

Digital Economy Strategy

30 November 2017

About the Warren Centre for Advanced Engineering

The Warren Centre brings industry, government, and academia together to create thought leadership in engineering, technology, and innovation. We constantly challenge economic, legal, environmental, social, and political paradigms to open possibilities for innovation and technology to build a better future.

The Warren Centre advocates for the importance of science, technology and innovation. Our 30 years' experience of leading the conversation through projects, promotion, and independent advice drives Australian entrepreneurship and economic growth.

This submission forms our response to the Digital Economy Strategy process initiated in September 2017. The specific terms of reference addressed in this submission are:

- The themes of: enabling and supporting the digital economy through standards and regulation; and trust, confidence, and security; and empowering all Australians through digital skills and inclusion;
- Artificial Intelligence on page 14 of the paper;
- Questions:
 7. What opportunities do we have in standards development and regulation to:
 - enable digital entrepreneurship, innovation and trade?
 - mitigate the risks associated with digital disruption?
 8. What digital standards do we need to enable Australian businesses to participate in global supply chains and maximise the opportunities of the digital economy?
 20. What opportunities do we have to equip Australians with the skills they need for the digital economy, today's jobs, and jobs of the future?
 21. What opportunities do we have to bridge the 'digital divide' and make the most of the benefits that digital technologies present for social inclusion?
 22. What opportunities do we have to ensure digital technology has a positive impact on the cultural practices and social relationships of Australians?

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Executive Summary

Australia along with the whole world is undergoing a rapid digital transformation. While the jobs disruption and regional effects are presently recognised in Australia, The Warren Centre believes that risks exist for public harm in artificial intelligence and machine learning technologies. We believe that very strong public benefits in economic growth and productivity improvements as well as enhanced health outcomes will flow from AI. It is important that machine learning and artificial intelligence develop. However, attention must be applied to mitigate the negative effects of AI programming that could exacerbate problems related to digital disruption.

We offer the following recommendations:

1. Additional research should be undertaken in the development of “ethical” machine learning and artificial intelligence.
2. Efforts should be undertaken to open multi-disciplinary engagement and discourse on AI. This should include IT developers, engineers, lawyers, ethicists, government, industry, academia and the public.
3. Greater public education and awareness are needed to understand the real benefits, risks and issues related to AI. Good public awareness informs better democracy and support for rational public policy.
4. Ethical AI guidelines should be developed based on Australian values of privacy, fairness and transparency.
5. Australia should establish international dialogues on AI and robotics ethics.
6. Enhanced STEM education along with diversity and inclusivity efforts are needed to promote domestic talent development and to minimise the potential for distorting effects of bias in AI and machine learning algorithms.

Rapid advance of machine learning and artificial intelligence

In recent years, technology advances in sensors, digital commercial transactions, massive data accumulation, machine learning, artificial intelligence and sophisticated robotic actuation have created remarkable innovations and commercialisation demonstrations. There is very strong potential for continued improvement in economic productivity and advancement in human health from these technologies. There is concern for employment displacement, and it is likely that the rapid advancement of technologies will disrupt industries and jobs more quickly than some people can retrain and adapt. The interim technology disruption will create a period of social discontent as employment conditions adjust. Productivity gains will create wealth that is not evenly distributed. First movers in markets are already creating new platforms with radically improved services and product offerings that disrupt established companies. Globalisation in the past three decades has already exposed areas of

Australia's economy where international competition effectively displaces local economic activity. The decline of domestic automotive manufacturing is a prime example.

These challenges are now recognised in business communications. For example, CEDA's report on *Australia's future workforce?* (2015) has been widely discussed.¹ It is estimated that 40% of jobs will be disrupted, and rural regional areas will be affected worse than urban centres.

In November, the Warren Centre's Innovation Advisory Committee met and discussed the challenges and opportunities presented by the Digital Economy Strategy paper. Two themes in the discussion are raised in this submission. Firstly, there is insufficient discussion presently within Australia about the need for ethical machine learning and artificial intelligence. There are large economic benefits from continued advancement and deployment of the technology, but there are also risks, and the potential harms from rogue AI that may disproportionately affect segments that are already disadvantaged, thus worsening socioeconomic situations for some citizens. Secondly, continued efforts for STEM education, diversity in STEM industries and inclusivity in digital technology development are needed.

The need for ethical machine learning and AI

Machine learning and artificial intelligence rely on a base of historical data. In numerous examples, it has been demonstrated that empirical data contains bias. Banking and lending data, criminal justice data, and insurance data have been shown to contain bias that harms the public. Bias inherent in historical data may not be easily detected.

