Distributed Ledgers and Blockchains
Opportunities for
Aotearoa New Zealand

Callaghan Innovation | New Zealand's Innovation Agency

centrality

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Foreword

The world is changing faster than ever before. Technology is changing our entire economy and society, and businesses can see the great wave of change approaching.

Tech is New Zealand's third-biggest export sector, bringing in more than $16 billion a year in overall revenue and employing almost 100,000 workers. But there is plenty of opportunity for the sector to expand and influence – it needs more brains, more ideas and more capital to bring those ideas to market.

At the forefront of this technological shift are digital technologies – including Artificial Intelligence, Big Data, Cloud Analytics, the Internet of Things and Blockchain. These emerging technologies are disrupting many sectors across the world.

Businesses recognise that to get or stay on top, they must innovate. Those that stay at the forefront of this change by investing in research and development and innovation capability will be more productive, grow faster and be more likely to contribute to positive social outcomes than those that do not.

There has been much attention and debate on blockchain and distributed ledger technologies. While these technologies have much potential, it can be challenging to understand what opportunities they really offer, and how these can be applied in a New Zealand context. We hope this report provides a useful analysis on the state of the blockchain and distributed ledger sector and the opportunities these technologies provide.

I encourage you to continue to debate and discuss the role of emerging technologies in our economy and society, and to learn more about the challenges and prospects that lie ahead for businesses. As a nation we must continue to take bold, brave steps into the unknown. We must stay future-focused and embrace the opportunities this new era will bring.

Vic Crone, Chief Executive, Callaghan Innovation

Executive Summary – potential for positive impact

Distributed ledgers and blockchains are emerging general purpose technologies that are likely to have a significant impact across all aspects of the economy. New Zealand has an opportunity to join the world leaders in this space, which would likely have a significantly positive impact on high-tech jobs and digital exports.

The technologies provide opportunities for a positive impact on many sectors, including primary industries, financial services, public services, arts and culture, science and research, and foreign aid. They also have the potential to contribute to regional economic development.

Over 20 billion USD have been allocated to blockchain startups from January 2017 to November 2018 through initial coin offerings. These technologies are fundamentally changing how startup capital is raised and could prove a meaningful opportunity for New Zealand companies to access much needed risk capital.

Despite a handful of standout companies, the New Zealand industry is lagging behind the industry in comparable economies. Action is required to unblock access to basic financial services and to provide a reasonable approach to goods and services tax on crypto-assets.

Significant opportunities exist to attract talent and high-growth companies to New Zealand. The industry does not need financial incentives or deregulation, it needs a government willing to engage with it and to clarify how existing rules apply to the emerging industry.

This report has eight considerations for the Government and private sector:

1. Convening a cross-agency blockchain working group.
2. Unblocking access to banking services for blockchain companies.
3. Promoting New Zealand as blockchain friendly.
4. Growing technology industries in regional Aotearoa New Zealand.
5. Focusing on security tokens.
6. Establishing a multidisciplinary research centre for decentralised computing.
7. Establishing a blockchain financial crime prevention forum.
8. Prioritising digital identity adoption and digital inclusion.

Background

Callaghan Innovation commissioned this report to explore the opportunities provided by distributed ledgers and blockchain technologies. The Ministry of Business Innovation and Employment (MBIE) and Centrality, a blockchain venture studio, provided additional funding. The Edmund Hillary Fellowship catalysed initial conversations during the New Frontiers summit in April 2018[1].

The report's lead author is Joshua Vial from Enspiral, a network of entrepreneurs working collaboratively to grow impact driven entrepreneurs and businesses. Joshua is an entrepreneur, educator and programmer focused on social impact.

The author interviewed more than 50 blockchain entrepreneurs and investors, government officials, academics and international experts (listed in the Acknowledgements). The author also completed a literature review, focusing on blockchain policy, initial coin offerings, and distributed ledger technologies (see the References at the end of this report).

Important blockchain concepts

To effectively understand the blockchain industry, it is important to understand the following core concepts:

– **distributed ledger**

– **blockchain technology**

– **consensus algorithm**

– **network validators**

– **tokens**

– **crypto-assets**

– **blockchain address**

– **smart contracts**

Distributed ledger

A distributed ledger is a set of data replicated across many networked computers. Ideally, computers in the network are in different locations and spread across many countries. A distributed ledger uses protocols so changes are consistently replicated to each computer and the data converges to an agreed known state. A good metaphor is a spreadsheet with its data and validation rules replicated on many computers. When a cell is changed in one instance of the spreadsheet, the rules mean the change is made across all instances of that spreadsheet.

A distributed ledger may be a:

– **public ledger** where anyone can view the data and anyone can validate new entries

– **permissioned ledger** where anyone can view the data but only approved validators can validate new entries

– **private ledger** where everyone needs approval to view the data and validate new entries.

FIGURE 1: Landscape of distributed ledger technologies

PUBLIC   PERMISSIONED   PRIVATE
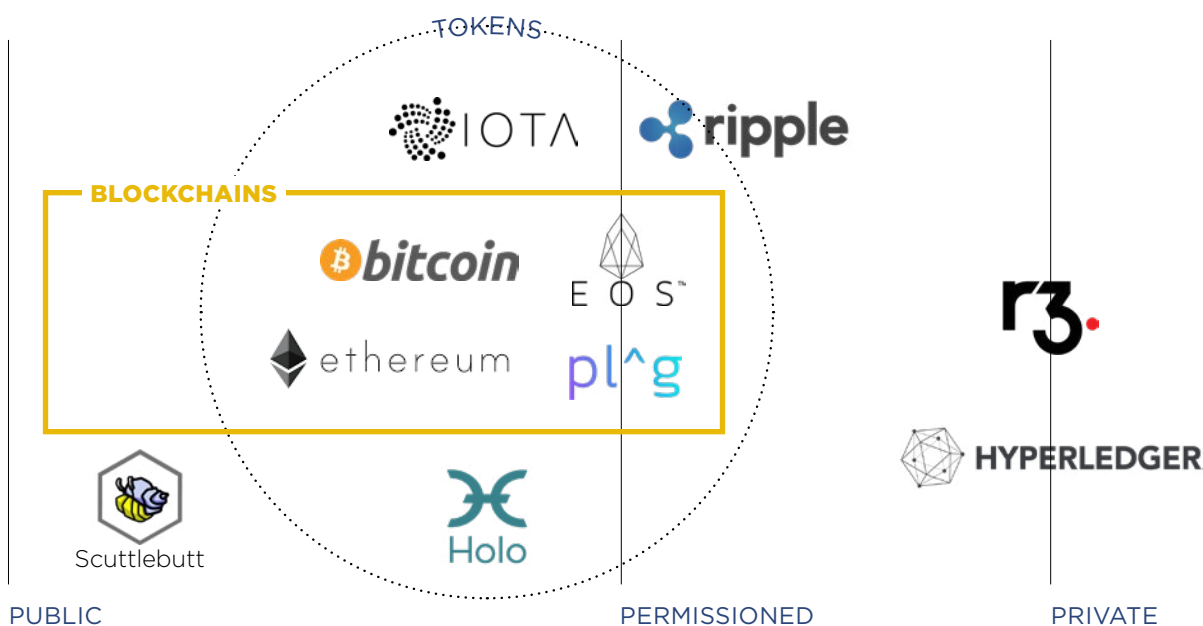
Blockchain

Blockchain technology is one type of distributed ledger. Therefore, while every blockchain is a distributed ledger, not every distributed ledger is a blockchain (as illustrated in Figure 1). A blockchain ledger is immutable, which means data cannot be removed or changed once it is published. The ledger uses economic incentives to coordinate and drive adoption of the ledger.

Consensus algorithm

A consensus algorithm is the protocol that ensures validators reach agreement about the state of the ledger. The Proof of Work protocol is one such algorithm, which Bitcoin and many other blockchain projects have adopted.

Network validators

Network validators are also known as miners or minters. Their role is to validate new entries in the blockchain and ensure they follow the rules of the blockchain. Validators of public blockchains typically receive payment in the form of new tokens issued or transaction fees paid in tokens for their services to the network.

Tokens

Tokens (or coins or crypto-assets) are created (and sometimes destroyed) by blockchain protocols, creating 'token economics', which defines the economic incentives of the blockchain. Tokens in different blockchains can have quite different attributes. Tokens (as summarised in Figure 2) can be further categorised as:

– **intrinsic** tokens, which are valuable only because buyers value them (for example, crypto-currencies such as bitcoin and digital collectibles such as CryptoKitties)

– **utility** tokens, which are valuable because of what they enable (for example, Ethereum's ether, which is used to pay for using smart contracts)

– **security** tokens, which are valuable because of what they return or control (for example, a token that pays interest or dividends or enables voting rights in a company

– **asset-backed** tokens, which are valuable because of what they redeem (for example, one True USD is redeemable for 1 United States Dollar (USD)).

FIGURE 2: Four categories of crypto-asset

INTRINSIC	UTILITY	SECURITY	ASSET BACKED
Valuable because it is valued by users	Valuable for what it enables	Valuable because of what it returns or controls	Valuable because of what it redeems

Blockchain address

Blockchain addresses are like bank accounts for crypto-assets. They are controlled cryptographically through a private key. Typically, whoever has the key has control of the tokens sent to that address. A blockchain address can be created directly through software without revealing any personal information. Unless identified through other means (such as registering with a crypto-asset exchange), people can use blockchain addresses anonymously.

Smart contract

A smart contract is a computer protocol that digitally facilitates, verifies, or enforces the negotiation or performance of a contract. For example, a simple coin-flip contract would allow two people to send a token to a smart contract, and then the contract would have a 50 percent chance of sending all tokens to one of the senders.

Brief history of blockchain

Bitcoin was the world's first blockchain. An anonymous person or group of people under the name of Satoshi Nakamoto launched bitcoin in 2008 with the intention of creating a peer-to-peer version of electronic cash.

The bitcoin experiment was somewhat successful. Although bitcoin has not received widespread adoption as a means of payment, the experiment did successfully launch a token with intrinsic value and spawned a new general purpose technology.

Over the last 10 years, the value of all bitcoins in the world has gone from 0 to 100 billion USD.[2] This rapid increase in value proves that people increasingly trust a distributed ledger and will assign intrinsic value to a crypto-asset.

A team lead by Vitalik Buterin launched the stable version of Ethereum, another blockchain, in 2015 with the addition of a fully functional programming language[3] that enabled smart contracts (see Box 1). Since then, entrepreneurs have launched over a thousand digital tokens on the Ethereum network and hundreds on alternative networks.

The number of people who own digital tokens worldwide is variously estimated, with a large amount of uncertainty, at 3 million to 13 million. Blockchain addresses are anonymous, so it is difficult to determine the total number of users. The higher estimate represents only about 0.36 percent of internet users.[4]

BOX 1: SMART CONTRACTS

Some blockchains use the distributed ledger to store computer programs known as smart contracts. A smart contract is visible to anyone who can view the blockchain and can be used for programmatically updating the distributed ledger.

If a distributed ledger is a spreadsheet, then smart contracts are very complex formulas for building applications on top of the data.

Unlike traditional contracts, which rely on a complex and expensive system to determine what happens if a party breaches the contract's terms, smart contracts are designed to prevent the terms from being broken in the first place.

Smart contracts are no substitute for the legal system, but for certain areas they have the potential for significant impact. Capital raising by exchanging one crypto-asset for another is one such area. Smart contract technology was a significant driver of the ICO boom in 2017.

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2   This report uses the international standard for currency codes, so the United States dollar is USD and the New Zealand dollar is NZD.

