WENDY J RISELEY

BLOCKCHAIN - A LINK TO FUTURE LAW REFORM:

Factors for a Regulatory Framework Response to Disruptive Technologies

LAWS 526 – Law Reform and Policy
Submitted for the LLB (Honours) Degree

Faculty of Law
Victoria University of Wellington
2016

Table of Contents

I Introduction

This world is being increasingly inundated with new technologies. Some fit in and improve the existing system, while others create imbalances in the market and challenges to the present legal structure. Examples of the latter include the Model T Ford assembly line, cellular telephones and the Internet. One such emerging and potentially disruptive technology taking the technological world by storm is the blockchain, the technology underlying Bitcoin. The blockchain is a distributed ledger which allows for a decentralised system of interactions. Its nascent application, Bitcoin, allows for secure financial transactions in virtual currency between parties who do not otherwise know each other and without the need of centralised services, such as banks or Paypal. The blockchain is now being developed to work with a variety of interactions between parties, whether to create autonomous self-executing smart contracts or establish a dependable and inviolable land title registry, all without the need for intermediaries. It has vast potential to change social constructs which have traditionally relied upon third parties to act as trusted intermediaries. However, in order for this innovation to develop its full potential and not become subject to misuse, some form of regulatory response is necessary.

Traditionally there have been several ways society has thought about the relationship between law and disruptive technology (DT). One of the main criticisms of the law reform process in this area has been its inability to keep pace with technological change. Generally, the regulatory responses to emerging technologies have fallen under three scenarios: i) no changes made to the law, ii) adapting existing law to encompass the new technology or iii) creating entirely new legislation. The advent of blockchain technology, as a complex and potential super disrupter to markets, can highlight a possible new way for regulation to address issues raised by up and coming DTs.

This paper introduces DTs in Part II. Part III reviews these traditional relationships between law and DTs and evaluates whether they are a valid way of thinking in today's rapidly changing technological landscape. Through the lens of blockchain technology, this paper proposes a new way of thought. In order to do so, Part IV first takes the reader on a journey to gain an understanding of this complex and unprecedented innovation. Part V applies the traditional views to the blockchain positing these methods could have dissatisfactory consequences. Then, while a complete framework is beyond the scope of this paper, suggestions are provided in Part VI for what could be taken into account to create a regulatory scheme for the blockchain and, as such, for DTs in general.

II Disruptive Technologies

In the 1990s, Clayton Christensen began a study into why businesses were regularly failing in the wake of new technology.[1] During the course of his research, he found emerging technology divided into two subcategories: sustaining and disruptive.[2]

Sustaining technologies improve and strengthen the existing market structure, while DTs interfere with that market structure. Incremental changes are good examples of sustaining technology, such as improvements in landlines with call waiting and voicemail. These improvements do not challenge the underlying existing technology of landlines but rather extend it, making landlines "less vulnerable to challenge by competitors".[3] On the other hand, DTs consist of "fundamental changes in direction … that reflect a rethinking of the basic premises of important areas of mainstream technology".[4] Some important DTs in recent history include cellular telephones and the Internet.

Well-established companies tend to focus on sustaining technologies which support their existing products. It becomes less in their interest to spend money and energy developing innovations which will undermine what the company has already established.[5] This focus is often supported by their current mainstream clients who are looking to improve upon their own existing goods and services, rather than risking the purchase of a product which may or may not prove profitable. Some major companies will often go a step further and lobby for law change that will exclude the disrupter.[6] Unfortunately, the habit of turning away from emerging DT is what Clayton Christensen discovered to be the root cause of company failure. At some point, out of the vast number of new innovations being continually developed, one will emerge that will take hold and undermine the existing framework. For companies that have not kept up, these developments can prove fatal as existing customers leave for other businesses that can offer this new technology.

---

[1] Clayton M Christensen *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail* (Harvard Business School Press, United States, 1997).

[2] Ray Campbell "Rethinking Regulation and Innovation in the US Legal Services Market" (2012) 9 NYUJL&Bus 1 at 7.

[3] James Henderson Jr "Tort vs Technology: Accommodating Disruptive Innovation" (2015) 47 ArizStLJ 1145 at 1151.

[4] At 1151.

[5] At 1152.

[6] Alexandre de Streel and Pierre Larouche, Organisation for Economic Development and Co-operation "Disruptive Innovation and Competition Policy Enforcement - DAF/COMP/GF(2015)7" (Background note for Session III, Global Forum on Competition, 20 Oct 2015) at [11-12].

In a similar way, law makers can get blindsided by new technology which undermines the existing legal system. If not regulated in time, the new technology can create loop holes in the law that are potentially harmful to consumers or even to the economy. In a knee-jerk reaction, startled law makers may ban the technology in an effort to protect citizens.[7] However, this can create issues in competition and stifle further innovation, harming the economy.

A Exponential Growth

Historically, DTs often began as luxury items. Once the price of production was reduced to a level many could afford, then the technology was able to disrupt the market. Even at that point, it could still take some time for news to spread and for the technology to take hold.[8] The telephone, for example, invented in 1876 took 35 years to be used by a quarter of the United States population.[9] In present day, however, technology can be made more cheaply. Costs can be lowered by reducing intermediaries and scalability improvements mean "rapid access to a potentially global customer base".[10] A growing population and increased global communication has contributed to technological change increasing at "300 times the scale and with roughly 3,000 times the impact" of the Industrial Revolution.[11] Thus, in contrast to the telephone, the mobile phone invented in 1983 took 13 years to be used by 25% of Americans. While the Internet itself, invented in 1991, took only seven years.[12] Not only has the spread of technology increased exponentially but so has its complexity. In 1965, Gordon Moore, co-founder of the Intel Corporation, famously predicted the number of components in an integrated silicon circuit would double every year.[13] His prediction has rung true for many decades[14] and has become an

[7] In August 2014, Berlin banned Uber for safety reasons. "Berlin bans Uber app citing passenger safety" (14 August 2014) BBC News <www.bbc.com>; There were concerns from the public this would stifle innovation. Jeevan Vasagar "Uber banned in Berlin on passenger safety grounds" (15 August 2014) Financial Times <www.ft.com>.

[8] de Streel and Larouche, above n 6, at [7].

[9] Chartered Accountants Australia and New Zealand in collaboration with the New Zealand Institute of Economic Research "Disruptive Technologies Risks, Opportunities – Can New Zealand Make the Most of Them?" (October 2015) <www.nzier.org.nz> at 16.

[10] de Streel and Larouche, above n 6, at [7].

[11] Chartered Accountants Australia and New Zealand, above n 9, at 16.

[12] Chartered Accountants Australia and New Zealand, above n 9, at 16.

[13] Gordon E Moore "Cramming more components onto integrated circuits" (1965) 38 Electronics 114 at 115.

example of technology's expansion generally. Moreover, as a result of this exponential growth in technology, there has also been a rapid acceleration of market disruption.[15]

Innovation allows for more growth with fewer resources and in this way improves productivity.[16] Hence, if innovation has long been understood to be the foundation of economic growth and "responsible for most of the increase in material standards of living that has taken place since the industrial revolution", then disruptive innovation "which involves breakthrough ideas that restructure or create entire markets, … is especially valuable".[17] The corollary to this is DTs now more than ever warrant a careful and considered regulatory approach.

Nevertheless, before any specific regulatory response can be considered, it is important for the stage to be properly set allowing an atmosphere that encourages innovation.

B Promoting Competitive Markets

Broad empirical evidence supports the proposition that a competitive market setting is paramount to fostering innovation, productivity and growth. This is a multi-faceted approach that encompasses a reliable competition law scheme, intercepting anti-competitive conduct by incumbent firms and preventing the "power of vested interests to block necessary reforms".[18]

There are some arguments against competition. The ability to charge monopoly prices for at least a short period often attracts business acumen, encouraging risk-taking which itself allows for innovation and economic growth.[19] It has also been argued that too much

---

[14] It is only beginning to slow now. Although, new technologies are now extending beyond what can be done with silicon. See Rachel Courtland "Gordon Moore: The Man Whose Name Means Progress" (30 May 2015) IEEE Spectrum <www.spectrum.ieee.org>.

[15] de Streel and Larouche, above n 6, at [8].

[16] Jonathan Chan and Herbert Fang "Rebalancing Competition Policy to Stimulate Innovation and Sustain Growth" (Occasional paper, Singapore Competition Commission, 18 November 2015) at [9].

[17] Jeremy West, OECD Secretariat, DAF/COMP(2015)3 "Hearing on Disruptive Innovation" (Issues paper, Session 3 of 123rd meeting of OECD Competition Committee, 28 May 2015) at [1].

[18] Nick Godfrey, Investment Climate Team "Why is Competition Important for Growth and Poverty Reduction?" (Issues paper, Session 1.3 of OECD Global Forum on International Investment, 27-28 March 2008) at 3.

[19] Chan and Fang, above n 16, at [11] citing *Verizon Communications v Law Offices of Curtis V Trinko, LLP* 540 U.S. 398 (2004).

competition can result in "little room for product differentiation".[20] Notwithstanding this, there may be an optimal range for competition where the greatest amount of innovation occurs.[21] In 2015, the OECD held a *Global Forum on Competition* during which significant focus was placed on disruptive innovation and competition policies. It was contended that competition policy is generally not "well placed to deal with disruptive innovation" and new measures need to be established. One concern was, because DTs sit outside the current market, normal market analysis and definitions used in antitrust law do not work. It was also emphasised that disruptive innovations (and the actions that prevent them) move at an increasingly rapid pace and it is difficult for authorities and regulators to keep up.[22]

Notably, many DTs originate in the United States. One argument for this lies with their arguably "less restrictive regulatory environment".[23] If this is the case, then a necessary factor in regulating DTs is to ensure regulations do not overly protect incumbents, thereby discouraging disruption.[24] At times, regulations may be created to serve legitimate policy objectives but at the same time discourage entry of DTs. Law makers must recognise "if the innovation fully addresses or obviates the underlying policy concern(s) that prompted the regulation, then applying it to the disruptive entrant nonetheless may be unnecessarily harmful to competition".[25] A robust competition law scheme is essential.

Certainly incumbent firms have a large incentive to prevent disruptive innovation from taking hold. Usually DTs are brought forward by smaller firms who have little to lose. In contrast, an established incumbent can lose significantly more if the DT takes hold in the market.[26] In many cases, incumbent firms find it much easier to prevent the DT rather than to change their business plan to encompass it, which requires taking risk and precious time and resources away from the sustaining technologies. There are several ways an incumbent firm might prevent the DT from disrupting the market, including by acquiring the new small firm or by influencing policy makers to exclude the DT through

[20] Chan and Fang, above n 16, at [11].

[21] Chan and Fang, above n 16, at [12].

[22] de Streel and Larouche, above n 6, at [45].

[23] West, above n 17, at [23], citing: Alberto Heimler, "Last Taxi to Europe," Project Syndicate (15 April 2015), available at: www.project- syndicate.org/commentary/uber-eu-protest-by-alberto-heimler-2015-04.

[24] West, above n 17, at [23].

[25] At [25].

[26] de Streel and Larouche, above n 6, at [11].

regulation.[27] Just as DTs are increasing at an exponential rate, so is incumbent firm awareness of DTs. This creates another reason for a properly functioning competitive environment to ensure incumbents are not stepping in and preventing innovation in an effort to protect their own interests.

III Regulating Disruptive Technologies

Establishing conditions that encourage innovation creates the foundation. This often will need to be supported by regulatory mechanisms in order to allow growth to occur in safe and productive directions. Ignoring the value of overseeing and managing the development of technology risks a fractured and chaotic expansion. Unpredictable growth could undermine the rule of law by creating uncertainty and may even leave the door open for nefarious pursuits by criminal syndicates. Further, because of exponential advancements in technology and their ability to increasingly disrupt large markets, it is prudent to develop a mechanism by which decision makers can react to create a regulatory system that supports innovation while still protecting citizens and incumbents.

As new technologies emerge, they can bring about new relationships, previously unheard of activities and unexplored forms of conduct.[28] They can create new markets, which require adjustments to the regulatory structure in order for it to remain effective. For example, there may be some uncertainty as to whether existing laws command, prohibit or authorise new conduct created by the innovation.[29] Alternatively the new technology might make some existing law redundant or obsolete.[30] Notwithstanding the ambulatory approach to statutory interpretation, the law may prima facie exclude the new technology. Therefore, in order to properly "encourage, facilitate, regulate or prohibit new things, activities and relationships" created by the new technology[31], some form of regulatory response may be required.

A Three Scenarios of Law Reform

Broadly, three main scenarios have historically taken shape as regulatory responses to the emergence of technologies: allowing the technology to fall under current legislation with

---

[27] de Streel and Larouche, above n 6, at [11-12].

[28] Lyria Bennet Moses "Agents of Change: How the Law 'Copes' with Technological Change" (2011) 20 GriffithLRev 763 at 767.

[29] Lyria Bennet Moses "Why Have a Theory of Law and Technological Change?" (2007) 8 MinnJLSciTech 589 at 595.

[30] Moses, above n 28, at 767.

[31] At 767.

no change, the adaptation of existing legislation to the new technology and the creation of specific legislation for a particular technology. Which of these three options is ideal? Can one be chosen to cover all DTs? Notably, different types of innovation seem to gravitate to certain regulatory response scenarios.

(1) As mentioned, some technological innovations require no legislative action at all as the technology does not threaten any existing societal values or regulatory schemes. The invention of the toaster, for example, did not prompt regulatory unease. These innovations are more likely to fall under sustaining technology category, rather than disruptive.

However, when a regulatory response is needed, other scenarios emerge in an attempt to "help law 'keep up' with technological change".[32]

(2) There are many cases where existing regulatory schemes are adapted to encompass new technologies. Existing laws may need to be reworded so as to include the new technology within their scope, while still leaving room future innovation.[33] This is prevalent in medical technological advances. Regulations in Australia and many other countries altered regulations for nanotechnology "to close the gap generated by technological change".[34] DTs that are self-contained applications with similarities to present day situations but which still create a new market, may be addressed by "modifying existing regulatory frameworks".[35] If a forward-thinking approach is used in drafting the legislation, sometimes by using technology neutral wording, the "hard edges of the law can be softened" building a flexible law, which leaves room for new entrants.[36]

One example is Uber, the rideshare application. While Uber is disrupting small passenger service in particular taxi and shuttle companies, it is its own application which uses other technologies in order to function. A DT such as Uber, has enough similarities with other already regulated areas, that addressing its regulatory concerns arising can be done more efficiently by adapting existing legislation. In New Zealand, the Land Transport Amendment Bill is presently in Select Committee. This bill changes the "regulatory

[32] At 765.

