Horizon Scanning Series

The Effective and Ethical Development of Artificial Intelligence: An Opportunity to Improve Our Wellbeing

Government

This input paper was prepared by Robert Hanson on behalf of 3A Institute

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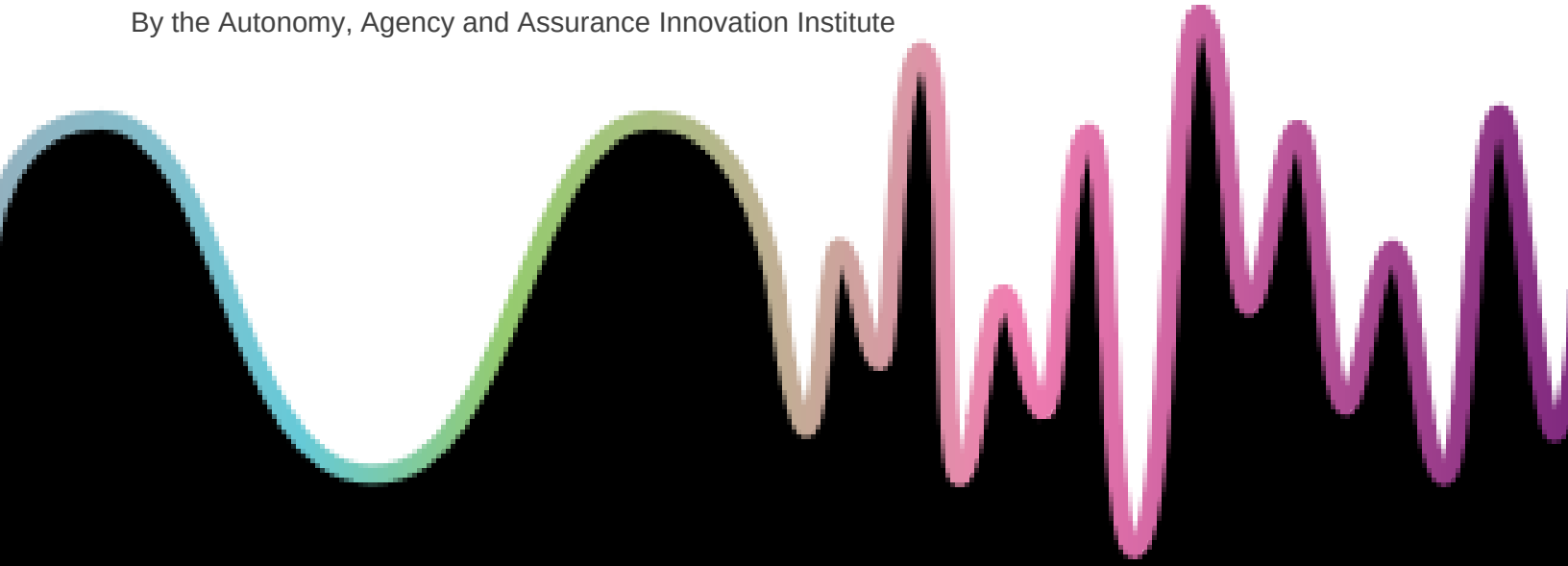
The opportunities and challenges presented by deployment of artificial intelligence in Australia and New Zealand

A submission to inform ACOLA on the government sector

By the Autonomy, Agency and Assurance Innovation Institute



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EXECUTIVE SUMMARY

‘We can only see a short distance ahead, but we can see plenty there that needs to be done.’

Alan Turing

The rapid rate of technological development has caught the world’s attention. The World Economic Forum has labelled this development as the start of the fourth industrial revolution. An industrial revolution fuelled by data instead of steam. As machines become faster, smarter and more connected, they are embedding in and extending the fabric of our society. Socio-technological systems are what is shaping our world today, and will undoubtedly significantly shape it further into the future.

In our current and emerging world the public sector of many governments are already employing various components of the constellation of technologies that make up Artificial Intelligence (AI). Their motivations include efficiencies, increasing demands for services and aging workforces and populations.

The challenge for adopting these emerging, and rapidly developing technologies, are that the policy / decision makers, and the institutions and mechanisms of government may not understand or be aware of the issues and impacts that come along with the opportunities and benefits. AI and other emerging technologies have far reaching impacts into the real world. These impacts generally have already been considered in our society; by courts, regulators, legislation and policy. Care and consideration should be placed in preparing these people, organisations, functions and policy documents to be ready for this emerging landscape.

