



Australian Government
Department of Industry, Science,
Energy and Resources



THE NATIONAL BLOCKCHAIN ROADMAP:

Progressing towards a
blockchain-empowered
future.



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Contents

Foreword	5
Executive summary	6
Context and opportunity	8
What is blockchain?	8
The blockchain opportunity for Australia	8
The blockchain landscape in Australia	10
Signposts for the future: 2020–2025	13
1: Regulation and standards	14
Regulation	16
Identity	16
Privacy	16
Security, data provenance, integrity and governance	16
Standards	19
2: Skills, Capability & Innovation	20
Skills	21
Foundational and specialist skills	21
Improving blockchain literacy	22
Fostering research, development and innovation	23
Government use of blockchain	23
Research and Development into the technology	24
Scalability	25
3: International investment and collaboration	26
Investment	27
Collaboration	29
4: Sectoral opportunities	30
Overview of sectoral opportunities	31
Overview of Australian agriculture	32
Issues in agricultural exports	32
Systemic issues	33
Wine sector	34
Overview of Australian Credentialing sector:	37
The University Sector	39
Overview	43
The ‘Know Your Customer’ challenge	43
The opportunity for blockchain as a KYC utility	44
Conclusion	45
Shortened Forms	46
Glossary	47
Appendix A	50

Foreword

On 18 March 2019, the Minister for Trade, Tourism and Investment, Senator the Hon. Simon Birmingham, and I jointly announced the development of a National Blockchain Roadmap (the Roadmap).

The Morrison Government is committed to supporting the technology sector. Technology, science and industry, working hand in hand, is where we can solve the real-world problems of today and grow the businesses and sectors of tomorrow. We are committed to making sure that we build an economy, that we improve productivity and that we create jobs.

This Roadmap highlights some of the enormous opportunities blockchain technology can enable—across our whole economy, not just in the financial sector. These opportunities include supply chains and logistics; agriculture; trusted credentials; and smart contracts—just to name a few. Australia has some real strengths in blockchain technology, from our world-class research to our innovative companies to our leading role in the development of international standards for blockchain.

This Roadmap not only identifies the current and future opportunities for blockchain but also provides the signposts for the future development and opportunities for this technology. And the greatest gains for blockchain-enabled economic transformation in our businesses and sectors will be realised when we all play our parts—government, the blockchain sector, and researchers.

I am very pleased that this Roadmap has been developed collaboratively with industry, universities and government, with an Advisory Committee—comprising representatives from each of these sectors—guiding the Roadmap's development. Work on the Roadmap has also been informed by a series of workshops hosted by the Department of Industry, Science, Energy and Resources.

Blockchain is a technology with real potential to save businesses money and to open new business and export opportunities. It will continue to evolve over the coming years, and for that reason, this Roadmap should be considered the start of the conversation between government, industry and universities on how we can all work together to move blockchain forward in Australia.

THE HON KAREN ANDREWS MP
MINISTER FOR INDUSTRY, SCIENCE AND TECHNOLOGY

Executive summary

‘Together, we can drive the long-term development and adoption of blockchain technology, and capitalise on the tremendous economic and social opportunities it offers.’

THE HON KAREN ANDREWS, MINISTER FOR INDUSTRY, SCIENCE AND TECHNOLOGY¹



The Australian Government has engaged with industry and researchers to develop the National Blockchain Roadmap to highlight blockchain’s potential and some of the opportunities that exist.

Blockchain technology is predicted to generate an annual business value of over US\$175 billion by 2025 and in excess of US\$3 trillion by 2030.²

The Australian Government has also provided support and funding for government, private sector and researchers, to foster innovation and collaboration around blockchain, through programs such as Austrade business missions to international markets; the Entrepreneur’s Programme; Australian Research Council Grants; and Business Research and Innovation Initiative pilots.

The Government’s investments have been improving blockchain technology, developing international standards for blockchain and helping businesses to bring blockchain products to market. Many of these investments are described in case studies throughout this Roadmap.

Australia’s ability to capitalise on our current standing and to realise the potential of blockchain—both domestically and internationally—relies on ensuring key fundamentals are in place:

- effective, efficient and appropriate regulation and standards
- the skills and capabilities that can drive innovation
- strong international investment and collaboration.

Getting these basics right for Australia’s maturing blockchain industry will ensure Australia is well positioned to take advantage of the valuable business opportunities and the jobs and growth this technology can enable.

1 <https://www.minister.industry.gov.au/ministers/karenandrews/speeches/adc-global-blockchain-summit>

2 <https://www.gartner.com/en/webinars/3878710/blockchain-potential-and-pitfalls>

As with any emerging, disruptive technology, blockchain and its uses will need regulatory frameworks that are fit for purpose. Challenges include maintaining trust; ensuring security of blockchain systems and the integrity of data; identifying participants in blockchain systems; balancing privacy with transparency; tech-neutrality; and the legal status of smart contracts.

The Australian Government has provided \$350,000 to Standards Australia to lead the development of international blockchain standards through the International Organization for Standardization (ISO), which will help address a number of these concerns as well as improve the interoperability of blockchains generally.

Given that blockchain is a relatively new technology, there is a need to both build a skills-base that can translate into the capability that drives innovation and to educate industry and government about blockchain's potential. A lack of familiarity with blockchain and its potential—along with concerns about the level of hype associated with new technologies—may unduly limit industry and policy decision-makers' appetite for engaging with blockchain.

Demand for blockchain-skilled workers is substantial, with rapid growth in blockchain-related job advertisements since 2016. The roughly 470,000 Australians with potentially relevant digital and information and communications technology (ICT) skills could form a solid cohort of blockchain-proficient professionals, provided the appropriate blockchain-specific training is made available.

Australia is not alone in recognising the potential of blockchain. Several other nations leading blockchain development—including the UK, the UAE, China, the Netherlands and Singapore—have adopted a broad approach to encouraging industry to trial blockchain—an approach which could be applicable in Australia.

However, Australia is already a significant leader in international collaboration on a number of key projects designed to improve the technical and regulatory environment for blockchain. It has also demonstrated innovation and leadership in blockchain in areas such as international standards, research, bond operations and smart programmable money, while also conducting trials in the energy, agricultural and public sectors.

Acknowledging the many possible applications of blockchain, this roadmap highlights some key opportunities available in the agricultural sector, education sector through credentialing and the financial services sector, specifically relating to Know Your Customer (KYC) identity checking requirements, in Chapter 4, Sectoral Opportunities.

Blockchain represents an opportunity to improve each step in the process of generating agricultural produce and getting it to the customer. A key example is the wine industry, for which blockchain solutions can offer transparency, data-sharing and efficiencies. It can assist in inventory tracking, facilitate automated payments between supply chain members, and reduce counterfeiting through provenance transparency, among other potential benefits.

Similarly, blockchain holds potential for the credentialing sector. Credentials are produced by the education sector, by professional and trade associations, and by government. These certifications benefit consumers by facilitating trust in professional and trade services, and employers by facilitating access to trusted information about skills and capabilities.

The financial services system goes hand in hand with distributed ledger technology—indeed, it is the genesis of blockchain innovation. There is significant opportunity to enhance consumer outcomes in financial sector. For example, a barrier to switching financial services providers is the KYC identity checking requirement—commonly involving presenting '100 points' of identification for verification. This challenge presents a unique opportunity to use blockchain technology to reduce costs and provide efficiencies for all parties.

Seizing the opportunities presented by blockchain will require government, industry and researchers to work together. This Roadmap signposts a number of key next steps to advance our collective efforts to proactively address challenges and embrace blockchain investment and opportunity in Australia, progressing towards a blockchain empowered future.

Context and opportunity

What is blockchain?

Blockchains are a particular type of 'distributed ledger' technology. At their core is a shared database that is organised as a list of 'blocks', with the constraint that an additional block of data is appended to the ledger only if a majority of nodes 'agree' that it is valid.

Agreement between multiple nodes about the validity of a block is derived via a 'consensus mechanism', of which there are several types. The new block is cryptographically 'chained' to the previous block that was added to the blockchain, which was chained to the block before it, and so on, all the way to the first block (the genesis block). Hence the name 'blockchain'.

As blocks are only added to the blockchain with the consensus of independent nodes, there is no single point of failure through which the blockchain's data can be corrupted. This makes unauthorised alterations significantly more difficult than they may be with traditional ledgers, which can be modified by a single trusted authority.

WHAT'S IN A 'BLOCK'?

Information in Blockchain systems is added in 'blocks'

The **header** includes metadata, such as a unique block reference number, the time the block was created, and a link back to the previous block.

The **content** typically includes a validated list of transactions made, their amounts, and the addresses of the parties to those transactions, along with digital assets and instruction statements.³

The blockchain opportunity for Australia

There are opportunities across our economy which can be seized and enabled by the use of blockchain technology: to create jobs, to create new economic growth, to save businesses money, and to improve our overall productivity. In addition, the combination of blockchain technology with other technologies, and the digital data underpinning blockchains, can add enormous additional economic value.

With broader application, Gartner predicts that blockchain will generate an annual business value of over **US\$175 billion by 2025** and in excess of **US\$3 trillion by 2030**.⁴ By 2023, blockchain will support the global movement and tracking of US\$2 trillion worth of goods and services annually.⁵ Within the financial services industry alone, analysts predict blockchain will **save US\$15–20 billion annually by 2022**.⁶ The costs to Australian food and wine producers of direct product counterfeiting and substitution, was estimated to be over **AU\$1.68 billion in 2017 alone**.⁷ Blockchain solutions can help to address this issue.

3 <https://www2.deloitte.com/us/en/insights/industry/public-sector/understanding-basics-of-blockchain-in-government.html>

4 <https://www.gartner.com/en/webinars/3878710/blockchain-potential-and-pitfalls>

5 <https://www.gartner.com/en/information-technology/insights/blockchain>

6 https://www2.deloitte.com/content/dam/insights/us/articles/4185_blockchain-public-sector/DUP_will-blockchain-transform-public-sector.pdf

7 FIAL 2017. *Counting the cost: Lost Australian food and wine export sales due to fraud*. Available at: https://fial.com.au/Attachment?Action=Download&Attachment_id=60

There is growing interest and investment in blockchain as a decentralised, peer-to-peer solution with the potential to deliver significant cost savings. Many people now have lower trust in social and traditional media, banks and governments to report the truth, protect privacy, and act in the interests of everyday people. Given this context, blockchain and other decentralised technologies may increasingly be preferred to traditional intermediaries. Blockchain's specific features make it an attractive option for conducting transactions and maintaining records, with potential applications across many sectors of the economy such as finance, trade, health, energy, water, resources, agriculture and credentials.

There are potential applications in both existing and emerging industries—from provenance, registries, energy and water trading, to blockchain for courts of law and spacecraft systems. Transactions facilitated by blockchain could open up new horizons for global trade and become the next step in the evolution of monetary systems.⁸

In 'Chapter 4: Sectoral opportunities', the Roadmap lists a number of sectors where blockchain shows strong potential. It showcases the agricultural sector with a wine export example; the 'trusted credentialing' sector with an education example; and the identity sector with a 'Know Your Customer' checks example.

While there are significant opportunities for blockchain technologies, some use cases are more suited to blockchain than others. As the US Department of Homeland Security (DHS) notes:

*Blockchain is best suited for use cases requiring at least three of the following: data redundancy; information transparency; data immutability; and a consensus mechanism. If only one or two are required then blockchain may work, but there are likely simpler or cheaper ways to solve the problem.*⁹

8 Lowe P. 2017. An eAUD? Address to the 2017 Australian Payment Summit. Sydney – 13 December 2017 Reserve Bank of Australia (www.rba.gov.au)

9 https://www.dhs.gov/sites/default/files/publications/2018_AEP_Blockchain_and_Suitability_for_Government_Applications.pdf

CASE STUDY: ASX & CHES

ASX Limited is implementing a blockchain-based solution as the post-trade infrastructure for Australia's equity market. The Clearing House Electronic Subregister System (CHES), developed by ASX over 25 years ago, is currently the core system used by ASX to perform clearing, settlement and other post-trade services for the Australian equity market.

In 2015, ASX started a process to evaluate replacement options for CHES. ASX commenced stakeholder consultation in 2016 to gain a better understanding of the new functionality and services that users of CHES would like delivered by the replacement system. Dominic Stevens, ASX Managing Director and CEO, announced in late 2017 that, following careful examination:

*We believe that using [blockchain] to replace CHES will enable our customers to develop new services and reduce their costs, and it will put Australia at the forefront of innovation in financial markets.*¹⁰

In 2019, ASX started customer development and testing for software vendors and in-house systems connected to CHES in a dedicated customer development environment. The blockchain solution is currently estimated to go live in the first half of 2021.