[33] Moses, above n 29, at 595.

[34] Moses, above n 28, at 767.

[35] At 767.

[36] Roger Brownsword "So What Does the World Need Now? Reflections on Regulating Technologies" in Roger Brownsword and Karen Yeung (ed) *Regulating Technologies: Legal Futures, Regulatory Frames and Technological Fixes* (Hart Publishing, Portland, Oregon, 2008) 23 at 27.

framework for small passenger service", including Uber.[37] While Uber argues it is unlike taxis and hire cars and therefore should be in its own class of rideshare service, the consultation review team did not agree.[38] It felt that "[c]onstraining the type of services by separate classes … would limit the flexibility of the regulatory regime to accommodate different types of services in the future".[39]

(3) In some situations the new technology may change the market landscape and have such a unique impact it requires entirely new regulation. This newly crafted legislation will be created either to apply more broadly "beyond the immediate technological context" or in a sui generis manner, namely created specifically for one type of technology.[40] There are often criticisms these types of created laws are too rushed and are poorly designed or conceived.[41]

Nonetheless, carefully prepared, they may be the only solution for some types of innovation. Disruptive meta-technologies, for instance, may require an entirely novel regulatory landscape in order to address their unique issues. Meta-technologies are those that affect other technologies and are made up of several technologies themselves.[42] They are, essentially, the technologies upon which other technologies are built. Because they are often creating a new playing field for technology, there is usually nothing of similar legislative construct to utilise. One example of a meta-technology arguably requiring specific legislative focus was recombinant DNA technology, the biotechnology upon which genetically modified organisms were created. The United Kingdom has implemented European Union laws to address issues raised by this technology.[43] In contrast, the United States used pre-existing legislation. This has been highly criticised as resulting in a "regulatory oversight of plant agricultural biotechnology".[44]

---

[37] Land Transport Amendment Bill 2016 (173-1).

[38] Ministry of Transport *Future of small passenger service* (April 2016) at 8; See also, Brad Kitschke, Director of Public Policy - Uber "Submission to Ministry of Transport on Small Passenger Service Review Options" (18 June 2015).

[39] Ministry of Transport *Future of small passenger service* (April 2016) at 8.

[40] Moses, above n 28, at 768.

[41] At 768.

[42] William Mougayer *The Business Blockchain: Promise, Practice and Application of the Next Internet Technology* (John Wiley & Sons Inc, New Jersey, 2016) at 10.

[43] Clare Feikert-Ahalt "Restrictions on Genetically Modified Organisms: England and Wales" (March 2014) Library of Congress <www.loc.gov>.

[44] Alan McHughen and Stuart Smyth "US regulatory system for genetically modified [genetically modified organism (GMO), rDNA or transgenic] crop cultivars" (2008) 6 Plant Biotechnology Journal 2 at 2.

B Law Lag

While these scenarios may be in some circumstances beneficial to coping with the rapidly changing and varied technological landscape, it is also imperative decision makers consider the "legal dilemmas resulting from technological change within a reasonable timeframe".[45] One of the central criticisms of the relationship between technology and law is often referred to as the pacing problem or "law lag".[46] The concern is the exponential rate of technological change which many authors feel leaves law reform plodding behind like the tortoise behind the hare.[47] This description suggests an urgent need for law to find a way to 'keep up' with that exponential rate of change. In response, there is pressure to create technologically specific regulation and calls to "'future proof' legislation through technology-neutral drafting".[48]

Nonetheless, while law reform may not move at the pace of technological evolution, this does not necessarily result in such concerns as the term 'pacing problem' suggests. It ignores the fact that law reform is often not required. Technology may be in a state of constant change but much of it requires no regulatory response. There was no cry for reform when the first programmable coffee maker came on the market. The creation of disc brakes on mountain bikes could comfortably fit in with existing safety regulations. Thus, for the bulk of the exponential change, a novel regulatory response is unnecessary.

Other more disruptive innovations do indeed require a regulatory response. Even in these cases, however, the unease suggested by the 'pacing problem' label may not, in reality, be such an all-encompassing issue. It ignores the possible benefits of a wait-and-see approach to technological innovation. This point provides an ingress into a discussion regarding the clash of ex ante versus ex post regulation. Ex ante regulation can also be described as "anticipatory government intervention", while ex post would be "remedial government intervention".[49]

Those highly concerned with law lag may favour ex ante legislation as a way to ensure regulations are in place before the technology takes hold. The focus is on anticipating bad

---

[45] Moses, above n 28, at 770.

[46] Moses, above n 28; See also, Gary E Marchant, Braden R Allenby and Joseph R Heckert (eds) (2011) *The Growing Gap Between Emerging Technologies and Legal-Ethical Oversight: The Pacing Problem*, (Springer, United States, 2011).

[47] Moses, above n 28, at 763.

[48] At 765.

[49] Client Services "Ex Post v. Ex Ante Regulatory Remedies Must Consider Consumer Benefits and Costs" (14 May 2015) The American Consumer <www.theamericanconsumer.org>.

conduct and preventing problems before they even arise. That said, having measures in place beforehand may create a false sense of security. The most appropriate or efficient response will not always be for "law to 'race ahead' of technology".[50]

Acting prematurely can reduce competition and create impractical regulation. Ex ante regulation protects early initial innovators but this can obstruct "more welfare-enhancing disruption caused by subsequent innovators".[51] Subsequent innovators incentivise incumbents to improve their products and service. Without proper competition, "[t]oday's plucky innovators are tomorrow's sleepy incumbents".[52] Furthermore, allowing innovation to establish itself within the social structure may expose new regulatory issues previously unanticipated or it may reveal that anticipated concerns did not eventuate. For example, legislation during the Victorian era demanded a minimum of three people to operate a motor vehicle: one to stoke the engine, another to drive and a third to walk ahead of the vehicle holding a red flag and lantern, warning pedestrians and riders of horses of the approaching vehicle.[53] By 1896, the law was repealed.[54]

With the best of intentions, it is still notoriously difficult to protect consumers in a digital era where preferences are continuously evolving quickly and unpredictably. Often the concerns of consumers in actual fact are different from those in theory. Policy makers overly confident in their ability to predict the needs of consumers may, for instance, create regulation favouring security over convenience. Yet in reality, consumers have been found to favour the latter, often choosing a less secure app simply because it requires one less click.[55]

Conversely, ex post regulation has the ability to be more refined and targeted. The longer time a technology has to establish itself, the clearer the issues will be due to time being taken to "debate the developments that have taken place and to determine how the regulatory framework should be adjusted".[56] This is not to say legislating ex post is

---

[50] Moses, above n 28, at 770.

[51] Alex Chisholm and Nelson Jung "Platform Regulation — Ex-ante Versus Ex-post Intervention: Evolving Our Antitrust Tools and Practices to Meet the Challenges" (2015) 11 CPI 1 at 6.

[52] At 6.

[53] Don Tapscott and Alex Tapscott *Blockchain Revolution: How the technology behind Bitcoin is changing money, business and the world*" (Portfolio Penguin, United States, 2016) at 297.

[54] Daniel Patrascu "Road Traffic History - Before the Streets Got Swamped" (6 November 2009) Auto Evolution <www.autoevolution.com>; "Red Traffic Laws" Wikipedia <www.en.wikipedia.org>.

[55] Chisholm and Jung, above n 51, at 5.

[56] Brownsword, above n 36, at 27.

without its concerns. Acting too late can be significantly detrimental. The pace of technological change will not, for instance, wait a decade for the courts to resolve an issue.[57]

Accordingly, the reference to law lagging behind technology does not necessarily mean laws need to also develop at similar exponential rates to technology. Rather the need is for law to keep up with technology by "better reflect[ing] [the] current technological capacity"[58]. Regulators should establish adequate mechanisms with an aim to ensure "legal issues resulting from technological change are identified and resolved soon after they arise".[59]

The three scenarios mentioned above could be considered conventional regulatory responses to new technologies with an aim to address issues before those issues become magnified and unwieldy. That said, finding a fitting and timely scenario for a particular technology is further complicated by the ever-changing and increasingly complex technological landscape. One major example which called for a different approach in order to appropriately target emerging concerns, was the advent of the Internet or cyberspace.[60] In the initial teething years of the Internet, a number of views arose as to how it should be regulated. As will be discussed below, blockchain technology is closely intertwined with the Internet. Not only is it also a meta-technology, it has been anticipated that it will catapult the Internet into an unprecedented and remarkable next phase of decentralisation.[61] As such, some of the original postulations regarding cyberspace regulation may now shed light on a way forward.

C Is the Internet Simply a Law of the Horse?

An argument in the early years of the Internet was expounded in Frank H Easterbrook's classic article, "Cyberspace and the Law of the Horse". Easterbrook concentrated on the

---

[57] Chisholm and Jung, above n 51, at 7.

[58] Moses, above n 28, at 768.

[59] At 765.

[60] Many different definitions for the term 'cyberspace' exist. The term is not technically the same as Internet. Cyberspace can be thought of as the environment of the Internet, for example. However, colloquially the term Internet is now more frequently used. For the purposes of this paper, the two terms will be used interchangeably to mean "the Internet as a whole", including "the interconnected computers and computer networks". See "Cyberspace" Your Dictionary <www.yourdictionary.com>.

[61] Mark Taylor "Blockchain is more than the second coming of the internet" (7 June 2016) Raconteur <www.raconteur.net>.

legal education system as a foundation of the law and posited that courses in law school should be "limited to subjects that could illuminate the entire law"[62]. If law schools taught, for example, Law of the Horse, students might study cases on the sale of horses, people being kicked by horses, the licensing and racing of horses, veterinarian horse care and even cases dealing with horse show regulations. Easterbrook's contention was that this would be "sorely deficient learning".[63] Important core areas of law would barely be glanced upon. Far better for students to study law of torts, commercial law or property law and add the horse cases into that learning. Easterbrook felt Cyberspace Law was tantamount to a Law of the Horse; neither would "illuminate the entire law".[64] Property in cyberspace, for example, should be understood through property law. "Most behavio[u]r in cyberspace is easy to classify under current property principles".[65]

Analogous to law school courses are the laws themselves. Consequently, entirely new schemes may be needlessly fabricated to give the impression a new area of law exists. These can often be addressed more efficiently with existing laws. In an article directly addressing Easterbrook's Law of the Horse theory, Lawrence Lessig agreed the aim should be courses which "illuminate the entire law" and an exclusive focus on the Law of the Horse would be shallow and doomed "to miss unifying principles".[66] However, his belief diverged from Easterbrook's view that cyberspace law is merely a Law of the Horse. Lessig argued that unlike the specific concerns posed by Law of the Horse, the concerns raised by cyberspace law are general and as such, need their own law.[67] Lessig argued that the architecture of cyberspace raises "threats to values implicit in the law".[68]

D Modalities of Regulation

But what is the architecture of cyberspace and how does that play a role in determining whether a unique regulatory response is warranted? Lessig contended that a holistic view at regulation encompasses more than just considering laws in isolation. Architecture, social norms, market and laws all play roles in regulating behaviour in society.[69]

---

[62] Frank H Easterbrook "Cyberspace and the Law of the Horse" (1996) UChiLegalF 207 at 207.

[63] At 207.

[64] Lawrence Lessig "The Law of the Horse: What Cyberlaw Might Teach" (1999) 113 HarvLRev 501 at 546.

[65] Easterbrook, above n 62, at 210.

[66] At 207.

[67] Lessig, above n 64, at 502.

[68] At 546.

[69] Lawrence Lessig *Code: Version 2.0* (Basic Books, United States, 2006) at 125.

Architecture regulates behaviour by creating physical limitations through the structure of the technology. The architecture of a road will limit where a person can travel. To use the example of smoking, the architecture of a cigarette will limit a person because of a cigarette's intensely strong smell, making it noticeable and often offensive to those in the vicinity. This regulates when and where a person will feel comfortable smoking. Social norms dictate that when driving in a car, it is polite to ask people before lighting up. The market regulates smoking by determining the price of cigarettes. Finally, laws have been established regulating the purchase of cigarettes. In this case, the laws are based on the architecture of cigarettes and the continually developing norms regarding cigarette smoking.[70]

Governments use a combination of these four modalities to regulate behaviour. Though this is not to say law simply "fashions itself" to the other three constraints.[71] Each will work and provide different tools to get to the necessary result. The modalities have a dynamic interaction, with each being fine-tuned in a search for the most cost-effective way to regulate while still protecting core values. One example from Lessig compares different ways to combat the stealing of car radios. On one hand, steeper penalties in the form of fines and prison sentences can be increased. Life in prison would likely be a powerful deterrent but would undermine the core value of the punishment fitting the crime. Alternatively, governments could encourage radio manufacturers to create security codes which electronically lock the radio to that specific vehicle, rendering the stealing of them pointless.[72] Enforcing a change in the architecture of the radio by changing the codes, creates a "constraint on the radio's theft, and like the threatened punishment of life in prison, it could be effective in stopping the radio-stealing behavio[u]r".[73]

Lessig predicted the key difference in regulating behaviour online would be found in the differences between the four "modalities of constraint".[74] He believed since the main change between real space and cyberspace is in the architecture, this would "be the most pervasive agent".[75] Architecture is essentially the code underwriting the Internet itself. It is here Lessig envisaged that the "most effective way to regulate behavio[u]r in

[70] At 123.
[71] At 126.
[72] At 126.
[73] At 126.
[74] Lessig, above n 64, at 510.
[75] At 511.

cyberspace [would] be through the regulation of code".[76] However, regulating through 'code' is not without its hurdles.

This is illustrated in a prevalent example of technology "being used more and more intentionally as an instrument to regulate human behaviour",[77] namely technological prevention measures (TPMs).[78] These architectural tools are used by copyright owners to "guard or restrict the use of their material stored in digital format".[79] By placing an anti-copying measure on a DVD, for example, the legal rights of copyright law can be enforced "in ways more universal and immediately effective than most laws are".[80]

Notably, these measures can also be used to establish new rights and controls beyond the scope of the law.[81] This raises some concerns in regulating by architecture. If the software's protective capabilities go too far, they may be beyond rights of challenge in the courts.[82] The potential for software that is entirely self-regulated may go so far as to "re-institute excessive censorship in society".[83] One form of TPMs are access control TPMs which control access to a TPM work.[84] While these TPMs are beneficial in protecting "technology that operates a timed film download service",[85] they could also be used to prevent access for legitimate purposes such as law enforcement, national security or even educational purposes. An example of this in practice is the "installation of filters designed to prohibit access to materials considered 'harmful to minors'".[86] Software can prevent access to websites that provide images to child pornography but this software can

---

[76] At 513.