Furthermore, programming communities show evidence of strong sexism and cultural bias.² Programming in Silicon Valley can be so dominated by young white males that the term "brogramming" is commonly applied. Exclusion of females and severe problems of cyber bullying in the industry highlight a dysfunctional inclusivity gap. These problems are said to exist also in the Australian tech industry.³ The issue of stubborn resistance within the industry to reform was highlighted this year when a Google employee issued an essay against diversity titled, "Google's Ideological Echo

¹ <http://www.ceda.com.au/Research-and-policy/All-CEDA-research/Research-catalogue/Australia-s-future-workforce>

² Claire McCullough, Svetlana Chesser and Bart Weathington, "Subtle and Not-So-Subtle Messages of Non-Inclusion", American Society for Engineering Education, 2017 ASEE Zone II Conference, at <http://zone2.asee.org/sessions/program/3/13.pdf>

³ <https://www.businessinsider.com.au/sexism-in-australian-tech-culture-joint-statement-2017-7>

Chamber".⁴

The result of this inclusivity gap affects not just the tech industry workplace, but also the ubiquitous products of the tech industry. How software is programmed may deeply affect the diverse range of human users who directly use the software and also those who are indirectly "handled" by the software: basically everyone in modern society.

Governance problems in the current generation of products, services and massive new tech companies and platforms are chronicled in an exposé published early this year by Brad Stone.⁵ Two quotes from Stone's book demonstrate the scale of the regulatory challenges:

"We are living in an era of robber barons. If you have enough money and can make the right phone call, you can disregard whatever rules are in place and then use that as a way of getting PR. And you can win."

Both were unleashing changes in communities' behavior whose full impact on society they couldn't possibly hope to understand. And each believed that the best tactic was simply to grow, harnessing the political influence of their user base to become too big to regulate.

In another expose,⁶ Cathy O'Neil describes an example of artificial intelligence in American banking that entrenches poor citizens in a cycle reinforcing discrimination and preventing escape from poverty. Data as simple as a postal code might exclude a US banking customer from being granted a loan for education. If the past history of loan repayment from a lower socioeconomic, higher minority neighbourhood feeds into a banking algorithm, the entry point for rising in education status may be closed off for people who are most vulnerable to discrimination. Such a biased loan approval system in the US university lending market makes poor people poorer.

Like the massive digitisation and re-engineering of 9000 of Deutsche Bank Germany's staff, National Australia Bank (NAB) announced recently that it would lay off 6000 employees and hire 2000 new staff with high computer skills.⁷ Banking decisions that were once reviewed by people are increasingly capable of being automated by machine learning and artificial intelligence. Increasingly, tools that are tested and

⁴ Lara Williams, "No way up this ladder", *New Scientist*, Volume 235, Issue 3139, 19 August 2017, Pages 22-23.

⁵ Brad Stone, *The Upstarts: How Uber, Airbnb, and the Killer Companies of the New Silicon Valley Are Changing the World*, 2017.

⁶ Cathy O'Neil, *Weapons of Math Destruction*, 2016.

⁷ See <https://thewarrencentre.org.au/the-future-of-work-nab-reskilling-foretells-dramatic-digital-shifts/>

commercialised in the US and Europe are being deployed in Australia.

In the US bricks-and-mortar retail sector, an atmosphere of extreme competition has spawned a disturbing use of electronic surveillance techniques in shopping malls and street level stores. UPenn Professor Joseph Turow catalogues some of the strange scenarios in *The Aisles Have Eyes: How Retailers Track Your Shopping, Strip Your Privacy, and Define Your Power*.⁸ Security camera technologies originally deployed to document and discourage shoplifting are being repurposed with facial recognition technology to monitor shoppers' purchasing habits and to accumulate massive amounts of data on consumers. Combined with the 'digital vapour trail' of personal devices, retailers can employ sophisticated tracking techniques using Bluetooth, Wi-Fi, and GPS along with the retailers' own electronic payment systems to collect massive amounts of data. Information from various sources can be synchronised, then synthesised in ways that are not understood by average consumers, not even technologically savvy people. Data collection across multiple devices and platforms is integrated across consumer-owned electronics and store-owned fixed hardware. Privacy policies that are obscure to buyers provide insufficient notice to persons who do not understand the broad and deep level of their personal interaction with data collection and machine learning.

The problem highlighted in the bank lending example and the retail shopping example above is that data sets, machine learning algorithms and artificial intelligence are opaque. In today's software systems, there is no transparency to interrogate and understand the reasons for decisions. If bias is "baked into" historical data sets and programmed into the algorithms that drive machine learning, the resultant artificial intelligence will reflect an ethical distortion from the values and expectations of the Australian community.