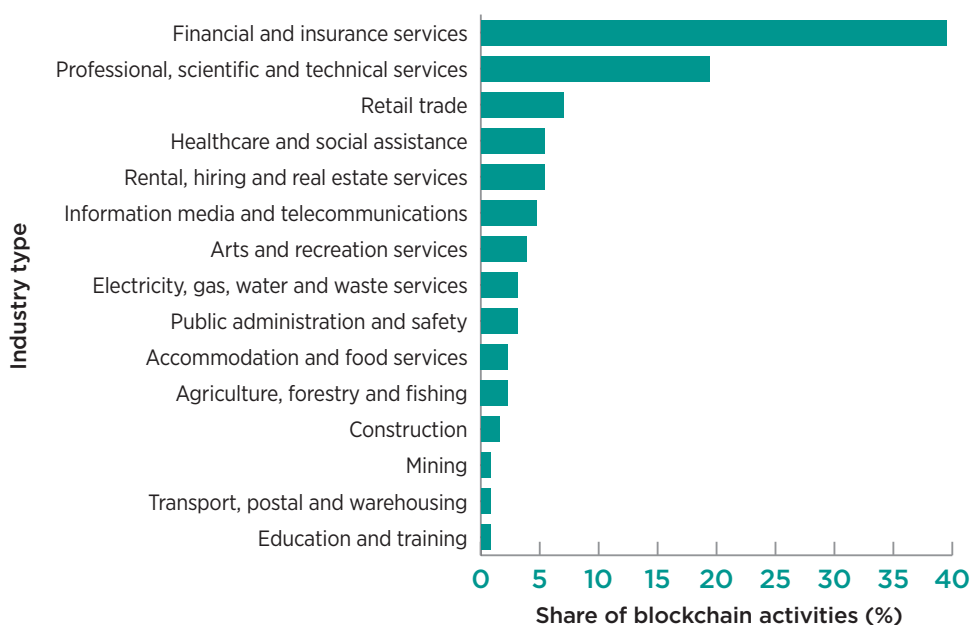
10 <https://www.asx.com.au/documents/asx-news/ASX-Selects-DLT-to-Replace-CHES-Media-Release-7December2017.pdf> <https://www.asx.com.au/documents/asx-news/ASX-Selects-DLT-to-Replace-CHES-Media-Release-7December2017.pdf>

The blockchain landscape in Australia

An analysis of 138 blockchain activities in Australia conducted by CSIRO's Data61 (the data and digital specialist data services arm of CSIRO), and published in April 2019, shows a general upwards trajectory, with most of this activity coming from small-to-medium sized businesses in New South Wales and Victoria. Although the majority of activities were recorded within capital cities, there were some examples of regional blockchain activities. For instance, over 30 businesses in the Central Queensland towns of Agnes Water and Seventeen Seventy are now accepting cryptocurrency as a form of payment, designed to appeal to international tourists in the niche market of crypto-funded travel.

The leading industry for blockchain activities in Australia is financial and insurance services, followed by professional, scientific and technical services, and retail trade (see Figure 1).

Figure 1: Share of Australian blockchain activities, by Industry



Around 93% of blockchain activities have been undertaken by small-to-medium sized organisations with 1 to 200 employees, with a growing share of start-ups in Australia identifying with the blockchain industry—up from 3.4% in 2016 to 8.1% in 2018. Analysis of blockchain activities also demonstrates that Australia is home to a number of world-first blockchain applications, which include bonds operations; smart programmable money; a national blockchain system and international standards; as well as industry-specific trials in energy, agriculture and the public sector.¹¹

Australia ranks sixth internationally in blockchain-related patent filings. There are currently 49 patent families, which are defined as a set of patents taken in various countries to protect a single invention, that address issues ranging from the data-processing side of the technology (encryption, transmission) to its applications in payment systems, administration and financial services.¹²

¹¹ <https://data61.csiro.au/en/Our-Research/Our-Work/Blockchain-2030>

¹² <https://data61.csiro.au/en/Our-Research/Our-Work/Blockchain-2030>

The Australian Government has invested in a wide range of blockchain-related activities to date. Funding has included support for government, private sector and university research, innovation and collaboration, through programs such as Austrade trade missions; the Entrepreneur's Programme; Australian Research Council Grants; and Business Research and Innovation Initiative pilots. The government has also provided funding to Standards Australia to enable Australia to lead the development of international standards for blockchain and it has committed to the development of this Roadmap, in close collaboration with industry and universities.

The Government's investments have been improving blockchain technology; demonstrating opportunities and use cases; and helping businesses bring blockchain products to market.

Figure 2: Example of how blockchain works

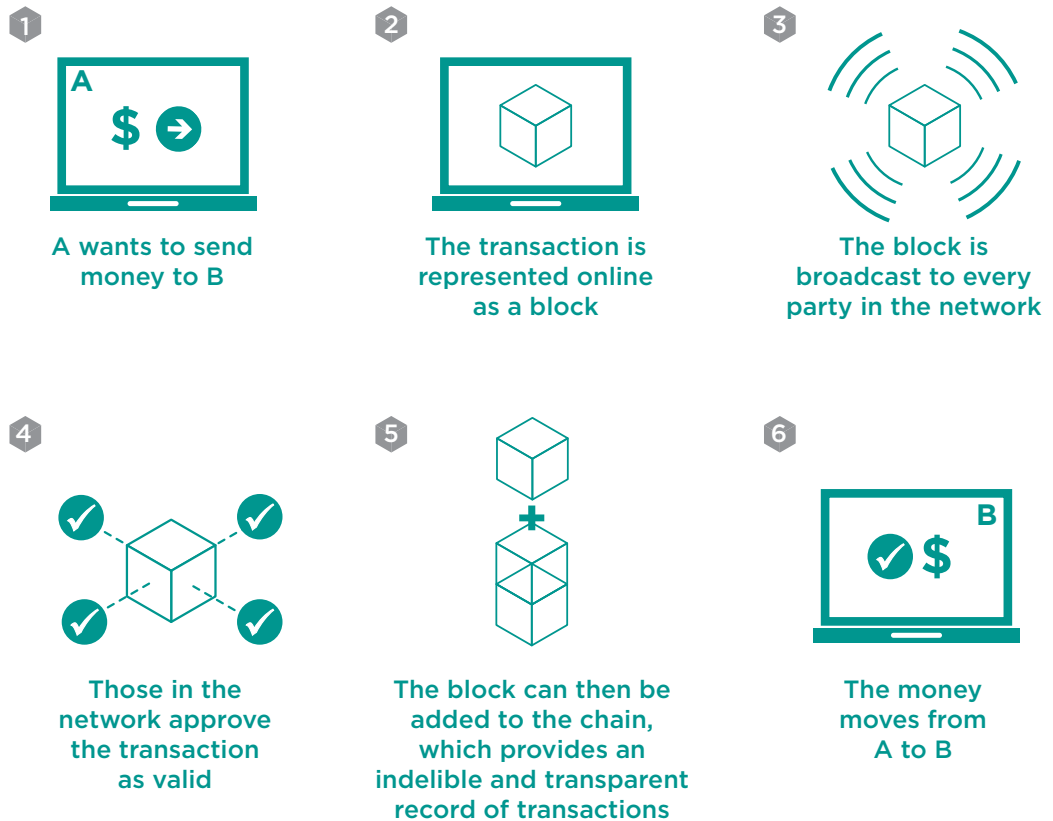


Figure 3: Blockchain myths busted



MYTH: BLOCKCHAIN IS BITCOIN

It may have been Bitcoin that brought blockchain to public attention, but the two are not synonymous. Blockchain is the underlying technology for Bitcoin, enabling bitcoin transactions to occur directly between two parties without going through a third party like a bank.



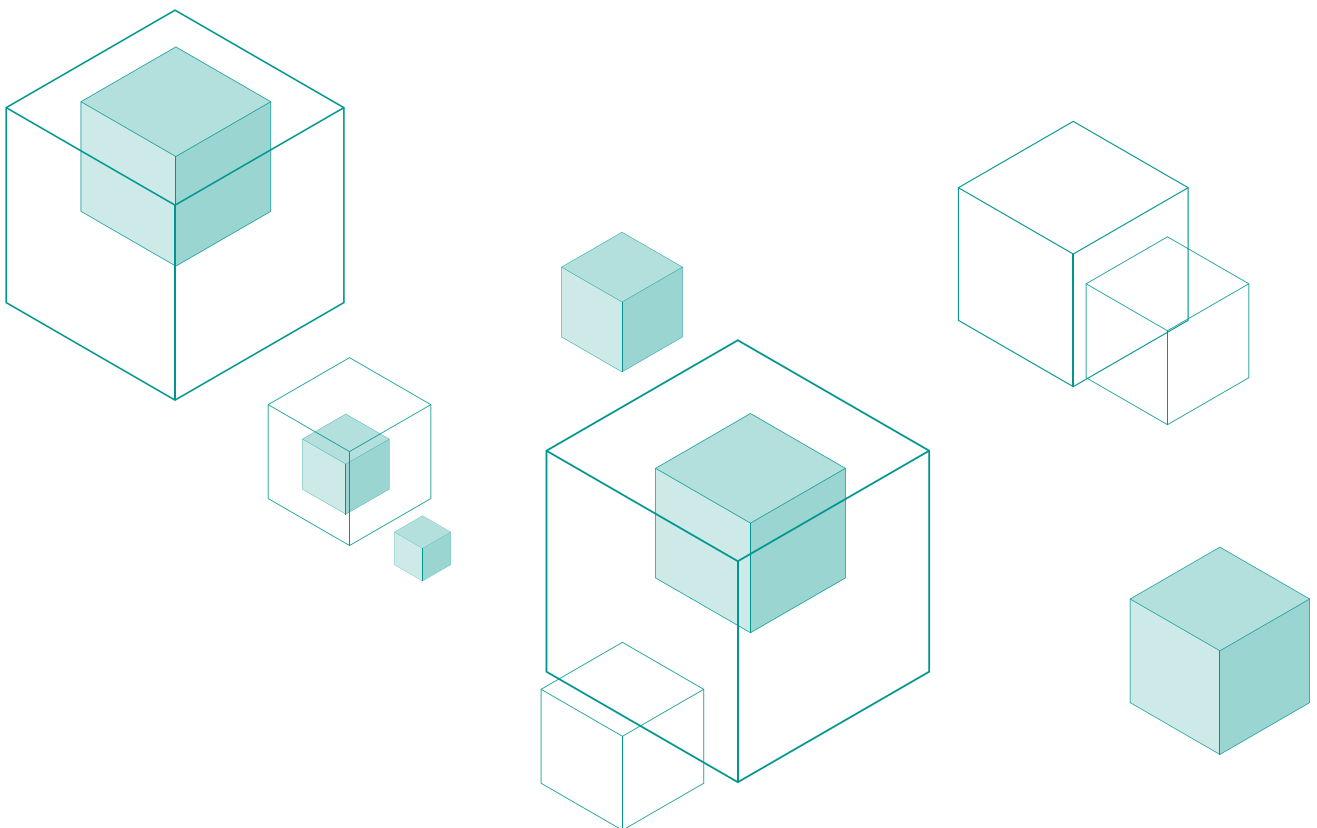
MYTH: BLOCKCHAIN IS FINTECH

Blockchain is often thought as being a financial services technology, because of its association with cryptocurrencies like Bitcoin as well as the high level of interest shown by the fintech sector. However, its application for the purpose of tracking and recording data can add value to many sectors—such as agriculture, healthcare, real estate and retail, to name just a few.



MYTH: THERE IS ONLY ONE TYPE OF BLOCKCHAIN

There is more than just one type of blockchain. In a public blockchain, anyone can read and write the blockchain and participate in the consensus process. In a private blockchain, a central authority regulates everything in the blockchain, including writing and reading from the chain and the consensus process—hence, it is not free for anyone and everyone. In a permissioned (private) blockchain, a predefined set of members have a role in the consensus mechanism and have special rights to read and/or write to the blockchain.



SIGNPOSTS FOR THE FUTURE: 2020–2025

1

Formalise the National Blockchain Roadmap Advisory Committee and rename it the **National Blockchain Roadmap Steering Committee**. The committee would have a Terms of Reference for it to oversee next steps following on from the Roadmap. The membership of the committee could be extended to include key regulators, it could also enable secondments to the committee for specific projects, and host ongoing Blockchain Meet-Up events. A role of the committee would be to provide advice on existing government programs and support that is available to the sector, for example the Incubator Support Program, Entrepreneurs Program, the Cooperative Research Centre projects program, the Business Research and Innovation Initiative and Venture Capital programs. This committee would ensure close ties with other relevant committees such as the Treasury Fintech Advisory Committee. The National Blockchain Roadmap Steering Committee can provide advice to government on the next two use cases to be explored jointly, taking into account whether there is industry or research sector support to progress the opportunity, as well as the size of the opportunity.

2

Establish a collaborative model comprising **working groups of industry, the research sector and government to progress analysis on the next use cases**, with each providing equal funding contribution. In progressing the next use cases, ensure there is a mechanism for direct engagement with relevant regulators. These working groups can provide advice to the Steering Committee on specific regulatory challenges, and potential options to progress solutions to these challenges, such as experiments or pilots of regulatory approaches.

3

Investigate options for **progressing the three use cases in the Roadmap**, including completing a full economic analysis of Agricultural wine exports and credentialing and investigating a possible pilot project on Know Your Customer (KYC) checks.

4

Government to establish and coordinate a **group of government blockchain users**, with State and Territory government representatives invited to join, to discuss the learnings from existing government use cases, promote and diffuse these learnings across government, and identify further government use cases.

5

Look internationally to **identify examples of countries using blockchain to provide efficient government services**, for example Estonia, for learnings for Australia.

6

Work closely with blockchain providers to **engage with the Business Research and Innovation Initiative (BRII) program** and have a specific challenge in one of the use case areas we know blockchain can provide good solutions.

7

Ensure that blockchain is included in broader policy work to **increase management capability around digital technologies**.

8

Industry and educational institutions work together to **develop common frameworks and course content for blockchain qualifications**.

9

Work with Austrade on a **capability development program for Australian blockchain start-ups** so that they are ready to expand globally and link qualified companies to Austrade supported programs such as Landing Pads.

10

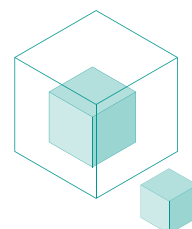
Work with Austrade to deliver a **blockchain focussed inbound investment program** introducing potential investors to Australia with a view to achieving outcomes that grow and bring capability to the Australian blockchain ecosystem.

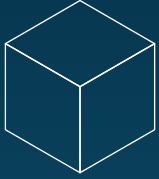
11

Leverage existing bilateral agreements to consider pilot projects or collaborations incorporating blockchain technology with other countries.

12

Work with relevant government departments to ensure **Australian businesses can connect into emerging digital trade infrastructure** being developed.





1: Regulation and standards



As with any emerging, disruptive technology, blockchain and its uses pose new challenges in terms of regulation. Ensuring our regulatory systems are fit for purpose for the future is a key challenge for government.