[77] Bert-Jaan Koops "Criteria for Normative Technology: The Acceptability of 'Code as Law' in light of Democratic and Constitutional Values" in Roger Brownsword and Karen Yeung (ed) *Regulating Technologies: Legal Futures, Regulatory Frames and Technological Fixes* (Hart Publishing, Portland, Oregon, 2008) 157 at 157.

[78] See generally, *Stevens v Kabushiki Kaisha Sony Computer Entertainment* [2005] HCA 58.

[79] "What is a technical protection measure (TPM?)" Ministry of Business, Innovation and Employment <www.mbie.govt.nz>.

[80] Michael Kirby "New Frontier: Regulating Technology by Law and 'Code'" in Roger Brownsword and Karen Yeung (ed) *Regulating Technologies: Legal Futures, Regulatory Frames and Technological Fixes* (Hart Publishing, Portland, Oregon, 2008) 367 at 377.

[81] Koops, above n 77, at 159.

[82] Kirby, above n 80, at 377.

[83] At 377.

[84] Trans-Pacific Partnership Agreement Amendment Bill, cl 226.

[85] Melina Eyre "Copyright Amendment Act Strengthens Australia' TPM Laws" (10 May 2007) iP Frontline <www.blog.ip.com>.

[86] Kirby, above n 80, at 377.

come at a cost preventing access to "lawful erotic materials or discussion about censorship itself or to websites concerned with subjects of legitimate interest, such as aspects of human sexuality, women's rights and even children's rights".[87]

Another concern which Justice Michael Kirby, in his extrajudicial contribution to *Regulating Technologies: Legal Futures, Regulatory Frames and Technological Fixes*, raises with regulation through architecture is that of retaining each nation state's values when techno-regulated content arrives from outside its borders. A great deal of this arrives from the United States where the First Amendment reigns high. Kirby J noted that "[t]he rest of the world tends to be less absolutist in this respect".[88] Free expression and free media need to be balanced against other important rights and protections, such as the right to privacy and protection of reputation.[89] Because of the prevalence of United States media, entertainment and popular culture, "what is done in that country to regulate information technology obviously has consequences world-wide".[90] Products, such as Playstation, that make their way into New Zealand from the United States may reflect the copyright laws and constitutional rights valued there. As a result, regulating by "architecture may challenge the previous assumption that, within its own borders, each nation state is entitled, and able, to enforce its own laws, reflecting its own values".[91]

A foundational aspect of creating regulation is adhering to core principles. A variety of views emerge regarding which principles are of key importance. The Better Regulation Task Force in the United Kingdom sets out 5 principles of regulation and while these were created in the context of competition laws, they can be applied generally. These are the principles of proportionality, accountability, consistency, transparency and targeting.[92] Authors Michael Trebilcock and Edward Iacobucci identify ten principles which they place into five oppositional pairs of: independence and accountability, expertise and detachment, transparency and confidentiality, efficiency and due process.[93] Another categorisation is that of dividing principles into two categories of criteria: substantive and procedural. Substantive criteria encompass human rights, such as embedding code which reflects equality, freedom of expression and privacy, and rule of law to ensure legal certainty and checks and balances. Procedural criteria includes democratic all-stakeholder

[87] At 377.
[88] At 378.
[89] At 378.
[90] At 378.
[91] At 379.
[92] Better Regulation Task Force *Principles of Good Regulation* (2003) at 1.
[93] Brownsword, above n 36, at 37.

decision making, transparency, accountability and freedom of choice, such as optional default settings in applications.[94]

While an analysis of the rationality of each of these principles is beyond the scope of this paper, the principle of 'choice' warrants further consideration. Regulating by technology's architecture versus by law has a distinct effect on the psychology of those regulated. An architectural restriction "influences how people *can* behave, while law influences how people *should* behave".[95] Because of this, regulating through architecture can sometimes preclude clear choice as to whether to adhere to the law. The capacity for choice provides the basis for a thriving and efficient "moral community".[96] To illustrate, some underground railway stations have set up waist-high automatic ticket barriers. Rather than obviating choice, making it impossible to ride the train without paying a fare, these barriers are symbolic. A person can choose to thwart the law by jumping the barrier, an act which significantly "dramatises the choice between morality and deviance".[97] Removing choice from the system weakens self-control. If people are "denied any autonomy, then they perceive that the moral responsibility lies entirely with the system, so that they no longer retain any obligations themselves".[98] Without feeling any reciprocal responsibility for the society within which they live, people will look for opportunities to outwit the system whenever possible.

The regulatory reaction then is for tighter regulation with even less choice in an attempt to address the new issues. In the era of pre-Internet, inventors adapted the machines themselves in an attempt to protect copyrights from unauthorised analogue copying on audio cassettes and photocopiers "but the eternally springing hopes were often enough dashed. Every locked door seemed to produce a hacker with a jemmy".[99] This back-and-forth game of offence and defence is exemplified more modernly in the 'technological arms race' with "increasingly ingenious circumvention being met by stronger and

---

[94] Koops, above n 77, at 167.

[95] At 159.

[96] Karen Yeung "Towards an Understanding of Regulation by Design" in Roger Brownsword and Karen Yeung (ed) *Regulating Technologies: Legal Futures, Regulatory Frames and Technological Fixes* (Hart Publishing, Portland, Oregon, 2008) 79 at 97.

[97] DJ Smith "Changing Situations and Changing People" in A von Hirsch, D Garland and A Wakefield (ed) *Ethical and Social Perspectives on Situational Crime Prevention* (Hart Publishing, Oxford, 2000) 147 at 169.

[98] Yeung, above n 96, at 99.

[99] William Cornish *Intellectual Property: Omnipresent, Distracting, Irrelevant?* (Oxford University Press, Oxford, 2004) at 54.

stronger TPMs".[100] It unfortunately focuses invention inwardly instead of moving it forward and can end up stifling progress.

E Regulating the Internet

Addressing these issues in a way that does not stymie the growth of a maturing innovation, can be further hampered by the complexity of the technology. Looking back at the Internet, it was not only elaborate from a technological point of view, it also changed the distribution of power at many societal levels. The response was to establish the Internet's design, organisation and standards through a bottom-up approach of self-regulation via the Internet's protocols, that is, its architecture, run by various governance groups.[101]

Finding a way to create some standardisation and control over such a global and decentralised network initially proved challenging. While early attempts were made by the United States government to regulate cryptography, by 1996 those laws were relaxed[102] and an understanding emerged towards a "'do no harm' approach".[103] Policy makers stepped back allowing the private sector to take the lead in regulating, agreeing that "Internet services should exist in a minimal regulatory environment that promotes investment and innovation".[104] Another aspect the United States government promoted was a global collaboration, in part by supporting the Organization for Economic Cooperation and Development and the World Trade Organisation in their efforts to adopt a "light-touch Internet regulatory regime" that promotes competition and reduces "trade barriers for information-technology goods and services".[105]

---

[100] Graeme Austin "Submission on the Trans-Pacific Partnership Agreement Amendment Bill" at [11].

[101] Jan van Dijk *The Network Society* (3rd ed, SAGE, London, 2012) at 144.

[102] See, Executive Order by William J Clinton "Administration of Export Controls on Encryption Products" (19 November 1996) 61 Federal Register of Presidential Documents 224.
See also: "W3C Activities Related to the US 'Framework for Global Electronic Commerce'" W3 <www.w3.org>.

[103] J Christopher Giancarlo "Comment: With blockchain, regulators should first do no harm" (12 April 2016) FT Trading Room <www.ft.com>.

[104] J Christopher Giancarlo, CFTC Commissioner "Regulators and the Blockchain: First, Do No Harm" (Special Address before the Depository Trust & Clearing Corporation 2016 Blockchain Symposium, Grand Hyatt, New York, USA, 29 March 2016) citing the Federal Communications Commission in In re Inquiry Concerning High-Speed Access to the Internet Over Cable and Other Facilities, GN Docket No. 00-185 (F.C.C. Mar. 15, 2002).

[105] Giancarlo, above n 104.

The Internet developed through the support of many different bodies coming together in an early version of a global solutions network (GSN). GSNs are a collaboration of "civil society, private sector, government, and individual stakeholders in non state [and web-based] networks".[106] The Internet is an example of the results achieved with a GSN. It was "curated, orchestrated, and otherwise governed by a once-unthinkable collection of individuals, civil society organisations, and corporations, with the tacit and sometimes active support of nation-states".[107] The result was a conglomeration of bodies created to address various aspects of the Internet's development by devising "centralised chokepoints" whereby governments could assert some indirect control.[108]

These multi-stakeholder groups have a common purpose of establishing global cyberspace standards in various areas. The Internet Engineering Task Force (IETF) handles the architectural development of the Internet, such as the Transmission Control Protocol/Internet Protocol (TCP/IP) standards.[109] It is geared to "making the Internet work better" and "avoids policy and business questions".[110] The International Corporation for Assigned Names and Numbers (ICANN) "decides which domain names and IP addresses can be used and registers these names worldwide".[111] And the Internet Society (ISOC) is a global organisation which "handles Internet standards, education and policy development"[112] with a mission to ensuring the Internet remains open and transparent.[113]

While there has been an increase in recent years of centralised bodies having a disproportionate amount of influence in cyberspace,[114] the key factor is no one body, whether it be government or corporation, controls the inner workings of the Internet. This has "proven that diverse stakeholders can effectively steward a global resource by inclusiveness, consensus, and transparency".[115] Due to that keen "policy foresight and initial regulatory restraint", the Internet was allowed to flourish and now transforms

---

[106] Tapscott and Tapscott, above n 53, at 283.

[107] At 283.

[108] Aaron Wright and Primavera de Filippi "Decentralised Blockchain Technology and the Rise of Lex Cryptographia" (12 Mar 2015) SSRN at 51.

[109] Jan van Dijk *The Network Society* (3rd ed, SAGE, London, 2012) at 144.

[110] "Getting started in the IETF" IETF <www.ietf.org>.

[111] Dijk, above n 101, at 144.

[112] "Internet Society (ISOC)" Techopedia <www.techopedia.com>.

[113] "Who we are" Internet Society <www.internetsociety.org>.

[114] In reference to the Internet 'Big 5': Google, Facebook, Amazon, Microsoft and Apple.

[115] Tapscott and Tapscott, above n 53, at 283.

nearly every aspect of day-to-day life.[116] The following statement by Don and Alex Tapscott, both leading authorities on innovation, sums up this point on the Internet: "That it has become a global resource in so short a time is astounding, in normal part thanks to strong leadership and governance and despite the powerful forces against it".

Hence, while the three scenarios discussed earlier have been traditional ways of reacting to new technologies, the advent of the Internet brought to light the need for another approach, one that endorsed a watchful eye without the use of legislative measures. Blockchain technology could now call for a progression on that approach. As an innovation, the blockchain has potentially far reaching applications and is being forecast to bring the world of cyberspace into a new phase of autonomy and decentralisation. It is also an unprecedented innovative construct and thus challenging to conceptualise and understand. As such, in order to better envisage what a regulatory framework might require in response to a DT like blockchain, the next section is devoted to providing an account of blockchain's historical development and an explanation of how the technology itself functions with some of its proposed applications.

IV Blockchain Technology

The early days of the Internet brought hope and excitement. It was thought it would "revolutionise the world economy"; "offer genuine privacy protection" and be "a platform for truth and trust".[117] Instead of being limited to the local newspaper for information, now there would be access to a seemingly unlimited amount of resources. An opinion could be voiced and heard across the globe. With the Internet, everyone would be "a participant, not an inert recipient".[118]

The Internet has in many ways surpassed expectation as a resource of information and brought countless opportunities for cross-border collaboration. It has become part of day to day life in many parts of the world. In New Zealand, household Internet use accounts for 91% of the population, more than double the global average and higher than most developed countries including Japan and Australia.[119] It has become a vessel for tremendous ingenuity and imagination, allowing for new technologies to be born at an exponential rate.

---

[116] Giancarlo, above n 103.

[117] Interview with Don Tapscott, CEO Tapscott Group (Rik Kirkland, McKinsey & Company, "How blockchains could change the world", May 2016) <www.mckinsey.com>.

[118] Interview with Don Tapscott, above n 117.

[119] Chartered Accountants Australia and New Zealand, above n 9, at 10.

Internet use also allows for a great deal of anonymity. People can hide behind pseudonyms and fabricate entire personas. As opposed to real space, cyberspace's unique architecture "permits users' attributes to remain invisible. So norms, or laws, that turn upon a consumer's age are more difficult to enforce in cyberspace. Law and norms are disabled by this different architecture".[120] As an example, to purchase adult material, a mere click on a button stating the user is over 18 is enough. By contrast, in real space a 10 year old child would find it difficult to pass for 18. Elaborate disguises would be complicated and often ineffective. Falsifying age or any other attribute online is a relatively simple task. Thus, the architecture of the Internet changes users' perceptions and awareness regarding who they are interacting with.

As a result, establishing and verifying information on the Internet, such as identities or financial transactions, requires third party intermediaries. These intermediaries make up a small but disproportionately powerful group of companies and governments and creates opportunities ripe for corruption and the obliteration of competition. It contributes to global wealth disparity, allows for the monetisation of personal information and erodes privacy.[121] At times, a user may not even know they are interacting with someone. In real space it is relatively easy for a person to tell when she is being followed or who is noting what purchases are made. Online this is much more difficult. Data is continually being collected about people, such as what purchases they make or what items they click on with their mouse.[122] There are very limited ways for a person to choose to protect their privacy in those instances especially as he is often unaware he is even being monitored. In early 2014, Microsoft, Facebook, Google and Yahoo disclosed that as a result of a court order, they turn data associated with tens of thousands of accounts over to the United States government every six months.[123] It has become a trade-off: personal information given in exchange for the ability to access the Internet and to interact online.

Intermediaries are a necessity outside cyberspace as well. Governments will use passports to authenticate identities and land registries are used to verify land title. However, one sanctuary free from the requirement of a trusted third party is a cash transaction. Transacting with cash does not require verification because the actual occurrence of the

---

[120] Lessig, above n 64, at 510.

[121] Ernst & Young "Big Data Backlash" EY Building a Better World <www.ey.com>.

[122] Lessig, above n 64, at 505.