Further concerns have been raised by risks of machine learning and artificial intelligence contributing to new, unique forms of collusion and digitally enhanced anti-competitive trade practices.⁹ Ezrachi and Stucke studied the US Department of Justice action regarding pricing algorithms on Amazon Marketplace in 2015. The legal researchers describe four types of collusion methods that could result when AI operates on digital commerce platforms. A "messenger" digital cartel can form where encrypted signals are transmitted in an overt anti-competitive scheme. "Hub and spoke" platforms can occur when one algorithm sets prices on multiple sites. In the closely related "predictable agent" and "digital eye" models, transparency and connectivity create "conscious parallelism" in pricing when AI algorithms seek profit

⁸ Joseph Turow, *The Aisles Have Eyes: How Retailers Track Your Shopping, Strip Your Privacy, and Define Your Power*, 2017 at <https://yalebooks.yale.edu/book/9780300212198/aisles-have-eyes>

⁹ Ariel Ezrachi and Maurice E Stucke, "Artificial Intelligence & Collusion: When Computers Inhibit Competition", *University of Illinois Law Review*, 2017, p 1775.

maximisation in oligopolistic markets. Machines can automatically cooperate as the result of machine learning strategies, thus stabilising high prices to the detriment of consumers.

Lack of international norms

There is currently a high volume of technology creation in the US (especially Silicon Valley) and in China. The US exports a large volume of digital technology globally, and much of Australia's technology import volume originates from the US. The EU creates less digital technology, but has undertaken more considered regulation on privacy and consumer protection, reflecting European sensibilities about individuals' rights in commerce. There are vast differences in US, EU and Chinese technology regulations. Recent developments in US net neutrality,¹⁰ reinforcement of the Great Firewall of China,¹¹ and EU action against Facebook's trans-Atlantic communication of personal data¹² are all examples of differences in domestic regulatory regimes. There are no international standards on data privacy, and the emerging fields of machine learning and artificial intelligence are areas where community expectations of fairness and ethical programming could increase challenges due to the opacity of AI algorithms. In the absence of international standards and local regulations (or appropriately effective and balanced local enforcement), de facto standards of commercial behaviour may be imported to Australia and normalised before local governments can react. Certainly Facebook and Twitter have re-set Australian norms about interpersonal communication. In the past two years, there are deep concerns in the US and UK (at least) about the effects of foreign actors on domestic elections.¹³ Antisocial digital media 'bots' have spouted fake news and stirred discontent that destabilises governments.

Detachment to local community standards

Australia's community standards of ethics and fairness are distinct.¹⁴ Australia's population has diverse multi-ethnic and multi-cultural roots. There are strong cultural ties to Britain and Europe, but proximity to the Asia-Pacific region as well as unique indigenous cultural influences define Australian values. Australia's history also created a unique sensibility of what is fair and right.

Australians share a common self-identity that embraces diverse origins, but still values

¹⁰ See for example, <https://thewarrencentre.org.au/tag/net-neutrality/>

¹¹ See for example, <https://thewarrencentre.org.au/whatsapp-china-great-firewall-reinforced/>

¹² See for example, <https://thewarrencentre.org.au/facebook-awaits-data-protection-ruling/>

¹³ See for example, <https://thewarrencentre.org.au/russian-rampage-first-the-us-and-now-the-uk/>

¹⁴ Stephen Johnston, Helen McGregor and Elizabeth Taylor, "Practice-focused ethics in Australian engineering education", *European Journal of Engineering Education*, 2000, Vol 25, No 4, 315-324.

community engagement.¹⁵ Fair dinkum and the fair go are alive and well. Gender, ethnic and sexual orientation diversities are respected.

Need for stewardship

Machine learning and artificial intelligence offer massive opportunities for improved economic productivity and advancement in fields such as health care, but there is a strong need for trust, accountability, transparency, security and privacy.

The UK's Royal Society recently recommended that the strong benefits and countervailing challenges posed by machine learning and AI require "careful stewardship".¹⁶ In its review, the UK Government Office for Science issued key recommendations on education, governance and research funding.¹⁷ There should be understanding of how machines make decisions so that external bodies can hold computer algorithms accountable if harmful decisions are made by AI.

In America, legal researcher Matthew Scherer says that a "regulatory vacuum" exists and that there is presently a serious shortage of legal scholarship on AI.¹⁸ Citing examples such as the outcomes of autonomous driving accidents and adverse outcomes from medical AI, Scherer expresses deep concern that governments lack competencies to address the speed of new technology deployment and the lack of visibility of how AI is actually making its decisions. He states:

The increasing ubiquity of AI makes it all but certain that AI systems will generate many public risks. Those risks may prove difficult for the legal system to address, because AI presents challenges not raised by the public risks of the twentieth century.

Ultimately, Scherer recommends that expert government agencies are needed with powers delegated from legislatures. Furthermore, common law tort reform will be necessary to align legal thinking developed in Victorian times to modern technology.