3   The language is computationally universal (or 'Turing complete') as compared with bitcoin's scripting language, which offers only a subset of the features.

4   M Novak. 2018. *The Implications of Blockchain for Income Inequality.* Available at SSRN: https://ssrn.com/abstract=3140440

Current state of the sector

Introduction

This section aims to provide an overview of the current state of the sector. Trials in Australia to improve the National Disability Insurance Scheme highlight the potential for 'smart money' to implement conditional payment systems. Supply chain applications present some of the most mature blockchain ecosystems and are being used to improve food safety and help New Zealand food producers increase exports.

ICOs are having a meaningful impact on startup financing. While not every blockchain project uses an ICO, they were one of the first widespread uses of blockchain technology and smart contracts. Over 20 billion USD has been allocated to blockchain companies through ICOs since January 2017. This growing pool of capital represents a significant funding opportunity for startups, researchers and established businesses.

The field is evolving rapidly and there are many projects under development to address challenges faced by the sector whether it is new consensus mechanisms to address scalability and energy efficiency, stable coins to address volatility, or data analytics to detect and prevent criminals from laundering money on public blockchains.

New Zealand companies issuing tokens through ICOs or running crypto-exchanges find it challenging to obtain bank accounts and urgent action is required to unblock access to basic financial services.

New Zealand legislation is largely adequate for the industry and an agile government willing to engage with the private sector offers a strategic advantage to the emerging sector.

Early applications of 'smart money' in Australia are showing promise

In November 2018 the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Commonwealth Bank of Australia successfully completed a ten month project exploring the potential for blockchain technology to create 'smart money'. Smart money is money that knows what it can be spent on, who it can be spent by and when it can be spent. The trial focused on enhancing the experience of participants and service providers for the National Disability Insurance Scheme (NDIS).[5]

"Participants and carers estimated that the proof of concept could save them between 1 hour and 15 hours per week, with an average result of 3 hours. Service providers estimated that the proof of concept could save them approximately 0.3% to 0.8% of costs as a percentage of revenue… We conclude that the economic benefits would be the order of hundreds of millions of dollars annually, if the proof of concept was leveraged to develop and implement a full-scale solution across Australia."[7]

FIGURE 3: Overview of smart money proof of concept
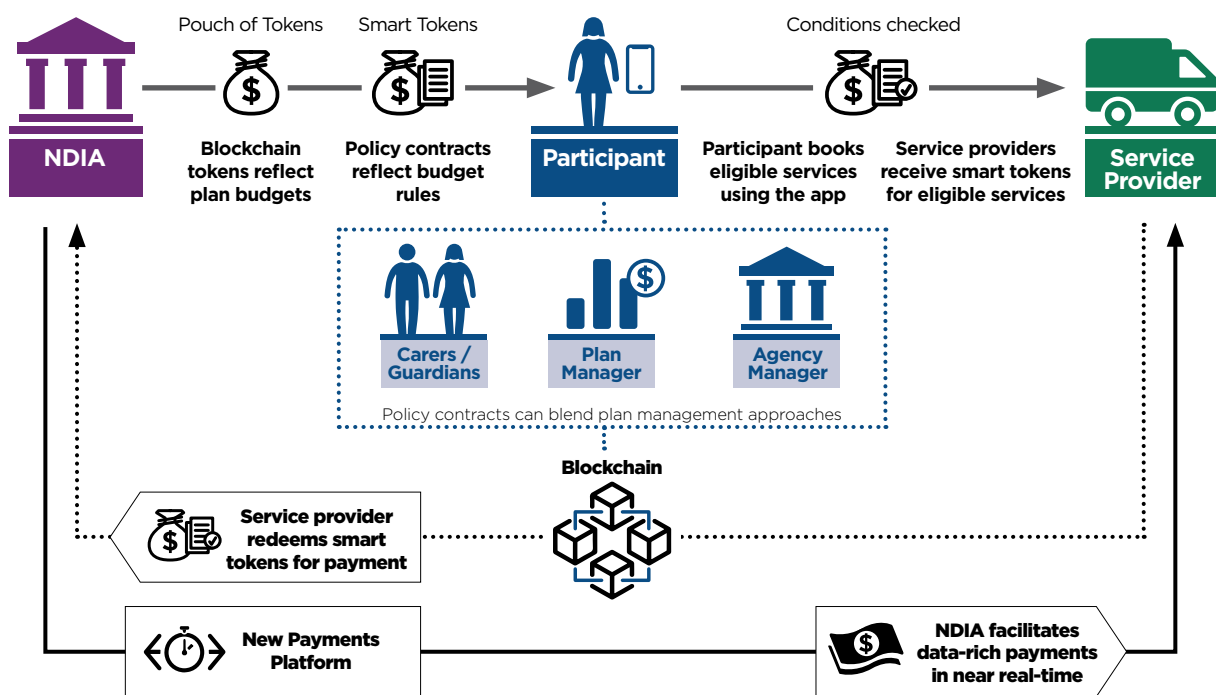
Source: Royal, D. Rimba, P. et al. 2018. Making Money Smart. Data 61 (CSIRO) and Commonwealth Bank of Australia.
https://data61.csiro.au/~/media/D61/Files/MakingMoneySmart/Making-Money-Smart--Report.pdf

The proof of concept operates on a permissioned Ethereum network with asset backed tokens that can be redeemed for Australian Dollars. The project successfully demonstrated that smart money can enhance the experience for participants in the NDIS and could increase the efficiency of the overall system.[6]

5   CSIRO. 2018. *'Smart Money' trial explores potential for blockchain* (release, October 9)
     https://www.csiro.au/en/News/News-releases/2018/Smart-Money-trial-explores-potential-for-blockchain
6   D Royal, P Rimba et al. 2018. *Making Money Smart* Data 61 (CSIRO) and Commonwealth Bank of Australia
7   ibid

Retailers using blockchains to increase food safety and tackle fraud

In September 2018 Walmart announced it would require suppliers of leafy greens to implement real-time, end-to-end traceability using IBM's Food Trust blockchain technology.[8] In an initial prototype of the system Walmart reduced the time to trace an item from store to farm from seven days to 2.2 seconds.[9] IBM have been developing the Food Trust system since 2016 in partnership with retailers like Walmart and Carrefour. After 18 months of testing, the system is now open for general availability and being used at scale.[10]

Most distributed ledger projects focusing on supply chains are still in early stages. A survey of nearly 450 organisations with active projects found that 87 percent were at the proof of concept stage, 10 percent were pilots and 3 percent were at-scale implementations. 81 percent of the organisations surveyed had over one billion USD annual revenue. Cost saving, traceability and transparency were the most common motivations for organisations pursuing the projects, with the United Kingdom, the United States and France having the most mature ecosystems.[11]

The Organisation for Economic Co-operation and Development (OECD) estimated global trade in counterfeit and pirated goods to be 2.5 percent of the global economy or USD 461 billion during 2013.[12] As the New Zealand mānuka honey industry can attest, counterfeit goods pose a real threat to exporting high value goods.[13, 14]

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BOX 2: CASE STUDY – ASUREQUALITY FOOD TRUST FRAMEWORK

New Zealand Post, AsureQuality (AQ) and New Zealand Trade and Enterprise have joined forces with Alibaba and local blockchain companies Trackback and Sylo to provide an export and tracking service for local high quality food producers.[15] The project has been in development for over 14 months and is currently in a pilot phase.

Chinese consumers consider fraudulent activity to be pervasive and a primary barrier to accessing safe food.[16] By scanning an AQ Assured Assurance Mark on their mobile phone a consumer can confirm their purchase is genuine and safe. Additionally, the project aims to connect New Zealand producers directly with Chinese consumers and remove intermediaries while maintaining high margins on premium products.

The first participant is the HUI Māori collective to launch a broad offering of high quality wine, mānuka honey, natural snack bars and tonic water direct to chinese consumers through an ecommerce platform.[17]

8 Walmart. 2018. *Walmart and Sam's Club to Require Real-Time, End-to-End Food Traceability with Blockchain.* (release, September 24)

9 R Kamath. 2018. *Food Traceability on Blockchain: Walmart's Pork and Mango Pilots with IBM.* The Journal of The British Blockchain Association

10 IBM. 2018. *IBM Food Trust Expands Blockchain Network to Foster a Safer, More Transparent and Efficient Global Food System.* (release, October 8). https://newsroom.ibm.com/2018-10-08-IBM-Food-Trust-Expands-Blockchain-Network-to-Foster-a-Safer-More-Transparent-and-Efficient-Global-Food-System-1

11 S Pai, M Sevilla et al. 2018. *Does blockchain hold the key to a new age of supply chain transparency and trust?* Capgemini Research Institute

12 OECD/EUIPO. 2016. *Trade in Counterfeit and Pirated Goods: Mapping the Economic Impact*, OECD Publishing, Paris.

13 R Stock. 2012. *Fake Manuka Honey Threatens Industry*. Stuff (Apr 23). http://www.stuff.co.nz/business/farming/6785848/Fake-manuka-honey-threatens-industry

14 New Zealand Herald. 2018. *Counterfeit manuka honey causing legal headaches in the US*, New Zealand Herald (August 28) https://www.nzherald.co.nz/business/news/article.cfm?c_id=3&objectid=12114712

15 N Mandow. 2018. *Māori food and wine exporters get onto the blockchain.* Newsroom (October 31). https://www.newsroom.co.nz/2018/10/30/300353/mori-food-and-wine-exporters-get-onto-the-blockchain

16 H Kendall, S Kuznesof et al. Forthcoming. *Chinese consumer's attitudes, perceptions and behavioural responses to food fraud.* Food Control, Volume 95, January 2019.

17 Blockworks. 2018. *Food Assurance and Blockchain set to transform NZ economy*. Scoop (October 3) http://www.scoop.co.nz/stories/BU1810/S00116/food-assurance-and-blockchain-set-to-transform-nz-economy.htm

Token sales and initial coin offerings have attracted significant capital

A token sale, often called an ICO, is "an open call, through the Internet, for the provision of cryptocurrencies in exchange for tokens generated through smart contracts and relying on the blockchain technology, allowing the pledger to enjoy an exclusive right or reward or financial claim".[18]

In 2014, Ethereum completed one of the world's earliest token sales, selling 50 million ether for 25,000 bitcoins,[19] which worked out to about 0.31 USD per ether.[20] In October 2018, 1 ether traded between 197 to 233 USD with a peak of over 1,400 USD in January of 2018.[21]

Ethereum went on to become one of the leading platforms from which other developers launched their own ICOs. Investors send ether to a smart contract and receive tokens for the new project as Ethereum-compatible ERC20 tokens.[22, 23]

Since 2014 over 20 billion USD has been raised by blockchain companies through ICOs.[24]