A regulatory environment that is conducive to innovation and growth is essential for Australia to take advantage of the blockchain opportunities available—including international investment opportunities. This can be achieved by ensuring our regulatory systems are principles-based and technology-neutral, and that regulators consider the importance of enabling innovation and investment when interpreting and enforcing regulations.

For example, Australia currently has a strong and effective national measurement system which provides confidence that the measurements made in Australia can be trusted both domestically and internationally. This system helps build confidence in measurement-based data which can be added to different blockchain applications. The current review of Australia's measurement laws is considering ways to ensure the laws remain fit for purpose, and supportive of innovation and changes in technology—such as blockchain applications.

Additionally, common blockchain standards will help address some of the risk identified with the technology, including security risks.

Blockchain technology engages with a range of regulatory issues that are common across a large number of use cases, including privacy, while other issues relate to specific uses, such as the use of smart contracts.

Companies using blockchain technologies have reported regulatory barriers when developing their products. For example, some companies proposing initial coin offerings have found it challenging to navigate financial services laws, and some relevant sections of the *Corporations Act 2001* are not technology-neutral (for example Part 7.11, which relates to title and transfer of securities¹³).

¹³ ASIC submission to Treasury review on initial coin offerings <https://treasury.gov.au/sites/default/files/2019-04/c2019-t353604-asic.pdf>

Regulation

Identity

Blockchain systems revolve around facilitating interactions between parties. In many blockchain systems, these parties remain pseudonymous, and don't need a verified identity to support them. In some blockchain systems, there needs to be confidence about the identity of the parties to a transaction—but the parties may remain anonymous to other users. This can help to ensure that fraud and cybercrime are reduced and increase the range of activities for which blockchain can be used.

Where a blockchain system needs verified identities, it can either create its own method of verifying an identity or access verified identities from trusted identity providers. These systems conduct the verification of someone's identity, and then can assert that the person has verified their identity, to the blockchain system. This can enable the blockchain system to assert the validity of someone's identity and, if necessary, pass on verified personal information to other parties to a transaction. Regulation or standards could describe the requirements for an identity to be verified, and for a provider of identity to be trusted when asserting the validity of an identity.

The Trusted Digital Identity Framework¹⁴ is the Australian Government's standard for the verification of digital identity. It sets out the requirements that participants in the digital identity ecosystem must meet, and the various levels of confidence that service providers can have in this identity. Currently, it is being used to accredit the various participants in the Digital Transformation Agency's federated digital identity platform. This is not designed specifically for reuse by blockchain systems but is an example of the kinds of standards which would be needed to enable trust in digital identities used to transact within a blockchain-based system.

Privacy

Using de-identification and pseudonyms is not necessarily enough to protect blockchain user privacy, because if those identifiers on the blockchain become linked to the real people behind them, all of their transactions and data could be publicly viewed on the blockchain ledger. This is an issue being considered as part of standardisation work in the International Organization for Standardization (ISO).

A key regulatory challenge for privacy and blockchain systems in Australia is the need to comply with the *Privacy Act 1988*.¹⁵ Due to the decentralised nature of blockchain, there is often no responsible party to seek remedy from if privacy is breached, nor ways to remove personal information from the ledger once entered.

Security, data provenance, integrity and governance

Blockchain systems provide security through cryptography, and consensus from participants, without the need for a central authority.

The data on blockchain ledgers is immutable, meaning it cannot be changed or deleted, even when incorrect or fraudulent. It is therefore critical to put systems in place to maximise the accuracy of data and to prevent fraud. Blockchain users need confidence about where data in the blockchain comes from (its provenance); that the data is accurate, without any accidental or deliberate errors (its integrity); and that there are appropriate systems in place to manage how the data is entered. One way of addressing this is classifying how trustworthy data is based on the source of the data, with data from highly reliable sources classed as having a high level of trust, and data with from less reliable sources classed as having a low level of trust.

¹⁴ <https://dta.gov.au/tdif>

¹⁵ Australian Computer Society Technical Whitepaper, *Blockchain Challenges for Australia* May 2019, p. 35.

Government regulatory activities

Several Australian Government agencies have sought to clarify the regulatory issues that affect the implementation and use of blockchain in the financial sector, including:

- Treasury, which has:
 - been conducting a review into issues related to Initial Coin Offerings during 2019.¹⁶ The review is seeking to assess:
 - what opportunities and risks arise from ICOs in Australia
 - whether our regulatory framework is well placed to allow these opportunities to be harnessed—while appropriately managing the associated risks
 - whether there are other actions that could be taken to better position Australia to capitalise on new opportunities
 - the tax treatment of ICOs.
 - led reforms to GST law for digital currency. Consumers who use digital currencies were previously paying GST twice: once on the purchase of a digital currency, and once again when using it to acquire goods and services subject to the GST. Since 1 July 2017, the double taxation of GST on digital currency has been removed: purchases of digital currency are no longer subject to the GST.
- The Australian Securities and Investments Commission (ASIC), which has:
 - developed an information sheet on evaluating distributed ledger technology¹⁷
 - developed an information sheet to assist issuers of initial coin offerings and crypto-assets to understand their obligations under the *Corporations Act 2001* and the *Australian Securities and Investments Commissions Act 2001*.¹⁸
 - established an Innovation Hub that fintech start-ups can approach for help to navigate the regulatory system, and has run series of meetups to engage directly with stakeholders.
- Australian Transaction Reports and Analysis Centre (AUSTRAC), which has implemented laws to regulate service providers of cryptocurrencies.
- The Australian Taxation Office, which has issued guidance on the tax treatment of cryptocurrencies in Australia.¹⁹

¹⁶ <https://treasury.gov.au/consultation/c2019-t353604>

¹⁷ ASIC Information Sheet 219 Evaluating distributed ledger technology (INFO 219) <https://asic.gov.au/regulatory-resources/digital-transformation/evaluating-distributed-ledger-technology/>

¹⁸ ASIC Information Sheet 225 *Initial coin offerings and crypto-assets* (INFO 225) <https://asic.gov.au/regulatory-resources/digital-transformation/initial-coin-offerings-and-crypto-assets/>

¹⁹ <https://www.ato.gov.au/General/Gen/Tax-treatment-of-crypto-currencies-in-Australia---specifically-bitcoin/>

CASE STUDY: AUSTRAC DIGITAL CURRENCY EXCHANGE PROVIDER REGULATION

In April 2018, AUSTRAC implemented new regulations for digital currency exchange (DCE) providers operating in Australia. The anti-money laundering and counter-terrorism financing (AML/CTF) laws regulate service providers who exchange cryptocurrencies, including bitcoin, for fiat currency (that is, legal tender) and vice versa.²⁰

All DCE providers with a business operation located in Australia must register with AUSTRAC and meet AML/CTF compliance and reporting obligations. The regulations help DCE providers implement systems and controls that can minimise the risk of criminals using them for money laundering, terrorism financing and serious financial crime, including cybercrime.

Australia was among the first countries in the world to introduce AML/CTF regulation for DCEs. The regulations have been welcomed by DCE providers, and are helping to improve trust in cryptocurrencies. Similar legislation is now being introduced around the world. AUSTRAC is focusing on the compliance of DCE providers and will continue to monitor the risks associated with cryptocurrencies.

CASE STUDY: IP AUSTRALIA SMART TRADEMARK²¹

IP Australia is investing in the development of ‘Smart IP rights’ starting with the ‘Smart Trade Mark’. Smart IP rights are a digital representation of intellectual property—a global first for IP offices. They can be used online to help in the prevention of misuse and malicious behaviour such as passing-off and counterfeiting. This is done by creating a connection between IP right holders on the official IP register and digital or online services or products that use the rights. Smart IP rights can create a thread of information referring to owners’ IP, including where it has been used digitally, validating who the official owner is and providing bibliographic data such as images on their right.

The initial concept was developed as a multi-technology platform using APIs, blockchain and mobile apps to create an authoritative link between a trademark and supply events. The agency has completed two pilots with Canberra-based producers and has successfully scanned and tracked products across borders from supplier to consumer. User feedback from the pilots highlighted the need for IP right holders to prove their authority as the true owner of an IP right, but in a way that is interoperable in a continually evolving ecosystem.

Smart Trade Mark is now being developed into a beta product which will leverage blockchain to securely record and notarise the generation of Smart Trade Marks. This is not done via a blockchain token asset but uses a blockchain’s immutable recording and cryptography to prove the link between an IP right and a product, using an identifier (a barcode or global ID) or a digital address (that is, a domain). This can then be integrated into a product via an Internet of Things (IoT) device or used in a digital space (using a trust badge embedded into a domain and then verified by the API bridge connecting to the Smart Trade Mark). The use of blockchain allows the creation of an undisputed audit trail which will enable users to view the historical state of each Smart Trade Mark and its network.

20 *Anti-Money Laundering and Counter-Terrorism Financing Act 2006* <https://www.legislation.gov.au/Details/C2019C00011>

21 <https://www.ipaustralia.gov.au/beta/smart-trade-mark>

Standards

Common standards for blockchain are crucial as the technology matures. Currently there is a lack of interoperability between blockchain platforms, and many will require replacement in the near future to remain competitive and to avoid security problems and obsolescence.²² Standards for blockchain will improve market confidence and support broader rollout of blockchain systems.

To address the issue, the Australian Government provided \$350,000 to Standards Australia to lead the development of international blockchain standards through ISO.²³ On behalf of Australia, Standards Australia submitted a proposal to the ISO in 2016 to establish a new ISO technical committee for blockchain standards topics, including interoperability, terminology, privacy, security and auditing. ISO Technical Committee 307, Blockchain and Distributed Ledger Technologies was created as a result of Australia's leadership, and Standards Australia manages the committee's secretariat. ISO Technical Committee 307 is now developing blockchain standards on the key topics.²⁴

ISO Technical Committee 307 published its first technical report in September 2019: ISO/TR 23455:2019 *Overview of and interactions between smart contracts in blockchain and distributed ledger technology systems*.

CASE STUDY: STANDARDS AUSTRALIA AND SMART CONTRACTS: REDUCING FRICTION IN TRADE AND TRANSACTIONS

Moving commodities, from wool to grains to wine, across borders is critical to an export-driven nation like Australia. Smart contracts are not new, but they open new opportunities to do this with greater speed and certainty. Smart contracts are self-executing contracts which can automate and authenticate processes where it is important for the participants in a process to be able to rely on and trust steps or conditions in a supply chain or exchange.

Smart contracts are the focus of a recent technical report published by the International Organization for Standardization (ISO), through ISO Technical Committee 307, Blockchain and Distributed Ledger Technologies. The report describes the functions of smart contracts and how they interact with each other on blockchains and distributed ledger environments. It will be the basis for a future Technical Specification, which will provide guidance on building these systems, based on comprehensive global mapping work underway through ISO/TC 307.

Standards Australia, with the active support of the Australian Government, played an instrumental leadership role in developing the report, initially proposing the broad area of work internationally and managing the secretariat of the ISO Technical Committee responsible for it. The former Department of Industry, Innovation and Science supported Standards Australia's push for blockchain standards in late 2016, resulting in the **Roadmap for Blockchain Standards**.

22 <https://www.gartner.com/en/newsroom/press-releases/2019-07-03-gartner-predicts-90--of-current-enterprise-blockchain>

23 <https://www.minister.industry.gov.au/ministers/karenandrews/media-releases/advancing-australias-blockchain-industry>

24 <https://www.iso.org/committee/6266604.html>



2: Skills, Capability & Innovation

‘It is vital Australia and our tech companies stay ahead of the game in one of the world’s fastest growing technology sectors.’

SENATOR THE HON SIMON BIRMINGHAM,
MINISTER FOR TRADE, TOURISM AND INVESTMENT²⁵

²⁵ <https://www.minister.industry.gov.au/ministers/karenandrews/media-releases/advancing-australias-blockchain-industry>

The success of blockchain in Australia will depend, in part, on industry and government addressing key skills requirements. There is a need to build the skills-base that can translate into the capability that drives innovation and helps blockchain reach its potential.

The skills of technology investment decision-makers—in businesses and in government—also need attention. One of three key findings from the Australian Institute of Company Directors (AICD) *Driving innovation* report was that ‘Australian boardrooms have low innovation and digital literacy levels’: that only 3% had science and technology expertise and only 35% said their board had the right skills and experience to assess both the ethical and practical implications of modern technology.²⁶

Department of Industry, Science, Energy and Resources research shows that the average Australian firm scores poorly on a measure of digital management capability, at a rate consistent with having only one out of eleven digital management practices in place.²⁷ Some examples of good digital management practices include:

- including information and communication technology in the business’s strategic plan
- approving investment in new digital technologies
- introducing new training programs for staff.