[123] Spencer Ackerman and Dominic Rushe "Microsoft, Facebook, Google and Yahoo release US surveillance requests" (3 February 2014) The Guardian <www.theguardian.com>.

transaction is both immediately visible and verifiable to all parties. Electronic payment online does not enjoy the same luxury. Banks or even Paypal are essential to ensure money is not double spent. These third parties play an important role in protecting the transacting parties and the economy as a whole by ensuring this type of fraud does not occur. However, financial institutions are not infallible. Not only can they be hacked but the 2008 global financial crisis (GFC) exposed the sheer frailty of the entire global financial industry. While the Internet has brought about an encouraging democratisation of information, the online experience has proven to come with great personal costs to privacy and security.

Auspiciously, in the year following the GFC, a mysterious person or persons, writing under the name, Satoshi Nakamoto, pseudonymously released a white paper and source code into the open source community.[124] That code outlined a new protocol which would allow people to transfer electronic cash securely and anonymously without the need for an intermediary. The protocol was called Bitcoin. Nakamoto made a few clarifying posts online and then disappeared from sight but developers took the protocol and put it into action.

Immediately, cryptographers and the technologically curious took notice. Soon small services saw potential, as is often the case with a disruptive innovation. These services arose in the form of exchange start-ups which converted money into Bitcoin (BTC). One of these was Mt Gox, a Bitcoin exchange that began in 2011. By 2013 it was handling 70% of all Bitcoin transactions.[125] As word spread of Bitcoin's unique features of anonymity, transaction speed (money could be transferred within minutes instead of days) and security, interest in the virtual currency grew from all areas. Unfortunately, one of those areas was an underground of illegal activity.[126] The most famous example of Bitcoin's dark web is Silk Road. This was an online blackmarket created and run by Robert Ulbricht, which sold illegal drugs in exchange for Bitcoin.[127] It gained extensive media attention and was shut down by the FBI in October 2013.[128] Subsequently, Mt Gox

[124] Satoshi Nakamoto "Bitcoin: A Peer-to-Peer Electronic Cash System" (2009) <www.bitcoin.org>.

[125] Paul Vigna "5 Things About Mt Gox's Crisis" *Wall Street Journal* (United States, 25 February 2014).

[126] The Silk Road and Mt Gox sagas are the most well-known. See generally, Lawrence Trautman "Virtual Currencies; Bitcoin & What Now After Liberty Reserve, Silk Road, and Mt. Gox?" 20 RichJL&Tech 13 (2014).

[127] Benjamin Weiser "Man Behind Silk Road Website Is Convicted on All Counts" *New York Times* (New York, 4 February 2015).

[128] Christopher Ingraham "How the FBI just made the world a more dangerous place by shutting down Silkroad 2.0 and a bunch of online drug markets" The Washington Post (United States, 6 November 2014).

claimed insolvency after nearly $480 million USD worth of Bitcoin belonging to customers had been stolen from the exchange.[129] Bitcoin had garnered an infamous name for itself, its value plummeted and economists predicted the life cycle of virtual currency had come to an end.[130]

However, Bitcoin's predicted demise did not eventuate. In fact, not only did Bitcoin recover but has since seen a steady climb in value. Now, nine years after its birth, there are nearly 16 million BTC in circulation,[131] which amounts on today's exchange rate to over $9 billion USD.[132] Each day the world sees in the neighbourhood of 200,000 Bitcoin transactions.[133] Why, after all the negative drama has Bitcoin survived and prospered?

Ulbricht was caught by the FBI and prosecuted. A federal jury found him guilty of seven felony charges.[134] The FBI proved they could "break the screen of anonymity afforded" by the bitcoin network.[135] As more criminals were caught and more trials took place, a critical detail was highlighted: any hacking and misuse had occurred in the centralised exchanges sitting at the outer edges of the Bitcoin world.[136] Once inside, the technology underlying Bitcoin had proven to be reliable, unhackable and immutable.[137] And now, this technology is being forecast to disrupt the world in unprecedented ways, reaching far beyond virtual currencies by creating decentralised systems to support and secure potentially anything requiring authentication or signature.[138] The technology is a distributed universal digital ledger and has piqued the interest of individuals,

---

[129] Kim Nillson "The missing MtGox bitcoins" (19 April 2015) WizSec Bitcoin Security Specialists <www.blog.wizsec.jp>; Carter Dougherty and Grace Huang "Mt. Gox Seeks Bankruptcy After $480 Million Bitcoin Loss" (1 March 2014) Bloomberg Technology <www.bloomberg.com>.

[130] Ian Johnston "Bitcoin voted one of 2014's worst investments as value plummets" (24 December 2014) Independent <www.independent.co.uk>; Andy Greenberg "Bitcoin's Price Plummets As Mt. Gox Goes Dark, With Massive Hack Rumored" Forbes <www.forbes.com>.

[131] "Bitcoins in Circulation" chart (6 August 2016) Blockchain Info <www.blockchain.info>.

[132] "Market Capitalization" chart (6 August 2016) Blockchain Info <www.blockchain.info>.

[133] "Confirmed Transactions per Day" chart (6 August 2016) Blockchain Info <www.blockchain.info>.

[134] Nicole Hong "Silk Road Creator Found Guilty of Cybercrimes" *Wall Street Journal* (United States, 4 February 2015).

[135] Joon Ian Wong "Dark Markets Grow Bigger and Bolder in Year Since Silk Road Bust" (6 October 2014) Coindesk <www.coindesk.com>.

[136] Mark Pascall "Blockchains, Smart Contracts and Ethereum for Dummies (an introduction)" video online <www.ethereum.nz> at approximately 6 minutes.

[137] At approximately 6 minutes.

[138] Michael Milnes "Blockchain: A Tech Trend for Business Lawyers in 2016" (15 December 2015) Linked in <www.linkedin.com>.

corporations, banks and even governments around the world. It is called the blockchain, also known as distributed ledger technology (DLT).[139]

Bitcoin, as the first application to use blockchain technology, has highlighted characteristics of the technology which indicate there is incredible potential to "transform capital markets".[140] The technology provides efficiency through disintermediation. Instead of relying on settlement and registration systems, transactions are automated, increasing speed. Buyers and sellers can deal directly with each other reducing cost by eliminating third party intermediaries.

Potential applications of blockchain technology go much further than finance and include making email safer, protecting artists from losing sales profits to music labels and distributors such as iTunes and Spotify, and securing personal data. Every day blockchain technology gains more ground and its possibilities seem limited only by human imagination. Fran Strajnar, co-founder and CEO of Brave New Coin, at New Zealand's recent blockchain conference, gave an idea of its scope: "If there is an industry that has more than two parties involved, there's a company out there disrupting it with blockchain technology or at least thinking they're going to".[141] Blockchain technology has been heralded as the "most disruptive invention since the Internet itself".[142] For the world, 2016 to the blockchain is like 1992 to the Internet. If developed carefully and conscientiously, this technology has the potential to change nearly every aspect of people's lives and, with the rate at which it is developing, that future is very close at hand.

A How Does the Blockchain Work?

In order to understand why the blockchain carries such potential, an understanding of how the technology functions is called for. The technology, however, is notoriously

---

[139] Many stakeholders are now preferring to use the term distributed ledger technology (DLT). However, this paper will retain use of the term blockchain technology in order to not confuse the DLT acronym with that of disruptive technologies (DT).

[140] Greg Medcraft, Chairman of Australian Securities and Investments Commission "The future of capital markets in a digital economy" (Distinguished speaker series, Carnegie Mellon University, Adelaide, Australia, 16 September 2015).

[141] Fran Strajnar "Beyond Blockchains: Enterprise Solution Designs" EthereumNZ <www.ethereum.nz> at approximately 1:50 minutes.

[142] Martin Hiesboeck "Blockchain is the most disruptive invention since the Internet itself - not just in finance" (6 April 2016) Digital Doughnut <www.digital doughnut.com>.

complicated and conceptually unlike anything seen before. As such, a full detailed explanation is beyond the scope of this paper. What follows is a high-level overview.

The blockchain can best be understood through its inceptive app, Bitcoin. Bitcoin has more in common with cash than with electronic payments.[143] It does not require a trusted third party to verify the transaction has taken place.[144] With traditional virtual channels, exchange of money requires an intermediary to prevent double spending. Double spending occurs when someone sends out money or makes a purchase using money they have already spent.[145] Usually double spending is prevented by clearing the transaction through central databases, such as Visa, Paypal or ANZ.[146] Consequently, in any transaction, parties need to be certain of a number of issues:

(1) The sender really has the initial amount of money he or she claims to have,
(2) [T]he sender really sends that amount of money, that is, the amount is actually removed from the sender's possession,
(3) [T]he sender sends the amount exactly once to exactly one other person in one transaction,
(4) [T]he amount is really credited to the recipient, in the right amount, and only once.[147]

Nakamoto's Bitcoin technology found a way to be certain of those issues without having to bring in a trusted third party, like a financial institution.[148] It works by publicly broadcasting any potential transactions and allowing a community to determine which are valid. These two components working together create an open and decentralised system.

1 The distributed ledger

The blockchain is similar to a traditional ledger used to record details of data, such as transactions. Each block on the blockchain is like a page of transactions from that ledger book. As each block is created it is linked to the previous block, creating a chain, hence the name *blockchain*. The key feature of the blockchain is that the information on this ledger is shared.[149] It is distributed among a number of people each receiving their own

[143] Mark Waldport "Distributed Ledger Technology: beyond blockchain" (United Kingdom Government Office for Science, Report by UK Government Chief Scientific Advisor, December 2015) at 5.

[144] Nikolei M Kaplanov "Nerdy Money: Bitcoin, the Private Digital Currency, and the Case Against its Regulation" (2013) 25 LoyConsumerLRev 111 at 116.

[145] Joshua J Doguet "The Nature of the Form: Legal and Regulatory Issues Surrounding the Bitcoin Digital Currency System" (2013) 73 LaLRev 1119 at 1128.

[146] Tapscott and Tapscott, above n 53.

[147] Carola F Berger "Bitcoin Part 1 – Byzantine Generals and Pseudonyms or: What is Bitcoin?" (4 June 2015) CFB Scientific Translations & Consulting <www.cfbtranslations.com>.

[148] Nakamoto, above n 124, at 1.

[149] Joshua A T Fairfield "Bitproperty" (2015) 88 SCalLRev 805 at 808.

identical copy.[150] Whenever the ledger is updated, it is automatically updated on every other ledger within minutes, even seconds.[151]

2 How are blocks created?

When a person spends Bitcoin, he is initially only sending out a proposal to the Bitcoin network to spend that money.[152] The Bitcoin network is a community of many active computers (called nodes). These nodes use a software program, or 'client', to connect to each other. The network responds to the proposal by the nodes competing to verify that transaction.[153] Because it would be inefficient to do the process by single transactions, the transactions are lumped together into a block and verified that way. Once a block of transactions is verified, it is linked to the previously solved block. All Bitcoin transactions that have ever occurred are recorded on this chain and can be traced back to the genesis block, the first ever Bitcoin transaction.[154]

The verification process has been described as voting but is more like a maths competition. The nodes, using a great deal of computing power, compete to solve a complex mathematical problem that has been attached to that block of transaction proposals.[155] When one of the nodes claims to solve the problem, they broadcast the answer to the network who verify if the solution is correct. The problems are designed to be very difficult to solve but very easy to verify.[156] If the proposed answer is determined to be correct by at least 51% of the nodes in the network, then that block of proposals becomes a true block and the proposed transactions are executed, locking them onto the chain of blocks before.[157]

3 What is the incentive to verify a block?

The incentive for the public to use their computers as nodes in the Bitcoin network is the earning of Bitcoins. These earnings come from two sources. Whenever a transaction proposal is placed on a tentative block a transaction fee is attached.[158] In addition, each

---

[150] With Bitcoin this 'number of people' is in the thousands of computers.

[151] Carola F Berger "Bitcoin Part 2 – Bitcoin Mining" (22 June 2015) CFB Scientific Translations & Consulting <www.cfbtranslations.com>.

[152] Berger, above n 151.

[153] Berger, above n 151.

[154] Tapscott and Tapscott, above n 53, at 35.

[155] Berger, above n 151.

[156] Tapscott and Tapscott, above n 53, at 31.

[157] Berger, above n 151.

[158] Nikolei M Kaplanov "Nerdy Money: Bitcoin, the Private Digital Currency, and the Case Against its Regulation" (2013) 25 LoyConsumerLRev 111 at 121.

block comes with newly minted Bitcoin (BTC). Once the solution is confirmed, the winning node collects the transaction fee and newly minted BTC. (Nodes that solve a block are called miners as they are essentially *mining* for new BTC.)

Satoshi wanted to address the issue of inflation and so the amount of newly minted BTC entering the system is halved every four years,[159] until the final halving in 2140, capping the total BTC at 21 million.[160] As the amount of newly minted BTC attached to a block lessens, the transaction fees increase, until eventually entire earnings for miners will be from transaction fees.[161]

4 The 10 minute block

The amount of computing power is continuously being changed algorithmically in reaction to the speed the mathematical problems are being solved.[162] The maths problem is complex enough that it takes approximately 10 minutes to complete. If the nodes begin to solve the problems faster, the algorithms adapt and become more complex. This is intentional. A faster process means less power is used and the blockchain could become more vulnerable.[163]

5 Honesty on the blockchain

The incentive and computing power help keep the system honest because rather than someone using the vast computing power to hack the block and all the blocks before it in order to be able to double spend, it is much more profitable to use that energy for solving the blocks and earning Bitcoin.[164] Another way the blockchain could be attacked would be if one person or group of people could gather together enough computing power to create a 51% majority (called a 51% attack).[165] At the moment there is no computer on Earth powerful enough to do so. The energy requirements to run Bitcoin have been estimated to be "comparable to the electricity usage of Ireland".[166] If Google, for example, decided to turn off all of its data and focus all the power generated by its 10 million or so servers, it would still only represent less than one per cent of the mining

---

[159] Tapscott and Tapscott, above n 53, at 36.

[160] Tapscott and Tapscott, above n 53, at 36, at 256.

[161] Nakamoto, above n 124, at 4.

[162] Interview with Don Tapscott, above n 117.

[163] Though new blockchains are being created all the time for other applications, which are faster and still secure.

[164] Nakamoto, above n 124, at 4.

[165] Berger, above n 151.