FIGURE 4: New initial coin offerings (ICOs) by month, June 2014–June 2018
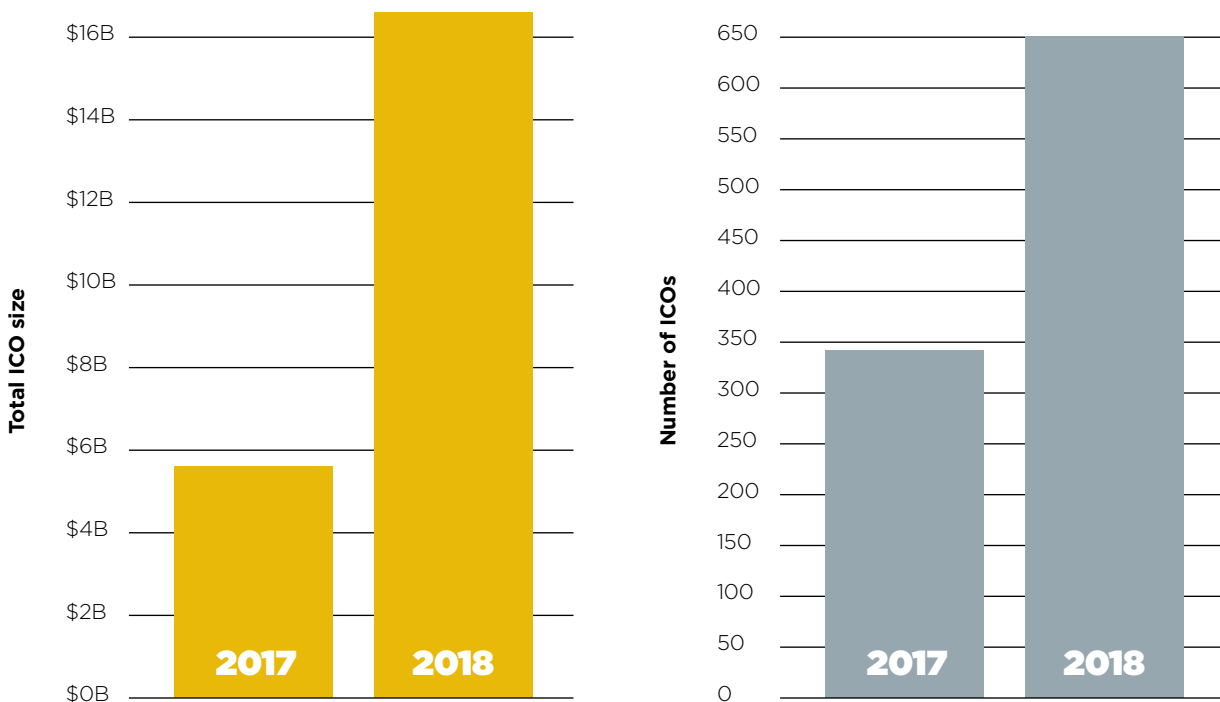
Source: CoinDesk, www.coindesk.com

18   S Adhami and G Giudici. 2018. *Token it Easy: Analyzing the rush of initial coin offerings.* SSRN working paper, p 12, as cited in S Adhami,
      G Giudici, and S Martinazzi. Forthcoming. Why do businesses go crypto? An empirical analysis of initial coin offerings.
      Journal of Economics and Business. Available at SSRN: https://ssrn.com/abstract=3046209

19   V Buterin. 2014. Ether sale: A statistical overview. *Ethereum* (blog, 8 August).
      https://blog.ethereum.org/2014/08/08/ether-sale-a-statistical-overview/

20   This data is from the IcoStats website: https://icostats.com/roi-since-ico

21   www.coinmarketcap.com/currencies/ethereum

22   ERC20. 2018. *Wikipedia* (last modified 14 June). https://en.wikipedia.org/wiki/ERC20

23   G Fenu, L Marchesi, M Marchesi, and R Tonelli. 2018. The ICO phenomenon and its relationships with Ethereum smart contract
      environment. International Workshop on Blockchain Oriented Software Engineering, Campobasso, Italy, 20 March.
      https://doi.org/10.1109/IWBOSE.2018.8327568

24   www.coindesk.com/ico-tracker. For an interactive visualisation of the ICO boom see www.elementus.io/token-sales-history

BOX 3: CASE STUDY – CENTRALITY

Centrality is a venture studio creating a peer-to-peer application marketplace. It partners with leading innovators in key industries to create blockchain applications that solve real-world problems.

In 2016, Centrality's five Kiwi co-founders provided initial seed capital for its proof of concept. In 2017, it secured 15 million USD in a token pre-sale. In January 2018, a public ICO was launched, raising 80 million USD in 6 minutes.

The company did not have clarity from the New Zealand Government about its position on ICOs (in particular, tax treatment), so the public ICO was conducted from Singapore.

Centrality and its partner companies employ more than 200 people in New Zealand with another 50 to 80 overseas. Approximately 60 percent of its workforce are developers and fewer than 10 are international hires who moved to New Zealand.

Centrality has invested 25 million to 30 million NZD in about 20 New Zealand companies. It focuses on providing initial capital for incubating startups to compete in global markets. It helped Performance Lab raise 10 million USD for its artificial intelligence–driven platform that provides coaching and insights to athletes.[25] Centrality is working closely with this company to help it raise funding of a further 15 million USD.

BOX 4: CASE STUDY – TECHEMY

Founded in 2014, Techemy[26] was one of the early blockchain companies in New Zealand. It launched Brave New Coin[27] to provide market data, news and insights for the blockchain industry. If you ask Amazon's Alexa about the price of bitcoin, the data supplied is by Brave New Coin.

Techemy has launched, invested in, acquired and partnered with multiple companies focused on serving the emerging industry. These include Techemy Capital (investment), Blockchain Labs[28] (smart contract auditing and development), Colony (an ICO syndication platform) and Dasset[29] (a registered New Zealand exchange). Most of this group's business is international, and it partners with top tier investors and ICO instigators.

Techemy receives a proposal for a new ICO approximately every four hours. In the last year, about 80 passed the initial screening, and the company helped ICOs raise over 500 million USD. Over that time, the group grew from eight staff to 67, most of whom are based in New Zealand, and it plans to reach 250 by the third quarter of 2019.

25   www.arda.ai
26   www.techemy.co
27   www.bravenewcoin.com
28   www.blockchainlabs.nz
29   www.dasset.co.nz

Direct funding to blockchain startups other than initial coin offerings

As well as the opportunity for New Zealand startups to raise funds through ICOs, startups may also secure funds directly from blockchain foundations or community funds.

Gaining a critical mass of developers is crucial for some blockchain platforms, so platforms are willing to offer significant incentives, including grants and direct investment.

Block One,[30] the company behind EOS that conducted the largest-ever ICO of over 4 billion USD, announced a 1 billion USD fund for directly investing in companies built on top of its technology. Many other projects offer similar, but smaller, pools of capital on attractive terms.

In 2017, New Zealand–based Secure Scuttlebutt[31] received a grant of 200,000 USD from Dfinity,[32] and, in 2018, Choice launched through the Kiwibank fintech accelerator in Wellington with a 1 million USD grant from the NEM Foundation.[33]

Multiple projects are pursuing 'stable tokens'

The prices of most crypto-assets are significantly more volatile than prices of other asset classes, which makes them ill-suited as money but attracts traders and speculators to the ecosystem.

Multiple efforts are under way to create 'stable tokens', which are intentionally designed to have low volatility. They have been described as the "Holy Grail of crypto-currency".[34] The two main strategies for achieving this stability are asset-backed tokens and pegged tokens.

Tokens such as Tether[35] and TrueUSD[36] are backed by the United States dollar, and OneGram[37] is backed by 1 gram of gold. A challenge with these tokens can be proving they hold the reserves they claim to. Tether, in particular, has been under a cloud of uncertainty, claiming major accounting firms are unwilling to provide an audit.[38]

Projects such as MakerDao,[39] Basis,[40] and Havven[41] use dynamic token supplies to peg the values of their tokens to the United States dollar, although their tokens are not directly redeemable for the currency to which they are pegged.

30 https://block.one/
31 www.scuttlebutt.nz
32 https://github.com/ssbc/grants-process/blob/master/grants.md
33 https://forum.nem.io/t/choice-a-liberated-payments-protocol-nem-community-fund-proposal/13380
34 S Lee. 2018. Explaining stable coins, the Holy Grail of cryptocurrency. *Forbes* (12 March).
    www.forbes.com/sites/shermanlee/2018/03/12/explaining-stable-coins-the-holy-grail-of-crytpocurrency/#5538590b4fc6
35 https://tether.to/
36 www.trusttoken.com/trueusd/
37 https://onegram.org/
38 S Town. 2018. Tether audit: FSS report states All USDT is fully backed, but can't prove it. *CryptoSlate* (21 June).
    https://cryptoslate.com/tether-audit-fss-report-states-all-usdt-is-fully-backed-but-cant-prove-it/
39 https://makerdao.com/
40 https://basis.io/
41 https://havven.io/

Energy efficient blockchains are on the way

In April 2018, the electricity required to run the Bitcoin network for a year was estimated as between 35 terawatt hours[42] and 61 terawatt hours.[43] For comparison, in 2014, all of New Zealand used 39 terawatt hours of electricity.[44] This enormous energy footprint is because the Proof of Work consensus algorithm tightly couples the security of a blockchain with electricity consumption.

BOX 5: PROOF OF WORK

The actual computation required to validate the transactions in a Proof of Work blockchain is small, but the more calculations a validator (often called 'miners' in reference to Bitcoin's original white paper[45]) completes, then the more likely they are to get paid.

Think of it as a race to solve a puzzle. The first miner to solve the puzzle and announce the solution to the network gets paid for that block. No one else receives payment. The chance of solving the puzzle is directly related to the computational power of a miner's nodes, which is directly related to how much electricity they consume.

In this way, mining is similar to burning electricity to enter a lottery that announces a winner every 10 minutes. As the mining power of the network increases (the hash rate), then the network becomes more secure, because it would take more computing power to disrupt.

If the price of the underlying token rises, then the profits miners earn increase. More miners then join the system, which increases the security of the network but also increases the electricity consumption. As the price of tokens is often connected to the market sentiment of the network, any Proof of Work blockchain that achieves significant uptake will result in unreasonable amounts of energy consumption.

Alternative consensus algorithms are being actively developed. Ethereum is planning to transition from Proof of Work to its Casper protocol's Proof of Stake.[46] EOS is built on top of a Delegated Proof of Stake blockchain which has a much smaller footprint.[47] Permissioned and private blockchains typically don't use proof of work.

42   S Bendiksen and S Gibbons. 2018. The Bitcoin Mining Network: Trends, marginal creation cost, electricity consumption & sources. White Paper. *CoinShares*. www.coinshares.co.uk/bitcoin-mining-cost/

43   S Lee. 2018. Bitcoin's energy consumption can power an entire country: But EOS is trying to fix that. Forbes (19 April). www.forbes.com/sites/shermanlee/2018/04/19/bitcoins-energy-consumption-can-power-an-entire-country-but-eos-is-trying-to-fix-that/#29550bb41bc8

44   Electricity Authority. 2016. *Electricity in New Zealand.* Wellington: Electricity Authority. www.ea.govt.nz/about-us/media-and-publications/electricity-nz/

45   Nakamoto, S. 2018, *Bitcoin: A peer-to-peer electronic cash system.* https://bitcoin.org/bitcoin.pd.

46   Proof of Stake FAQs. 2018. *Ethereum* (wiki). https://github.com/ethereum/wiki/wiki/Proof-of-Stake-FAQs

47   dantheman. 2017. DPOS consensus algorithm: The missing White Paper. *Steemit*. https://steemit.com/dpos/@dantheman/dpos-consensus-algorithm-this-missing-white-paper

Scalability is a hot topic of research and development

Scalability refers to both the size of the ledger (blockchain size) and the number of transactions per second (throughput). Both Bitcoin and Ethereum struggle to scale.

Bitcoin's throughput capacity is estimated at 7 transactions per second and Ethereum's at 15.[48] For comparison, Visa can handle an average of 2,000 with a peak of 56,000. In 2017, Alipay set a world record with 256,000 transactions per second.[49]

When more transactions are initiated than the network can process, validators choose which transactions to include, which leads to a bidding war in transaction prices. The network effectively becomes clogged with transactions, and miners prioritise the ones that will pay them the highest fee with the unprocessed transactions sitting idly with wait-times that can be hours.