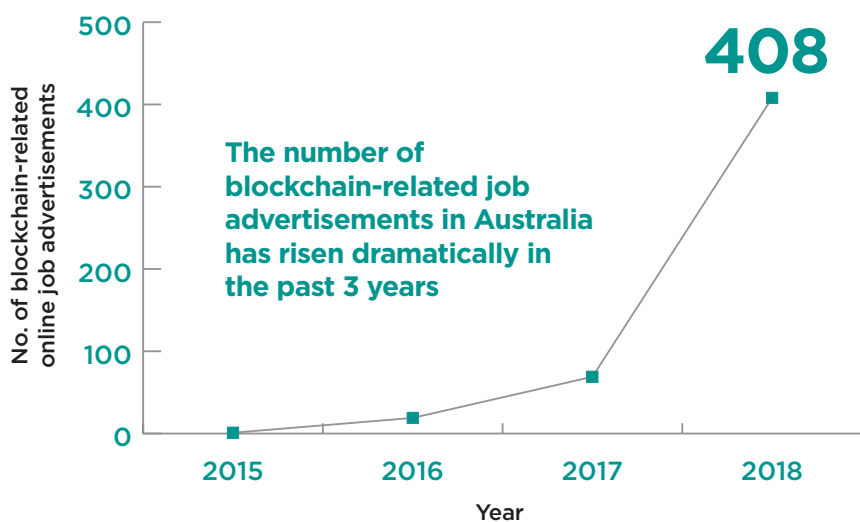
Skills

Foundational and specialist skills

ICT skills are essential to developing an effective skills base for advancing blockchain technology. Australia’s percentage share of tertiary graduates with ICT qualifications in 2017 was just over 4.1%, which was around half that of Singapore (8.2%) and lower than New Zealand (6.7%) and Finland (6.3%) for the same period.²⁸

Demand for blockchain-skilled workers is substantial,²⁹ with rapid growth in blockchain-related job advertisements since 2016—notably an increase between 2017 and 2018 of over 300%, which significantly outstrips supply.³⁰

Figure 4: Number of blockchain-related online job advertisements in Australia³¹



²⁶ <https://aicd.companydirectors.com.au/advocacy/research/driving-innovation-the-boardroom-gap>

²⁷ <https://www.industry.gov.au/data-and-publications/development-of-management-capability-scores>

²⁸ Source: UNESCO Institute of Statistics <http://data.uis.unesco.org/>

²⁹ <https://www.acs.org.au/content/dam/acs/acs-publications/ACS-Blockchain-Technical-Whitepaper-2019.pdf>

³⁰ <https://www.acs.org.au/content/dam/acs/acs-publications/ACS-Data61-Blockchain-2030-Report.pdf>

³¹ Data61 analysis, Source: Burning Glass Technologies, <https://www.acs.org.au/content/dam/acs/acs-publications/ACS-Data61-Blockchain-2030-Report.pdf>

CASE STUDY: RMIT & SINGAPORE

In 2018, RMIT piloted a blockchain-focused course with a number of schools across Singapore. The success of this pilot has seen RMIT's short course, *Developing Blockchain Strategy*, included in Singapore's SkillsFuture list of training for mid-career professionals.³⁶ The course provides skills for understanding, applying and assessing the value of blockchain technology for your business, as well as for engaging with technical, legal and regulatory issues.³⁷

Given Australia has around 470,000 people with potentially relevant digital and ICT skills,³² an opportunity exists for Australia to develop a solid cohort of blockchain-proficient professionals—provided the appropriate blockchain-specific training is made available.

Australia is already developing the means to address this need, with a number of Australian universities taking the lead in developing modules and courses which specialise in blockchain.³³ A number of online courses, including courses offered by established universities, are also currently available.³⁴ Furthermore, the Australian Government continues to support initiatives to increase proficiency among young Australians in core science, technology, engineering and maths (STEM) skills, so that in the future they will have the requisite capabilities to engage with and drive the technologies that will underpin Australia's productivity.³⁵

Improving blockchain literacy

A lack of familiarity with blockchain and its potential, along with concerns about the level of hype associated with new technologies, may unduly limit industry and policy decision-makers' appetite for engaging with blockchain. Education of decision-makers is key to ensuring that government and businesses are able to identify the right use-cases for blockchain.

There is also a need for appropriate legal advice, which requires legal professions to engage with and understand blockchain technology and its implications, both in itself—for example, data retention—and in its practical applications—for example, smart contracts. The demand for blockchain-related legal services in Australia has already seen law firms such as King & Wood Mallesons, Herbert Smith Freehills, Piper Alderman and Hall & Wilcox provide advice regarding blockchain in an Australian context, with several providing initial guidance online.

³⁶ <https://www.rmit.edu.au/news/all-news/2019/march/skillsfuture-singapore>

³⁷ <https://futureskills.rmit.edu.au/blockchain>

³² <https://www.acs.org.au/content/dam/acs/acs-publications/ACS-Data61-Blockchain-2030-Report.pdf>

³³ <https://www.acs.org.au/content/dam/acs/acs-publications/ACS-Data61-Blockchain-2030-Report.pdf>

³⁴ <https://www.acs.org.au/content/dam/acs/acs-publications/ACS-Data61-Blockchain-2030-Report.pdf>

³⁵ <https://www.education.gov.au/support-science-technology-engineering-and-mathematics>

Fostering research, development and innovation

Government use of blockchain

The Digital Transformation Agency (DTA) undertook a discovery in 2018 examining the potential of blockchain for government services.³⁸ The discovery found that blockchain was still an emerging technology and that agencies should focus on the business problem that needed to be solved, rather than go straight to a technical solution issues. The DTA recommended that:

Agencies should continue to monitor blockchain developments and look for opportunities to enhance service delivery, which this technology may unlock in the future.

Since that time, some government use cases have been explored using blockchain technology.

IP Australia co-leads the Committee on World Intellectual Property Organization (WIPO) Standards Blockchain Task Force which is exploring the potential of blockchain technology for the IP Rights ecosystem. The taskforce comprises over fifteen member states and is undertaking standardisation activities—leveraging Standards Australia’s work on ISO standards for blockchain—including the development of guidance and recommendation documents on terminology, definitions and the technology itself; use-case determination; and best practice approaches to support IP offices, IP professionals and industry.

³⁸ <https://www.dta.gov.au/help-and-advice/technology/blockchain>

CASE STUDY: IP AUSTRALIA & IP RIGHTS MANAGEMENT

In 2017, IP Australia collaborated with Australian blockchain start-up Civic Ledger to assess blockchain’s potential for the IP system and for streamlining existing processes. The trial explored how to digitally represent and process IP rights on a blockchain, with smart contracts to test the registration, amendment and the direct transfer of tokenised patents from an owner to another party. 14 patent processes were developed as smart contracts—emulating patent life cycle events—and involved the tokenisation of over 50,000 patents.

A supplementary stage of the trial built a concept marketplace to undertake the execution of patent licencing between two parties. The concept was built around green technology patents with a prototype user interface which allowed a user to browse available patents, request and buy a patent licence, and allowed the patent owner to authorise the request. The IP Rights Registration and Exchange Protocol (IPRx) was developed as the framework for the concept, supported by smart contract modules. The key focus was to design a concept with emphasis on representing a patent market ecosystem that leverages tokenisation and decentralisation to create new economic opportunities.

CASE STUDY: PERTH MINT GOLD TOKEN^{39, 40}

In October 2019, the Perth Mint, the world’s largest refiner of newly-mined gold, announced it had partnered with leading precious metals digitisation company Infinigold to establish the blockchain-based Perth Mint Gold Token (PMGT).

PMGT is digitised gold that allows users to conveniently acquire and have entitlement over government-guaranteed physical gold stored at The Perth Mint in a trusted and cost-effective way. It offers institutional investors a competitive alternative to traditional gold products such as gold Exchange Traded Funds (ETFs), with the additional benefits of real-time trading and settlement enabled by blockchain technology. Subject to final regulatory consultation, PMGT will become directly tradable against traditional gold products, including gold ETFs, CME gold futures, and physical XAU.

With PMGT, InfiGold and the Perth Mint are leading the transformation of gold into a multi-billion dollar digital asset. In the two weeks following PMGT’s launch in October 2019, over 1,400 investors had registered for new digital accounts.

Perth Mint is the trading name of Gold Corporation, which is wholly owned by the Western Australia government.

³⁹ <https://www.perthmint.com/media-infinigold-pmgt.aspx>

⁴⁰ <https://www.perthmint.com/media-tpm-golden-growth.aspx>

Research and Development into the technology

Australian research has been leading in areas of blockchain. For example, CSIRO's Data61 is one of the world's top blockchain research organisations and has authored five of the 30 most-cited blockchain research papers globally.

Data61 is designing blockchain-based systems for different industry applications and assessing their trustworthiness. Data61's capabilities include designing software systems with blockchain as a component; analysing and improving trustworthiness of blockchain to better understand the guarantees and limitations of different protocols; researching human behaviour and patterns of use and misuse; and developing smart contracts.

In addition, the RMIT Blockchain Innovation Hub (BIH) is the world's first research centre on the social science of blockchain. The BIH was established at the end of 2017 within the College of Business. Bringing together economics, sociology, public policy and political economy, the BIH provides a new way to understand the global blockchain evolution. The BIH has established RMIT as a global leader in blockchain research, education, and impact.

A number of other Australian universities are undertaking research into blockchain, such as the University of Sydney, which is developing the Red Belly Blockchain (see case study below).

Swinburne University has established a Blockchain Innovation Lab, focusing on delivering strong research outcomes and supporting industry growth regarding blockchain in areas such as blockchain architecture, smart contracts, applications and proof-of-concept, performance and efficiency as well as security and privacy. Swinburne University is also partnering with ArtChain Global on a blockchain-based system for the registration, trade and protection of artwork.⁴¹

Similarly, Monash University has established a Blockchain Technology Centre to explore and develop blockchain technology and introduce relevant blockchain content into cross-faculty curriculums.⁴² Their blockchain research is addressing issues such as anti-money laundering in cryptocurrency, enhancing blockchain-enabled supply chains, privacy and security,⁴³ as well as facilitating information exchange between blockchain and non-blockchain networks.⁴⁴

⁴¹ <https://www.swinburne.edu.au/digital-capability-platform/our-labs/blockchain-innovation-lab/>

⁴² <https://www.monash.edu/blockchain>

⁴³ <https://www.monash.edu/blockchain/research>

⁴⁴ <https://h.cash/#section3>

Scalability

A significant challenge for blockchain is scalability. The data and energy-intensity of some blockchains has been flagged as a potential barrier to scaling the technology in a way that could allow its application to a range of tasks and processes. For example, blockchains such as Bitcoin and Ethereum support transaction rates of roughly seven and 20 per second respectively, which compares unfavourably with Visa's rate of 56,000 transactions per second.^{45, 46}

Australian innovation, however, is proving that even this significant hurdle can be overcome, with Red Belly Blockchain completing 30,000 transactions per second in large-scale experiments.

CASE STUDY: RED BELLY BLOCKCHAIN⁴⁷

Red Belly Blockchain is a technology from the University Sydney and CSIRO's Data61 that addresses key challenges for blockchain platforms, such as the slow responsiveness of blockchain transactions and the low rate at which blockchain-based transactions can be executed. Awarded an Australian Research Council grant of \$855,000 in 2018, the Red Belly Blockchain has already demonstrated significant potential, achieving a transaction response time of about 3 seconds compared with Bitcoin's 10 minutes, and a transaction rate of 30,000 per second in large-scale experiments, compared with Bitcoin's seven. In doing so, Red Belly Blockchain has overcome one of the most notable obstacles to scaling the technology, opening the way to blockchain being applied more broadly within the finance sector and expanding into the agricultural and education sectors.⁴⁸

45 <https://www.acs.org.au/content/dam/acs/acs-publications/ACS-Data61-Blockchain-2030-Report.pdf>

46 <https://www.visa.com.au/about-visa/newsroom/press-releases/iou-go-mobile-bringing-peer-to-peer-payments-into-the-digital-age.html>

47 <https://www.redbellyblockchain.io/>

48 AFR, 25/09/2018 - CSIRO and Sydney University Create Superfast Blockchain



3: International investment and collaboration

‘... taking up technologies, such as blockchain, can give Australia an edge on the international stage. It’s a competitive industry. So, it’s important we keep pace with the rest of the world when it comes to new technologies — if we’re not constantly pressing ahead, then we risk going backwards. In other words, we want to help position Australia as a global leader in blockchain technology.’

SENATOR THE HON JANE HUME, ASSISTANT MINISTER FOR SUPERANNUATION, FINANCIAL SERVICES AND FINANCIAL TECHNOLOGY⁴⁹

⁴⁹ Speech to APAC Conference, Sydney 23 June 2019 <http://ministers.treasury.gov.au/ministers/jane-hume-2019/speeches/address-apac-blockchain-conference-sydney>

Australia is not alone in recognising the potential of blockchain. Several nations have made considerable inroads with regard to not only the technology itself, but in developing an environment that can support and promote it. For example, Estonia has used the KSI blockchain to back its business, healthcare, property and succession registries, as well as its digital court system and state gazette.⁵⁰

In October 2019, Xi Jinping, President of the People's Republic of China, said that China needs to 'seize the opportunity' afforded by blockchain technology. President Xi noted that blockchain technology already has a wide array of applications within China, from financing businesses to mass transit and poverty alleviation.⁵¹

Likewise, in October 2019, the European Commission released its report, *Blockchain now and tomorrow: Assessing the impact of distributed ledger technologies*, which provides an in-depth exploration of blockchain and its potential, while also avoiding the hype associated with the technology.⁵²

Investment

A 2018 PWC survey of global executives concluded that 7% currently consider Australia to be a blockchain leader, ahead of Japan (6%), the UK, Denmark, India and Hong Kong (each at 5%). While still significantly behind the US (29%) and China (18%), respondents predicted that only Australia, China and India were on target to expand their share through to 2023.⁵³

IBM has been investing in blockchain in Australia, stating that:

IBM has invested in local provisioning of blockchain network as a service out of its local IBM Cloud data centres in Australia.