[166] Waldport, above n 143, at 5.

power used by the Bitcoin network.[167] A hacker "would have to commit fraud in the light of the most powerful computing resource in the world, not just for that ten-minute block but for the entire history of commerce, on a distributed platform".[168]

6 Anonymity on a public ledger

Another way Bitcoin is like cash is the feature of anonymity. How can there be anonymity when everything is put on a public ledger? While all the transactions are publicised, the person behind the transaction is kept private. Like a double lock on a security box, the public has a key to unlock and see the proposed transaction information. The person spending the Bitcoin has a private key. This means they have control over certain aspects of the transaction they want to keep private (for example, personal information of parties involved).[169]

The above process unearths several core principles inherent in the creation of a blockchain. First, integrity and accountability are encoded into the technology through its structure and process. By being decentralised, no one person is trusted. The system is designed to make it more worthwhile to act honestly than to behave without integrity.[170] With blockchain technology, value is an incentive: "Satoshi programmed the source code so that, no matter how selfishly people acted, their actions would benefit the system overall and accrue to their reputations, however they chose to identify themselves".[171] Further, the technology distributes power among users. As such, it eliminates the situation whereby a central authority could shut a system down or censor material. Finally, this distribution also creates security, as there is "no single point of failure".[172] These principles have intrigued developers to find a way to expand the technology to encompass more than just Bitcoin's basic transactions.

---

[167] "Bitcoin is 100 times More Powerful than Google" (20 April 2015) CryptoCoinNews <www.cryptocoinsnews.com>.

[168] Interview with Don Tapscott, above n 117.

[169] Carola F Berger "Bitcoin Part 3 – Hashes, Public Key Cryptography "For Dummies" and the Block chain" (22 June 2015) CFB Scientific Translations & Consulting <www.cfbtranslations.com>.

[170] Tapscott and Tapscott, above n 53, at 30.

[171] At 36.

[172] At 38.

B The Next App of the Blockchain: Smart Contracts

At a conference in Wellington New Zealand,[173] Mark Pascall, Ethereum.nz organiser, explained the next stage of the blockchain. He noted, while the Bitcoin blockchain stores transaction information, a blockchain has the capability to store any kind of data, including instructions.[174] If, for example, Alice would like to send Bob some Bitcoin but Alice and Bob agree they would like two other people to authorise the exchange and they also would like the transaction to occur only between the hours of 9 and 10 pm on a Sunday, then all of this information could be put onto the blockchain.[175] Those terms and conditions are immutable. They cannot be hacked nor even changed by the parties.[176] They have been cryptographically locked into the system.[177] This is what has become known as a 'smart contract' and it will automatically execute when the conditions have been met.[178]

The concept of a 'smart contract' goes back to the 1990s, when Nick Szabo published an article detailing the premise.[179] At the time, there was no technology that could support his ideas. However, in 2014, 19 year old Canadian Russian, Vitalik Buterin, thought there could be a way to adapt the blockchain technology that supported Bitcoin to handle the more complex sets of data found in contracts. He wrote a white paper and co-founded a company by the name of Ethereum to create an entirely new blockchain for smart contracts.[180] Ethereum's blockchain went live at the end of 2015. With some fine-tuning by March 2016, the world saw for the "first time in human history … a way to create complex transactions between untrusted parties … without an intermediary".[181]

Pascall provided more of a sense how the blockchain for smart contracts works through the example of an auction.[182] If Alice wanted to sell her home by auction on the blockchain, she could design the parameters or have a lawyer do so. She would publicise

---

[173] Ethereum Mini-Conference "The Blockchain – Disrupting Global Commerce" (May 2016) Wellington and Auckland, New Zealand <www.ethereum.nz>.

[174] Pascall, above n 136, at approximately 10 minutes.

[175] At approximately 10 minutes.

[176] At approximately 5:30 minutes.

[177] At approximately 5:30 minutes.

[178] At approximately 10:40 minutes.

[179] Nick Szabo "The Idea of Smart Contracts" (1997) Nick Szabo <www.szabo.best.vwh.net>.

[180] Morgen Peck "The Uncanny Mind That Built Ethereum" (14 June 2016) Backchannel <www.backchannel.com>.

[181] At approximately 14:40 minutes.

[182] At approximately 16:20 minutes.

the parameters of the auction and pay some Ether (ETH) to run it.[183] This acts as a transaction fee for the miners. Possibly Alice might email the link to some potential buyers. If Bob decides he likes this home and wants to purchase it, he can bid on it. The contract will take his ETH and hold it.[184] If at the end of the auction, no one has bid higher, then Alice will get Bob's ETH and Bob will get Alice's home. If Charles comes along and bids higher than Bob, the contract will take Charles' ETH and return Bob's.[185] Incidentally, blockchains could also exist in the future for land title registry. In that case, the self-executing smart contract would automatically update the title of the land to Bob's name on the land transfer blockchain.

Because smart contracts formalise legal provisions into source code, the parties are free from the uncertainty of ambiguous language and unreliable contractual performance, allowing for a more efficient structure to their relationship.[186] While, for the time being, there may still be a need to back up a smart contract in legal writing in order to make it judicially enforceable, this application of the blockchain has been heralded as "one of the first truly disruptive technological advancements to the practice of law since the invention of the printing press".[187] The role for lawyers may shift away from a focus on specific performance, since the performance and enforcement of the contracts is self-executing and not reliant on the honesty of the parties or the need for intermediary intervention. The focus may instead shift to working with smart contract programmers to ensure the correct parameters for standardised contracts have been implemented into code.[188]

C Potential uses of Smart Contracts

As it can apply to any data or information, smart contracts have seemingly boundless implementation possibilities. The ability for financial transactions to be made on incremental scales opens up the world of transactions to the bank-less. Consider a day labourer in California who wants to send money home to his family in Guatemala. Because the amounts being sent home are too small for debit and credit cards, banks do

[183] Ethereum is funded with Ether, which has the trading name ETH. This is similar to Bitcoin (BTC) on the Bitcoin blockchain.

[184] Pascall, above n 136, at approximately 18:20 minutes.

[185] At approximately 19:00 minutes.

[186] Wright and de Filippi, above n 108, at 11.

[187] At 10.

[188] James Greenland "Ethereum, blockchain, and smart contracts – the future of law?" (5 May 2016) New Zealand Law Society <www.lawsociety.org>.

not serve these circumstances.[189] The labourer will "cash his pay check at a money mart for a 4% fee", then go to the "convenience store to wire it home … where he gets dinged again on flat fees, exchange rates, and other hidden costs".[190] Virtual currencies can enable micropayment transactions to anyone internationally. Smart contracts could even leverage micropayment potential to allow employers to pay employees in real time (that is, daily or even hourly) with taxes remitted.[191]

That same micropayment ability could solve issues for artists, who could be paid royalties in real time without going through recording labels.[192] They could track and control the use of their work through the blockchain without the need for intermediaries such as iTunes or Spotify.[193] This could even create a situation where artists encourage the remixing and reuse of their work. The more their creations are being used by the public, the more compensation they would be receiving.[194] A company called Verisart uses the blockchain to "confer digital provenance to any physical work".[195] They are building a worldwide ledger for museum pieces, private artwork, and collectibles which would allow anyone to check on the authenticity of a piece, its history and condition from their mobile phones. If there is an auction, they can bid on it using blockchain technology. Seller and buyer identities can stay private while authenticity of the piece is ensured and sale is conducted on a smart contract so it will actually play out.[196]

Even the placement of a website such as Wikipedia onto the blockchain could provide users with "small sums for writing, removing spam or fact-checking a page".[197] The micropayments could be garnered from sponsors or editors who contribute funds to an escrow account. Each editor's account could be linked to their reputation. Attempting to

---

[189] Carmen Nobel "Mobile Banking for the Unbanked" (13 June 2011) Harvard Business School Working Knowledge <www.hbswk.hbs.edu>.

[190] Wright and de Filippi, above n 108, at 30.

[190] Tapscott and Tapscott, above n 53, at 56.

[191] Wright and de Filippi, above n 108, at 12; see BitWage <www.bitwage.com>, an international wages and client management tool using the blockchain.

[192] Wright and de Filippi, above n 108, at 12; George Howard "'Bitcoin For Rock Stars' A Year Later: An Update From D.A. Wallach On Blockchain And the Arts Part 1" (25 September 2015) Forbes <www.forbes.com>.

[193] Interview with Don Tapscott, above n 117; See also Imogen Heap's release of her single "Tiny Human" on an Ethereum blockchain built by Consensys: https://consensys.net/static/UjoRelease.pdf.

[194] Wright and de Filippi, above n 108, at 30.

[195] Tapscott and Tapscott, above n 53, at 131.

[196] Verisart <www.verisart.com>.

[197] Wright and de Filippi, above n 108, at 31.

corrupt an article would result in a decline in that editor's account funds. The idea being that on one hand, defacing the blockchain Wikipedia would hurt not only one's reputation but also his pocketbook, while on the other, micropayments create incentives to participate.[198] The transparency of the blockchain and constant verification by hundreds or even thousands of participants also promotes higher quality of participation and hinders censorship.

Because smart contracts are able to manage data on the blockchain from a variety of distinct and unrelated sources, the blockchain is the necessary foundational tool to enable the Internet of Things to become a reality. The Internet of Things is the machine-to-machine communication through "billions of networked Internet-enabled devices".[199] It allows for inanimate objects to be "equipped with the ability to transfer data - without human or computer input".[200] Notably, not all the devices can be trusted and machines can be virally infected and malicious. By using blockchain technology, tangible property can be registered and then controlled over the Internet or by other machines, turning it into 'smart property'. "A blockchain can store the relationship between Internet-enabled machines at any given moment, and smart contracts can allocate corresponding rights and obligations of connected devices".[201] Using private cryptographically encoded keys, items could be secured so they can only be used by designated people. An example could be a rental property which only unlocks for the person who has made a rental payment. The idea being that "your near-field communication-enabled smartphone can sign a message with your public key as proof of payment and the smart lock will open for you".[202] Continual research is being done in this area. IBM, for example, has now "demoed a working prototype of a washing machine that orders its own detergent using the smart contracting applications of distributed ledger technology".[203]

---

[198] Tapscott and Tapscott, above n 53, at 131.

[199] Wright and de Filippi, above n 108, at 15; see also IBM: "The Rise of Blockchain" (20 November 2015) PaymentsNZ <www.paymentsnz.co.nz>.

[200] Chartered Accountants Australia and New Zealand, above n 9, at 19.

[201] Wright and de Filippi, above n 108, at 15.

[202] Tapscott and Tapscott, above n 53, at 117.

[203] Carla Reyes "Moving Beyond Bitcoin to an Endogenous Theory of Decentralised Ledger Technology Regulation: An Initial Proposal" (2016) 61 VillLRev 191 at 201, citing Aaron Wright and Primavera de Filippi "Decentralised Blockchain Technology and the Rise of Lex Cryptographia" (12 Mar 2015) SSRN (footnote 71); Eena Pureswaran and Paul Brody "Device Democracy: Saving the Future of the Internet of Things" (2015) IBM Institute for Business Value.

D Disruptive Apps of the Future: Decentralised Organisations

One of the most radical applications of the blockchain being looked at to date are decentralised organisations and decentralised autonomous organisations (DAOs).[204] Decentralised organisations are "the execution and interconnection of a variety of smart contracts that interact with one another in a decentrali[s]ed and distributed manner".[205] Binding together multiple smart contracts to create decentralised organisations means the blockchain can be used to replicate corporate governance models by distributing the decision making powers amongst people (and even machines). This "prevents the execution of an action until multiple parties agree to a transaction".[206] Rather than authority in an organisation being top-heavy, it becomes distributed amongst shareholders who can "participate in decision-making through decentrali[s]ed voting".[207] This encourages transparency, may reduce or eliminate instances of corruption and could address issues of abuse by concentrated powers.

In New Zealand, Uber has recently launched a Christchurch branch using unlicensed drivers and uncertified vehicles in direct violation of national laws. Under s29A of the Land Transport Act 1998, drivers of passenger service vehicles must hold a passenger endorsement on their license.[208] This ensures the driver is a "fit and proper person" according to the Transport Agency, has a valid licence and a current medical certificate.[209] Their vehicles must also meet the requirements for a commercial vehicle's Certificate of Fitness. Up until March 2016, Uber required these in compliance with the legislation.[210] In March, it announced these would no longer be necessary and, in addition, costs for rides would be cut by 20 per cent. This move indicates the power sitting within these mammoth organisations. If all 300 drivers in Christchurch were each fined $1000 and Uber paid those drivers for their fines, as they have in other countries, it still would hardly create a drop in the ocean of Uber's financial success of $60 billion USD.[211] But while the fines may be paid, passenger endorsement infringements can

---

[204] DAOs are also called Distributed Autonomous Corporations (DACs).

[205] Wright and de Filippi, above n 108, at 15.

[206] Wright and de Filippi, above n 108, at 16.

[207] Wright and de Filippi, above n 108, at 16.

[208] Land Transport Act 1998, s 29A.

[209] New Zealand Transport Agency "P endorsements for carrying passengers" (April 2016) Factsheet 42 NZTA <www.nzta.govt.nz>.

[210] Andy Knackstedt "Transport Agency clarifying passenger transport rules for Uber drivers" (29 April 2016) New Zealand Transport Agency: National Office.

[211] John McCrone "Uber's liquid ride: why it's ignoring NZ laws" (2 July 2016) The Press <www.stuff.co.nz>.

prevent drivers from being able to drive passenger service vehicles in the future.[212] Unfortunately, many of the Uber drivers are immigrants with limited employment options. Since March, they may now be lured to the job because of the ease to become a qualified Uber driver. This previously took a number of months at a cost of $2000 and now can be accomplished in one week for $20.[213] Furthermore, those who were already driving for Uber as of March found themselves facing a 20 per cent cut to their income with no advance warning.[214] This blatant disregard for national transport legislation, employment rights and even arguably human rights, gives rise to search for a new answer. The advent of the blockchain has potential to bring such immense power under control if regulated carefully.

One method of doing so could be through the DAOs mentioned above. DAOs are "both autonomous (in the sense that, after they have been deployed on the blockchain, they no longer need nor heed their creators) and self-sufficient (in the sense that they can accumulate capital, such as digital currencies or physical assets)".[215] If a DAO were created to replace a centralised transportation service such as Uber, one company would not create the program. Instead, individual developers would each create the interface, payment system, GPS, etc. These would come together in the DAO. As new developers come in and create an improved program, the DAO transportation system would switch over, upgrading to the new program automatically. The users and developers would be connected through smart contracts whereby, "each of these programs would be building toward a whole that could be far cheaper than existing "ride-sharing" services".[216] Without the power all in one basket, the conscious act of dismissing legal edicts and personal rights would be far-fetched. Societal morality would be better placed to bestow checks and balances.