One strategy for increasing throughput is to choose a more centralised consensus algorithm. For example, Hyperledger uses a consensus algorithm that is more centralised than Bitcoin and Ethereum and can achieve throughputs of 3,500 transactions per second and a latency of less than 1 second.[50] Throughput decreases as the number of nodes increase, but the European Central Bank and Bank of Japan concluded that the technology could scale to meet the demand of a real-time gross settlement system.[51]

EOS is another example of a blockchain that is planning to increase throughput through centralised validators using a Delegated Proof of Stake consensus algorithm. This algorithm aims to strike a middle ground between radically decentralised Bitcoin and Ethereum and more centralised Hyperledger.

PL^G is blockchain technology developed by Centrality that has a configurable consensus mechanism. Based on Proof of Stake, it is energy efficient and provides true finality after each block. Developers can configure the protocol to be both centralised and decentralised, which helps with throughput scalability. The technology is designed to be run across many independent blockchains, which helps with blockchain size.[52]

The Lightning Network[53] and Plasma[54] are examples of emerging technologies for scaling both throughput and blockchain size, without replacing the consensus algorithm.

Blockchain foundations provide significant research funding

Many blockchains have charitable foundations that provide research grants. In June 2018, the Ripple Foundation announced funding of 50 million USD to 17 universities, including the College of Law at the Australian National University.[55] The Ethereum Foundation provided grants of over 2.5 million USD in March 2018[56] and 2.84 million USD in May 2018.[57] Additionally, many foundations such as NEM[58] and Blockstack[59] have general purpose funds that researchers can apply for.

These organisations represent a significant opportunity for New Zealand academics to attract resources. Work is required to grow and attract talent, as highly specialised expertise is required to win the grants.

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48   K Croman, C Decker, I Eyal et al. 2016. *On scaling Decentralized Blockchains (A position paper)*.
www.comp.nus.edu.sg/~prateeks/papers/Bitcoin-scaling.pdf

49   Alipay. 2017. "World Record!! We've processed 256,000 payment transactions per second (TPS) for @AlibabaGroup 5 minutes and 22 seconds into #Double11. That's a year-on-year increase of over 101%" (tweet, 10 November).
https://twitter.com/alipay/status/929123909970153472?lang=en

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www.ibm.com/blogs/research/2018/02/architecture-hyperledger-fabric/

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53   https://lightning.network/

54   L Schor. 2018. Explained: Ethereum Plasma. *Medium* (blog, 29 May).
https://medium.com/@argongroup/ethereum-plasma-explained-608720d3c60e

55   Team Ripple. 2018. Ripple introduces the University Blockchain Research Initiative. *Ripple* (4 June).
https://ripple.com/insights/ripple-introduces-the-university-blockchain-research-initiative/

56   Ethereum Team. 2018. Announcing beneficiaries of the Ethereum Foundation Grants. *Ethereum Blog* (7 March).
https://blog.ethereum.org/2018/03/07/announcing-beneficiaries-ethereum-foundation-grants/

57   Ethereum Team. 2018. Announcing May 2018 cohort of EF Grants. *Ethereum Blog* (2 May).
https://blog.ethereum.org/2018/05/02/announcing-may-2018-cohort-ef-grants/

58   https://nem.io/community-fund/

59   https://blockstack.org/funding

Bitcoins are no replacement for money

Even though bitcoin was intentionally designed to serve the purpose of electronic cash[60] and the value of a single bitcoin has risen significantly, it is not considered to be fit for widespread use as money. The Bank of International Settlements argues bitcoin's lack of scalability and volatility and the fragility of its decentralised consensus are fundamental flaws that will prevent it from fulfilling its original intent.[61]

Furthermore, other researchers argue that even if the technology were sufficient, it is unlikely the public would trust the technology without institutional backing and regulation.[62]

Industry proponents of the technology tend to agree with criticisms about Bitcoin's scalability and volatility, although they argue the technology is at an early stage and still in development.[63] The claim that the consensus mechanism is fragile is more contentious.[64]

Emerging blockchain technologies such as the Lightning Network[65] and Plasma[66] may be able to address some of the concerns by scaling, respectively, Bitcoin and Ethereum transaction volumes. Additionally, alternative consensus algorithms such as proof of stake[67] for reducing energy usage are in development.[68]

Other non-blockchain, distributed ledger technologies such as directed acyclic graphs[69] (used in IOTA[70] and RChain[71]) or validating distributed hash tables (used in Holochain[72]) might also contribute solutions to scaling and energy usage, although these technologies are experimental and less mature than Bitcoin and Ethereum.

Core problems of unstable value because of a rigid money supply are more intractable. In particular, creating a decentralised algorithm to replace a central bank's role in modifying currency supply to follow the needs of an economy would be a significant accomplishment that, as yet, remains speculative.

One potential path is centrally banked cryptocurrencies where a central bank controls the money supply, but blockchain technology is used to ensure transparency, auditability and programmability through smart contracts.[73] The Bank for International Settlements views this as a mid-term policy question that would come with significant financial vulnerabilities and unclear benefits.[74]

60 S Nakamoto. 2018. *Bitcoin: A peer-to-peer electronic cash system*. https://bitcoin.org/bitcoin.pdf

61 Bank for International Settlements . 2018. Cryptocurrencies: Looking beyond the hype. In *Annual Report 2018* (chapter V, pp 91–114). www.bis.org/publ/arpdf/ar2018e5.htm

62 J Vaz and K Brown. 2018. *Cryptocurrencies, Institutions and Trust*. Monash University and Australian Centre for Financial Studies (Funding Australia's Future, stage IV). https://australiancentre.com.au/publication/cryptocurrencies-and-trust/

63 O Williams-Grut. 2018. Central bankers claim bitcoin could break the internet – the crypto world thinks they're missing the point. *Business Insider* (19 June). www.businessinsider.com.au/crypto-responds-to-the-bank-of-international-settlements-bitcoin-report-2018-6

64 P Amery. 2018. How fragile are cryptocurrencies? *New Money Review* (21 June). www.newmoneyreview.com/index.php/2018/06/21/how-fragile-is-bitcoin/

65 https://lightning.network/

66 L Schor. 2018. Explained: Ethereum Plasma. *Medium* (blog, 29 May). https://medium.com/@argongroup/ethereum-plasma-explained-608720d3c60e

67 Proof-of-stake. 2018. *Wikipedia* (last modified 8 June). https://en.wikipedia.org/wiki/Proof-of-stake

68 Bank for International Settlements. 2018. Cryptocurrencies: Looking beyond the hype. In *Annual Report 2018* (chapter V, pp 91–114). https://www.bis.org/publ/arpdf/ar2018e5.htm

69 Technically, blockchains are a very specific type of directed acyclic graph.

70 S Lee. 2018. Explaining directed acylic graph (DAG), the real blockchain 3.0. *Forbes* (22 January). www.forbes.com/sites/shermanlee/2018/01/22/explaining-directed-acyclic-graph-dag-the-real-blockchain-3-0/#2a12f64c180b

71 M Birch. 2017. Correct-by-construction Casper: A visualization for the future of blockchain consensus. *Medium* (blog, 28 December). https://medium.com/rchain-cooperative/a-visualization-for-the-future-of-blockchain-consensus-b6710b2f50d6

72 Shared storage on validating DHT. 2018. *GitHub*. https://github.com/holochain/holochain-proto/wiki#shared-storage-on-validating-dht

73 G Danezis and S Meiklejohn. 2015. *Centrally Banked Cryptocurrencies*. Available from Cornell University Library: https://arxiv.org/abs/1505.06895

74 Bank for International Settlements. 2018. Cryptocurrencies: Looking beyond the hype. In *Annual Report 2018* (chapter V, pp 91–114). www.bis.org/publ/arpdf/ar2018e5.htm

Illicit uses of tokens are still a concern

The Bitcoin ledger is public and pseudo-anonymous, making it amenable to analysing how criminals attempt to launder money and transact on the black market using this technology.[75]

A 2018 study from the Center on Sanctions and Illicit Finance estimated that between 2013 to 2016 minimally 0.61 percent of all bitcoin transactions to digital currency services (such as exchanges, gambling sites, ATMs and mixers) were from illicit sources. That amount dropped from 1.07 percent in 2013 to 0.12 percent in 2016 – most likely because of bitcoin's popularity increase, but may also be due to improved anti-money laundering practices and better subterfuge in money laundering techniques.[76]

The 2018 study also recommended more anti-money laundering practices on mixers and online gambling, stronger anti-money laundering practices for European exchanges, improved knowledge sharing between jurisdictions, and adaptations to law enforcement techniques.

Another study estimated that from January 2009 to April 2017, 44 percent of peer-to-peer bitcoin transactions (those not sent to exchanges or conversion services) were associated with illegal activity.[77] This estimate was generated from network cluster analysis of the entire bitcoin blockchain and is likely an overestimate. For example, the researchers' algorithms estimated 106 million distinct bitcoin users, which is much higher than other estimates. The researchers postulate that the availability of pseudo-anonymous cross-border payments has an effect on the black market analogous to the impact of the internet on legitimate e-commerce.

In the United Kingdom, HM Treasury evaluated the risk of digital currencies being used for money laundering as relatively low.[78] It evaluated banking, real estate, accounting and legal services as high risk activities. From a cybercrime perspective, the threat is higher with digital currencies playing a role in victim to criminal payments (for example, ransomware) and criminal to criminal payments (crime as a service and criminal marketplaces) and laundering the proceeds of cyber-dependent crime (for example, bitcoins stolen in an exchange hack).

Like other general purpose technologies, distributed ledgers and blockchains enable criminal activity while also enabling new forms of prevention and investigation. Growth of illicit uses of these technologies has led to the emergence of companies specialising in detection and prevention of criminal crypto-asset activities such as Elliptic.[79]

On the other hand, these technologies offer opportunities to reduce crime in other areas, such as identity theft and fraud. For example, Single Source[80] is a Centrality-backed venture using blockchain to reduce inflated insurance claims, payment defaults and first-party credit fraud.

Exchanges and token issuers are de-anonymising users

Most crypto-assets are pseudo-anonymous. Some, like Monero or ZCash, aim for truly anonymous transactions. This is a significant barrier to integration with existing financial systems because of money laundering concerns. Exchanges and token issuers have adapted by implementing strong 'know your customer' practices, which effectively de-anonymise users who interact with those services. This practice has allowed companies dealing in crypto-assets to engage banking partners. New Zealand banks have been slow to engage, causing significant pain for the emerging industry.

75   Turner, A, and Irwin, A. 2018. Bitcoin transactions: A digital discovery of illicit activity on the blockchain. *Journal of Financial Crime* 25(1): 109–130. https://doi.org/10.1108/JFC-12-2016-0078

76   YJ Fanusie and T Robinson. 2018. *Bitcoin Laundering: An analysis of illicit flows into digital currency services.* Center on Sanctions and Illicit Finance, Foundation for Defense of Democracies, and Elliptic. www.defenddemocracy.org/content/uploads/documents/MEMO_Bitcoin_Laundering.pdf

77   S Foley, JR Karlsen and TJ Putniņš. 2018. *Sex, Drugs, and Bitcoin: How much illegal activity is financed through cryptocurrencies?* (15 January). Available at SSRN: https://ssrn.com/abstract=3102645 or http://dx.doi.org/10.2139/ssrn.3102645

78   HM Treasury, 2017. *National Risk Assessment of Money Laundering and Terrorist Financing.* London: HM Treasury. www.gov.uk/government/publications/national-risk-assessment-of-money-laundering-and-terrorist-financing-2017

79   www.elliptic.co

80   www.mysinglesource.io

BOX 6: CASE STUDY – CRYPTOPIA

Cryptopia[81] launched in 2014 as a hobby project of programmers Rob Dawson and Adam Clark. By 2017, it had 30,000 users. The pair quit their jobs and put all their savings into the business. By 1 December 2017, the business hit 500,000 users. By the month's end, it was a million, continuing to rise to 1.4 million in January 2018.[82]

The company overtook the New Zealand Stock Exchange with peak daily trading volumes of 280 million NZD in January. It was clearing over 1 million NZD in trading fees per day.[83] In February 2018, Cryptopia had its bank accounts shut down over money-laundering concerns.[84] It has since addressed those concerns and re-established its bank accounts.