*With IBM operating the infrastructure locally in Australia, organisations are able to run blockchain solutions sovereign to the Australian market. IBM is pleased that Australia is becoming a leader in the implementation of blockchain for industry and that IBM Australia is playing a key role to drive this success.*⁵⁴

Financial services are seen as the most advanced industry in developing blockchain (46%) compared with industrial products and manufacturing (12%), energy and utilities (12%), healthcare (11%) and government (8%).⁵⁵ However, these figures represent a shift away from the financial services sector as the near-exclusive user of blockchain technology in 2017 (82%) and a growing engagement with blockchain's potential across a broader range of industries.⁵⁶

Australia has demonstrated innovation and leadership in blockchain in areas such as international standards, bond operations and smart programmable money, while also conducting trials in the energy, agricultural and public sectors.⁵⁷ For example, in a world-first trial, the Commonwealth Bank of Australia and CSIRO's Data61 conducted a trial for smart money (also known as programmable money), motivated by the context of Australia's National Disability Insurance Scheme (NDIS).⁵⁸ The proof-of-concept trial demonstrated that smart money would, if scaled and applied across the NDIS ecosystem, result in annual economic benefits equating to hundreds of millions of dollars.⁵⁹

50 <https://www.pwc.com/gx/en/services/legal/tech/assets/estonia-the-digital-republic-secured-by-blockchain.pdf>

51 https://www.coindesk.com/president-xi-says-china-should-seize-opportunity-to-adopt-blockchain?utm_source=&utm_medium=&utm_campaign=

52 <https://ec.europa.eu/jrc/en/news/blockchain-now-and-tomorrow-assessing-impact-distributed-ledger-technologies>

53 <https://www.pwc.com/gx/en/issues/blockchain/blockchain-in-business.html>

54 IBM Statement supplied to Department of Industry, Science, Energy and Resources, October 2019.

55 <https://www.pwc.com/gx/en/issues/blockchain/blockchain-in-business.html>

56 <https://www.pwc.com/gx/en/issues/blockchain/blockchain-in-business.html>

57 ACS Data61 Blockchain 2030

58 ACS Data61 Blockchain 2030 p. 63

59 <https://www.csiro.au/en/News/News-releases/2018/blockchain-trial-could-lead-to-smarter-money>

CASE STUDY: PELLAR TECHNOLOGY

Established in 2017, Pellar Technology has been providing enterprise blockchain solutions to clients in Korea, Singapore, Malaysia and Thailand.

Pellar built their own blockchain, capable of transacting at 20,000 transactions per second, which is dramatically faster than many of the existing solutions in the market. Pellar offers end-to-end blockchain solutions using their platform, the demand has been predominantly in the finance and supply chain sector. Their solutions have been used to build digital banks, asset trading, and manufacturing systems. Their system processes over 10 million transactions daily.

A client in Malaysia is using their platform to disrupt digital payments, using Pellar's blockchain to bypass the existing banking and payment infrastructure in order to reduce transaction fees and latency. Pellar have also assisted a large automotive manufacturer in Thailand to record car ownership, manufacturing and servicing information on blockchain, to help provide transparency and trust.

The Australian market has been substantially slower for Pellar, as they have found businesses are hesitant to invest and adopt blockchain technologies. Pellar are still optimistic that the domestic market will eventually trial new ideas and technologies.

Recently, Pellar was named 2019 Emerging Exporter of the Year by the Victorian Government and nominated as 2019 Blockchain Company of the Year by Fintech Australia.

CASE STUDY: INTER-GOVERNMENT LEDGER

The Australian Border Force (ABF) has developed the Inter-Government Ledger (IGL)—a capability (proof of technology) to share documents electronically between participating governments. For international trade, there is an issue where an importing regulator has no direct relationship with an exporter and, more importantly, there is no digital mechanism to verify documents they provide. This leads to the importing regulator to rely upon physical documents—supported by signatures and wet stamps—to validate the claim or information on that document, rather than being able to use digitised data. Moving these paper documents adds costs and delays to the international trade process. The IGL aims to assess the viability of replacing paper documents with high-integrity digital processes. IGL involves a blockchain solution that will help streamline the process, reduce costs and reduce compliance issues at the border by creating a ledger of electronically verifiable digital documents, suitable to all trading partners.

The World Trade Organization has highlighted the potential for blockchain to increase the participation levels of micro, small and medium enterprises (MSMEs) in international trade by lowering barriers to entry, providing access to trade finance and facilitating trade procedures.⁶⁰ Small-to-medium enterprises or organisations account for roughly 93% of Australian blockchain activity.⁶¹

IBM have noted that blockchain could significantly transform international trade, in part by helping reduce the physical paperwork associated with customs clearance, transportation and logistics, and thus become the future of trade infrastructure—provided the challenges faced by the technology are addressed and projects demonstrate success.⁶²

Singapore has announced plans to develop blockchain-based digital trade infrastructure in the form of 'TradeTrust', a set of standards, digital infrastructure and governance and legal frameworks which will facilitate the exchange of digital trade documentation. TradeTrust is anticipated to achieve efficiencies in cross-border trade and logistics documentation processes and to reduce costs associated with paper-based processes.⁶³

Collaboration

A number of annual blockchain-specific conferences and events are held internationally which represent opportunities for increased collaboration between jurisdictions, as well as for Australian businesses to attract investment and promote their services. High-profile events include New York's Consensus, Shanghai's Wanxiang Blockchain Summit, Dubai's Future Blockchain Summit, Singapore's Blockchain Summit and the OECD Global Blockchain Policy Forum. In addition to business missions to New York, Shanghai, Taipei and Dubai, Austrade has held international virtual events for Australia-based parties to attend.

One barrier to increasing investment and collaboration across borders is a limited understanding of the blockchain-related needs of potential customers or investors, relative to the services which Australian blockchain firms can provide. Improving the 'pitching' skills of Australian blockchain businesses—as well as taking a more targeted approach to helping blockchain providers find the right customer or investor—may help maximise the impact of international engagement opportunities.

⁶⁰ WTO Report

⁶¹ ACS Data⁶¹ Blockchain 2030 (stats are 50.7%; 31.2%)

⁶² <https://www.ibm.com/downloads/cas/KJDPQKBE>

⁶³ <https://www2.imda.gov.sg/programme-listing/international-trade-and-logistics/tradetrust>

CASE STUDY: AUSTRADE 2019 MISSION TO CONSENSUS

Austrade has run a number of overseas missions to create export and partnership opportunities for Australian blockchain businesses, as well as to build Australia's reputation as a global blockchain leader. In May 2019, Austrade partnered with the (then) Australian Digital Commerce Association (now Blockchain Australia) and the former Department of Industry, Innovation and Science to send 43 delegates from 36 Australian organisations to the world's largest blockchain conference, Consensus, in New York. The mission generated a number of export and investment leads and also raised the public profile of the Australian blockchain industry. The delegation also generated a number of links between participants, which has increased collaboration within the domestic ecosystem.

CASE STUDY: NETHERLANDS

The Netherlands established the Dutch Blockchain Coalition in 2017 as a joint partnership between industry, government and the research sector to identify where blockchain's practical potential lies, as well as identifying related challenges.

In 2017–18, DBC partners invested over €1 million and made 30 FTE available to realise an agenda with three lines of action:

- **Conditions:** informing the development of blockchain technologies with standards and norms that are compatible with European views, values, norms and regulations
- **Human Capital agenda:** improving domestic capacity in blockchain expertise within organisations, through a range of initiatives
- **Self-Sovereign Identity (SSI):** developing a 'digital passport' that the citizen installs via a blockchain app and which can only be unlocked and used with a facial scan of the owner.

DBC has also established a number of working groups for 2019, focussing on Cyber Security, Legal, Governance, Cabinet & Board Level Engagement, and Research Agenda respectively.



4: Sectoral opportunities



Overview of sectoral opportunities

The ability of blockchain technology to establish a single, recognised source of truth and to manage decentralised and transactional data without a central authority provides a versatility that can be of benefit to many different applications.

At present, Australia's financial services sector has been the most prominent advocate and adopter of blockchain technology to date, undertaking nearly 40% of blockchain activity in the country.⁶⁴ The professional, scientific and technical services sector represents nearly 20%, with the remaining activity spread across a wide range of sectors, from retail through to mining, contributing to approximately 40% of overall blockchain activity in Australia.⁶⁵

Blockchain and DLT provide new ways for organisations to work together, and new ways to represent and manage digital assets, as represented in the matrix below:

	Simple coordination	Complex coordination
Property rights	<p>(Digital assets)</p> <p>Custodial services</p> <p>Simple settlements</p>	<p>(Value chain)</p> <p>Provenance</p> <p>Trade finance</p> <p>Conditional settlements</p>
Information & authorisation	<p>(Conventional IT)</p> <p>Records management</p> <p>Greater redundancy across geographically spread nodes</p>	<p>(Network)</p> <p>Customs & single window</p> <p>Trade certificates</p> <p>Logistics events</p>

There are opportunities to be realised through the use of blockchain technology in other sectors, in addition to those of the financial services and professional, scientific and technical services sector, where blockchain technology has traditionally been employed. Industry has also identified the opportunities that could be harnessed through blockchain in the legal sector, construction sector and government sector, specifically with respect to managing licences, permits and registries.

To showcase some opportunities, three use cases were selected for analysis. The following chapter will highlight the use of blockchain in the agriculture sector, with a focus on supply chains and wine exports; the education sector, with a focus on trusted credentials and facilitating trusted information about an individual's skills and capabilities; and the financial sector, with a focus on identify checks, specifically 'Know Your Customer' checks.

⁶⁴ ACS Data61 Blockchain 2030 - <https://www.acs.org.au/content/dam/acs/acs-publications/ACS-Data61-Blockchain-2030-Report.pdf>

⁶⁵ ACS Data61 Blockchain 2030 - <https://www.acs.org.au/content/dam/acs/acs-publications/ACS-Data61-Blockchain-2030-Report.pdf>

Sectoral Showcase 1: Agricultural Supply Chains: wine exports

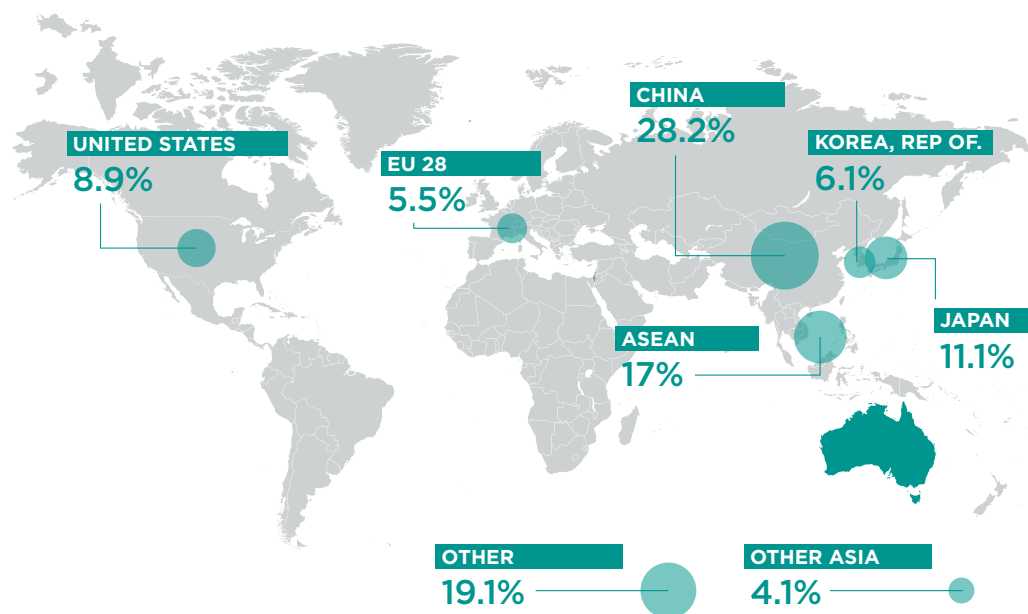
Overview of Australian agriculture

Australia's agriculture is shaped by its varied environment and climate, providing both a competitive advantage in our diversity of production and a challenge for policy and on-farm decision-making.⁶⁶

Total production in agriculture was \$60 billion in 2018–19, with the largest contributions coming from horticulture (\$11.6 billion), cattle (\$11.3 billion), wheat (\$6.2 billion), sheep/lamb (\$4.7 billion), wool (\$4.5 billion), milk (\$4.3 billion), and fisheries (\$3.2 billion).⁶⁷ In 2018–19, Australia exported \$50.7 billion in agricultural products, and \$1.6 billion in seafood.⁶⁸

Australia's principal export markets are China, South East Asia (ASEAN countries), Japan, the United States, the European Union (EU), and the Republic of Korea (Figure 5).⁶⁹

Figure 5. Australia's principal export markets⁷⁰



Issues in agricultural exports

The safety, quality, taste and well-regulated production of Australian-branded agricultural goods—which make them popular and high-value commodities in foreign markets—also make the Australian brand an attractive target for counterfeiting. Counterfeiting is one aspect of food fraud, involving imitation of an authentic food product and infringement of associated intellectual property rights. Food fraud costs the global food industry an estimated US\$40 billion each year.⁷¹

66 <http://www.agriculture.gov.au/abares/research-topics/agricultural-commodities/sep-2019/agriculture-overview>

67 ABARES 2019, Agricultural commodities: September quarter 2019

68 Australian Bureau Statistics, International trades and Services, Australia, cat. No. 5368.0, Canberra, and ABARES 2019, Agricultural commodities: September quarter 2019

69 ABARES 2019, Agricultural commodities: September quarter 2019

70 ABARES 2019, Agricultural commodities: September quarter 2019

71 CSIRO 2017. *Food and agribusiness: A roadmap for unlocking value-adding growth opportunities for Australia*. Available at: <https://www.csiro.au/en/Do-business/Futures/Reports/Food-and-Agribusiness-Roadmap>

For Australian exporters, the cost of food and wine fraud in 2017 was estimated at over \$1.68 billion.⁷² By sector, dairy incurred the highest costs (\$360 million), followed by wine (\$303 million), meat and live animals (\$272 million), horticulture (\$248 million) and seafood (\$189 million).

There have been multiple reports of counterfeit Australian agricultural commodities in overseas markets. For example, Australia's export beef brands command premium price tags, especially in the Chinese marketplace, but just under half of the Australian-branded beef on offer actually originates in Australia⁷³. Other target food commodities include citrus and cherries, infant formula and high-end Australian wine brands. The presence of these substandard, counterfeit goods represents a risk to Australia's clean and green reputation and may limit our access to certain export markets.

Along with the economic and reputational costs to industry, food fraud can also impact biosecurity, human health and social outcomes. An example of this occurred in January 2016, when two imported nut products were subject to allergen recalls due to undeclared presence of peanuts. One of these products had been repackaged and misrepresented as pine nuts within Australia, and the other was largely (95%) peanuts but was labelled 'sliced almonds'— both higher value products.