In order to effectively manage this transition to the fourth industrial revolution, and manage the foreseeable issues, there are several courses of action available for us to undertake:

1. Educational platforms and frameworks that are able to produce well-reasoned stewards for our global digitised society, with designers capable of exceeding our imaginations.

2. Guidelines and advice for procurement, especially for Public Sector and small and medium enterprises, which informs them of the importance of technological systems and how they interact with social systems and legal frameworks.

3. Enhanced governance and regulatory mechanisms to natively deal with issues arising from cyber-physical systems and AI through existing arbiters, and institutions.

4. Integrated interdisciplinary design and development requirements for AI and cyber-physical systems that have social impacts.

The emphasis is on building upon existing capability – not re-inventing the wheel. Collaborative and integrated approaches are how Australia and New Zealand would better harness their resources.

In order to catalyse these courses of action, we recommend that the following two actions be initiated:

1. A roadmap for international, regional and national policy work, including the development of standards and agreements where appropriate, and

2. A framework for interdisciplinary AI and cyber-physical system education, including the development of international standards

INTRODUCTION

"We're living in a time when we can use technology to redesign systems that are more inclusive, accountable and fair, and empower people left behind in the age of institutional trust... But my optimism comes with big caveats."

Rachel Botsman

We cannot overstate the impact of the emerging constellation of technologies comprised by the term **Artificial Intelligence (AI)** on the public sector.[1] Both in terms of the capabilities and implications AI presents now, and for the near future. There are clear examples and indicators of how these radically transformative technologies can be adopted today, as well as their potential consequences – both positive and negative. Decision and policy makers, however, generally have not had significant experience with the use of these technologies; consequently, they face many uncertainties and unknowns. Fortunately research is being conducted that may illuminate the complex and nuanced features of this emerging landscape. The impact made by this research will directly relate to how considered, long-term and holistic its body of research becomes.

OVERVIEW OF THE SECTOR

The term 'algorithmic governance' is being used to describe the way governments, especially nation-states, express their regulatory capabilities via **cyber-physical systems**[2]. Algorithmic governance is usually associated with societal controls and is linked to certain regimes; and their surveillance programs.[3] In reality any nation-states that can afford AI technologies are employing them in an effort to increase efficiencies and productivity across their legislative, executive and judicial arms; even if they are not aware that they are. Indeed in countries facing aging-demographics, including many Westernised nations, the adoption of AI is driven by the confluence of pressures including increasing health and aged-care demands, changing public expectations for service delivery (and increased responsiveness in general), in addition to an often diminishing/aging workforce.[4] If imperatives for action outstrip appropriate consideration, foreseeable and preventable risks may manifest.

The use of AI by China in their 'social credit' system is often cited as the first large-scale implementation of 'algorithmic governance'[5], and perhaps a sign of things to come. However, it is important to remember that technology is located physically and culturally, and that the Chinese public and government are operating within a particular worldview and set of values. It is important to consider that different societies will

[1] Pencheva, Esteve & Mikhaylov (2018)

[2] '**Cyber-physical systems (CPS)** are engineered systems that are built from, and depend upon, the seamless integration of computation and physical components. Advances in CPS will enable capability, adaptability, scalability, resiliency, safety, security, and usability that will expand the horizons of these critical systems. CPS technologies are transforming the way people interact with engineered systems, just as the Internet has transformed the way people interact with information. New, smart CPS drive innovation and competition in a range of application domains including agriculture, aeronautics, building design, civil infrastructure, energy, environmental quality, healthcare and personalized medicine, manufacturing, and transportation. Moreover, the integration of artificial intelligence with CPS creates new research opportunities with major societal implications.'
National Science Foundation (2018)

[3] Mozur (2018)

[4] Japan's response to this is called Society 5.0, 'A human-centered society that balances economic advancement with the resolution of social problems by a system that highly integrates cyberspace and physical space.'
http://www8.cao.go.jp/cstp/english/society5_0/index.html
accessed 1 August 2018

[5] Mozur (2018)

respond and react to the application and potential of technology in different ways.[6]

Decisions are increasingly being assisted, or even delegated to AI. Whilst there are demonstrable advantages in productivity and efficiency for using intelligence augmentation across judicial, executive and legislative decision making, the unintended or unforeseen impacts of doing so may violate laws, ethical standards or cultural norms. Standards of behaviour are fluid and subject to alteration. Hardcoding, and/or obfuscating their embodiment in technology may result in manifestations of these values in ways and at times that ultimately form significant breaches; even violating social licences to operate. Public sector design and acquisition processes must take into account the potential for societal change at structural, programmatic and cross-jurisdictional levels. Most benefit will come from an evolution of existing practice and process, NOT the addition of supplemental or stand-alone processes.