The rapid growth put severe stress on the company, which struggled to scale up its staff and meet the demand for its services. Cryptopia successfully managed the transition, provides livelihoods for about 100 employees and contractors and is working on future products to support the secondary token markets.[85]

Access to basic banking services is a challenge

The most common complaint from New Zealand blockchain companies is difficulty in obtaining bank accounts. Many banks have policies of refusing service to crypto-asset exchanges or token issuers. Those willing to do so can take months to become comfortable with risk exposure.[86] Blockchain companies are high-cost, low-value clients to banks. Since banks are ultimately accountable for the quality of their clients' anti-money laundering practices, they have little incentive to engage with the industry.

The difficulty obtaining bank accounts is a significant barrier to blockchain innovation. Urgent action is required if the industry is to reach its full potential. Exchanges and token issuers are key players in the emerging industry, and challenging banking relationships make it harder for them to operate in New Zealand than other jurisdictions.

Blockchain companies need clear guidance on their anti-money laundering obligations. When those obligations are met, they should be able to easily access banking services.

81   www.cryptopia.co.nz

82   C Hutching. 2018. From a two-man operation a year ago, Cryptopia surges on bitcoin. *Stuff* (10 January). www.stuff.co.nz/business/100421588/from-a-twoman-operation-a-year-ago-cryptopia-surges-on-bitcoin

83   C Hutching. 2018. Speculative surge in bitcoin boosts Christchurch firm. *Stuff* (9 January). www.stuff.co.nz/business/100399058/speculative-surge-in-bitcoin-boosts-christchurch-firm

84   S Edmunds. 2018. Bank pulls support for cryptocurrency platform Cryptopia. *Stuff* (1 February). www.stuff.co.nz/business/101038176/bank-pulls-support-for-cryptocurrency-platform-cryptopia

85   N Mandow. 2018 *Suspended NZ crypto 'coins' to be re-released early 2019.* New Zealand Herald, November 8. https://www.nzherald.co.nz/business/news/article.cfm?c_id=3&objectid=12156765

86   A Sims, K Kariyawasam, and D Mayes. 2018. *Regulating Cryptocurrencies in New Zealand. Wellington: New Zealand* Law Society.

BOX 7: CASE STUDY – EASY CRYPTO

Easy Crypto[87] is a company that sells bitcoin and other crypto assets to the New Zealand public. This company was founded by siblings who had friends and family interested in cryptocurrencies but found the technology inaccessible. The siblings saw an opportunity to create a simple and safe way for people to buy crypto-assets. They ran initial tests in late 2017, and launched in January 2018.

Easy Crypto undertakes 'know your customer' due diligence on all customers and only sells coins for New Zealand dollars. Therefore, its money laundering risks are low to moderate. Despite this, it appears that just by having 'crypto' in the company name meant most banks refused service without learning about Easy Crypto's business or its compliance processes. It took Easy Crypto four months and approaches to 11 different banks to finally secure a banking partner.

Easy Crypto wishes to extend its services to purchasing coins from customers, but must work through this business model change in partnership with its bank.

New Zealand legislation is largely adequate for the industry

Unlike other countries, New Zealand regulators have largely been able to accommodate emerging industries without requiring legislative change. In particular, the Financial Markets Conduct Act 2013 has given the Financial Markets Authority the flexibility to regulate exchanges and ICOs appropriately, as well as focus on innovation. The Anti-Money Laundering and Countering Financing of Terrorism Act 2009 is sufficient to govern exchanges and token issuers. Any challenges faced from anti-money laundering practices can be solved downstream of legislation.

Inland Revenue's approach of treating crypto-assets as property for income tax purposes is consistent with comparable jurisdictions. While compliance costs are high for entities with a large number of crypto-asset transactions, companies such as Wellington's Cryptfolio are building tools to simplify compliance.[88]

Goods and services tax (GST) is one area where legislative action may be required for the industry to thrive. If crypto-assets are treated as taxable goods, from a GST perspective, New Zealand will be at a significant disadvantage compared with jurisdictions that take a different position. Inland Revenue has yet to publish guidance on GST. It has the benefit of learning lessons from countries such as Australia, which amended its GST Act in July 2017 before the ICO boom.

The report *Regulating Cryptocurrencies in New Zealand* extensively overviews international regulatory responses, although this is an area that will require constant attention.[89] For example, the Government of Canada recently published a regulatory impact analysis statement on its anti-money laundering legislation, based off its 2015–2016 evaluation from the Financial Action Task Force. This analysis has lessons highly relevant to New Zealand.[90]

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87   www.easycrypto.nz/

88   J Wright. 2018. Generating end-of-year cryptocurrency tax reports with CryptFolio. *Medium* (blog, 29 May).
      https://medium.com/cryptfolio/generating-end-of-year-cryptocurrency-tax-reports-with-cryptfolio-4756c618edcf

89   A Sims, K Kariyawasam, and D Mayes. 2018. *Regulating Cryptocurrencies in New Zealand*. Wellington: New Zealand Law Society.

90   Government of Canada. 2018. Regulatory Impact Analysis Statement. *Canada Gazette* part I, vol 152, no 23) (Regulations Amending Certain Regulations Made Under the Proceeds of Crime (Money Laundering) and Terrorist Financing Act, 2018).
      www.gazette.gc.ca/rp-pr/p1/2018/2018-06-09/html/reg1-eng.html

Opportunities provided by the sector

Introduction

The most immediate opportunity provided by the technology is high-paying technology jobs. Salaries are higher than salaries in the overall information and communications technology (ICT) sector, and the number of jobs is growing rapidly. The influx of capital through ICOs and the growing number of enterprise applications makes it likely these trends will continue. Blockchain companies have high levels of distributed workforces, which means the location of key personnel matters more than where the company is incorporated.

The technology also presents many opportunities for catalysing other sectors such as supply chains, financial services, science and research, arts and culture, and foreign aid. A small sample of sectors and projects is discussed to provide a flavour of what people are working on. Many more could have been included.

The technology also offers long-term opportunities for more radical change that have been lightly touched on. Emphasis has been placed on short-term, highly probable opportunities.

High-paying tech jobs

The blockchain sector could be a substantial source of high-tech jobs in New Zealand. Salaries are slightly higher than overall ICT salaries,[91] and the number of jobs is growing rapidly[92] (see Figure 4). In quarter 1 of 2018, it was the fastest growing skill on freelancing website Upwork.[93] Given the amount of capital raised in ICOs deploying over the next three to five years, it is likely these trends will continue.

The influx of capital from ICOs has not just grown employment opportunities in the sector, it has changed their very nature. Blockchain startups often have highly distributed teams, so a company doesn't need to be based in New Zealand to provide work opportunities for New Zealanders.

This makes the *place where talent wants to live* strategy – of team leads, founders and other key personnel choosing to live in New Zealand – highly relevant and will have a significant impact on wider employment opportunities. For example, Horizon State is incorporated in Australia, but the chief technical officer lives in Wellington, leading to jobs for a team of 10 in New Zealand.

91   L Mearian. 2018. Blockchain moves into top spot for hottest job skills. *Computerworld* (1 May).
      www.computerworld.com/article/3235972/it-careers/blockchain-moves-into-top-spot-for-hottest-job-skills.html

92   S Rodriguez. 2018. Salaries for blockchain engineers are skyrocketing, now on par with AI experts. CNBC (21 October).
      www.cnbc.com/2018/10/21/how-much-do-blockchain-engineers-make.html

93   Upwork. 2018. Upwork releases Q1 2018 Skills Index, ranking the 20 fastest-growing skills for freelancers. *Upwork* (press release).
      www.upwork.com/press/2018/05/01/q1-2018-skills-index/

OPPORTUNITIES PROVIDED BY THE SECTOR

FIGURE 5: Annual blockchain job postings, 2010–2017
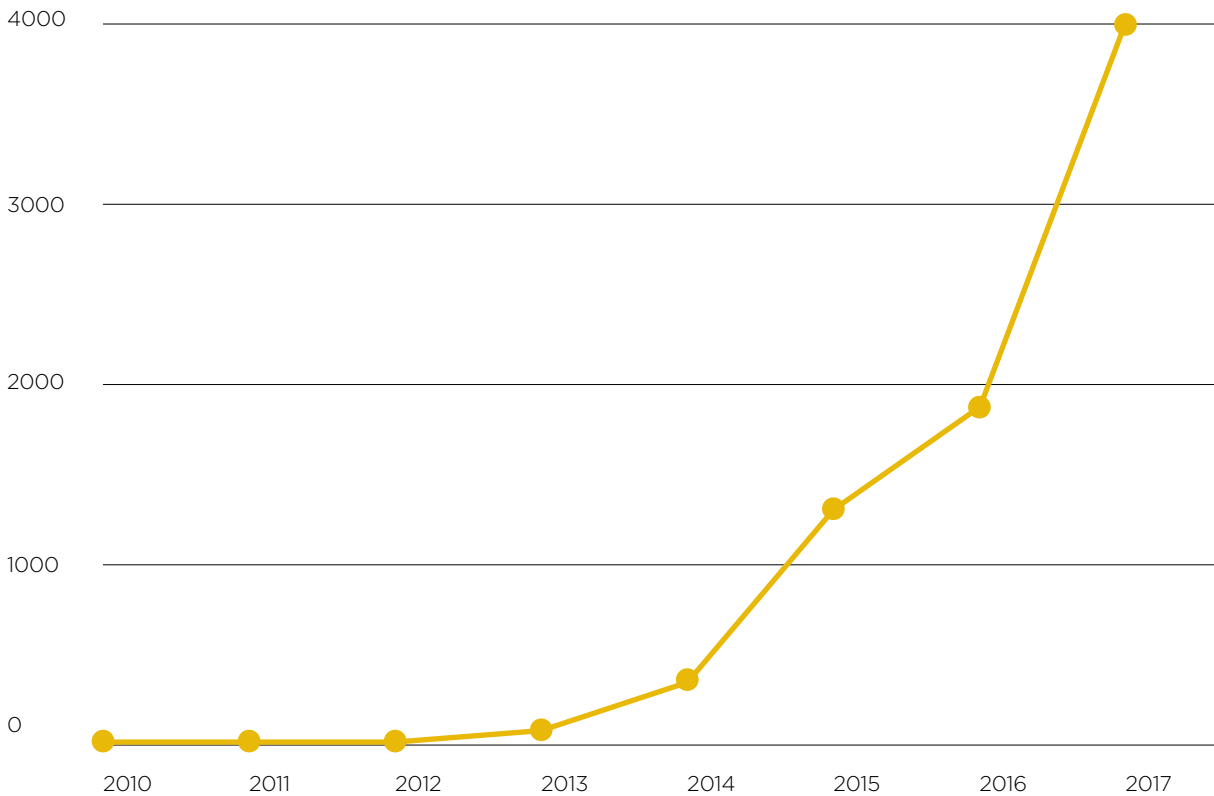
Source: S Brittle. 2017. Job postings for blockchain skills double over 2016. Burning Glass Technologies
(30 October). www.burning-glass.com/blog/job-postings-blockchain-skills-double-2016/

These jobs do not need to be limited to urban New Zealand. EPIC Westport is a business hub on a mission to grow innovation with a focus on blockchain-based initiatives in beautiful, regional New Zealand. It has partnered with the NEM foundation to launch the first NEM Innovation Hub in New Zealand.[94]

Regardless of the jurisdiction of the company providing the work, if the employee or contractor is a tax resident in New Zealand then an increase in local jobs will lead to an increase in tax revenue through PAYE (Pay as You Earn).