Systemic issues

Combatting food fraud provides an example of the complexity of regulation in relation to the agriculture sector. The broad scope of food fraud is not addressed in a single law and is generally defined as a violation of several laws.⁷⁴ This poses challenges for enforcing food laws across all levels of government in Australia.

More broadly, the complex interaction of government, industry and international trading partner-related regulation has been recognised by the Productivity Commission, as in its recent inquiry into regulation in agriculture. The Commission found that the cumulative burden of regulation on farmers is substantial, with 'a vast and complex array of regulations ... in place at every stage of the supply chain—from land acquisition to marketing—and ... applied by all levels of government.'⁷⁵

Industry-led regulatory schemes also place requirements on agricultural producers and food manufacturers across the supply chain. In addition to these domestic regulatory activities, the international trade policy environment and consumer expectations about food are changing. Australia's trading partners are applying more rules and requirements to food exports relating to food safety, provenance and authenticity.

New technologies will enable increased scrutiny and produce-testing at any stage along the supply chain. As non-tariff trade measures such as these are estimated to be costing businesses up to three times as much as formal trade barriers, ensuring regulatory processes are streamlined will yield significant economic efficiencies.

Blockchain technology can contribute to this effort through providing reliable, secure tracking of provenance, including recording of environmental details (such as temperature in storage), in addition to the payment benefits delivered by blockchain-based smart contracts.

72 FIAL 2017. *Counting the cost: Lost Australian food and wine export sales due to fraud*. Available at: https://fial.com.au/Attachment?Action=Download&Attachment_id=60

73 <https://www.farmonline.com.au/story/5403286/food-fraud-bites-aussie-ag-exports/>

74 Spink, J, Hegarty, V, et al. 2019. *The application of public policy theory to the emerging food fraud risk: Next steps*

75 Productivity Commission 2016, *Regulation of Australian agriculture*, Report no. 79, Canberra

Wine sector

Overview

Australia's wine sector is one of the success stories of the agricultural sector. Australia is the world's 5th largest wine producer, and the largest in the southern hemisphere, with 146,000 ha of vineyards. 63% of wine produced is exported, with \$2.89 billion in value exported in the year ending September 2019, demonstrating a growth of 7% compared with the previous period. Volume declined by 8% to 774 million litres in this period, reflective of growing demand for Australian premium wines. See the infographic below for a summary of key export markets.⁷⁶

The Australian wine sector is made up of 65 wine regions, with approximately 2500 wineries and over 6,000 grape growers.⁷⁷ The sector employs over 160,000 staff and contributes over \$45 billion to the Australian economy.⁷⁸ It also serves to increase Australia's reputation as producer of high quality food & beverage products and as a tourism destination.

Figure 6: Australian wine export statistics, year ending September 2019

AUSTRALIAN WINE EXPORT STATISTICS Year ending September 2019



Source: Wine Australia

⁷⁶ <https://www.wineaustralia.com/news/media-releases/export-report-september-2019>

⁷⁷ <https://www.wineaustralia.com/report-downloads/e2ad0473-60d8-4486-a7e4-b07321231335>

⁷⁸ <https://www.wineaustralia.com/report-downloads/e2ad0473-60d8-4486-a7e4-b07321231335>

Blockchain solutions and opportunities: from vine to international customer

The process of growing, producing and transporting wine is complex, with many different participants involved in the process. Key segments of the supply chain are outlined below.

At most stages of the wine supply chain, there is a need for the transfer of data or accreditations. This presents a tremendous opportunity for blockchain solutions to combine with other technologies—such as the Internet of Things (IoT)—to generate efficiencies and to remove red tape. Some potential benefits are outlined below:

GROWERS

- Quality data on soil composition and temperature enable better decision-making and opens the possibility of data-sharing with the vineyard
- Allows for optimisation of cultivation methodology

WINERIES

- Real-time sensor data from the production process
- Automatic generation of production records can expedite audit processes

BOTTLERS

- Trace information from grower to the bottle
- Opportunity to serialise or hash each individual bottle on a blockchain
- Autocheck of labelling requirements with Wine Australia and relevant parties

DISTRIBUTORS (BOTH DOMESTIC AND INTERNATIONAL)

- Cold-chain logistics management
- Inventory tracking
- Smart contracts to automate payment between members of the supply chain
- Automation of documentation and regulatory processes
- Links to accredited buyers or distributors
- Harmonisation of processes with relevant international agencies

CONSUMERS

- Reduction in counterfeiting through transparency of provenance
- Consumer can see story of the product from vineyard to glass
- Promotion of 'Brand Australia'

REGULATORS

- Harmonisation of documentation for wine export approval for quality and assurance processes and wine export licencing
- Harmonisation of documentation and provenance information for the Label Integrity Program to demonstrate adherence to international wine-labelling obligations, including use of geographical indications (GIs)
- Harmonisation of record keeping and testing for compliance with domestic and importing country winemaking standards.

ALL PARTICIPANTS AND STAGES

- Opens up opportunity for cheaper and better finance
- Reduction of risk through transparent provision of data and information
- Reduction in the number of intermediaries in the supply chain, and opportunity to sell directly to market.



Growers



Wineries



Bottlers



Distributors



Consumers



Regulators



All participants and stages

Challenges

Despite the significant opportunities presented by using blockchain technology in the wine sector, there are many barriers to adoption. These barriers include:

- the cost of the solution can be perceived as being higher than the benefit;
- the benefits are obtained by many actors in the supply chain, while the cost may be borne by one or two parties
- limited interest in, and capacity for, technological adoption
- general lack of digitisation in parts of the agricultural sector
- limited access to capital to adopt solutions
- limited access to digital infrastructure—such as broadband—that can facilitate the technology and its application
- slow adoption curve, due to low risk appetite
- limited understanding of blockchain technology and/or a sense that the technology is overhyped or not appropriate for this use case
- a lack of incentive to innovate
- uncertainty regarding the impact of increased transparency and unease with data usage, storage and control.

Summary

Blockchain solutions present a tremendous opportunity to add transparency, data sharing and efficiencies to the wine sector. While there are some blockchain pilots operating in the sector, there remains significant opportunity for Australia's wine industry—and the agricultural sector more broadly—to harness blockchain technology.

It is important to recognise that there are informational, operational and financial impediments to uptake of the technology, both the firm level and more broadly. The agriculture sector and the technology sector will need to work together to navigate these, to ensure successful adoption and implementation of solutions.

CASE STUDY: MITCHELL WINES & KPMG

Mitchell Wines is a family-owned boutique winery in South Australia's Clare Valley, producing dry-grown wines since 1975. Mitchell Wines partnered with KPMG Australia to explore the use of emerging technologies, such as IoT and blockchain, to extract value across grape growing, winemaking and export activities.

The KPMG Origins platform enables supply chain participants to fairly share trusted information. Using blockchain technology, the platform provides an infrastructure of trust for trading partners and integrates with interactive digital applications on both mobile and existing enterprise channels, meeting the varying needs of B2B and consumer segments.

The combination of grower and winery process digitisation through mobile applications, automated data capture and distribution using blockchain, can create efficiency, deliver trust and tell a unique story of Australian and South Australian wine excellence to domestic and overseas consumers. From an operational perspective, bringing all the data into one place helps participants to view their businesses in a new light and enables them to make better and more timely decisions—from analysing historical spray and weather data to fermentation progress and inventory management.

Blockchain technology also has the potential to enable immutable record keeping of winemaking data, to facilitate future compliance and production audit activities. Creating a trusted source of data can also unlock export and import process efficiencies, as supply chain partners digitise in the future. Finally, sharing critical traceability data with supply chain participants also enables differentiation and communication with a broad set of consumers across a variety of markets. Visibility of trusted data across supply chain participants enables everyone to extract value and automate a number of manual and paper-based processes.

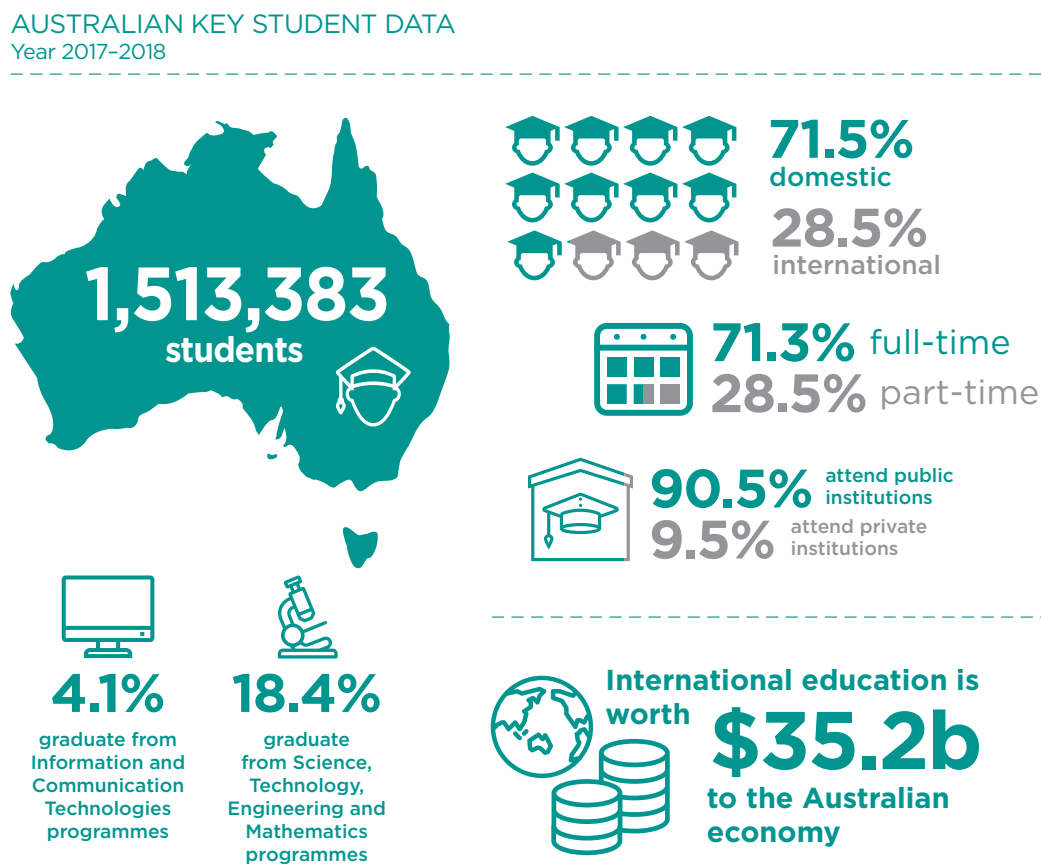
Sectoral Showcase 2: Trusted Credentials

Overview of Australian Credentialing sector:

Credentials are a type of institutional technology that are produced by the education sector, professional and trade associations, and by government. These certifications benefit consumers by facilitating trust in professional and trade services, and employers by facilitating trusted information about skills and capabilities.

Tertiary education is Australia's third largest export industry, behind iron ore and coal. And Australia is the third largest education exporter in the world, contributing a significant share to the production and export of credentials and qualifications. International education was worth \$35.2 billion to the Australian economy in 2018.⁷⁹

Figure 7: Key statistics on Australia's tertiary education sector⁸⁰



Credentials are an important element in a modern economy. The more complex and developed the economy, the more it utilises efficient and effective credential infrastructure and production. As we move towards an increasingly digitised workplace, it will become necessary to easily and securely prove a person's identity and credentials.

Australia's skilled labour markets are dependent upon proof of identity and verified credentials, and the intersection of the education sector and access points into Australian labour markets is the area where credentialing and its infrastructure are most valued.

⁷⁹ <https://internationaleducation.gov.au/research/Research-Snapshots/Documents/Export%20Income%202018%20Country%20Infographic.pdf>

⁸⁰ Data source: Department of Education, Skills and Employment

Blockchain innovation can benefit a major export industry, increasing administrative efficiency and facilitating adoption of digital technology in tertiary education—as well as improve the functioning of Australia’s labour markets; increasing the quality of job matching; and lowering the cost of employment process.

Issues in Credentialing

The potential for credentials fraud is significant, with conservative estimates indicating 25% of people include falsehoods on their résumés.⁸¹ For example, the NSW ICAC’s Operation Bosco discovered an employee who had used false academic qualifications, certified by a Justice of the Peace, for over 15 years to obtain senior positions in the public and private sectors.⁸²

There have been multiple instances of organised fraud in regard to the creation and sale of fraudulent qualifications, from those targeting specific industries such as construction,⁸³ to those targeting both university and vocational education-issued qualifications.⁸⁴

Verifying credentials can be a time-consuming process, particularly for those employers who may have to deal with verifying multiple applications by contacting the issuing institutions. It can also be time-consuming and costly for students, who (prior to 2017) had to prove their credentials to new employers via hard copy transcripts, paid for at university credentialing service offices.

Universities have responded to calls to ensure student data is portable in an increasingly digital, globalised environment by establishing a centralised higher education repository. My eEquals, launched in 2017, provides secure access to certified official transcripts and degree documents for 47 universities across Australia and New Zealand and are expanding to non-university higher education providers and TAFEs. Students are able to access their higher education qualification documentation through the online platform, where they can share their records with prospective employers, and other educational institutions around the world.⁸⁵

This has addressed a number of issues in the higher education sector, creating administrative efficiencies and making it easier for students to access their higher education qualifications. However, the qualified trade sector, as well as the professional accreditation sector, may face additional concerns. For example, it is difficult for a member of the public seeking to hire a qualified tradesperson—for instance, a builder or electrician—to verify those qualifications.

a. Verification inefficiencies

For employers, verifying credentials currently takes a long time. Human resources departments spend weeks doing background checks on new employees, creating costly inefficiencies in the hiring process. There is a demand from industry for a streamlined process where credentialing, background checks and safety checks (such as Working With Children Checks) can be completed instantaneously.

b. Market dynamics

The credentials market is expanding with the rise of micro-credentials (mini qualifications that demonstrate skills, knowledge and experience in a given subject area or capability). Industry, employers and students are demanding short courses to quickly address skills gaps, including for rapidly developing technologies such as blockchain.

c. Greater demand from high-risk sectors:

High-risk sectors, where a lack of a credentials can have a life-or-death consequence, are particularly interested in this area. There is a use case, for example, in the volunteering, humanitarian and aid work sector, where vulnerable communities need to be protected by adequate credential checks.

