tech Strategy 2025 outlines its approach to ensuring responsible development and adoption of advanced technologies, including robotics. The strategy emphasizes the importance of ethical considerations, data security, and safety. It also promotes collaboration between industry, academia, and government to create innovative solutions that benefit society and the economy.

Japan: Japan's Robot Strategy, published in 2015, highlights the need for regulatory reforms, safety standards, and ethical guidelines to ensure the responsible development and deployment of robotics technologies. The strategy also emphasizes the importance of education and training to develop a skilled workforce and facilitate the integration of robotics into various sectors.

South Korea: The South Korean government's Intelligent Robot Development and Supply Promotion Act focuses on fostering the robotics industry while addressing safety, ethical, and social concerns. The act promotes research and development, industry collaboration, and the creation of standards and guidelines to ensure the responsible development and adoption of robotics technologies.

European Union: The European Union's Robotics 2020 Strategic Research Agenda outlines a comprehensive approach to address the responsible development and deployment of robotics technologies. The agenda emphasizes ethical, legal, and societal issues, including safety, privacy, and data security. It also promotes collaboration among member states, industry, and research institutions to develop innovative solutions that benefit society and the economy.

15. How can we ensure Australian workers benefit from the adoption of robotics and automation?

Ensuring Australian workers benefit from the adoption of robotics and automation requires a multi-faceted approach that addresses potential challenges and leverages opportunities. Here are some key strategies:

Education and training: Investing in education and training programs that equip workers with the skills needed to work alongside robotics and automation technologies is essential. This includes upskilling and reskilling initiatives for workers whose jobs may be impacted by automation, as well as programs that develop skills in robotics, programming, data analysis, and related fields.

Inclusive workforce planning: Encouraging businesses to engage in inclusive workforce planning that considers the potential impact of robotics and automation on jobs and identifies new job opportunities can help ensure workers are prepared for the transition.

Support for job transitions: Providing support to workers who may be displaced by automation, such as job placement assistance, career counseling, and financial support, can help ease the transition to new roles and minimize potential negative impacts.

Collaboration between industry, academia, and government: Fostering collaboration among these stakeholders can help align education and training programs with industry needs, ensuring that workers are equipped with the skills required to thrive in the evolving job market.

Promoting innovation and entrepreneurship: Encouraging innovation and entrepreneurship in the robotics and automation sector can create new job opportunities and stimulate economic growth. This can be achieved through financial incentives, mentorship programs, and the creation of innovation hubs and co-working spaces.

Fair and equitable labour practices: Ensuring that the adoption of robotics and automation does not lead to unfair labour practices, such as excessive reliance on temporary or precarious work, is critical. Policymakers and businesses should promote fair and equitable labour practices that protect workers' rights and ensure decent working conditions.

Social dialogue and stakeholder engagement: Engaging workers, unions, employers, and other stakeholders in discussions about the adoption of robotics and automation can help ensure that diverse perspectives are considered, and potential concerns are addressed proactively.

Several countries have addressed issues related to workforce development, job transitions, and ensuring that workers benefit from the adoption of robotics and automation in their national strategies. Here are a few examples:

Germany: Germany's High-Tech Strategy 2025 focuses on workforce development, emphasizing the importance of education, training, and upskilling to prepare workers for the digital transformation. The strategy includes initiatives such as the "Qualification Initiative for Germany," which aims to help workers adapt to the changing job market and acquire necessary skills.

Japan: Japan's Robot Strategy highlights the need for human resource development to ensure workers can thrive in an economy increasingly influenced by robotics and automation. The strategy promotes education and training programs that develop skills in robotics, programming, data analysis, and other relevant fields.

United States: The United States' National Robotics Initiative 2.0 (NRI-2.0) recognizes the potential impact of robotics and automation on the workforce and emphasizes the importance of education and workforce development. The initiative supports research and development projects that explore innovative approaches to worker training and education.

Singapore: Singapore's National Robotics Programme focuses on preparing the workforce for a future with robotics and automation by promoting education and training initiatives, such as SkillsFuture, which aims to equip Singaporeans with relevant skills for the digital economy.

European Union: The European Union's Robotics 2020 Strategic Research Agenda includes a focus on workforce development and the potential impacts of robotics and automation on employment. The agenda promotes education and training programs, research on new work models, and the importance of social dialogue among stakeholders to address potential challenges and opportunities.