BOX 8: CASE STUDY – HORIZON STATE

Horizon State uses blockchain technology to create decision-making tools that build trust.[95] The company completed an ICO in October 2017, raising 900,000 USD.

When considering the ICO, the company evaluated Switzerland, New Zealand and Australia. Switzerland was the most favourable jurisdiction in terms of clarity of legal and accounting rules, although Australia was nearly as good. New Zealand was a long way behind, so the company incorporated in Australia.

Horizon State began by providing a voting application but has since expanded into providing a full suite of community engagement tools, including surveying, fundraising and voting tools. It provides the technology for MiVote,[96] is running significant trials in Indonesia[97] and was recently announced as a World Economic Forum technology pioneer.[98]

Horizon State integrated with the Ethereum blockchain and are adding support for others such as Waves,[99] NEM[100] and Hyperledger.[101] The company employs 24 people: 8 in Australia, 10 in New Zealand and 6 across Europe and the United States.

Attracting high growth companies and talent

"If we care for our environment and create a just, equitable and creative society, a 'place where talent wants to live', then we can attract the best in the world, and provide an opportunity for our most talented Kiwis to see their future here"

Sir Paul Callaghan, GNZM FRS FRSNZ[102]

Blockchain companies do not need financial incentives, deregulation or special rules. They only require knowledge of how existing rules apply to them and the ability to engage with regulators when this is unclear.

As a small country attractive to talent with accessible regulators and an agile government, New Zealand is in a prime strategic position to attract and retain high-growth tech companies.

95   www.horizonstate.com

96   www.mivote.org.au

97   E Skella. 2018. Horizon State strikes strategic partnership to empower millions in Indonesia. *Medium* (blog, 29 March).
     www.medium.com/horizonstate/horizon-state-strikes-strategic-partnership-to-empower-millions-in-indonesia-fb530e5e8af0

98   E Skella, 2018. Horizon State joins Google, Dropbox and Spotify as World Economic Forum technology pioneers. *Medium* (blog, 20 June).
     www.medium.com/horizonstate/horizon-state-joins-google-dropbox-and-spotify-as-world-economic-forum-technology-pioneers-78df2063d1fc

99   www.wavesplatform.com

100 www.nem.io

101 www.hyperledger.org/

102 P Callaghan. 2011. Sustainable economic growth for New Zealand: An optimistic myth-busting perspective
     (paper for the StrategyNZ: Mapping our Future workshop, March 2011).
     www.mcguinnessinstitute.org/wp-content/uploads/2016/08/Sir-Paul-Callaghan-Paper-Sustainable-Future-Institute.pdf

BOX 9: CASE STUDY – STRONGHOLD

Stronghold[103] is an exchange focused on the Stellar network. In 2017, its co-founders launched the business in San Francisco. In April 2018, after facing uncertainty about licensing requirements in the United States, Stronghold set up operations in New Zealand. A single regulator (the Financial Markets Authority) with a high degree of literacy about crypto-exchanges and a willingness to engage with Stronghold was a big selling point.

The co-founders had initially planned to have just a regulatory team in New Zealand. After arriving, they realised it made more sense to also migrate their development and operations teams. While some specialist roles are easier to recruit in San Francisco, 90 percent of their required technology can be built by Kiwi developers. Relocation makes sense from both financial and lifestyle points of view.

Such relocation is under a 24-month review. The ability to secure reliable banking partners, attract talent and work effectively with their United States–based teams will significantly determine whether New Zealand will become Stronghold's home.

BOX 10: CASE STUDY – EDMUND HILLARY FELLOWSHIP AND GLOBAL IMPACT VISA

In January 2017, Immigration New Zealand launched the Global Impact Visa.[104] In a world first, Immigration New Zealand partnered with the Edmund Hillary Fellowship[105] to attract exceptional talent to New Zealand and accelerate the growth of entrepreneurship, innovation and investment in our country.

More than 1,100 people have applied to the fellowship, with 109 selected from 20 countries. Fellows are active across many industries, but the highest calibre, largest and most influential group comprises Fellows focusing on blockchain. They include the co-founder of Coinbase (the first billion dollar blockchain company), the co-founder of Augur (one of the first Ethereum initial coin offerings) and the head of innovation at UNICEF who has launched an impact-driven blockchain investment fund.

Many other entrepreneurs, technologists and investors who are active in the blockchain space are also part of the fellowship.

The Edmund Hillary Fellowship's success in attracting high-calibre international Fellows has led to a growing awareness of New Zealand as a place of interest among the world's leading blockchain players. Many Fellows are excited by the government's willingness to engage with the private sector and the ease of doing business in a modern economy that values fair and open collaboration.

Despite New Zealand's relatively immature blockchain industry, many people see the potential for New Zealand to become a world leader in this sector. The amount of interest from people in blockchain makes these people one of the fastest growing demographics applying for Global Impact Visas.

103 www.stronghold.co
104 www.immigration.govt.nz/new-zealand-visas/options/start-a-business-or-invest/i-want-to-invest-or-do-business-in-nz/the-global-impact-visa
105 www.ehf.org

Access to growth capital

Kiwi companies often struggle to raise funds for the 'scale up' phase of growth. Capital attracted to the blockchain sector could make a significant impact on the New Zealand startup ecosystem. Funds can be raised directly through an ICO, blockchain-focused venture capital firms, or mature blockchain ventures.

It is important to take a balanced approach toward helping develop New Zealand entrepreneurs' understanding of distributed ledger technologies and the associated capital markets, while avoiding the 'add blockchain to everything' hype. Additionally, the potential for New Zealand companies to lead the world in issuing security tokens – without becoming 'blockchain companies'– should not be overlooked.

Catalyst for other sectors

In May 2018, the European Parliament's Committee on Industry, Research, and Energy passed a resolution on distributed ledger technologies. It highlights the potential impact of these technologies across all sectors of the economy, specifically naming energy and environmentally friendly applications, transport, healthcare, supply chains, education, creative industries and the financial sector.[106]

Most projects are very early in their development, and a challenge for the industry is building useful applications that solve real-world problems. The following sections highlight a small sample of projects across three areas: supply chains, financial services, and arts and culture.

SUPPLY CHAINS AND PROVENANCE

Many projects are focused on solving supply chain problems with distributed ledgers, which could have a significant impact on New Zealand's primary industries.

New Zealand Post and Fonterra are partnering with Alibaba to use blockchain technology to track consumers' orders in an effort to increase food safety.[107] Centrality's Trackback project is in live trials with a supply chain traceability solution to showcase New Zealand products in international markets.[108]

Australian-based Blockgrain uses blockchain technology to help participants in the grain supply chain make better informed decisions, eliminate paperwork, reduce inefficiency and risk, open markets and increase profits.[109]

Provenance is a blockchain company from the United Kingdom that is creating and fostering open, accessible information about products to transform the global economy. The company has completed pilot projects focused on tracing sustainably caught tuna[110] and proving that farmers have received fair compensation.[111]

106 European Parliament. 2018, *Resolution* 2017/2772. www.emeeting.europarl.europa.eu/committees/agenda/201805/ITRE/ITRE(2018)0516_1/sitt-7992717

107 A Shaw. 2018. Alibaba, Fonterra and NZ Post team up to track orders using blockchain technology. *NZ Herald* (27 April). www.nzherald.co.nz/business/news/article.cfm?c_id=3&objectid=12039985

108 A McDonald. 2018. Centrality monthly update—July 2018. *Medium* (blog, 5 July). https://medium.com/centrality/centrality-monthly-update-july-2018-d3c87bb35fbf

109 www.blockgrain.io

110 Provenance. 2016. *From Shore to Plate: Tracking tuna on the blockchain.* www.provenance.org/tracking-tuna-on-the-blockchain

111 Provenance. No date. *Increasing Financial Transparency with Proof of Fair Payment* (case study). www.provenance.org/case-studies/fairfood

OPPORTUNITIES PROVIDED BY THE SECTOR

FINTECH AND FINANCIAL SERVICES

Distributed ledger technologies offer significant opportunities for innovation in the banking and financial services industries.

The European Central Bank and the Bank of Japan completed a joint study on the applications of distributed ledger technology. They concluded the technology, while not yet mature,[112] is capable of meeting performance needs of real-time gross settlement systems, while strengthening their resilience and reliability.[113] A second report concluded that distributed ledger technology could run cross-ledger securities settlement systems using 'delivery versus payment', allowing parties to settle transactions through "cross chain atomic-swaps" while avoiding counterparty risk.[114]

The Australian Stock Exchange is replacing its Clearing House Electronic Subregister System (CHESS) which provides core clearing, settlement and post-trade services for the Australian equities market with a purpose-built distributed ledger technology system.[115] In August 2018 the World Bank partnered with the Commonwealth Bank of Australia to raise 110 million AUD through the world's first bond to be created, allocated, transferred and managed using distributed ledger technology.[116]

ANZ has completed three distributed ledger proof of concepts that focus on cross-border payments and correspondent banking,[117] managing bank guarantees,[118] and managing policies and payments between insurance companies and brokers.[119] In each case, the technology was deemed sufficient with further work required on business process adaptation and industry collaboration.

MEDIA DISTRIBUTION AND FUNDING ARTS AND CULTURE

Many software platforms' media distributors (such as Spotify, Netflix, Youtube, Apple and Amazon) have significant controlling power, leading to 'take it or leave it' terms for artists and content creators.

SingularDTV is using blockchain technology to build a decentralised entertainment industry, shifting power from distributors to creators.[120] By using its Tokit platform, artists can raise funds, reach audiences and control their content by tokenising their intellectual property.[121] In 2017, international DJ Gramatik launched a token on SingularDTV, raising 2.25 million USD and giving holders a share in revenue from future works.[122]

Artchain offers artists and collectors the ability to register artworks on the blockchain to prove their provenance and reduce secondary market costs.[123] Typically, artists' works increase in value throughout their careers, and most of the value increase is captured by collectors. By using blockchains to prove provenance and facilitate secondary markets, it is possible for artists to earn a portion of the revenue every time a work is resold, which can have a significant impact on artists' livelihood.

INTERNATIONAL DEVELOPMENT

While blockchains and distributed ledgers show significant potential for wealthy economies, they may have an even greater impact for developing countries.