The **Correctional Offender Management Profiling for Alternative Sanctions (COMPAS)** case study is an example of the procurement of an AI system by the public sector where an inordinate amount of effort was required in order to uncover the inherent bias in the system; bias that was causing significant social harms.[7]

There is a truth in the phrase, 'technology has a country'. Values, norms, perceptions (bias)[8] and even interpretations of policy and law are often, and usually unconsciously, embodied in the products by the people designing and making them. The nature of the 'black-box' of technological products cloaks or masks their inner composition and lends them to export these human qualities across borders, boundaries and jurisdictions; often unwittingly to both their producer and/or consumer.[9] Technologies are also neither good nor evil, but can be used for both. They may also have a 'dual-use', in the national-security sense of the term, where benign or beneficial functionality may harbour sinister capabilities.[10] For example technology has been harnessed by nation-states and manipulated in order to project political and social influence; demonstrating the ability for algorithmic governance to be subverted for offensive purposes. The nation-state can be hacked.

The Cambridge Analytica example[11] demonstrated the capability for the use of social media platforms in information operations by politically motivated actors. This demonstration illustrates that not only are traditional physical 'critical infrastructures' vulnerable to cyber interference, but so too are more invisible systems. In fact there is an argument that data should be considered critical infrastructure.[12] Serious consideration should be paid to the protection of data in a world where highly integrated socio-technical systems form the nation state. Critical infrastructure protection should be reimagined accordingly.

As governments employ AI technologies in their orthodox service delivery and administrative roles, they are, and will continue to identify and expand the ways they express their authority, stewardship and oversight. This may be as benign as the use of sensors and machine learning to provide monitoring of infrastructure in order to schedule targeted and efficient predictive maintenance.[13] Or it may be as radical as profiling the demographics, movements and even emotional state of their citizens ostensibly to improve access to, and the quality of services, for

[6] Lyon (2007)
[7] Agwin, Larson, Mattu & Kirchner (2016)
[8] Danks & London (2017)
[9] Ananny & Crawford (2016)
[10] National security use of AI relates more broadly to economic concerns than just narrowly towards weapons of mass destruction. This can include transparency of governmental decision making.
[11] Confessore (2018)
[12] Chapman (2018)
[13] For example: advanced data analytics for water solutions https://research.csiro.au/data61/advanced-data-analytics-for-water-solutions/ online accessed 26 July 2018

inclusivity, equality, sustainability and economic reasons. AI presents a platform for generating trust and 'sunshine' across the public and private sector alike, however the transparency and accountability required for these outcomes must start with the governance of the technology itself.[14]

Collectively societies around the world are able to learn and share by encoding their experience and knowledge of AI into standards and guidelines. As societies coalesce over standards they form as a collective in which assurances are able to be sought for areas such as quality, safety, security, privacy and legislative compliance.[15] The artefacts for these standards need to cover an array of activities. Primarily they need to highlight connections with, and/or enhance and elaborate on existing governance and regulatory mechanisms. Given the ubiquity of technology and the way it pervades every aspect of our societies, the existing governance and regulatory mechanisms exist and operate from the transnational[16], national[17], provincial, municipal and organisational level. How pragmatic and translatable the frameworks for these standards are depends on three main factors. Firstly, how well do the frameworks translate across cultures and ideologies with differing perceptions and values? Secondly, how practical are these frameworks to implement? Thirdly, how well do these frameworks cover and relate to various disciplines involved in their interpretation and implementation; including technological, policy, governance, and legislative?

TRENDS

There are five significant trends worth considering from a public sector point of view. First, the ready accessibility to affordable and scalable facial recognition technology. Second, the use of non-traditional interfaces, such as voice and gesture recognition. Third, the use of remote sensing and automated analysis. Fourth, the rate of advancement in robotics and automation. Fifth, the emergence of accountability frameworks and methodologies.

1. **Automated Facial Recognition Technology (AFRT)** presents the ability to identify an individual from any recent or historical image. Coupling this technology with algorithms that claim to be able to classify sexual and political orientation, emotional state as well as IQ presents an unprecedented capability to label an individual with sensitive information. Whilst there are constructive arguments for national security and law enforcement use of AFRT, there are cultural, regulatory and legislative issues to consider.[18]

   Law enforcement's use of Amazon's facial recognition system is being called into question.[19] [20] Scope creep in keeping the databases that run these systems is also being questioned.[21]

2. Voice and gestured control change the nature of the relationship people have with the interface and the system. Unless the human factors and ergonomics are carefully considered[22], there is potential to introduce unintended consequences; from humans not realising they are interacting with a machine, to the loss or misuse of controls – especially where safety and security are critical.