16. What are the existing strengths in the skills and capabilities of Australia's robotics and automation workforce? Are there existing or expected gaps that need to be addressed?

Australia has several strengths in the skills and capabilities of its robotics and automation workforce. These strengths include:

World-class research institutions: Australian universities and research centres are internationally renowned for their work in robotics, automation, and related fields. This academic excellence has produced a strong talent pool of researchers, engineers, and innovators.

Industry expertise: Australia has a growing number of companies specializing in robotics, automation, and AI, particularly in sectors such as mining, agriculture, healthcare, and logistics. This industry expertise contributes to the development of a skilled workforce in these areas.

Multidisciplinary approach: Australia's robotics and automation workforce benefits from a multidisciplinary approach that combines expertise in engineering, computer science, data analytics, and other relevant fields, fostering innovation and the development of comprehensive solutions.

However, there are existing and expected gaps that need to be addressed to fully leverage Australia's potential in robotics and automation:

Skill shortages: As the demand for robotics and automation technologies increases, there is a growing need for skilled professionals in these fields. Addressing skill shortages through targeted education and training programs is crucial to ensuring a robust and competitive workforce.

Retraining and upskilling: As robotics and automation technologies continue to evolve and reshape the job market, it is essential to invest in retraining and upskilling initiatives for workers who may be impacted by these changes. This will help maintain a skilled and adaptable workforce capable of meeting industry needs.

Attracting and retaining talent: Local start-ups and smaller companies in Australia may struggle to compete with larger international firms in attracting and retaining top talent. Developing strategies to incentivize and retain skilled professionals within the country is important to nurture a thriving robotics and automation ecosystem.

Diversity and inclusion: There is a need to improve diversity and inclusion within the robotics and automation workforce, particularly regarding gender, cultural backgrounds, and socioeconomic backgrounds. Promoting diverse perspectives can lead to more innovative and inclusive solutions.

Several countries have addressed issues related to workforce development, skill gaps, and talent attraction and retention in their robotics strategies. Here are a few examples:

Germany: Germany's High-Tech Strategy 2025 places a strong emphasis on education, training, and upskilling initiatives to address skill shortages and prepare the workforce for the digital transformation. The strategy also promotes collaboration between industry and academia to ensure a steady pipeline of skilled professionals.

United States: The United States' National Robotics Initiative 2.0 (NRI-2.0) recognizes the importance of addressing workforce development and skill gaps. The initiative supports research and development projects aimed at innovative approaches to worker training and education, as well as fostering collaboration between industry, academia, and government.

Singapore: Singapore's National Robotics Programme focuses on preparing the workforce for a future with robotics and automation by promoting education and training initiatives. Programs like SkillsFuture aim to equip Singaporeans with the necessary skills for the digital economy, addressing skill gaps and encouraging lifelong learning.

South Korea: South Korea's Intelligent Robot Development and Supply Promotion Act includes provisions for workforce development, training, and education to address skill gaps and ensure a competitive robotics and automation industry. The act promotes collaboration between industry, academia, and government to develop skilled professionals and foster innovation.

European Union: The European Union's Robotics 2020 Strategic Research Agenda highlights the importance of addressing workforce development, skill gaps, and talent attraction and retention. The agenda promotes education and training programs, research on new work models, and collaboration among member states, industry, and research institutions to develop innovative solutions.

17. What are the barriers to training, attracting and retaining skilled and qualified workers to produce and adopt robotics and automation in Australia? How can these be addressed?

There are several barriers to training, attracting, and retaining skilled and qualified workers to produce and adopt robotics and automation in Australia. These barriers include:

Limited awareness and understanding: Many people may not be fully aware of the opportunities and benefits associated with robotics and automation careers. This lack of awareness could result in a lower number of individuals pursuing education and training in these fields.

Competition with overseas companies: Local startups and smaller companies in Australia may struggle to compete with larger international firms in attracting and retaining top talent. The competitive salaries and resources offered by global corporations can be challenging to match for smaller domestic players.

Skill gaps in education and training: There may be a lack of targeted education and training programs that cater to the specific skill requirements of the robotics and automation industry, making it difficult to adequately prepare the workforce.

Insufficient collaboration between industry and academia: A lack of strong collaboration between industry and academic institutions can result in a mismatch between the skills developed in educational programs and the skills required by employers.