Some have concerns reminiscent of science fiction's dystopia that "[a]n ill-intentioned decentrali[s]ed autonomous organization … could be akin to a biological virus or an uncontrollable force of nature".[217] However, others, recognising "the fact that a DAO still

---

[212] New Zealand Transport Agency "Driving without a licence" NZTA <www.nzta.govt.nz>.

[213] Jo Moir "Uber could be banned if it doesn't comply with the law: Transport minister" (9 August 2016) Stuff <www.stuff.co.nz>.

[214] John McCrone "Uber's liquid ride: why it's ignoring NZ laws" (2 July 2016) The Press <www.stuff.co.nz>.

[215] Wright and de Filippi, above n 108, at 17.

[216] DJ Pangburn "The Humans Who Dream of Companies That Won't Need Us" (19 June 2015) Fast Company <www.fastcompany.com>.

[217] Wright and de Filippi, above n 108, at 17.

requires humans to develop its various … parts", feel this is unlikely.[218] Rather more concerning is the missing human element when doing security checks on users and drivers. The "presence and identity" of someone who is ensuring the safety behind a service is not easily replaced by machine.[219] Further concerns in this area are addressed in the next section.

The applications envisaged by blockchain developers are seemingly limitless in their potential to disrupt present day societal constructs. They also bring challenges unique to the DT sector and suggest a new approach is necessary in order to protect the development both of the technology and the society with which it interacts.

V Regulating Blockchain Technology

A number of technical challenges still face blockchain innovation in its development, including scaling the technology for a worldwide market, inaccessibility to the average person as it is not yet user-friendly and that the energy consumed is unsustainable.[220] Nonetheless, for the purposes of this paper, the challenges of market risks and regulatory concerns are more pressing.

A Market Risks and Regulatory Challenges of Blockchains

1 Illegal activity

While the criminals behind the Silk Road saga were apprehended and prosecuted, illegal activity on the blockchain is adapting. DAOs could be used to create marketplaces for the trade of illegal goods. While the users might be able to be traced, the system could not be shut down because it is located on and executed by thousands of different computers simultaneously.[221]

Digital currencies could become grand tax havens.[222] Users are not anonymous but they are pseudo-anonymous. Tracing addresses to owners is difficult. "A party seeking to avoid taxes could set-up multiple digital currency accounts and transfer funds between these accounts with ease".[223] In addition, there are continuously evolving anonymising

[218] Pangburn, above n 216.

[219] Pangburn, above n 216.

[220] Tapscott and Tapscott, above n 53, at 253-259.

[221] Wright and de Filippi, above n 108, at 21.

[222] "The Rise of Blockchain" (20 November 2015) PaymentsNZ <www.paymentsnz.co.nz>.

[223] Wright and de Filippi, above n 108, at 21.

software which can frustrate the regulatory measures designed around Know Your Customer and Anti-Money Laundering rules.[224]

2 Difficult to regulate

It is much more difficult for governments to control and regulate. Decentralising currency, if it were to become widespread, would mean monetary policies used by governments to control recession and depression, could no longer be used. It is possible if left unregulated, widespread use of digital currency could lead to "continual waves of severe recessions and depressions".[225]

The blockchain can make it more difficult for enforcement agencies and governments to detect criminals. Because blockchain makes encrypted communication easier, surveillance by governments and corporations could be eradicated on the blockchain. However, in getting rid of unwanted monitoring, legitimate scrutiny is also vanquished. This could create a breeding ground for the coordination of criminal activity.[226] Furthermore, because blockchain technology allows for innovative advances without an intermediary, governments have no specific entity to point their regulation towards. Without fear of being monitored, criminal activity can be fostered "and an entirely new chapter of cyberwarfare and cybercrime may emerge".[227]

3 Accountability

Blockchain technology allows for more integrated cross-border transactions because computers attached to the chain are located all over the world. If each transaction on the blockchain were to come "under the legislative umbrella of wherever a node exists", then the blockchain technology would "need to be compliant with a potentially unwieldy number of legal and regulatory regimes".[228] In the case of fraud, the location of the fraudulent act could have occurred simultaneously in several different jurisdictions.[229]

---

[224] At 22. NB: Know Your Customer rules refer "to the requirement for banks and other financial institutions to monitor, audit, collect, and analyze relevant information about their customers (or potential customers) before engaging in financial business with them". Genci Bilali "Know Your Customer-or Not" (2012) 43 UTolLRev 319 at 319; Anti-money laundering rules place "heightened requirements on banks, broker-dealers, and other depository institutions to identify and verify account holders for anyone opening an account at [a] financial institution". Wright and de Filippi, above n 108, at 22 footnote 96.

[225] Wright and de Filippi, above n 108, at 20.

[226] At 22.

[227] At 24.

[228] Gregory Brandman and Samuel Thampapillai "Blockchain – Considering the Regulatory Horizon" (7 July 2016) <www.law.ox.ac.uk>.

[229] Brandman and Thampapillai, above n 228.

As noted above, decentralised organisations pose some particular regulatory challenges. By being deployed on the blockchain, they are trans-national creating the question of which jurisdiction governs. However, greater regulatory challenges are raised by DAOs. These organisations are not owned by any single entity and still they interact with the public in ways which "might give rise to specific rights and obligations".[230] This takes the issue of accountability one step further than with decentralised organisations. Rather than which jurisdiction should prevail, the question is who can be held liable when an organisation runs itself autonomously.

There are a few possibilities, though each comes with its drawbacks:

In the "nearest person theory", the creators of a DAO would be held "jointly liable for any foreseeable damages it might cause under product liability law".[231] However, the creators cannot always be identified. A DAO could be developed by hundreds or even "thousands of anonymous individuals, or even other [DAOs]".[232]

The users of a DAO could be held vicariously liable if they were in some way controlling and receiving "direct or indirect financial benefit from the [DAO]'s operation".[233] This creates issues in causation as there would be an injustice in holding "a user liable for a third party's actions, which the user did not know, or did not have a good reasons to believe could potentially cause harm to someone".[234]

The DAO itself could be held liable. These measures would need to be "specifically encoded into the contract or the organizational structure of the [DAO]".[235] The difficulty of externally shutting down or holding a DAO liable, would change the balance between law and architecture. If DAOs become very attractive to consumers, then unless governments use coercive measures (or ones that violate fundamental rights and freedoms such as privacy and expression) against the consumers using the DAOs, they may find exclusively regulating by law has no effect. DAOs run by no particular entity cannot be held liable in traditional ways. This further supports the need for a vigilant monitoring of

---

[230] Wright and de Filippi, above n 108, at 54.

[231] At 55.

[232] At 55.

[233] At 55.

[234] At 55.

[235] At 55.

the four modalities, specifically the architecture, and their interdependence with blockchain technology.

4 Governance

At the moment there are numerous voices putting out thoughts regarding a way forward for blockchain. There is "recklessness and chaos and calamity" with little structure and leadership. Blockchain and digital currencies have been compared to the "Wild West" of the online world.[236] The Internet saw a "sophisticated governance ecosystem" established early on.[237] That same diligent guidance and focus is vital for developing a blockchain best practice. Potentially, the government could play a stronger leadership role in providing a structure towards blockchain governance with an aim to ensure the standards created are in line internationally.

5 Standardisation

The present enthusiasm and fervour surrounding blockchain technology is also contributing to a wide range of quality in its development. Without common standards, it will be difficult to "create uniform technology and network protocols that would enable multiple networks to interface meaningfully with each other".[238] Creating common standards would require collaboration on a global level.

6 Redundancy of existing law

Blockchain technology has the potential to alter the merit that some areas of law carry. Because it does not require intermediaries, areas of law based on providing trust may be of less importance. The way humans interact with contracts will change. Smart contracts can automate increasingly complex agreements which are "virtually irreversible and demonstrably justifiable".[239] Because they self-execute the need for specific performance and possible equitable remedies, will be less necessary than the need for a lawyer who can help ensure the smart contract is coded correctly.[240] Certain commercial law state provisions may need to be updated, such as the United States Uniform Commercial Code or New Zealand's Personal Property Securities Act 1999, in order "to accommodate securities transactions on a smart contract".[241]

---

[236] Interview with Don Tapscott, above n 117.

[237] Interview with Don Tapscott, above n 117.

[238] Brandman and Thampapillai, above n 228.

[239] Joe Dewey and Shawn Amuial "Blockchain Technology Will Transform the Practice of Law" (25 June 2015) Bloomberg Law Big Law Business <www.bol.bna.com>.

[240] Dewey and Amuial, above n 239.

[241] Institute of International Finance "Getting Smart: Contracts on the Blockchain" (May 2016) IIF at 9.

B Blockchain and the Three Scenarios of Law Reform

These unique challenges indicate some legislation will be necessary. In contrast, the Internet did not require its own legislation. It grew on the collaborative framework put in place by GSNs. A "multistakeholder network worked for the Internet, but … there will be a greater role for regulation of blockchain technologies".[242] This is because the blockchain "democratises value and cuts to the core of traditional industries"[243] by not requiring trust between parties and distributing power (even away from any humans at all, as with DAOs).

In considering how one would support the regulation of the blockchain architecture with statute, the three scenarios discussed above are important. As with recombinant DNA technology of the early 1980s, the blockchain is a nascent meta-technology. There is no fore runner with an established regulatory scheme where the language can be broadened to also harness blockchain technology. Moreover, this is not an example of a sustaining technology which is so innocuous it can improve convenience in living but requires no legislative action. The blockchain is simply not a toaster. Thus, the final option may be to build an entirely new piece of legislation created solely for blockchains.

Notwithstanding this as a possibility, simply creating new legislation in the traditional manner could result in ineffective or even detrimental laws. Traditional views on the relationship between law and DTs could allow for legislation which overpowers the technology and impedes or displaces its basic pillar of decentralisation. Given the issues stated above, such as accountability and standardisation, any legislation developed needs to primarily concern itself with shoring up the integrity of the technology and protecting its evolution so the principles of incentivised value, security and distribution of power can flourish.

Timing is one vital consideration. It is common for people to "overestimate the effect of a technology in the short run and underestimate the effect in the long run".[244] In this case, the technology is still developing. As seen above with decentralised organisations, new

---

[242] Tapscott and Tapscott, above n 53, at 299; see also: Don Tapscott and Louis St Amour "The Remarkable Internet Governance Network - Part 1", Global Solutions Networks Program, Martin Prosperity Institute, University of Toronto, 2014.

[243] Tapscott and Tapscott, above n 53, at 299.

[244] Pangburn, above n 216.

applications are being imagined and put into motion every day and with them new issues and concerns.

Regulating too early risks over-regulating or regulating improperly by focusing on the wrong issues. As noted, this could have the unfortunate consequence of thwarting the growth of blockchain technology and its unique and remarkable opportunities for free expression and a free exchange of ideas. Leaving it too late or not regulating at all could allow for the newly developing decentralised system to be overrun with illicit activity. The only option for governments at that point could be to resort to draconian measure to regain control. Those measures also risk violating fundamental rights, "such as privacy and freedom of expression".[245]

C International Responses to the Blockchain

The blockchain will be facing similar challenges to the 1990's Internet with its trans-national and decentralised characteristics. Research into blockchain technology thus far indicated the Internet governance model may be a "good template".[246] This technology, however, promises to take the democratisation of information introduced by the Internet to a new level, which will require greater measures to "ensure that consumers and citizens are protected".

Internationally, a consensus is forming which recognises early regulation could stifle this innovation and cause a chilling effect on the core freedoms it reinforces. Many different regulators are coming together to develop mechanisms by which to regulate blockchains and their applications.

On 26 April 2016, European Parliament's Committee on Economic and Monetary Affairs voted to adopt a virtual currencies and blockchain report. The Commission at the same time has been looking into updating the Anti-Money Laundering Directive with a purpose of widening its scope to include virtual currency platforms.[247] While the main focus of the report is virtual currency applications built on top of the blockchain platform, it also calls for a smart regulatory approach to blockchains in general.

---

[245] Wright and de Filippi, above n 108, at 55

[246] Tapscott and Tapscott, above n 53, at 299.

[247] European Digital Currency & Blockchain Technology Forum "MEPs pass virtual currencies and blockchain report" (26 April 2016) EDCAB <www.edcab.eu>.

The report proposes a taskforce to provide the "necessary technical and regulatory expertise to support the relevant public actors"[248] and warns against a "heavy-handed approach".[249] The focus of the taskforce is to monitor applications built upon blockchains and to "identify standards for best practice", recommending appropriate and proportionate regulatory measures and "addressing potentially arising consumer protection issues and systemic challenges".[250] Consistent with concerns around regulating DTs in general, the report favoured "precautionary monitoring instead of pre-emptive regulation". More specifically it calls for the taskforce to be supported in its endeavour with an adequate budget and staffed with a diverse group of both regulators and technical experts. And as with all DTs, this does not mean a passive inattentiveness. The rapid changes to technology as it grows and modifies require vigilance so any necessary and applicable regulation can be put in place at the right time.

The United Kingdom's Financial Conduct Authority (FCA) supports a 'do no harm' approach as it "continues to monitor the development of this technology but is yet to take a stance until its application is clearer".[251] The FCA is working with firms to develop solutions to blockchain issues around consumer protection. There is a continuing motif of following a "coordinated and informed approach".[252]

The Australian Securities and Investment Commission (ASIC) and the International Organisation of Securities Commission (IOSCO) likewise call for measures which focus on "harnessing the opportunities and the broader economic benefits – not standing in the way of innovation and development".[253] ASIC has responded with measures which include:

> (1) Educating investors and financial consumers in "understanding the opportunities and the risks of participating in the digital economy".[254]

---

[248] Jakob Von Weizsäcker, Committee on Economic and Monetary Affairs "Draft Report on virtual currencies (2016/2007(INI))" (23 February 2016) at 7.

[249] European Digital Currency & Blockchain Technology Forum, above n 247.

[250] Von Weizsäcker, above n 248, at 7.

[251] Christopher Woolard, FCA Director of Strategy and Competition "UK FinTech: Regulating for innovation" (FinTech Week 2016, UK FinTech: Regulating for innovation, London, 22 February 2016).

[252] Woolard, above n 251.