   The Australian Tax Office has already implemented a voice recognition system to authenticate callers to their phone system; saving

[14] Ananny & Crawford (2016)
[15] Examples of initiatives include the University of York's Assuring Autonomy International Programme https://www.york.ac.uk/assuring-autonomy/ which is spearheading research, training and standards in the safety of robotics and autonomous systems. online accessed 26 July 2018
[16] For example: The International Bill of Human Rights that consists of the Universal Declaration of Human Rights (UDHR), International Covenant on Civil and Political Rights (ICCPR), and the International Covenant on Economic, Social and Cultural Rights (ICESCR)
[17] Including: Workplace Health and Safety and Privacy legislation
[18] Mann & Smith (2017)
[19] Snow (2018)
[20] Wood (2018)
[21] Mann & Smith (2017)
[22] Meister (1999)

time and money.[23] How long will it be before AI voice assistants handle every call?[24]

3. The use of remote sensing by increasingly affordable platforms in the built environment, in the air, or even in space, are creating rich opportunities for augmenting decisions; and raising significant privacy and ethical issues.

   Unmanned aerial vehicles (UAV) are planned to be used autonomously to perform safety scanning of Singapore's **Mass Rapid Transit (MRT)** tunnels.[25] Turning a three-hour two-person job into an automated task taking just minutes to perform.

   AI is also being used to 'see' the WiFi signals that bounce off people, even through walls.[26] This technology is presented as useful for monitoring the elderly, however it is effectively x-ray vision. Similar technology can also detect emotion.[27] [28] We will have no option but to wear our hearts on our sleeves.

4. The use of robotics in the home, at work and for transport, as well as exoskeletons, have been identified as crucial workforce multipliers against our aging demographic backdrop. Especially for the health and aged-care sectors. There are, however, many questions around accountability, liability, safety and security.

   Singapore's MRT is already fully automated, as are other train services, such as Rio Tinto's AutoHaul.[29] Numerous trials are being conducted around the region, and the world, for other autonomous public transport.[30] [31] Salary savings and the removal of driver error are the expected benefits, but where are the standards for these autonomous vehicles?[32] [33]

5. There has also been significant interest and development in mechanisms and frameworks that grapple to define and articulate the accountability of technology, particularly AI and autonomous systems where there are questions and uncertainty about the accountability of the human operator. These frameworks present examples that may only continue to reduce excuses for inaction as they become more sophisticated and widely adopted.[34]

The recent actions by industry to call for regulations cut across all these trends. The usually observed evolution of regulatory frameworks generally starts with self-regulation. Industry, however, has started calling for regulation, with respect to facial recognition[35] [36] and fake news[37]. This should represent a red flag for policy makers. Generally industry calls for self-regulation.[38]

If industry is seeking government oversight, there are clearly significant issues at stake. Additionally, this will also require international co-operation with other jurisdictions. Policy work, as previously mentioned, should incorporate these (and other) AI issues into existing mechanisms where possible, and clearly explain how they relate to existing mechanisms when they cannot be.

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[23] https://www.ato.gov.au/general/online-services/voice-authentication/ accessed 1 August 2018
[24] Marcus & Davis (2018)
[25] Singapore's Land Transport Authority (LTA) to Tap on Technology to Enhance Tunnel Inspections https://www.lta.gov.sg/apps/news/page.aspx?c=2&id=8c205baa-6ee5-4cfd-a152-66ba6943bc11 accessed 1 August 2018
[26] Zhao et al (2018)
[27] Zhao et al (2016)
[28] Nummenmaa et al (2013)
[29] Rio Tinto completes first fully autonomous rail journey in Western Australia http://www.riotinto.com/media/media-releases-237_23264.aspx accessed 1 August 2018
[30] Joint News Release by the LTA & MOT - Autonomous Vehicles to Transform Intra-Town Travel by 2022 https://www.lta.gov.sg/apps/news/page.aspx?c=2&id=39787c15-ad56-4d1a-8ba9-4ea14860f9b4 accessed 1 August 2018
[31] Driverless bus trial in Netherlands is first on public roads https://www.theguardian.com/technology/2016/jan/28/driverless-bus-trial-in-netherlands-will-be-first-on-public-roads accessed 1 August 2018
[32] University of York's Assuring Autonomy International Programme https://www.york.ac.uk/assuring-autonomy/ accessed 1 August 2018
[33] Danks & London (2017a)
[34] Such as AI Now's Algorithmic Impact Assessments
[35] Smith (2018) (Microsoft)
[36] Wood (2018) (Amazon)
[37] Apple CEO Tim Cook called for stronger data privacy regulations to prevent "dire" situations like the leak of Facebook user information from happening again.
[38] Data Governance Australia http://datagovernanceaus.com.au/dga-code-of-practice/ accessed 26 July 2018