Diversity and inclusion challenges: The robotics and automation sector, like many STEM fields, faces issues with diversity and inclusion, which could limit the talent pool and hinder innovation.

To address these barriers, Australia can consider the following strategies:

Promote awareness: Conduct awareness campaigns to inform the public about the benefits and opportunities of careers in robotics and automation, inspiring more people to pursue education and training in these fields.

Support local companies: Provide financial incentives, grants, and other support mechanisms to help local companies attract and retain talent, making them more competitive with larger international firms.

Develop targeted education and training programs: Invest in education and training programs that specifically cater to the skill requirements of the robotics and automation industry, ensuring a skilled workforce is available to meet industry needs.

Strengthen industry-academia collaboration: Foster collaboration between industry and academic institutions to align education and training programs with the skills required by employers, creating a seamless transition from education to employment.

Encourage diversity and inclusion: Implement policies and initiatives that promote diversity and inclusion within the robotics and automation workforce, ensuring a broader talent pool and fostering innovation.

Several countries have addressed issues related to training, attracting, and retaining skilled and qualified workers in their robotics strategies. Here are a few examples:

Germany: Germany's High-Tech Strategy 2025 emphasizes the importance of education, training, and upskilling initiatives to prepare the workforce for the digital transformation. The strategy also promotes collaboration between industry and academia to ensure a steady pipeline of skilled professionals.

United States: The United States' National Robotics Initiative 2.0 (NRI-2.0) focuses on workforce development and supports research and development projects aimed at innovative approaches to worker training and education. This initiative also encourages collaboration between industry, academia, and government to better align education with industry needs.

Singapore: Singapore's National Robotics Programme aims to prepare the workforce for a future with robotics and automation by promoting education and training initiatives. Programs like SkillsFuture help equip Singaporeans with the necessary skills for the digital economy, addressing skill gaps, and encouraging lifelong learning.

South Korea: South Korea's Intelligent Robot Development and Supply Promotion Act includes provisions for workforce development, training, and education to address skill gaps and ensure a competitive robotics and automation industry. The act promotes collaboration between industry, academia, and government to develop skilled professionals and foster innovation.

European Union: The European Union's Robotics 2020 Strategic Research Agenda highlights the importance of addressing workforce development, skill gaps, and talent attraction and retention. The agenda promotes education and training programs, research on new work models, and collaboration among member states, industry, and research institutions to develop innovative solutions.

18. How can Australia improve the diversity of its robotics and automation workforce and better include under-represented groups?

The importance of a diverse and inclusive robotics and automation workforce. To improve the diversity of Australia's robotics and automation workforce and better include under-represented groups, the following strategies can be considered:

Promote awareness and accessibility: Conduct targeted outreach and awareness campaigns to encourage under-represented groups to pursue careers in robotics and automation. Provide information about available education, training programs, and career paths to help break down barriers to entry.

Scholarships and financial support: Offer scholarships, grants, and financial support to under-represented groups, enabling them to access education and training opportunities in robotics and automation fields without financial constraints.

Inclusive educational programs: Develop inclusive educational programs that cater to diverse learning styles, abilities, and backgrounds. Provide mentorship and support systems that enable under-represented groups to excel in their studies and careers.

Foster inclusive work environments: Encourage companies to create inclusive work environments by implementing diversity and inclusion policies, providing unconscious bias training, and promoting flexible work arrangements that accommodate various needs.

Diverse representation in leadership: Encourage organizations to include diverse representation in leadership roles, which can inspire under-represented groups to pursue careers in robotics and automation and foster a more inclusive culture within the industry.

Partnership with community organizations: Collaborate with community organizations that represent under-represented groups to develop targeted initiatives and programs that address specific barriers and challenges faced by these communities.

Industry-wide diversity initiatives: Support and promote industry-wide initiatives that aim to improve diversity and inclusion within the robotics and automation sector. Encourage the sharing of best practices, success stories, and resources to drive collective progress.

Monitor and evaluate progress: Establish metrics and benchmarks to track progress on diversity and inclusion initiatives. Regularly evaluate the effectiveness of these programs to ensure they are delivering the desired outcomes and make improvements as needed.