81 https://www.icac.nsw.gov.au/newsletter/issue48/resume_fraud.html

82 https://www.icac.nsw.gov.au/newsletter/issue48/resume_fraud.html

83 <https://www.smh.com.au/national/nsw/fake-tradies-husband-and-wife-alleged-ringleaders-in-qualification-fraud-20181219-p50n5k.html>

84 <https://www.news.com.au/finance/work/careers/the-great-aussie-degree-scam-forgers-raking-in-thousands-selling-bogus-qualifications/news-story/37a95801652821f9357ba94c20bbf29a>

85 <https://www.myequals.edu.au/participants/>

The consequences of fraudulent credentials are significant in this area.

Credentialing codes of conduct within these organisations, along with peer endorsements, may also allow workers to incrementally prove their trustworthiness using micro-credentialing.

The University Sector

In 2016, 41% of Australian 19-year-olds were enrolled in higher education institutions.⁸⁶

The qualifications students gain from this study are valuable to students and employers. However, the value of the qualifications could be eroded if employers can't trust that they are genuine. Securing the reputation of qualifications from Australia's tertiary institutions is critical to maintaining the \$32.4 billion international education market and its flow-on benefits.

Blockchain Solutions

Blockchain technology offers technological infrastructure on which credentials can be managed and shared. The ability to record or reference credentials on a blockchain provides benefits to students, education providers, employers and other service providers (including recruitment agencies) in the employment value chain.

Students benefit from full ownership of their credentials. The ability to share credentials (or particular aspects of those credentials) with prospective employers or other entities—without the involvement of the authority that originally granted the credential—would represent a significant change in the way credentials are managed, with possible benefits for privacy and selective disclosure.

Blockchain-based credentials can enable significant efficiency gains, as they can lower the transaction costs for employers and employment service providers in the verification and validation of credentials. Reduced opportunities for credentials fraud would increase the value of those credentials. An easily verifiable credential is likely to be of more value to a student and employer than one which has a higher risk of fraud.

Students will also benefit when they take their credentials into an overseas market, where the ability of foreign employers to verify credentials might be lower than in the Australian domestic market. Inefficiencies in verifying credentials across borders are well known, and Australian credentials providers are well placed to offer students more useful credentials when they are in a global market.

Blockchain-enabled credentials also allow for a more innovative and flexible credentialing industry. Empowering students with ownership over their own credentials will allow them (either independently or in concert with education providers) to build custom mixtures of micro-credentials, professional qualifications, and degrees.

For providers, trusted blockchain credentials also provides an opportunity to integrate with and coordinate around global, mutually recognised credentials.

⁸⁶ <https://grattan.edu.au/wp-content/uploads/2018/09/907-Mapping-Australian-higher-education-2018.pdf>

CASE STUDY: RMIT OFFERS STUDENTS BLOCKCHAIN-BASED DIGITAL CREDENTIALS

Since late 2018, RMIT has offered blockchain-enabled credentials to students and RMIT Online learners through an innovative pilot program with their credentials platform partner, Credly. The pilot provides an opportunity to test and refine the application of blockchain in unlocking the full potential for individuals—and organisations—to communicate and discover skills and competencies to a range of audiences.

Students who complete the nominated micro-credentials and online short course from the RMIT Creds and Future Skills portfolio, are given the opportunity to ‘publish’ their earned digital credential to the blockchain, seamlessly providing meaningful data about their earned skills and capabilities. The digital credentials selected for this program—Collaborating Online; Global Leader Experience; Application Package; and; Developing Blockchain Strategy—had enrolments from individuals from diverse backgrounds and experiences.

To date, 55 participants have chosen to save their digital credential on Ethereum, the public decentralised blockchain platform chosen by RMIT for this pilot. Three students have saved more than one of their credentials. Students aged between 21 and 25 represent the highest percentage of blockchain users, but there was fairly widespread engagement from various pilot cohorts, undergraduate, postgraduate and ‘short course’ participants, and from Australian and Vietnam campuses.

One of the key learnings is that many participants do not fully understand the potential benefits of having a blockchain record—of having a streamlined, immediate and verifiable record of one’s skills, competencies or academic credential. To realise sustainable and potential benefits from a blockchain distributed ledger, all agents and players within the ecosystem—students, staff, education providers, employers, government—must be convinced of the benefits, including verification, increased efficiencies and speed of transactions.

Deputy Vice-Chancellor Education and Vice-President, Professor Belinda Tynan, said:

...we’re exploring the latest application of this technology as part of our commitment to enhancing our students’ experience. This pilot is a good example of how RMIT works with industry to provide real-world benefits to our students, affording them ... better tools to communicate the industry-relevant skills and experiences needed for economic and life opportunities.

Challenges and opportunities

Challenges exist regarding the implementation and use of blockchain technology across the economy.

In terms of security, concerns exist over the security and privacy of user data. Currently, learning institutions collect and maintain data on student learning. Blockchain provides the opportunity for the decentralised storage of learner data, accessible by the learner alone. This may be undermined if a single issuing authority has access to every blockchain, via a centralised database service. Data security will therefore be affected by the business model adopted, whether that be a monopoly or competitive market.

Regulatory challenges exist for centralised standards and oversight. It is particularly difficult to edit or alter an existing blockchain, meaning that retrospective regulation on blockchains will be difficult to enforce. Proactive regulation is therefore essential. Regulation may be created in collaboration with international standards and bodies, such as the Internet Engineering Task Force (IETF).⁸⁷

Credentialing outside of an official learning institution will remain a difficult endeavour, unless the blockchain technology can be adequately taken up by workplaces themselves. Skills gained within the workplace are traditionally hard to credential, and this may persist under any new model adopted.

Everyone in the credentialing ecosystem needs to see the value of blockchain in credentialing: each stakeholder, including employers, learning providers and students, needs to learn how blockchain can benefit them individually. Not all students currently understand why blockchain is needed or understand its value. Employers are also sceptical of new credential verification technology, if they do not properly understand how that technology works.

Blockchain technology may play a role in the future of the credentials sector by offering a more effective, scalable and secure alternative platform for the production and use of credentials. In doing so, it has the potential to improve the functioning of Australia's labour markets, increasing the quality of job matching and lowering the cost of HR functions.

Opportunities exist across the economy to develop and deliver trusted credentials using blockchain technology, including:

- high school education and equivalencies (completion certification)
- higher education credentials (course credits, graduate certificates, diplomas, bachelor's degrees, higher degrees)
- vocational education credentials and trade certifications (hairdressing, electrician, builder, etc.)
- industry and professional association-based qualifications (e.g. Accounting (CPA, ACA), Law (the Bar), Finance (FINSIA))
- proficiency qualifications (e.g. languages, driving)
- occupational licenses (e.g. surgeons, dentists, pilots, teachers, electricians)

Opportunities exist for all stakeholders in the credentialing sector, including students, employers and education providers. Students have the chance to gain:

- ownership and control over their own data (transcripts, certificates)
- faster methods of verifying credentials to prospective employers
- the ability to translate credentials for overseas jurisdictions (including translation into foreign languages and/or credentials frameworks)
- updated skills verification in real time that can be shared with prospective employers or used to secure work experience placements.

⁸⁷ <https://www.ietf.org/>

Learning providers have the chance to gain:

- global collaboration between institutions (the ability to recognise credentials from any country at every institution)
- the ability to implement micro-credentialing to showcase student skills over time
- cost and time savings in the issuing of certificates, transcripts and other credentialing resources
- the ability to recognise and verify foreign credentials.

Employers have the chance to gain:

- trust in credentials.
- cost savings in HR departments.
- verification of soft skills and micro-credentials in jobseekers.
- faster verification and background checks of new employees.

CASE STUDY: AUSTRALIAN RED CROSS AND TYPEHUMAN: MAKING IT EASIER TO TAKE HUMANITARIAN ACTION

As part of the Australian Red Cross's commitment to create a nation that takes humanitarian action, ARC facilitates the deployment of volunteers in support of community outcomes and is investing in technology that supports humanitarian outcomes via new initiatives such as Humanitech.

In mid-2018, motivated by an expensive and slow process for conducting background checks of volunteers and humanitarian workers, the Australian Red Cross partnered with Typehuman to explore the opportunity for blockchain credentials: the goal being to streamline the background check process, and to increase the sector's capacity to take humanitarian action.

Background checks for organisations such as the Australian Red Cross involve performing police checks, verifying Working With Children Checks and other relevant qualification verifications. While technology options exist, they are unacceptably limited in their credential coverage, and in their future ability to extend to other uses. Further, 50% of volunteers are participating, with more than one organisation—an inefficiency duplicated across the sector.

Solving this challenge in its entirety would require credentials such as Working With Children Checks to be offered natively by issuing organisations, something not immediately actionable by the project team. However, because background checks are duplicated across the sector there was an opportunity to support an individual's mobility between organisations by offering blockchain credentials—recognising the background checks already performed along with other experiences and qualifications gained along the way.

12 months on, the project team has found blockchain credentials to be a viable technological solution to this problem. Other organisations share this view, becoming pilot users of a blockchain credentialing solution. As a result, the Australian Red Cross is commercialising this solution and planning an early 2020 launch, laying the foundation for streamlined background checks and civic innovation.

It is well established that the limiting factor for the growth and utility of blockchain credentials will be whether other organisations opt to issue and recognise them: a digital coordination problem. To address this, a growing coalition of organisations (the Trust Alliance) has come together to shepherd the emergence of an open credential ecosystem and to address the digital coordination problem. Members of the Trust Alliance include the Australian Red Cross, Oxfam Australia, RedR Australia, Telstra Foundation, Swinburne University, RMIT, Bridge of Hope, and EWBA.

Sectoral Showcase 3: Building competition in the financial sector through transferable ‘Know Your Customer’ checks

Overview

Building competition in the Australian financial system is a priority for the Australian Government. Australia has one of the most concentrated financial services systems in the world. In a sector where products and services often involve complex fee and interest structures, it is vital that barriers to switching providers be minimised, so that there is every incentive to offer competitive products and to put consumer interests first.

The Productivity Commission’s Inquiry into Competition in the Australian Financial System⁸⁸ highlighted the low levels of switching by bank customers, with one in two consumers still banking with their first ever bank and only one in three having considered switching banks in the past two years. This consumer inertia can make it harder for new competitors—including neobanks and fintechs—to gain market share. It also means consumers may not be getting the best possible deal from their banks.

There are a number of factors that may contribute to low rates of switching by retail consumers. In a report examining consumer switching behaviours⁸⁹, Deloitte noted that switching is often not difficult for most products and not as difficult as people perceive. However, low rates of switching persist.

One of the frictions which may limit consumer switching is the process of customer due diligence (CDD). CDD requirements – often referred to as ‘Know-Your-Customer’ or KYC checks – are set out under Australia’s anti-money laundering and counter-terrorism financing (AML/CTF) regime. Regulated businesses are required to identify and verify their customers’ identity; provide reports to AUSTRAC about financial transactions; and implement systems and controls to identify, mitigate and manage the risk that their business will be exploited for money laundering, the financing of terrorism, and other serious financial crimes.

Not only does compliance with CDD requirements generate costs for financial service providers when they take on new customers, there is some evidence to suggest that the process provides disincentives for consumers to switch due to the time and effort required.⁹⁰

Blockchain technology may provide an opportunity to reduce costs and to increase efficiencies in the provision of financial services, enhance the competitiveness of new market players, and support higher rates of consumer switching. As the use of blockchain in financial technology develops beyond cryptocurrencies, it presents opportunities to enhance consumer outcomes in retail banking, including through facilitating the KYC process.

The ‘Know Your Customer’ challenge

It is vital that all financial institutions are able to verify that their customers are who they say they are. The penalties imposed on entities who fail to carry out due process in complying with their AML/CTF obligations are significant.

However, many Australians setting up a bank account have multiple existing accounts for which a KYC check has already been undertaken. When a bank signs up a new customer, they may be required to undertake these checks afresh if they are not able to rely upon a previous KYC check. It is clear there are opportunities to provide better outcomes for consumers and financial service providers through the sharing of KYC information.

⁸⁸ <https://www.pc.gov.au/inquiries/completed/financial-system/report/financial-system.pdf>

⁸⁹ <https://www2.deloitte.com/au/en/pages/financial-services/articles/open-banking-survey-2019.html#>

⁹⁰ <http://documents.worldbank.org/curated/en/219201522848336907/Private-Sector-Economic-Impacts-from-Identification-Systems.pdf>

The value of allowing consumers to share the results of KYC processes in financial services was identified in the Australian Open Banking Review. Recommendation 3.4 of the Review noted that KYC processes are slow and cumbersome, and that allowing customers to instruct their bank to share the result of an identity verification performed on them could generate efficiencies in the system.

These issues were also identified by the statutory review of the *Anti-Money Laundering and Counter-Terrorism Financing Act 2006 (Cth)*, tabled in Parliament in April 2016. This review recognised that an expanded ability to rely on the identification of another party would be an important measure that could deliver greater efficiencies and significant regulatory relief for reporting entities under the AML/CTF regime.

On 17 October 2019, the Morrison Government introduced the *Anti-Money Laundering and Counter-Terrorism Financing and Other Legislation Amendment Bill 2019*, which expands the circumstances under which regulated entities can rely upon the CDD undertaken by another entity. If passed by the Parliament, this legislation would allow entities regulated for AML/CTF purposes to rely on identification and verification carried out by another regulated entity—where appropriate to the money laundering and terrorism financing risk, and where the records of the verification procedure can be made available on request. To rely on the CDD undertaken by another entity, reporting entities will need to enter into written arrangements. These agreements will be subject to undertaking due diligence on the third party's identification and verification procedures.