A different American legal researcher argues that a new breed of expert

¹⁵ Mark McCrindle, "21st Century Australia: Understanding the Shifts" [online], *Culturescope*, Vol. 93, 2010: 4-6.

¹⁶ *Machine learning: the power and promise of computers that learn by example*, Royal Society, 2017 at <https://royalsociety.org/topics-policy/projects/machine-learning/>.

¹⁷ *Artificial intelligence: opportunities and implications for the future of decision making*, Government Office for Science, 2016, at

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/566075/gs-16-19-artificial-intelligence-ai-report.pdf

¹⁸ Matthew U Scherer, "Regulating Artificial Intelligence Systems: Risks, Challenges, Competencies and Strategies", *Harvard Journal of Law and Technology*, 29:353, Spring 2016, p 353.

government agency similar to pharmaceutical or medical device regulators (the US FDA or Australian TGA) is needed, a so-called “FDA for Algorithms”, to regulate artificial intelligence to prove that certain high-risk systems are “safe and effective for intended use”.¹⁹

STEM education, diversity and inclusivity

For many years, the Warren Centre has advocated for strong STEM education to prepare students for the future.²⁰ We are currently launching a new program called Inclusion² focussing on encouraging greater gender diversity and inclusivity for the STEM professions and the entrepreneurship community. As digital transformation unfolds, it is obvious that Australia’s efforts to improve diversity and inclusivity must accelerate. Otherwise, the undesirable effects of disruption are likely to be worsened.

When the Warren Centre Innovation Advisory Committee met, there was strong praise from our industry advisors for an effort called The Australian Computing Academy. We are not affiliated with the initiative, but this is the sort of effort that the Warren Centre has recommended in the past. The Academy provides primary and secondary educators with the resources and skills required to fulfil the ambitious goals of the Australian Curriculum: Digital Technologies. The Academy is delivering a series of free National Digital Technologies Challenges to support the Australian Curriculum until December 2020. The Digital Technologies Challenges program involves 18 challenges of 4–5 weeks for the Years 5–6 and Years 7–8 bands of the Digital Technologies curriculum.

The challenges are multi-week, in-classroom activities co-designed with educators. The challenges are mapped against the Australian Curriculum: Digital Technologies and come with support materials, such as lesson plans, notes, hints and videos with further online support and a telephone hotline for teachers. The challenges are engaging and authentic, often reflecting on real-world problems. They are designed to be interactive, providing real-time feedback to the learners, helping them to tackle curriculum concepts and improving their code.

The Academy also provides support for teachers in several ways, including teacher professional development workshops delivered throughout the country; an online virtual community for teachers; and a messaging and phone help desk to ask for content, technical or pedagogical support and discuss how teachers are using the activities in the classroom. In 2016, the Warren Centre undertook support for technology teachers to analyse a professional survey. There were consistent messages

¹⁹ Andrew Tutt, “An FDA for Algorithms”, *Administrative Law Review*, Winter 2017, 69:83.

²⁰ See for example, “Vision for a STEM Nation”, 2015 at <https://thewarrencentre.org.au/wp-content/uploads/2014/11/Warren-Centre-Submission-wc2980-14.pdf>

from the teachers that this was exactly the type of ongoing professional development support they needed.

We applaud the efforts of the Australian Computing Academy and look forward to reports on their program outcomes. Australia needs more efforts like this.

Conclusion

To maximise the positive economic effects of digital transformation and to minimise the harmful effects of disruption and bias in algorithms, we recommend the following. Additional research should be undertaken in the development of “ethical” machine learning and artificial intelligence. Moving beyond academia and technology developers, efforts should be undertaken to open multi-disciplinary engagement and discourse on AI. This should include IT developers, engineers, lawyers, ethicists, government, industry, academia and the public. The public’s current view on AI and robotics may inhibit acceptance of advanced technologies in Australia. Some views may inhibit innovation and forfeit domestic economic growth opportunities to foreign countries. Greater public education and awareness are needed to understand the real benefits, real risks and substantives issues related to AI. This is not all about job loss and disruption. Better public awareness will inform better democracy and better public policy.

Ethical AI guidelines should be developed based on Australia’s own unique sensibilities and values of privacy, fairness and transparency. The nation should not delegate this to foreign companies or foreign governments. Australia should establish international dialogues on AI and robotics ethics and seek to influence international norms to reflect Australia’s own ethic of fairness.

Enhanced STEM education along with diversity and inclusivity efforts are needed to promote domestic talent development and to minimise the potential for the distorting effects of bias in AI and machine learning algorithms.

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About the Warren Centre for Advanced Engineering

The Warren Centre constantly challenges the economic, legal, environmental, social and political issues raised by innovation. We collaborate with industry, government and academia to achieve globally significant outcomes.

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