Several countries have addressed the issue of diversity and inclusion in their robotics strategies, recognizing the importance of a diverse workforce for driving innovation and growth. Here are a few examples:

United States: The United States' National Robotics Initiative 2.0 (NRI-2.0) emphasizes the importance of broadening participation in robotics and automation fields. The initiative supports efforts to engage under-represented groups through targeted outreach, education, and research programs, as well as fostering collaboration between diverse institutions.

European Union: The European Union's Robotics 2020 Strategic Research Agenda acknowledges the need for a diverse and inclusive robotics workforce. The agenda encourages efforts to attract and retain talent from under-represented groups and promotes collaboration among member states, industry, and research institutions to develop and share best practices for diversity and inclusion.

United Kingdom: The UK's Industrial Strategy includes a focus on diversity and inclusion, with the aim of building a workforce that reflects the broader population. The strategy supports initiatives that promote diversity in STEM education and career pathways, as well as efforts to create inclusive work environments within the robotics and automation sector.

Canada: Canada's Pan-Canadian Artificial Intelligence Strategy highlights the importance of diversity and inclusion in AI and robotics research and development. The strategy supports programs aimed at increasing the representation of women, minorities, and other under-represented groups in AI and robotics fields through targeted outreach, mentorship, and funding opportunities.

19. How can we help workers transition and develop the skills they need to work alongside robotics?

Helping workers transition and develop the skills necessary to work alongside robotics is essential for the successful integration of robotics and automation technologies. Here are some recommendations to support this transition:

Training and upskilling programs: Develop targeted training and upskilling programs that focus on the specific skills required for working with robotics, such as programming, systems integration, maintenance, and data analysis. Collaborate with industry, academia, and vocational institutions to design and deliver these programs.

Lifelong learning initiatives: Encourage a culture of lifelong learning, providing opportunities for workers to continuously update their skills and adapt to technological advancements in robotics and automation.

Cross-disciplinary education: Promote cross-disciplinary education that combines robotics and automation knowledge with other relevant fields, such as business management, ethics, and design, to prepare workers for a wide range of roles in the industry.

On-the-job training and apprenticeships: Facilitate on-the-job training and apprenticeship programs that allow workers to gain practical experience in working with robotics and automation technologies, under the guidance of experienced professionals.

Financial support and incentives: Provide financial support and incentives for individuals and employers to invest in worker training and development, such as grants, tax breaks, or subsidies for training programs.

Collaboration between industry and academia: Foster collaboration between industry and academic institutions to ensure that the skills developed in educational programs align with the needs of employers, creating a seamless transition from education to employment.

Adaptability and resilience training: Encourage training programs that focus on adaptability and resilience, equipping workers with the mindset and skills to navigate the rapidly changing robotics and automation landscape.

Soft skills development: Recognize the importance of soft skills, such as problem-solving, communication, teamwork, and critical thinking, in the context of working with robotics and automation. Incorporate soft skills development into training and education programs.

Several countries have addressed the issue of helping workers transition and develop the skills necessary to work alongside robotics in their national strategies. Here are a few examples:

Germany: Germany's High-Tech Strategy 2025 emphasizes the importance of training and upskilling the workforce for the digital transformation. The strategy supports initiatives like the "Training Offensive" aimed at increasing digital skills among the workforce, as well as the Industry 4.0 initiative that focuses on fostering collaboration between industry and academia to prepare workers for the changing job market.

Singapore: Singapore's National Robotics Programme aims to prepare the workforce for a future with robotics and automation. The SkillsFuture initiative is designed to equip Singaporeans with the necessary skills for the digital economy, encouraging lifelong learning and offering targeted training programs and support for workers to adapt to technological advancements.

United States: The United States' National Robotics Initiative 2.0 (NRI-2.0) highlights the importance of workforce development in the context of robotics and automation. The initiative supports research and development projects aimed at innovative approaches to worker training and education, as well as fostering collaboration between industry, academia, and government to ensure the alignment of education and industry needs.

European Union: The European Union's Robotics 2020 Strategic Research Agenda recognizes the need to develop a workforce with the skills to work alongside robotics and automation technologies. The agenda encourages the development of education and training programs, research on new work models, and collaboration among member states, industry, and research institutions to ensure workers are prepared for the evolving job market.

Japan: Japan's New Robot Strategy emphasizes the importance of human resource development in the context of robotics and automation. The strategy promotes the integration of robotics education in primary, secondary, and higher education, as well as the development of training programs for workers to acquire the necessary skills to work alongside robots.