[253] Greg Medcraft, Chairman of Australian Securities and Investments Commission "The future of capital markets in a digital economy" (Distinguished speaker series, Carnegie Mellon University, Adelaide, Australia, 16 September 2015) at 6.

[254] At 6.

> (2) Guidance in cyber resilience and creation of an "Innovation Hub" designed to make it easier for start-ups and finch businesses to "navigate the regulatory system".[255]
>
> (3) Surveillance with blockchain requires knowledge and understanding to clarify "how blockchain security might be compromised", "who should be accountable for the services that make the blockchain technology work", and "how transactions using blockchain can be reported to and used by the relevant regulator".[256]
>
> (4) Addressing the challenge of enforcement by establishing an understanding of "how regulatory action can be taken where a transaction entered into here or overseas is recorded in the blockchain".[257]
>
> (5) Providing knowledgeable policy advice to ensure the most applicable regulation is put in place at the appropriate time.[258]

IOSCO's focus has been more on the multilateral aspect of regulation development. Priorities include international policy and strengthening cooperation through a Multilateral Memorandum of Understanding, which "enables 105 regulators to share information".[259] Both ASIC and IOSCO stress rules created around blockchain technology must be globally consistent.[260]

The forethought and considered approach of these international entities is heartening. It speaks to the global communities' recognition of the delicacy needed in using regulation to aid the development of blockchain technology. By adapting the Internet's multi-stakeholder approach to the blockchain, it could eventually create a mixture of regulation and governance "where transparency and public participation are valued … as a complement to the existing [legislative] systems".[261] Thus as is being done in the United Kingdom and Australia, creating an initial taskforce in New Zealand to monitor the blockchain's development would be in step with global practice, namely creating taskforces to monitor, seek a global standardisation for blockchain technologies and create any necessary regulatory responses.

---

[255] At 6.

[256] At 7.

[257] At 7.

[258] At 7.

[259] At 8.

[260] At 7.

[261] Tapscott and Tapscott, above n 53, at 297.

One aspect of concern is that while these regulators, and also writers around the globe, are advocating for some form of cautioned blockchain technology regulation, they are approaching the discussion with a narrow concentration on the blockchain's financial data applications[262]. With little regard to the blockchain's potentially innumerable other applications, this risks ignoring the vast potential issues which may arise in the varied applications far beyond the financial sector.

In some ways this progression is not surprising. Blockchain technology has come into the limelight only after years in the wings. Its original role was a supportive and foundational behind-the-scenes one while Bitcoin took flight. During that fledgling phase, the United States was at the forefront of regulatory responses which focused predominantly on virtual currencies, in particular Bitcoin.[263] In 2013, the United States Senate was holding hearings on virtual currencies.[264] The following year, the Internal Revenue Service clarified that for tax purposes Bitcoin would be treated as property rather than currency.[265] As seen from the above, this focus has been continued in other jurisdictions.

D Suggestions for Regulating Blockchain

A narrow focus on regulatory responses to blockchain technology accentuates the debate between ex ante and ex post regulation. This arguably creates a lacuna in the present blockchain technology regulatory landscape. With only virtual currency regulation as the closest regime to rely on, the consequence for new applications on the blockchain may be that they become "subject to payments laws that are ill-suited to the issues presented by the technology".[266]

New entrants are in this way, hampered "for fear of triggering one or more known or unknown regulatory priorities by introducing a new and innovative application of the

---

[262] See for example, Francesca Sales "Congress questions blockchain security amid ransomware news" (18 March 2016) Tech Target Serach CIO <www.serchcio.techtarget.com>; Andreas Guadamuz and Chris Marsden "Blockchains and Bitcoin: Regulatory Responses to cryptocurrencies" (7 December 2015) First Monday Peer-Reviewed Journal on the Internet <www.firstmonday.org>.

[263] Kyle Torpey "The United States Is Falling Behind in Bitcoin Regulation" (25 April 2016) Bitcoin Magazine <www.bitcoinmagazine.com>.

[264] Timothy Lee "This Senate hearing is a Bitcoin lovefest" (18 November 2013) The Washington Post <www.washingtonpost.com>.

[265] Carter Dougherty and Richard Rubin "Bitcoin Is Property Not Currency in Tax System, IRS Says" (25 March 2014) Bloomberg Technology <www.bloomberg.com>.

[266] Reyes, above n 203, at 211.

underlying technology".[267] In this sense, using ex ante regulation to jump ahead and regulate virtual currencies has created a gap for the underlying technology. There is some urgency to filling that gap and preventing a true law lag in the area of blockchains to develop as "the level of decentralization in the ecosystem is only expected to grow".[268]

The Internet had a similar hurdle to cross. The TCP/IP, which enable the Internet, empower "numerous financial applications that are regulated".[269] The TCP/IP, however, requires a different approach and is "not regulated as a financial instrument".[270] Likewise, it may be that at the present moment the predominant uses for blockchain technology are virtual currencies but this is not set to last. While Bitcoin itself may require regulation, some structure and plan of action should be put in place to give blockchain technologies a distinct recognition and to protect them from being subsumed into virtual currency regulation. Thus, recognition between the platform itself versus the applications which run upon it, is crucial to bear in mind while establishing a regulatory framework.

Applying Lessig's regulatory modalities to the blockchain may be helpful. Using the architecture of the blockchain could maintain necessary constraints with the least amount of risk of chilling the freedoms the blockchain proposes. By embedding laws directly into code or using laws indirectly to "shape social norms, structure markets, and influence architectural design", governments could incentivise proper development of blockchains.[271] And because the blockchain is transparent, governments cannot act covertly. Transparency in law-making is essential. Supporting the proposed architecture with statute may be the best way to regulate an evolving and intensely disruptive innovation such as the blockchain.

VI Applying Blockchain Regulation to DTs in General

While the blockchain is quite evidently a very unique innovation with potentially far reaching applications into almost any area of life, it is also a good technology for understanding how decision makers can create a methodology for regulating disruptive

---

[267] At 211.

[268] At 221.

[269] Jerry Brito "Brookings Institution: Like the early internet, blockchain tech deserves a careful, light touch from regulators" (13 January 2015) Coin Center <www.coincenter.org>, citing Sheel Tyle and Mohit Kaushal "The Blockchain: What It Is and Why It Matters" (13 January 2015) Brookings Institution <www.brookings.edu>.

[270] Brito, above n 269, citing Sheel Tyle and Mohit Kaushal "The Blockchain: What It Is and Why It Matters" (13 January 2015) Brookings Institution <www.brookings.edu>.

[271] Wright and de Filippi, above n 108, at 56.

innovations. The complexity of blockchain technology and the speed at which it is developing corresponds to the current development of DTs in general. The pace of change is exponential, the quantity of people exposed to the technology is ballooning and the complexity of the various innovations is intensifying.

Exploring the possible implications of regulating blockchain technology indicates the conventional way of looking at the relationship between technology and the law could be inefficient or even detrimental. Previous technologies presented relatively straightforward issues. The pre-Internet era of copyright law essentially consisted of adapting to "new forms of creation (e.g. cinema) and, more importantly, of new ways to disseminate copyrighted works (radio, then television broadcasting, cable, satellite)" and extending the rights in copyright law through analogy.[272] While there was some law lag and some challenges, there was no pressing need to reformulate the way regulators responded to technologies then because technology was developing at a slower rate. To address this new world of DTs, regulators need to have a different understanding of what the relationship between law and technology needs to achieve.

A Five Factors for a Framework

Internationally, work is already being done to prepare for a smoother transition into a more decentralised world. The common themes raised can equally be applied to DTs generally. From across the globe, there is a call for collaboration from a variety of stakeholders, for robust competitive markets and for a cautious, watchful, considered approach to any potential legislation. There is also increased understanding that utilising a variety of resources when regulating may be a more efficient way to manage technological concerns. Further, there is heightened awareness that many DTs now affect the world as a whole. These assorted realisations can be consolidated to constitute five essential factors necessary in developing a regulatory framework response to modern DTs.

1 First Factor: Collaboration

The New Zealand Institute of Economic Research (NZIER) believes New Zealand is "well placed to adjust to disruptive technologies" due to its relatively light regulation, comparatively low deficit, resilience as shown during the GFC, and an overall more

[272] Phillip Louis Landolt *Collective Management of Copyright and Related Rights* (Kluwer Law International, The Netherlands, 2006) at 11.

youthful population than in other OECD member countries.[273] NZIER has called for the development of a regulatory framework which would create a positive innovative environment. Increasing knowledge is a vital starting point. By investing in research and development programmes, it would allow for an educated and collaborative basis from which to consider the regulatory needs of technological advancements.[274]

With the increase in complexity of innovations today, a multilateral approach in order to be able to get a full picture of issues raised is sound reasoning. Judge Richard Posner voices concern this "age of breakneck technological change … will thrust many difficult technical and scientific issues on judges, for which very few of them … are prepared".[275] In the same vein, Kirby J has observed that the courts are "experts without a great deal of expertise".[276] This could also be said of the parliamentary and executive branches. To be able to develop appropriate regulatory measures, an in-depth understanding of the technology is needed so its variety of potential disruptions can be appreciated.

As such, a collusion of experts in diverse areas, including law, business, politics, science and technology would allow a compilation of expertise. Decision makers would then be better placed in creating appropriate and proportionate legislation if or when the time comes. It would "ensure, notably that regulators are forewarned but also, as experience is gathered, that regulators are forearmed".[277] The technology regulation question is not one that can be answered by any one group. As Kirby J has said, "There are no real experts on the subject of regulating technologies".[278]

2 Second Factor: Robust Competitive Markets

Greater understanding through a collaboration of stakeholders, academics and regulators is one crucial foundational basis from which to find a proper balance in DT regulation. Another important factor is a robust competitive market. Regulatory concerns regarding DTs include the protection of citizens, protection of established incumbents, flexibility

---

[273] Chartered Accountants Australia and New Zealand, above n 9, at 9.

[274] At 14.

[275] Richard A Posner "The Role of the Judge in the Twenty-First Century" (2006) 86 BULRev 1049 at 1049.

[276] Brownsword, above n 36, at 23, citing Michael Kirby "New Frontier: Regulating Technology by Law and 'Code'" in Roger Brownsword and Karen Yeung (ed) Regulating Technologies: Legal Futures, Regulatory Frames and Technological Fixes (Hart Publishing, Portland, Oregon, 2008) 367 at 373.

[277] Brownsword, above n 36, at 23.

[278] Kirby, above n 80, at 373.

and promoting competition, thereby protecting disruptors.[279] Striking a proper balance with a look to future as yet uncontemplated innovations should be paramount in planning any regulatory response.

3 Third Factor: Do No Harm

Generally, ex ante legislation has not been heralded as a preferred approach to regulating DTs. Anticipating issues in a technology that is still developing can be problematic and consequently, inefficient. An issue that the discussion around blockchain has highlighted is the possible risk of ex ante regulation centering attention on one popular application of an underlying technology. The focus of decision makers, task forces and collaborators generally on the virtual currency application of blockchain technology is worrisome. Ensuring regulatory responses to virtual currency are kept distinct from the underlying blockchain technology can help prevent upcoming non-virtual currency applications from being subsumed under inappropriate legislation. Applying this to DTs in general, regulatory responses to applications of an underlying technology must be proportionate to the technology as it develops. They must recognise that further developments of that underlying DT may not fall under a current regulatory landscape simply because it uses the same underlying technology.

The 'Do No Harm' approach used during the Internet's initial growth and now suggested for the blockchain can similarly be applied to DTs in general. This approach does not condone passivity, which would risk opening the door to unstable development and rampant illegal activity. An emphasis on actively monitoring a DTs growth in the market should be a centrepoint of any collaborative efforts. The United Kingdom Royal Society and the Royal Academy of Engineering has suggested:

> [T]he Chief Scientific Advisor should establish a group that bring together the representatives of a wide range of stakeholders to look at new and emerging technologies and identify at the earliest possible stage areas where potential health, safety, environmental, social, ethical and regulatory issues may arise and advise on how these might be addressed.[280]

The measures ASIC is taking during the blockchain's developmental stage may be equally helpful with many DTs. These include educating the wider sector on the technology, setting up 'hubs' to help businesses navigate any regulatory scheme

---

[279] OECD "Disruptive innovations and their effect on competition" (June 2015) OECD Directorate for Financial and Enterprise Affairs <www.oecd.org>.

[280] The Royal Society and the Royal Academy of Engineering "Nanoscience and Nanotechnologies: Opportunities and Uncertainties" RS Policy document 19/04 (London, Royal Society, 2004) at [9.7].

established, surveillance of the technology and its emerging issues, addressing any potential global regulatory conflicts and providing sound policy advice as to a way forward.

4 Fourth Factor: Modalities

Often some legislation will be needed with a DT, whether it is new legislation entirely or adapting existing legislation. But legislating alone can be rigid when working with an ever changing landscape. Law lag may not be the all-encompassing issue authors make it out to be, since much technology is already addressed by present regulation. However, "in the regulation of technology, events rarely, if ever, stand still".[281] Thus, the nature of DTs, such as the Internet and blockchain, calls for proportionate regulatory responses which are awake to different methods of regulating.

Using a combination of the other modalities mentioned in this paper, can create a holistic, flexible and more efficient way to regulate. Exploring the various modalities has highlighted that modifying the architecture of a technology may be most suitable for the blockchain. This could become the case for many DTs. Adapting the programming code upon which the technology is built would likely be faster than passing legislation and could ensure regulatory needs are met in a timely manner.

In some cases, like the blockchain, eventually supporting the architectural regulation with statute will allow legislation to "bind to the technology and … evolve with it".[282] This could ensure consistency and prevent issues which may arise from too much self-regulation. It could also ensure pre-determined global standards are met.[283] Once again, this could only be done with the aid of multiple stakeholders who have expertise in coding and other aspects of a technology's architecture.

5 Fifth Factor: Global Awareness

Another factor highlighted by the blockchain is the transnational aspect of DTs today. Because the blockchain is decentralised, it knows no borders. Other DTs may not be so decentralised but they are still spreading across the globe faster than they ever have before. This will make global collaborative efforts crucial. The GSNs developed in the early days of the Internet could likewise be advantageous in creating global standards in many DTs, especially for meta-technologies that have cross border applications. In

---

[281] Kirby, above n 80, at 370.

[282] Brownsword, above n 36, at 27.

[283] See 'Fifth Factor' below.

addition, aligning any state measures with international standards may be helpful in creating a more seamless integration which supports new innovative entrants while still protecting incumbents and the public.