112   Bank of Japan and the European Central Bank. 2017. BOJ/ECB Joint Research Project on Distributed Ledger Technology (release, 6 September). www.boj.or.jp/en/announcements/release_2017/data/rel170906a2.pdf

113   Project Stella. 2017. *Payment Systems: Liquidity saving mechanisms in a distributed ledger environment.* Germany: European Central Bank and Bank of Japan. Available at: www.ecb.europa.eu

114   Project Stella. 2018. *Securities Settlement Systems: Delivery versus payment in a distributed ledger environment.* Germany: European Central Bank and Bank of Japan. Available at: www.ecb.europa.eu

115   Australian Securities Exchange. 2018. *CHESS Replacement: New scope and implementation plan* (consultation paper). Sydney: ASX. www.asx.com.au/documents/public-consultations/chess-replacement-new-scope-and-implementation-plan.pdf

116   World Bank. 2018. *World Bank Prices First Global Blockchain Bond, Raising A$110 Million.* (release, August 23) https://www.worldbank.org/en/news/press-release/2018/08/23/world-bank-prices-first-global-blockchain-bond-raising-a110-million

117   ANZ and Wells Fargo. 2016. *Distributed Ledger Technology and Opportunities in Correspondent Banking.* https://bluenotes.anz.com/media/1002/ANZ_WellsFargo_DLT_Paper_HIRES.pdf

118   ANZ and IBM. 2017. *Distributed Ledger Technology and Bank Guarantees for Commercial Property Leasing.* www.ibm.com/industries/au-en/banking/downloads/Whitepaper-Bank_Guara.pdf

119   ANZ. 2018. *Distributed Ledger Technology for Reconciliation between Insurance Companies and Brokers.* www.anz.co.nz/resources/f/d/fd397495-8c57-41e0-b9b6-9c51b410a8b8/Distributed-Ledger-Technology.pdf

120   www.singulardtv.com

121   www.tokit.io

122   SingularDTV. 2017. Gramatik launches $9 million entertainment economy, the GRMTK token. *Medium* (blog, 11 November). https://medium.com/singulardtv/gramatik-launches-9-million-entertainment-economy-the-grmtk-token-944d1e332361

123   www.artchain.world

Particularly relevant applications emerging include philanthropy, aid finance, remittances, identity rights, land rights, governance, democracy and environmental protection.[124]

RSK is a protocol for building smart contracts on top of the bitcoin network with a mission of providing financial services to 2.5 billion unbanked people.[125]

Disberse[126] is one of many 'blockchain-for-good' ventures aiming to distribute and track aid finance. Aid totalling over 600 billion USD is distributed internationally each year. Ensuring these funds reach their intended destination and have maximum impact is a significant challenge for the sector.

Oxfam launched a collaborative research project called Oxchain, which explores applications of the blockchain including "the reconfiguration of economic, social and cultural life which may be made possible by digital, peer-to-peer value exchange".[127]

A Chama is an informal cooperative society that is normally used to pool and invest savings by people in East Africa, particularly in Kenya. Chamapesa is a project taking the successful group savings and investment pool practices of Chamas and making them administratively efficient using a distributed ledger.[128]

UNICEF has undertaken multiple initiatives to explore the potential for blockchain to help with fundraising, children's rights, women's rights and identity.[129] The UNICEF Innovation Fund (led by Christopher Fabian, an Edmund Hillary Fellow) is actively making seed-stage investments in aligned for-profit companies.[130]

Public services

Blockchains offer governments new opportunities to improve transparency, prevent fraud and establish trust in the public sector. Several countries have announced blockchain initiatives exploring the technology's potential, although most projects are in early stages. Adoption of blockchains is still limited because of technical, organisational and legal challenges.[131]

The European Parliament's Committee on Industry, Research and Energy highlighted the technology's potential to reduce bureaucracy, decentralise governance, hold government accountable, improve transparency of funding and improve social good.[132]

More than 30 Dutch government organisations have concluded a blockchain project or pilot, including to collect tourist taxes more efficiently, assign parking spaces to citizens with disabilities, request healthcare services, and log access to information in criminal trial proceedings.[133]

Inherent features such as distributed consensus as a basis for trustworthy system-of-record, transparency and emergent properties such as immutability make the technology interesting for developing countries vulnerable to corruption, fraud and lack of trust. This could be applied, for example, to administering and monitoring New Zealand's foreign aid programmes.

Short-term applications for better public services include audits, attestations such as licensing, accreditation and secure document management. Longer-term possible applications include tax collection, rebates and subsidy distribution, fitness warranties, elections,[134] procurement and social welfare payments. These applications would need substantial progress to be made on digital identity, digital inclusion and, possibly, central bank digital currencies. But they would have very significant positive impacts for New Zealand infrastructure.

124   D Lehr and P Lamb. 2018. Digital currencies and blockchain in the social sector: How decentralized technologies are transforming philanthropy and NGO work. *Stanford Social Innovation Review* (18 January). ssir.org/articles/entry/digital_currencies_and_blockchain_in_the_social_sector1

125   www.rsk.co

126   www.disberse.com

127   http://oxchain.uk/the-project/

128   https://chamapesa.com/

129   UNICEF. 2017. *Blockchain at UNICEF* (page last updated 12 January). http://unicefstories.org/blockchain/.

130   UNICEF. No date. *Blockchain Call: UNICEF funding opportunity for blockchain start-ups.* http://unicefstories.org/blockchaincall/

131   F Batubara, J Ubacht and M Janssen. 2018. Challenges of blockchain technology adoption for e-government: A systematic literature review. In *Proceedings of 19th Annual International Conference on Digital Government Research.* New York: ACM. https://doi.org/10.1145/3209281.3209317

132   European Parliament. 2018. *Resolution 2017/2772.* www.emeeting.europarl.europa.eu/committees/agenda/201805/ITRE/ITRE(2018)0516_1/sitt-7992717

133   www.blockchainpilots.nl/home-eng

134   In its March 2018 election, Sierra Leone stored 70 percent of its polling directly onto the blockchain: J Biggs. 2018. Sierra Leone just ran the first blockchain-based election. TechCrunch (15 March). https://techcrunch.com/2018/03/14/sierra-leone-just-ran-the-first-blockchain-based-election/

BOX 11: CASE STUDY – 2 SHAKES

2 Shakes is a social enterprise launched in the R9 govtech accelerator[135] in 2016. It focuses on making it easier for users of government services to delegate authority to a third party acting on their behalf.

The company provides cloud software so professionals such as bookkeepers, accountants, lawyers and financial advisors can use electronic signatures to capture a client's consent to act on their behalf with government and private organisations.

When a document is electronically signed, the company stores a hash[136] of the document in the Ethereum blockchain. Anyone sighting the electronic document in the future can then use software to validate that the document existed at a certain time and was not modified in anyway.[137]

Central bank digital currency

Numerous central banks are researching the topic of central bank digital currencies, generating a growing debate on whether such currencies are feasible or desirable. A central bank digital currency could improve the efficiency of payment systems, but might pose a financial stability risk. The topic is relatively new, so a wide variety of questions still need explored.[138]

Like other central banks, the Reserve Bank of New Zealand is evaluating digital currencies, and published an analysis outlining the pros and cons in June 2018. The key finding is that when evaluated against the four key central bank functions[139] the pros and cons are mixed and there is a clear need for further research.[140]

Many of the technical limitations identified by the Reserve Bank such as slow payment authorisation, inefficient energy use, lack of transaction scalability, and consumers losing access to funds are accurate critiques of current public distributed ledger technology. Some of these technical limitations can be addressed currently by using a permissioned distributed ledger. All of the technical limitations can likely be overcome as the technology matures further.

Distributed ledger technologies enable the disintermediation of information systems, including financial systems. The current financial system, which the Reserve Bank is responsible for maintaining the stability and efficiency of is heavily intermediated. This intermediation results in significant inefficiencies as can be seen in the work MBIE has been undertaking to address challenges in the retail payments sector.[141]

As distributed ledger technologies mature it is likely that the financial system will face significant disruption from disintermediation. Given the digital nature of the technology it is also possible that this disruption could occur swiftly. Consideration should be given to the role a central bank digital currency (CBDC) could play in responsibly disintermediating areas of the financial system to ensure its long term stability.

135   Creative HQ. 2016. NZ'S Govtech accelerator: Why you should get involved. *News* (18 January).
      https://creativehq.co.nz/nzs-gov-tech-startup-accelerator-what-is-r9/

136   A hash is an electronic fingerprint that is unique to the document and can be used to prove that the document has not been tampered with after the fingerprinting.

137   2 Shakes. 2017. Kiwi GovTech startup makes online signatures safer with blockchain breakthrough. (media release, 3 March).
      www.2shakes.co.nz/wp-content/uploads/2016/05/Blockchain-Media-Release_V1-003.pdf

138   J Meaning, B Dyson, J Barker, and E Clayton. 2018. *Broadening Narrow Money: Monetary policy with a central bank digital currency.* Bank of England Working Paper 724. https://ssrn.com/abstract=3180720

139   Currency distribution, payments, monetary stability, and financial stability

140   A Wadsworth. 2018. *The pros and cons of issuing a central bank digital currency.* Reserve Bank of New Zealand Bulletin, Vol. 81, No. 7

141   www.mbie.govt.nz/info-services/business/competition-policy/retail-payment-systems

Consideration ought also be given to the innovation potential of a CBDC, beyond improving payment efficiency. A crypto-asset interoperable with smart contracts and with a stable value backed by sound monetary policy is much more than a convenient form of cash. It represents programmable money, allowing for significant innovation in financial services. Such innovation is already conjectured as GST remitted at the point of payment, legal contracts including automated financial execution, artificially intelligent agents directly transmitting funds and Internet of Things devices sending micropayments.

Programmable money represents a paradigm shift with many challenges and opportunities. It is a future that is emerging independent from the actions of central banks. Both central banks and the emerging industry could benefit from closer collaboration.

Internet of Things

There is much potential from the integration of blockchain technology and the Internet of Things. Many applications focus on supply chain integration (for example, a wireless scanner executing payment through a smart contract when it scans a parcel at the point of delivery) or on a more complex application where goods such as medicine are accepted for delivery only if the Internet of Things thermometer confirms the temperature never crossed a certain threshold.

One dynamic of Internet of Things technology is that the amount of data being produced is growing faster than the amount of bandwidth is growing. This means traditional cloud computing (where all data is sent to a central server) is being replaced by fog or mist computing where the data is hosted in a swarm of devices. Blockchain technology is very well suited to coordinating this type of swarm.

Projects such as IOTA,[142] Helium[143] and Filament[144] use blockchain technology to coordinate Internet of Things devices so the data produced is valid. The technology can also use economic incentives to coordinate the actions of multi-stakeholder networks of Internet of Things devices.

Examples of blockchain applications using Internet of Things are early stage in New Zealand. Centrality has announced partnerships with Jasmy from Japan[145] and InfiniVision from China.[146] Edmund Hillary Fellowship Fellow Samantha Jones recently secured NZD 1.2 million from the NEM Foundation to help end worker and environmental exploitation in the garment industry by building a supply chain tracking application using Internet of Things technology.[147]

142   www.iota.org/

143   www.helium.com/

144   https://filament.com/

145   S Jeong. 2018. Centrality partners with IoT company Jasmy. *Medium* (blog, 26 June).
      https://medium.com/centrality/centrality-partners-with-iot-company-jasmy-10a36446f5ee

146   S Jeong. 2018. Centrality partners with InfiniVision. *Medium* (blog, 26 June).
      https://medium.com/centrality/centrality-signs-partnership-with-infinivision-2ee51089c907

147   C Winter 2018. New app to help consumers track where, how garments are made. *Stuff* (18 July).
      www.stuff.co.nz/business/105511192/new-app-to-help-consumers-track-where-how-garments-are-made?rm=m

Mass collaboration through aligned economic incentives

One of the biggest opportunities presented by blockchain technology is the combining of software and economic incentives to structure collaboration. Blockchains can create economic games that people can freely join but become incentivised to collaborate to create value. The rules of the game are encoded in the software chosen to run, while developers act as legislators in the system, encoding the rules to reflect the wishes of the wider community.