20. How are businesses and governments adopting robotics technology in Australia? Do they use Australian-made products?

We have observed that businesses and governments in Australia are increasingly adopting robotics technology across various sectors. Here are some examples of how robotics technology is being implemented in Australia:

Agriculture: Australian farmers are using robotics and automation technologies to improve efficiency, reduce labour costs, and increase precision in tasks like crop monitoring, planting, and harvesting. For example, SwarmFarm Robotics, an Australian company, provides robotic platforms for precision agriculture.

Mining and resources: Robotics and automation are being used in the mining sector to increase safety, productivity, and cost-effectiveness. Australian companies like Rio Tinto and BHP have adopted autonomous trucks and drilling systems to improve operational efficiency.

Healthcare: Australian healthcare providers are using robotics to assist in surgeries, patient care, and logistics. For instance, the Australian company Micro-X has developed a mobile x-ray unit using a robotic arm, making it easier to deploy in various healthcare settings.

Manufacturing: Australian manufacturers are adopting robotics technology for tasks such as assembly, packaging, and quality control, aiming to increase productivity and competitiveness. Companies like ABB and Universal Robots have a presence in Australia, providing robotic solutions for manufacturing businesses.

Logistics and warehousing: Robotics and automation are being used in logistics and warehousing to improve efficiency in tasks like sorting, packing, and inventory management. Australian companies like Cohesio Group are providing automation solutions for businesses in this sector.

Several countries have addressed the issues of business and government adoption of robotics technology and the use of domestically produced products in their national robotics strategies. Here are some examples:

Germany: Germany's High-Tech Strategy 2025 focuses on the adoption of Industry 4.0 technologies, including robotics, by businesses and governments. The strategy supports initiatives to strengthen Germany's position as a leading provider of robotics and automation technologies, encouraging the use of German-made products and fostering collaboration between research institutions, industry, and government.

Japan: Japan's New Robot Strategy aims to accelerate the adoption of robotics technology across various sectors, including manufacturing, healthcare, and infrastructure. The strategy encourages the development of Japan's robotics industry and promotes the use of domestically produced robotics technologies.

South Korea: South Korea's Intelligent Robotics Development Strategy focuses on expanding the adoption of robotics in industries such as manufacturing, logistics, and healthcare, while also supporting the growth of the domestic robotics industry. The strategy aims to increase the competitiveness of South Korean robotics companies and promote the use of South Korean-made robotics products.

United States: The United States' National Robotics Initiative 2.0 (NRI-2.0) supports research and development projects aimed at advancing robotics technology and increasing its adoption across various sectors. While the strategy doesn't explicitly focus on promoting the use of American-made robotics products, it does emphasize the importance of strengthening the domestic robotics industry and workforce to maintain global competitiveness.

China: China's Made in China 2025 strategy aims to transform the country into a global leader in high-tech industries, including robotics. The strategy encourages the adoption of robotics technologies across various sectors while also focusing on developing China's domestic robotics industry, promoting the use of Chinese-made robotics products.

21. Which Australian industry sectors would benefit the most from more robotics and automation? Why?

We believe several Australian industry sectors could significantly benefit from increased adoption of robotics and automation, given their potential to improve efficiency, productivity, safety, and sustainability. Key sectors that stand to gain the most include:

Agriculture: Robotics and automation can help address labour shortages, increase precision in farming operations, and optimize resource use. Technologies like autonomous tractors, drones for crop monitoring, and robotic harvesters can improve productivity and sustainability in the agriculture sector.

Mining and resources: The mining industry can benefit from robotics and automation by enhancing safety, reducing environmental impact, and increasing operational efficiency. Autonomous vehicles, robotic drilling systems, and remote operation centres can contribute to these improvements.

Manufacturing: Robotics and automation can increase productivity, reduce labour costs, and improve product quality in manufacturing. Collaborative robots, automated assembly lines, and advanced inspection systems can help manufacturers remain competitive in the global market.

Healthcare: Robotics can assist in surgeries, patient care, and logistics, ultimately improving healthcare outcomes and efficiency. Surgical robots, telemedicine solutions, and automated drug dispensing systems are examples of automation technologies that can benefit the healthcare sector.