Under these arrangements, the relying entity will not be held liable for one-off breaches of compliance committed by the relied-on entity, provided that due diligence has been conducted on their procedures and the relying entity has obtained the relevant customer identity information and other documentation from the relied-on entity without delay.

Internationally, the Financial Action Task Force (FATF), the global AML/CTF standard-setting body, is developing guidance to clarify how digital identity systems can be used for KYC.⁹¹ A recent FATF consultation paper identified the potential of digital identity systems to facilitate and enhance KYC processes.

The opportunity for blockchain as a KYC utility

Blockchain could be an effective solution to support the sharing of KYC information — allowing the results of KYC checks to be transmitted securely, at speed and with the highest level of confidence.

Not only could a blockchain solution help to minimise duplicative checking, but it could also provide an opportunity for financial institutions to simplify their record keeping and remove unnecessary manual effort in their AML/CTF processes. KPMG estimates that approximately 80 per cent of KYC/AML resources are spent on information gathering and processing, rather than on assessing risk.⁹² The benefits would not be limited to inter-bank switching: a significant proportion of duplicative KYC resources are deployed within financial institutions.

The exceptional level of data integrity provided by a digital signature over blockchain may give financial service providers confidence that further validation of KYC data can be minimised, depending on the risk profile of the customer, and on the nature of the service the relying entity will be providing. It would also facilitate a high level of transparency in the provision of KYC data and allow it to be shared and updated in real time.

KPMG recently worked with Bluzelle Networks, a consortium of three banks and the Singaporean Info-Communications Media Development Authority to develop a proof-of-concept KYC utility on a blockchain platform.⁹³ While challenges would need to be addressed for such a utility to be used more widely, this proof-of-concept demonstrated viability of a blockchain solution and the efficiency gains it could potentially deliver.

91 <https://www.fatf-gafi.org/publications/fatfrecommendations/documents/consultation-digital-id-guidance.html>

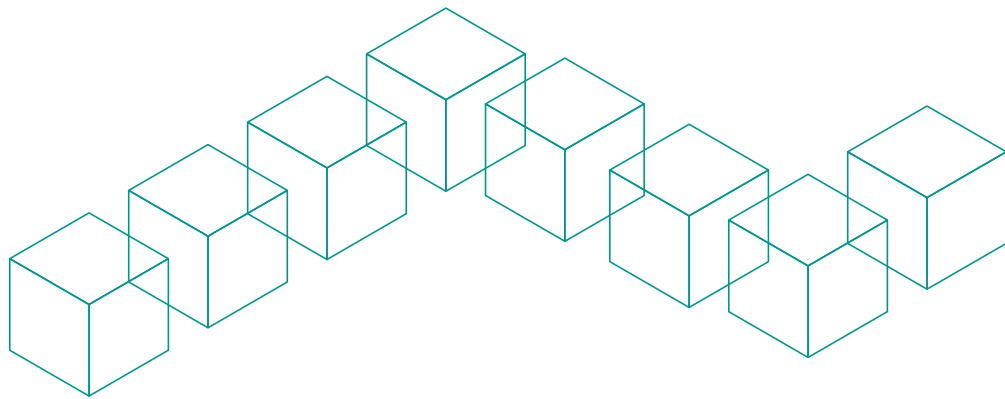
92 <https://assets.kpmg/content/dam/kpmg/xx/pdf/2018/03/kpmg-blockchain-kyc-utility.pdf>

93 <https://assets.kpmg/content/dam/kpmg/xx/pdf/2018/03/kpmg-blockchain-kyc-utility.pdf>

Using blockchain for transferable KYC has the potential to enhance competition in the financial sector by making it easier and faster for customers to switch providers. Combined with the Consumer Data Right that the Australian Government is implementing, there is potential for the process of switching banks to become as simple as a single click, where — subject to robust privacy restrictions pertaining to the use of their data — a consumer may consent to the transfer of their transaction data and their identity verification, together, from one financial service provider to another, subject to the receiving provider choosing to accept and rely on that information.

A fast and secure KYC transfer utility could also enable challenger banks and other fintechs to increase their competitiveness. The 2019 EY Fintech Australia Census reported that three quarters of Australian fintechs regard transferable KYC as an effective initiative to support growth in the Australian fintech ecosystem.

The importance of mitigating risks associated with anti-money laundering and counter-terrorism financing will need to be considered alongside any developments to ensure that any proposals do not compromise the integrity of Australia's AML/CTF regime. Rather, through close collaboration, efficiencies could be explored which both strengthen the AML/CTF regime and reduce regulatory burden.



Conclusion

While blockchain initially gained prominence in the public sphere through Bitcoin and other cryptocurrencies, its potential for the broader economy is beginning to be appreciated by other sectors. As outlined in this Roadmap, there are significant opportunities for the technology across multiple sectors in the economy: to save money, solve problems, increase efficiencies in multiple processes, and enable new opportunities. There are some challenges to realising these opportunities which need to be addressed in order to capitalise on this promising technology. However, it is clear that, in the spheres of regulation and standards, skills, capability and innovation, and international investment and collaboration, there is significant and positive progress towards resolving those issues and forging ahead with blockchain initiatives in Australia.

Continued progress will rely on government, industry and the research sector sharing a vision and a focus for the development of blockchain for the whole economy, which this Roadmap's signposts provide. All three sectors must ultimately continue to work together in the collaborative spirit that helped produce this Roadmap, to ensure that Australia can seize the opportunities of a blockchain-empowered future.

Shortened Forms

ACS	Australian Computer Society
AML	Anti-Money Laundering
API	Application Programming Interface
ASEAN	Association of Southeast Asian Nations
B2B	Business to business
CDD	Customer Due Diligence
CTF	Counter-Terrorism Financing
DCE	Digital Currency Exchange
DLT	Distributed Ledger Technology
FIAL	Food Innovation Australia Limited
ICO	Initial Coin Offering
IoT	Internet of Things
IP	Intellectual Property
ISO	International Organisation for Standardization
KYC	Know Your Customer
STEM	Science Technology Engineering Mathematics
TAFE	Technical and Further Education

Glossary

Anti-Money Laundering and Counter-Terrorism Financing (AML/CTF)	AML/CFT legislation and regulation aims to prevent money laundering and the financing of terrorism by imposing a number of obligations on the financial sector, gambling sector, remittance (money transfer) services, bullion dealers and other professionals or businesses that provide particular regulated services.
Application Programming Interface (API)	API is a technical interface to a web service or programming language library that exposes functions or methods in the interface to be able to be invoked by clients using a programming language.
Association of Southeast Asian Nations (ASEAN)	ASEAN is a regional intergovernmental organisation comprising of ten countries in Southeast Asia, which promotes intergovernmental cooperation and facilitates economic, political, security, military, educational and sociocultural integration among its members and other countries in Asia.
Block	A block in a blockchain is the container of transactions. Each block contains a timestamp and a link to the previous block.
Business to business (B2B)	B2B refers to commerce between two businesses rather than to commerce between a business and individual consumer. Transactions at a wholesale level are usually B2B.
Bitcoin	Bitcoin is a peer-to-peer payment system. It is a decentralised digital currency without a central bank or single administrator that can be sent from user to user on the peer-to-peer bitcoin network without the need for intermediaries.
Blockchain	A blockchain is a type of distributed ledger, comprised of unchangeable, digitally recorded data in packages called blocks. Each block is then 'chained' to the next block, using a cryptographic signature. This allows block chains to be used like a ledger, which can be shared and accessed by anyone with the appropriate permissions.
Consensus Mechanism	Consensus mechanisms refer to the process of attaining agreement on the status of the network in a decentralised way. It facilitates the verification and validation of information being added to the ledger, ensuring that only authentic transactions are recorded on the blockchain.
Customer Due Diligence (CDD)	CDD is the process where relevant information about the customer is collected and evaluated for any potential risk for the organization or money laundering/ terrorist financing activities.
Cryptocurrency	A form of digital currency based on mathematics, where encryption techniques are used to regulate the generation of units of currency and verify the transfer of funds.
Cryptography	A method for securing communication using code. The main example of cryptography in cryptocurrency is the symmetric-key cryptography used in the Bitcoin network. Bitcoin addresses generated for the wallet have matching private keys that allow for the spending of the cryptocurrency. The corresponding public key coupled with the private key allows funds to be unlocked. This is one example of cryptography in action.
Digital Currency Exchange (DCE)	DCE refers to a business that allows customers to trade cryptocurrencies or digital currencies for other assets, such as conventional fiat money or other digital currencies.

Digital identity	A digital identity is an online or networked identity adopted or claimed in cyberspace by an individual, organization, or electronic device.
Distributed Ledger Technology (DLT)	DLT is a digital system for recording the transaction of assets in which the transactions and their details are recorded in multiple places at the same time. Unlike traditional databases, distributed ledgers have no central data store or administration functionality.
Disruptive Technology	A technology that displaces an established technology and shakes up the industry or a ground-breaking product that creates a completely new industry.
Fintech	Refers to software and other modern technologies used by businesses that provide automated and improved financial services.
Initial Coin Offering (ICO)	ICO is an event in which a new cryptocurrency sells advance tokens from its overall coinbase, in exchange for upfront capital. ICOs are frequently used for developers of a new cryptocurrency to raise capital.
Internet of Things (IoT)	The internet of things, or IoT, is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.
Intellectual Property (IP)	Refers to creations of the mind, such as inventions, literary and artistic works, designs, and symbols, names and images used in commerce.
International Organization for Standardization (ISO)	The International Organization for Standardization (ISO) is headquartered in Switzerland. The ISO defines rules and standards to aid in tasks for virtually all products that people use, including rules and standards about how products are made and how quality control tests should be performed.
KSI blockchain	KSI is a blockchain technology designed in Estonia and used globally to make sure networks, systems and data are free of compromise, all while retaining 100% data privacy. It means that no-one – not hackers, not system administrators, and not even government itself – can manipulate the data.
Know Your Customer (KYC)	KYC is the process of a business verifying the identity of its clients and assessing their suitability, along with the potential risks of illegal intentions towards the business relationship.
Latency	Describes some type of delay. It typically refers to delays in transmitting or processing data, which can be caused by a wide variety of reasons.
Neobank	A type of direct bank that is 100% digital and reaches customers on mobile apps and personal computer platforms only. Neobanks do not operate traditional physical branch networks.
Nodes	A computer connected to the blockchain network is referred to as a 'node'. Most nodes are not full nodes and full nodes can be difficult to run due to their bulky size.
Micro-credentials	Certification-style qualifications that individuals choose to study to improve a skill found in a particular industry area. They are short, low-cost online courses that provide learners with a digital certification or a 'digital badge' when complete.
Science, Technology, Engineering and Mathematics (STEM)	STEM is a curriculum based on the idea of educating students in four specific disciplines – science, technology, engineering and mathematics.

Smart contract	Smart contracts are contracts whose terms are recorded in a computer language instead of legal language. Smart contracts can be automatically executed by a computing system, such as a suitable distributed ledger system.
Smart/programmable money	Digital or digitised currency that can be programmed to limit its use, for instance only permitting use once certain criteria have been met. It can also potentially track the use of the currency.
Technical and Further Education (TAFE)	TAFE is a government run system that provides education after high school in vocational areas.
Technology-neutral	The freedom of individuals and organisations to choose the most appropriate and suitable technology to their needs and requirements for development, acquisition, use or commercialisation, without dependencies on knowledge involved as information or data.
Tokenisation	The process of replacing sensitive data with unique identification symbols that retain all the essential information about the data without compromising its security.
Trust badge	A symbol placed on a website that assures visitors that a page is legitimate and that all their data is collected through secure third-party service providers.
Use case	In software and systems engineering, a use case is a list of actions or event steps, typically defining the interactions between a role (or actor) and a system, to achieve a goal.

Appendix A

Feedback from Workshops government, universities and industry stakeholders in 2019

Regulation and standards

The following issues were identified:

- The **identity** of participants in blockchain systems, and how to trust participants are who they say they are.
- The **privacy** of information on the blockchain, which could potentially be linked to individuals and businesses, and how to balance privacy needs with transparency in open blockchains.
- The **security** of blockchain systems, and how to balance security needs with other factors.
- The **provenance and integrity of data** on the blockchain, and how effectively it can be used as evidence for regulation and enforcement activities, as well as how information that was found to be incorrect could be erased.
- The **legal standing of smart contracts** and the role of each government agency in the development of smart contracts and associated templates.
- The need for **interoperability and common standards** to support broader adoption of blockchain.
- The need for an **innovative regulatory system** with a focus on opportunities.
- The challenges of understanding and solving regulatory problems for a **rapidly evolving technology**.
- Uncertainty with the **regulatory and taxation treatment of Initial Coin Offerings (ICO)**.

Skills, capability and innovation

The following issues were identified:

- Uncertainty in **anticipating** and meeting the demand for skills.
- Lack of **accredited** courses and **measurable educational** standards.
- Identifying the **specific skills** required.
- Improving the blockchain-related **literacy** and skills of **decision-makers**.
- Foster stronger **communication** amongst **businesses** and **tech companies**.
- Increase Australia's levels of **high-end tech skills**.
- Difficulty **attracting** and retaining talent.

International investment and collaboration

The following issues were identified:

- Highly competitive international environment.
- Setting the **right narrative around blockchain**.
- Few **'totemic' projects** that highlight Australian blockchain capabilities.
- Interoperability.
- **Limited incentive** for maintaining a local presence.
- Connecting the **right businesses with the right tech solutions**.
- Availability of **Venture Capital**.
- Need for **improved domestic investment and government incentives** in the technology and innovation sector.
- **Appropriate regulatory setting** to attract international investment.

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