For example, bitcoin mining can be understood as 'buy computers and waste electricity to earn digital tokens that are provably scarce'. The outcome of this particular game is a secure network for token transactions. It isn't the best game in the world, but it was sufficient to create a network valued at over 60 billion USD, launching a new industry and a general purpose technology.

One aspect of designing crypto-assets is token economics: designers decide how tokens are created, used and destroyed. Governance is a particularly rich area of exploration, because crypto-asset designers decide who has governance rights and how are they implemented. Governance is also an area where the input from politicians and public servants is of great benefit to the emerging industry.

Binance is a good example of a game optimised for financial returns. As a privately owned crypto-asset exchange, it has a simple business model: charge traders a small fee on each trade. It is a model that benefits from positive network effects, and the utility increases as more traders join the system. In July 2017, Binance launched a utility token[148] through an ICO that created

200 million tokens on the Ethereum blockchain, raising 15 million USD for the company. A trader could use the token to pay fees at a discount, starting at 50 percent in year 1 and decreasing over time to 0 percent at year 5. Each quarter, Binance destroys tokens worth 20 percent of its profit, until half of the tokens have been destroyed.[149]

This economic game incentivised traders to purchase the coin. As supply decreased each quarter, its price went through the roof: from 0.10 USD per coin to over 12 USD in July 2018, with a January 2018 peak of 24 USD. ICO investors, speculators and traders were incentivised to recruit more traders to the exchange. In less than a year, Binance became the fastest company to reach a billion-dollar valuation and one of the largest crypto-asset exchanges in the world.

While there is nothing new in financial schemes offering early adopters outrageous returns, the Binance example has important differences. The system operates with complete transparency so participants can evaluate the risks compared with the potential reward. More importantly, the instigator of the game can only change the rules if the participants agree to the changes by upgrading the software[150] at the heart of the system.

What would it look like if, instead of using company profits as the foundation for the token economics of a crypto-asset, designers chose to put measures such as water quality, carbon emissions, regional gross domestic product or recidivism rates at the heart of an economic game? New technologies applied to old ideas such as social and environmental bonds might provide powerful tools.

148 www.coinmarketcap.com/currencies/binance-coin/

149 O Dale. 2018. Beginner's guide to BNB coin: Token for the Binance cryptocurrency exchange. *Blockonomi* (1 May). www.blockonomi.com/bnb-coin

150 For standalone blockchains, this is the software that validators run. For examples such as Binance, it is the smart contracts hosted on the Ethereum blockchain.

BOX 12: CASE STUDY – TOHA COMMONS

The Toha Commons[151] is an early stage venture using distributed ledger technology to build a community owned micro-economy platform. Stakeholders will be able to use the platform to collaborate to do environmental work while generating a high value environmental data.

The team have partnered with leading philanthropists, scientists, community groups and entrepreneurs to contribute to the predator free movement. They aim to create an environmental impact market for New Zealand by "building a fast, free-flowing market for verifiable biosphere data and investment in environmental work".[152]

The project is a manifestation of the data commons blueprint,[153] a community designed framework for a principles based approach to high trust data reuse and value sharing.

Like the blockchain industry, crypto-assets for facilitating value-creating collaboration are an early stage 'social technology' with few proven examples. The possibility, however, for large-scale impact is significant and worth exploration.

Countries, governments, corporations and money are legal and social constructs that have evolved to help humans work together. Distributed ledgers and smart contracts have the potential to evolve new social constructs, which could result in transformational impacts over the coming decades.

151   www.toha.nz

152   R Oram. 2018. *Targeting predators with technology.* Newsroom (November 18).
      https://www.newsroom.co.nz/2018/11/17/323356/targeting-predators-with-technology

153   www.datacommons.org.nz

Considerations

The distributed ledger and blockchain industry is growing quickly. There is a reasonable chance that underlying technologies will cause innovations on a scale comparable to the internet, artificial intelligence and the Internet of Things. The sector could be a significant contributor to high-tech jobs and high-value exports in the country.

The research and interviews conducted in the development of this report raised a number of considerations for the private sector and government in seeking to make the most of the opportunity presented by these novel technologies. Those considerations include:

1. Convening a cross-agency blockchain working group.

2. Unblocking access to banking services for blockchain companies.

3. Promoting New Zealand as blockchain friendly.

4. Growing technology industries in regional Aotearoa New Zealand.

5. Focusing on security tokens.

6. Establishing a multidisciplinary research centre for decentralised computing.

7. Establishing a blockchain financial crime prevention forum.

8. Prioritising digital identity adoption and digital inclusion.

Convening a cross-agency blockchain working group

To stay close to the industry as it develops, the Government could consider convening a cross-agency working group. Such a group could, for example:

- keep abreast of international research and development

- engage directly and collaborate with the emerging industry

- develop the public service's understanding of the technology

- advise on opportunities for using the technology for better government services

- develop policy and recommendations for legislative change, as required.

New Zealand does not need a regulatory sandbox – the Financial Markets Conduct Act 2013 already provides the Financial Markets Authority with a mandate that allows the flexibility to innovate.

However, a working group could help government officials to build understanding through direct engagement with the private sector.

Unblocking access to banking services for blockchain companies

Blockchain companies in New Zealand find it extremely difficult to access basic banking services. Banks bear the ultimate risk for the quality of a blockchain company's anti-money laundering compliance programme.

Consideration could be give to how the Reserve Bank could support banks to provide services to blockchain companies. For example by providing safe harbour to banks that provide services to blockchain companies with an up-to-date anti-money laundering audit.

The Reserve Bank and the Financial Markets Authority could give consideration to producing guidelines to support a level of auditing appropriate to the risk exposure of individual blockchain companies, avoid blanket de-risking, and ensuring compliance costs are not onerous.

Banks and the blockchain industry should actively engage in initiatives that support New Zealand to be a world leader in blockchain financial crime prevention, using this as evidence to maintain good relationships with corresponding banks. Blockchain companies should be able to easily access the standards they need to meet in order to obtain banking services. Without access to banking services, it is likely the New Zealand blockchain industry will remain stunted despite any other interventions.

Promoting New Zealand as blockchain friendly

Existing blockchain companies moving to New Zealand will have a substantial impact on high-skill jobs and industry development. Consideration should be given to how best to attract these companies to New Zealand, including by raising awareness of the benefits of establishing a in New Zealand and promoting New Zealand's blockchain credentials.

Growing technology industries in regional Aotearoa New Zealand

Vibrant regions are crucial to Aotearoa New Zealand's future, and high-paying jobs in technology businesses could be an important component. New Zealand is already seeing growth in blockchain industries in the regions (for example EPIC Westport[154]) and consideration could be given to how best to support further growth. Strategic investments by the Provincial Growth Fund could provide one mechanism, as could supporting hubs and co-working spaces in the regions.

Focusing on security tokens

Many ICOs use utility tokens to avoid compliance with expensive securities regulations that are ill-suited for the emerging industry. In light of this the Financial Markets Authority could give consideration to creating clear guidelines for companies to launch security tokens and comply with existing regulations. At the same time, the private sector needs to consider how best to develop quality deal flow and reduce the cost of compliance through standardisation.

New Zealand is well positioned to strike a balance between consumer protection and ease of doing business. If New Zealand were to become the go-to jurisdiction for launching quality security tokens, we could see a rapid influx of capital and talent to the country. This would place New Zealand on the industry's radar very quickly.

One strategy might be to identify a high-profile, high-quality ICO to use as an example for others to follow. However we would need to move quickly – if other jurisdictions become known for security tokens first, then any benefit from New Zealand's solutions would be limited.

Establishing a multidisciplinary research centre for decentralised computing

Consideration could be given to establishing a multidisciplinary research centre with a focus on distributed ledger and blockchain technologies. Such a centre might for example have research chairs focused on technology, entrepreneurship and public policy with the flexibility to add chairs in other disciplines as opportunities arise.

Initial funding could come from both the public and private sectors, but with the aim to become self-sustaining through private funding from top tier blockchain foundations. Such a centre could be hosted by a single university or a consortium, and it should aim to attract world-leading academic talent to our country.

Establishing a blockchain financial crime prevention forum

Blockchains and crypto-assets have been widely criticised for enabling financial crime, but the technology also offers significant potential to provide solutions.

Mitigating the potential harm caused by financial crime using this technology (as well as using distributed ledgers to reduce existing financial crime such as fraud and identity theft) is a valuable niche to pursue in its own right. Doing so would further enhance New Zealand's reputation as a trusted jurisdiction, attracting quality companies to the country.

The blockchain industry needs to acknowledge the high-risk nature of the technology and actively resource solution development to help keep people safe online. Crypto-assets and public ledgers provide an opportunity for sophisticated tools and techniques that keep people safe, deterring financial crime.

There is an opportunity for New Zealand to lead the world in this area. Establishing a blockchain financial crime prevention forum could provide an initial opportunity for deeper collaborations across the public, private and academic sectors.

Prioritising digital identity adoption and digital inclusion

While digital identity is not intrinsically a blockchain technology, there is an important relation that can dramatically increase the value of blockchains and distributed ledgers. Just as New Zealand was a world leader with the adoption of EFTPOS (electronic funds transfer at point of sale), it could aim to lead the world in the adoption of digital-identity protocols.

Consideration could be given to how best to support the creation of vendor-neutral standards and implementing blockchain-friendly government system interfaces of digital identity to complement RealMe.[155] If New Zealand can lead the world in digital identity adoption, then our value proposition will increase significantly as a jurisdiction in which to test and launch distributed ledger technologies.

Many potential applications of distributed ledgers and blockchains are interesting only when a significant portion of the population is using them. Likewise, the people who have access to these emerging technologies will have a significant advantage over people who do not, which will reinforce social inequality.

Widespread digital identity adoption and digital service access for all New Zealanders would help to unlock the full potential of blockchain and distributed ledgers.

155   RealMe is a secure way to prove who you are when you are online and to log into many New Zealand government sites and services.

Conclusion – potential for innovation is significant and New Zealand could be a world leader

Blockchain and distributed ledger technologies have the potential to cause significant innovation across a large number of sectors. They can grow our direct technology exports and help ICT to become the second biggest contributor to gross domestic product by 2025. They can help our primary industries capture high-value niches and connect more directly to consumers through supply chain innovations. They are already creating impacts for startup financing and could play a role in New Zealand companies accessing growth capital.

The industry has significant potential to create high-tech jobs and digital exports, which could catalyse many other sectors. Many people spoken to in the development of this report identified unblocking access to basic banking services and developing a reasonable treatment of GST on crypto-assets as significant short-term priorities. While the considerations raised in this report focus on generating short-term impacts, the technology has significant long-term potential, particularly in light of moves towards increased digital identity uptake.

New Zealand often prides itself on being a nation of early adopters – whether it is giving women the vote, instigating eight-hour paid working days, climbing mountains or adopting electronic payments. There is much unclaimed terrain in the blockchain space: widespread use of security tokens, social bonds on the blockchain, mass digital identity adoption, and centrally banked digital currencies. New Zealand could be a world leader in this space. We have a highly educated society with a rapidly growing ICT sector. Our reputation and ability to attract talent are second to none, and our government is agile and willing to engage. But most importantly, we know how to work together.

I have had the pleasure of speaking and corresponding with many people throughout the preparation of this report. I have been continuously impressed by the approachability and willingness of many busy people to collaborate, and it reminds me why many of us choose to base ourselves in New Zealand.

It gives me hope that we can out-collaborate countries that are further ahead and use this emerging technology to create something special in Aotearoa New Zealand.

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