Logistics and warehousing: Robotics can optimize sorting, packing, and inventory management operations in logistics and warehousing. Automated guided vehicles, robotic picking systems, and warehouse management software can improve efficiency, reduce errors, and lower costs.

Construction: Robotics and automation can enhance productivity, safety, and quality in the construction industry. Technologies such as robotic bricklaying, 3D printing of building components, and autonomous construction equipment can help transform the sector.

Environmental management and waste disposal: Robotics can improve waste sorting, recycling, and monitoring of environmental conditions. Automated waste sorting systems, robotic recycling systems, and drones for environmental monitoring can contribute to more sustainable practices in these areas.

Other countries have addressed the potential benefits of robotics and automation for specific industry sectors in their national robotics strategies. Some examples include:

Germany: Germany's High-Tech Strategy 2025 places a strong emphasis on Industry 4.0, which includes the adoption of robotics and automation in sectors like manufacturing, logistics, and healthcare. The strategy promotes the digitization and modernization of these industries to maintain global competitiveness and enhance efficiency.

Japan: Japan's New Robot Strategy focuses on the use of robotics in manufacturing, healthcare, infrastructure, and agriculture. Japan aims to develop and deploy advanced robotics technologies in these sectors to improve productivity, address labour shortages, and enhance the quality of life for its citizens.

South Korea: South Korea's Intelligent Robotics Development Strategy supports the adoption of robotics in manufacturing, logistics, healthcare, and services. The strategy aims to increase the competitiveness of these industries by investing in robotics research, development, and commercialization.

United States: The United States' National Robotics Initiative 2.0 (NRI-2.0) emphasizes the importance of robotics in sectors such as manufacturing, agriculture, healthcare, and transportation. The strategy supports research and development projects that can advance robotics technologies and increase their adoption in these industries.

China: China's Made in China 2025 strategy targets several industries for the adoption of advanced robotics and automation technologies, including manufacturing, agriculture, healthcare, and logistics. The strategy aims to transform these industries, improve efficiency and productivity, and establish China as a global leader in high-tech sectors.

22. What are the barriers to increased adoption of robotics and automation? How can we address these barriers?

Several barriers to the increased adoption of robotics and automation in the country. These barriers can be addressed through various strategic measures:

High upfront costs: Robotics and automation technologies can be expensive, particularly for small and medium-sized enterprises (SMEs). Addressing this barrier involves offering financial incentives, grants, or subsidized loans to support businesses in adopting these technologies.

Lack of awareness: Many companies may not be aware of the potential benefits of robotics and automation or the available solutions. Increasing awareness can be achieved through industry events, workshops, and targeted educational campaigns that showcase the benefits and opportunities of these technologies.

Skills gap: The lack of skilled workers and expertise in robotics and automation can hinder adoption. To address this gap, Australia should invest in education and training programs, promote STEM subjects, and facilitate collaboration between industry and academia.

Limited local ecosystem: A limited local ecosystem of robotics manufacturers and service providers can make it challenging to adopt these technologies. Supporting the growth of the local robotics ecosystem through research and development investments, business incentives, and fostering collaboration can help overcome this barrier.

Regulatory hurdles: Outdated or overly restrictive regulations can impede the adoption of robotics and automation. To address this, the government should review and update relevant regulations, ensuring they support innovation and growth in the sector while maintaining safety and ethical considerations.

Resistance to change: Employees and management may be resistant to adopting new technologies due to fear of job loss or perceived complexity. Addressing this barrier requires effective communication about the benefits of robotics and automation, as well as implementing retraining and upskilling programs for affected workers.

Cybersecurity concerns: The increased use of robotics and automation can raise concerns about data security and privacy. Strengthening cybersecurity infrastructure, promoting best practices, and developing industry-specific guidelines can help address these concerns.

Several countries have addressed the barriers to increased adoption of robotics and automation in their national strategies. Some examples include:

Germany: Germany's High-Tech Strategy 2025 and Industrie 4.0 initiative address the barriers of high upfront costs and skills gaps by providing funding for research and development, promoting collaboration between industry and academia, and investing in workforce education and training programs in robotics and automation.

Japan: Japan's New Robot Strategy tackles the barriers of limited local ecosystems and resistance to change by promoting collaboration between industry, government, and academia, fostering innovation, and encouraging the adoption of robotics in various sectors like healthcare and agriculture, where the country faces significant labour shortages.