GAP ANALYSIS

The excitement and hype around the adoption and development of AI technologies has produced a surge in demand for workers in this field. Training and education for this sector subsequently is similarly in high demand. The challenge here is that the impact of these technologies are far-reaching, requiring a broad (and sometimes niche) knowledge and skills to manage. As with the establishment of standards for AI generally, frameworks for education and training would generate assurances of quality, safety, security, privacy and legislative compliance. In addition to these hygiene factors, a robust framework for AI education would foster a generation of creative and innovative designers. The types of workers needed around the world to harness the coming industrial-revolutionary wave for both productivity and human flourishment if we want a better Australia (and world), not just wealthier technology companies.

The relationship of education to our emerging industrial revolution is under examination. Crucial and critical questions are being asked of the role of universities, and their offerings against this backdrop.[39] Including reimagined offerings such as micro-credentialing, where specific skills and concepts are sought and accredited in a dynamic and living tapestry of marketable offerings, at the right level for the right person in the right place at the right time. These offerings need to embody the values enshrined in the respective governance and regulatory mechanisms. There is no such thing as 'ethics' to be learned for AI, there are only values reflected in the rules by which society conducts itself.

The **Autonomy, Agency and Assurance (3A) Innovation Institute** of the Australian National University, we have recognised this fundamental need to recast the role of educating the professionals engaged in the conversation of (re)designing and (re)engineering cyber-physical and information systems to include the human dimension.

The 3A Institute has initiated a research agenda to build a new body of knowledge for use by both a new dedicated practitioner, and anyone else with skin in the game.[40] The body of knowledge will apply scientific principles and interdisciplinary practices through a pragmatic lens that considers the full spectrum of benefits and harms presented by technology; for the betterment of humanity. Clearly the different roles and tasks demanded across society, however, requires a range of complimentary educational offerings. For example novel programs such as Swinburne University of Technology's Factory of the Future[41] are to be lauded for their pragmatic approach in providing industry-based learning to practitioners for the advanced manufacturing sector. Notably there has also been a recent surge in new ethics courses for AI and autonomous systems from academia[42] and industry.[43] In order to be effective, however, there needs to be a cohesive and cogent approach.

LOOKING FORWARD

The next ten years will see a continued altering complexion of the national demographic. An older Australia with increased lifestyle and age-related disease. The economy will continue to be restructured, driven by internal and external forces. Environmental factors will continue to shape the public's consciousness, consumption behaviour and

[39] Hall & Presenti (2017)
[40] Taleb (2018)
[41] Swinburne's Factory of the Future https://www.swinburne.edu.au/research/strengths-achievements/strategic-initiatives/factory-of-the-future/ accessed 29 July 2018
[42] Singer (2018)
[43] New IEEE Courses on Ethics and AI and Autonomous Systems http://theinstitute.ieee.org/resources/products-and-services/new-ieee-courses-on-ethics-and-ai-and-autonomous-systems accessed 29 July 2018

resource expenditure. In this landscape it is admirable to attempt to harness the productivity of AI to ameliorate declining workforces and demands in services, for example by increasing fraud detection in massive datasets,[44] optimising traffic management systems[45] and otherwise generating services that are transparent, and accountable and fostering sustainability. The challenge with AI is that it is to the fourth industrial revolution what steam was to steam engines. Steam engines fundamentally changed our world. The question is, what will AI power?

If over the next ten years the policy position and stance from industry remains 'digital first', then there will be two drivers exerted on the public. Firstly, we can imagine the public will have lived, even visceral and possibly shared experiences of the negative impacts emerging today but manifest in potentially much more intimate and damaging ways.[46] The trajectory for emerging technology is certainly towards use cases where the user will have to trust technology explicitly. Secondly they would have a growing inability to opt-out or choose alternatives.

In this future, experienced and knowledgeable users will demand greater transparency and accountability for products and services.[47] An appreciation and awareness of the impact to themselves and their community from the data they generate and consume may drive political action. The principle risk is that cyber-physical systems will emerge that not only do not conform to societal values, but are introduced invisibly and without means of effective redress. This foreseeable collision of factors clearly calls for proactive efforts. Doing nothing is not an option. Public response would be swift, sophisticated and severe.

CALL TO ACTION

The ways that emerging technologies are impacting on all aspects of society means that there is a fundamental requirement to both embrace and prepare for this change in a holistic and meaningful way. The transformation of our society requires the involvement of and work by all the respective thought-leaders and decision makers involved. In a moral sense, it should probably include the participation of the public and the communities and stakeholders directly impacted by these changes.

There will always remain an attraction to focus on the technology. The allure that technology will solve all of our problems has been labelled as 'techno-chauvinism'.[48]

Left unchecked techno-chauvinism, may lead to piecemeal and ad-hoc approaches to technological governance and regulation that will only address a portion of the impact. Similarly, the establishment of capabilities, and programmes that focus on technology, and not the broader socio-technological systems involved, would fail to address the majority of significant issues AI presents to society. The system as a whole is being reinvented, and we may choose to reimagine it now or have it redeveloped without our input.

In order to exert influence over our future, and shape the system of our society in ways that fit our current and emergent values, there are several platforms that we can start building:

1. Educational platforms and frameworks that are able to produce well-reasoned stewards for our global

[44] Meihr (2017)
[45] Alibaba cloud launches Malaysia city brain to enhance city management, https://pressreleaseworldwide.blogspot.com/2018/01/alibaba-cloud-launches-malaysia-city.html accessed 1 August 2018
[46] Rice (2007)
[47] Diakopoulos (2014)
[48] Broussard (2018)

digitised society, with designers capable of exceeding our imaginations.

2. Guidelines and advice for procurement, especially for Public Sector and small and medium enterprises, which informs them of the importance of technological systems and how they interact with social systems and legal frameworks.

3. Enhanced governance and regulatory mechanisms to natively deal with issues arising from cyber-physical systems and AI through existing arbiters, and institutions.

4. Integrated interdisciplinary design and development requirements for AI and cyber-physical systems that have social impacts.

RECOMMENDATIONS

In order to catalyse these courses of action, we recommend that the following two actions be initiated:

1. A roadmap for international, regional and national policy work, including the development of standards where appropriate.[49]

This roadmap would identify the relevant significant policy documents (such as the International Bill of Human Rights) to which Australia's legislative and regulatory system should be aligned. Triggers should be identified for when intervention would be required by existing governance and regulatory mechanisms. Such as for determining accountability, or assessing compliance with privacy or safety provisions. These triggers should then be tested to see if the respective institutions, functions and policy documents are able to deliver on their mandates to prevent, prepare for, respond to or recover from harm.

2. A framework for interdisciplinary AI and cyber-physical system education, including the development of international standards.

This framework would support the national/regional interest in embracing technology as part of the fourth industrial revolution, where all aspects to society are impacted. The development of effective socio-technological systems would provide a competitive advantage, and support public good.

International frameworks for the education of these practitioners would leverage the existing educational sector, provide it with a competitive advantage, and enable scaling, flexibility and dynamic capability building across the sector in order to be able to meet changing and niche requirements.

In order for these frameworks to be effective, they need to integrate with all relevant disciplines and professions. Notably these include the law[50] [51] and public policy[52]; where stellar examples already exist. They, however, need to become mainstream, spanning beyond the traditional university approaches.

The emphasis needs to be on collaboration and integration. Reinventing the wheel is unnecessary and counter-productive. National, regional and international effort is required across industry, academia and governments in order to realise the benefits promised by technology. Australia and New Zealand would be prudent to actively promote their interests and invest in their capabilities, lest they let our societies be shaped by decisions abroad.

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[49] Danks & London (2017a)
[50] University Technology Sydney's New Legal Futures and Technology Major https://www.uts.edu.au/future-students/law/course-experience/new-legal-futures-and-technology-major accessed 29 July 2018
[51] Swinburne University of Technology's Double Degree Bachelor of Law & Bachelor of Computer Science https://www.swinburne.edu.au/study/course/bachelor-of-laws-bachelor-of-computer-science/ accessed 29 July 2018
[52] Carnegie Mellon University's Heinz College (Australian Campus) Public Policy and Management https://www.australia.cmu.edu/study/public-policy-and-management accessed 29 July 2018

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