South Korea: South Korea's Intelligent Robotics Development Strategy addresses the barriers of high upfront costs, skills gaps, and limited local ecosystems by providing financial incentives for research and development, promoting STEM education, and supporting the growth of domestic robotics companies.

United States: The United States' National Robotics Initiative 2.0 (NRI-2.0) addresses barriers such as the skills gap, lack of awareness, and regulatory hurdles by funding research and development projects, promoting collaboration between industry and academia, and engaging in regulatory reviews to ensure that regulations are up-to-date and support innovation in robotics and automation.

China: China's Made in China 2025 strategy tackles the barriers of limited local ecosystems and high upfront costs by investing heavily in the development of advanced manufacturing technologies, including robotics and automation, and providing financial incentives for businesses to adopt these technologies.

23. How do current regulations and standards help or limit the adoption of robotics? How could we improve these?

Current regulations and standards play a crucial role in the adoption of robotics and automation. They can both help and limit the adoption, depending on how well they address the evolving needs of the industry.

Helpful aspects of current regulations and standards:

Safety: Regulations and standards ensure that robotic systems are designed, deployed, and maintained with safety considerations in mind, protecting workers, customers, and the public.

Quality assurance: Standards ensure that robotic systems meet minimum requirements for performance, reliability, and interoperability, which in turn can enhance confidence in these technologies.

Ethical considerations: Regulations can help address ethical concerns related to privacy, data security, and potential bias in automated decision-making.

Limiting aspects of current regulations and standards:

Outdated regulations: Regulations that have not kept pace with technological advancements can hinder the adoption of robotics and automation, as they may not adequately address new technologies or applications.

Overly restrictive regulations: Overly restrictive regulations can impede innovation, limit the growth of the robotics industry, and discourage companies from adopting these technologies.

Inconsistency across jurisdictions: Different regulations and standards across states or countries can create challenges for businesses, especially those operating across borders, leading to increased complexity and costs.

Improving regulations and standards:

Regular reviews: Regularly reviewing and updating regulations and standards to ensure they are up-to-date and aligned with technological advancements will facilitate the adoption of robotics and automation.

Stakeholder engagement: Engaging with industry, academia, and other stakeholders in the development and revision of regulations and standards will ensure they remain relevant, practical, and effective.

Harmonization: Aligning regulations and standards across jurisdictions can help reduce complexity and costs for businesses, encouraging the adoption of robotics and automation technologies.

Flexibility: Ensuring that regulations and standards are flexible enough to accommodate new technologies and applications while maintaining safety, ethical considerations, and quality assurance will support innovation and growth in the robotics industry.

Several countries have addressed the issues raised in question 23 regarding regulations and standards in their robotics strategies:

European Union: The European Union has established a regulatory framework for artificial intelligence and robotics that focuses on promoting innovation while ensuring safety and ethical considerations. The EU is working on harmonizing standards across its member states to reduce complexity and costs for businesses operating across borders.

United States: The National Institute of Standards and Technology (NIST) in the United States has developed guidelines and standards for robotics and automation technologies to ensure safety, interoperability, and performance. The U.S. government also encourages collaboration between industry, academia, and regulatory agencies in developing and updating regulations to keep pace with technological advancements.

Japan: Japan's New Robot Strategy focuses on creating a flexible regulatory environment that supports the development and adoption of robotics technologies. The Japanese government is committed to revising existing regulations and creating new ones as needed to address the evolving needs of the robotics industry while ensuring safety and ethical considerations.

South Korea: South Korea's Intelligent Robotics Development Strategy emphasizes the importance of developing and updating regulations and standards to support the growth of the robotics industry. The government actively engages with industry stakeholders to ensure that regulations are relevant, practical, and effective in promoting innovation and the adoption of robotics technologies.

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Japan: Japan's New Robot Strategy focuses on creating a flexible regulatory environment that supports the development and adoption of robotics technologies. The Japanese government is committed to revising existing regulations and creating new ones as needed to address the evolving needs of the robotics industry while ensuring safety and ethical considerations.

South Korea: South Korea's Intelligent Robotics Development Strategy emphasizes the importance of developing and updating regulations and standards to support the growth of the robotics industry. The government actively engages with industry stakeholders to ensure that regulations are relevant, practical, and effective in promoting innovation and the adoption of robotics technologies.