VII Conclusion

Blockchain technology provides hope and excitement for a world more evenly distributed in its wealth and power. It has vast potential to disrupt nearly every market where trust is required between parties, and promises to be the missing link between what the Internet is and what it was intended to be. It is also complex and developing very quickly as it gathers attention around the globe. While the blockchain raises these attributes to a new level, in some form these are characteristics of many modern day DTs. As such, factors relevant in a regulatory response to the blockchain will be useful for many DTs.

The varying landscape of modern day DTs generates a need for new ways of thinking about the relationship between law reform and technology. If a systematic framework is developed which allows for collaboration between differing expertise and differing global viewpoints and if a robust competitive market is supported, innovation has greater potential to flourish. Furthermore, an atmosphere of cooperation will inform decision makers to develop flexible, regulatory frameworks for the increasingly diverse and prolific disruptive innovations. Overall, a holistic approach will better provide a holistic regulatory response and will support an enterprising and innovative future.

VIII Bibliography

A Cases

Stevens v Kabushiki Kaisha Sony Computer Entertainment [2005] HCA 58.

B Legislation

Executive Order by William J Clinton "Administration of Export Controls on Encryption Products" (19 November 1996) 61 Federal Register of Presidential Documents 224 (US).

Land Transport Act 1998, s 29A.

Land Transport Amendment Bill 2016 (173-1).

Trans-Pacific Partnership Agreement Amendment Bill, cl 226.

C Books and Chapters of Books

Roger Brownsword "So What Does the World Need Now? Reflections on Regulating Technologies" in Roger Brownsword and Karen Yeung (ed) *Regulating Technologies: Legal Futures, Regulatory Frames and Technological Fixes* (Hart Publishing, Portland, Oregon, 2008) 23

Clayton M Christensen *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail* (Harvard Business School Press, United States, 1997).

William Cornish *Intellectual Property: Omnipresent, Distracting, Irrelevant?* (Oxford University Press, Oxford, 2004).

Jan van Dijk *The Network Society* (3rd ed, SAGE, London, 2012).

Michael Kirby "New Frontier: Regulating Technology by Law and 'Code'" in Roger Brownsword and Karen Yeung (ed) *Regulating Technologies: Legal Futures, Regulatory Frames and Technological Fixes* (Hart Publishing, Portland, Oregon, 2008) 367.

Bert-Jaan Koops "Criteria for Normative Technology: The Acceptability of 'Code as Law' in light of Democratic and Constitutional Values" in Roger Brownsword and Karen Yeung (ed) *Regulating Technologies: Legal Futures, Regulatory Frames and Technological Fixes* (Hart Publishing, Portland, Oregon, 2008) 157.

Phillip Louis Landolt *Collective Management of Copyright and Related Rights* (Kluwer Law International, The Netherlands, 2006).

Lawrence Lessig *Code: Version 2.0* (Basic Books, United States, 2006).

Gary E Marchant, Braden R Allenby and Joseph R Heckert (eds) (2011) *The Growing Gap Between Emerging Technologies and Legal-Ethical Oversight: The Pacing Problem*, (Springer, United States, 2011).

William Mougayer *The Business Blockchain: Promise, Practice and Application of the Next Internet Technology* (John Wiley & Sons Inc, New Jersey, 2016).

DJ Smith "Changing Situations and Changing People" in A von Hirsch, D Garland and A Wakefield (ed) *Ethical and Social Perspectives on Situational Crime Prevention* (Hart Publishing, Oxford, 2000) 147.

Don Tapscott and Alex Tapscott *Blockchain Revolution: How the technology behind Bitcoin is changing money, business and the world* (Portfolio Penguin, United States, 2016).

Karen Yeung "Towards an Understanding of Regulation by Design" in Roger Brownsword and Karen Yeung (ed) *Regulating Technologies: Legal Futures, Regulatory Frames and Technological Fixes* (Hart Publishing, Portland, Oregon, 2008) 79.

D Journal Articles

Ray Campbell "Rethinking Regulation and Innovation in the US Legal Services Market" (2012) 9 NYUJL&Bus 1.

Alex Chisholm and Nelson Jung "Platform Regulation — Ex-ante Versus Ex-post Intervention: Evolving Our Antitrust Tools and Practices to Meet the Challenges" (2015) 11 CPI 1.

Joshua J Doguet "The Nature of the Form: Legal and Regulatory Issues Surrounding the Bitcoin Digital Currency System" (2013) 73 LaLRev 1119.

Frank H Easterbrook "Cyberspace and the Law of the Horse" (1996) UChiLegalF 207.

Joshua A T Fairfield "Bitproperty" (2015) 88 SCalLRev 805.

James Henderson Jr "Tort vs Technology: Accommodating Disruptive Innovation" (2015) 47 ArizStLJ 1145.

Nikolei M Kaplanov "Nerdy Money: Bitcoin, the Private Digital Currency, and the Case Against its Regulation" (2013) 25 LoyConsumerLRev 111.

Leslie Lamport, Robert Shostak, and Marshall Pease "The Byzantine Generals Problem" (1982) 4 ACM Transactions on Programming Language and Systems 382.

Lawrence Lessig "The Law of the Horse: What Cyberlaw Might Teach" (1999) 113 HarvLRev 501.

Alan McHughen and Stuart Smyth "US regulatory system for genetically modified [genetically modified organism (GMO), rDNA or transgenic] crop cultivars" (2008) 6 Plant Biotechnology Journal 2.

Gordon E Moore "Cramming more components onto integrated circuits" (1965) 38 Electronics 114 at 115.

Lyria Bennet Moses "Agents of Change: How the Law 'Copes' with Technological Change" (2011) 20 GriffithLRev 763.

Lyria Bennet Moses "Why Have a Theory of Law and Technological Change?" (2007) 8 MinnJLSciTech 589.

Richard A Posner "The Role of the Judge in the Twenty-First Century" (2006) 86 BULRev 1049.

Carla Reyes "Moving Beyond Bitcoin to an Endogenous Theory of Decentralised Ledger Technology Regulation: An Initial Proposal" (2016) 61 VillLRev 191.

Lawrence Trautman "Virtual Currencies; Bitcoin & What Now After Liberty Reserve, Silk Road, and Mt. Gox?" 20 RichJL&Tech 13 (2014).

Aaron Wright and Primavera de Filippi "Decentralised Blockchain Technology and the Rise of Lex Cryptographia" (12 Mar 2015) SSRN.

E Reports

Better Regulation Task Force *Principles of Good Regulation* (2003).

Gregory Brandman and Samuel Thampapillai "Blockchain – Considering the Regulatory Horizon" (7 July 2016) <www.law.ox.ac.uk>.

Kevin Buehler, Daniele Chiarella, Helmut Heidegger, Matthieu Lemerle, Akash Lal, Jared Moon "Beyond the Hype: Blockchains in Capital Markets" (December 2015) Global Corporate & Investment Banking Practice - McKinsey Working Papers on Corporate & Investment Banking No 12.

Chartered Accountants Australia and New Zealand in collaboration with the New Zealand Institute of Economic Research "Disruptive Technologies Risks, Opportunities – Can New Zealand Make the Most of Them?" (October 2015) <www.nzier.org.nz>.

Alexandre de Streel and Pierre Larouche, Organisation for Economic Development and Co-operation "Disruptive Innovation and Competition Policy Enforcement - DAF/COMP/GF(2015)7" (Background note for Session III, Global Forum on Competition, 20 Oct 2015).

Clare Feikert-Ahalt "Restrictions on Genetically Modified Organisms: England and Wales" (March 2014) Library of Congress <www.loc.gov>.

James Mancini, OECD Competition Division "Protecting and Promoting Competition in Response to 'Disruptive' Innovation in Legal Services – DAF/COMP/WP2(2106)1" (Issue Paper at 61st Meeting of OECD Working Party No2 on Competition and Regulation, 13 June 2016).

Ministry of Transport *Future of small passenger service* (April 2016).

Satoshi Nakamoto "Bitcoin: A Peer-to-Peer Electronic Cash System" (2009) <www.bitcoin.org>.

New Zealand Transport Agency "Driving without a licence" NZTA <www.nzta.govt.nz>.

New Zealand Transport Agency "P endorsements for carrying passengers" (April 2016) Factsheet 42 NZTA <www.nzta.govt.nz>.

The Royal Society and the Royal Academy of Engineering "Nanoscience and Nanotechnologies: Opportunities and Uncertainties" RS Policy document 19/04 (London, Royal Society, 2004).

Mark Waldport "Distributed Ledger Technology: beyond blockchain" (United Kingdom Government Office for Science, Report by UK Government Chief Scientific Advisor, December 2015).

Jakob von Weizsäcker "Draft Report on virtual currencies (2016/2017(INI))" (European Parliament, Report by Committee on Economic and Monetary Affairs, 23 February 2016).

F Submissions

Graeme Austin "Submission on the Trans-Pacific Partnership Agreement Amendment Bill" (May 2016).

Brad Kitschke, Director of Public Policy - Uber "Submission to Ministry of Transport on Small Passenger Service Review Options" (18 June 2015).

G Conference Papers

Jonathan Chan and Herbert Fang "Rebalancing Competition Policy to Stimulate Innovation and Sustain Growth" (Occasional paper, Singapore Competition Commission, 18 November 2015).

J Christopher Giancarlo, CFTC Commissioner "Regulators and the Blockchain: First, Do No Harm" (Special Address before the Depository Trust & Clearing Corporation 2016 Blockchain Symposium, Grand Hyatt, New York, USA, 29 March 2016).

Nick Godfrey, Investment Climate Team "Why is Competition Important for Growth and Poverty Reduction?" (Issues paper, Session 1.3 of OECD Global Forum on International Investment, 27-28 March 2008).

Inge Graef, Sih Yuliana Wahyuningtyas, Peggy Valcke "How Google and others upset competition analysis: disruptive innovation and European competition law" (25th European Regional Conference of the International Telecommunications Society (ITS), Brussels, Belgium, 22-25 June 2014).

Greg Medcraft, Chairman of Australian Securities and Investments Commission "The future of capital markets in a digital economy" (Distinguished speaker series, Carnegie Mellon University, Adelaide, Australia, 16 September 2015).

OECD "Disruptive innovations and their effect on competition" (June 2015) OECD Directorate for Financial and Enterprise Affairs <www.oecd.org>.

Jeremy West, OECD Secretariat, DAF/COMP(2015)3 "Hearing on Disruptive Innovation" (Issues paper, Session 3 of 123rd meeting of OECD Competition Committee, 28 May 2015).

H Online Materials

"About R3" R3CEV <www.r3cev.com>.

Spencer Ackerman, Dominic Rushe "Microsoft, Facebook, Google and Yahoo release US surveillance requests" (3 February 2014) The Guardian <www.theguardian.com>.

Carola F Berger "Bitcoin Part 1 – Byzantine Generals and Pseudonyms or: What is Bitcoin?" (4 June 2015) CFB Scientific Translations & Consulting <www.cfbtranslations.com>.

Carola F Berger "Bitcoin Part 2 – Bitcoin Mining" (22 June 2015) CFB Scientific Translations & Consulting <www.cfbtranslations.com>.

Carola F Berger "Bitcoin Part 3 – Hashes, Public Key Cryptography "For Dummies" and the Block chain" (22 June 2015) CFB Scientific Translations & Consulting <www.cfbtranslations.com>.

"Berlin bans Uber app citing passenger safety" (14 August 2014) BBC News <www.bbc.com>.

"Bitcoin is 100 times More Powerful than Google" (20 April 2015) CryptoCoinNews <www.cryptocoinsnews.com>.

"Bitcoins in Circulation" chart (6 August 2016) Blockchain Info <www.blockchain.info>.

Jerry Brito "Brookings Institution: Like the early internet, blockchain tech deserves a careful, light touch from regulators" (13 January 2015) Coin Center <www.coincenter.org>.

Richard Brown "Bitcoin Mining: The First Technology Platform that Works Because It Goes Slow?" Richard Gendal Brown: Thoughts on the Future of Finance <www.gendal.me>.

Richard Brown "How to Explain the Value of Replicated, Shared Ledgers from First Principles" Richard Gendal Brown: Thoughts on the Future of Finance <www.gendal.me>.

Richard Brown "Towards a Unified Model for Replicated Shared Ledgers" Richard Gendal Brown: Thoughts on the Future of Finance <www.gendal.me>.

Clayton Christensen "Key Concepts - Disruptive Innovation" Clayton Christensen <www.claytonchristensen.com>.

Client Services "Ex Post v. Ex Ante Regulatory Remedies Must Consider Consumer Benefits and Costs" (14 May 2015) The American Consumer <www.theamericanconsumer.org>.

Coindesk "Bitcoin Glossary" <www.coindesk.com>.

"Confirmed Transactions per Day" chart (6 August 2016) Blockchain Info <www.blockchain.info>.

Rachel Courtland "Gordon Moore: The Man Whose Name Means Progress" (30 May 2015) IEEE Spectrum <www.spectrum.ieee.org>.

"Cyberspace" Your Dictionary <www.yourdictionary.com>.

Joe Dewey and Shawn Amuial "Blockchain Technology Will Transform the Practice of Law" (25 June 2015) Bloomberg Law Big Law Business <www.bol.bna.com>.

Carter Dougherty and Grace Huang "Mt. Gox Seeks Bankruptcy After $480 nlion Bitcoin Loss" (1 March 2014) Bloomberg Technology <www.bloomberg.com>.

Carter Dougherty and Richard Rubin "Bitcoin Is Property Not Currency in Tax System, IRS Says" (25 March 2014) Bloomberg Technology <www.bloomberg.com>.

Ernst & Young "Big Data Backlash" EY Building a Better World <www.ey.com>.

European Digital Currency & Blockchain Technology Forum "MEPs pass virtual currencies and blockchain report" (26 April 2016) EDCAB <www.edcab.eu>.

European Digital Currency & Blockchain Technology Forum "European Union virtual currency legislation published" (5 July 2016) EDCAB <www.edcab.eu>.

Melina Eyre "Copyright Amendment Act Strengthens Australia' TPM Laws" (10 May 2007) iP Frontline <www.blog.ip.com>.

"Getting started in the IETF" IETF <www.ietf.org>.

Andy Greenberg "Bitcoin's Price Plummets As Mt. Gox Goes Dark, With Massive Hack Rumored" Forbes <www.forbes.com>.

J Christopher Giancarlo "Comment: With blockchain, regulators should first do no harm" (12 April 2016) FT Trading Room <www.ft.com>.

James Greenland "Ethereum, blockchain, and smart contracts – the future of law?" (5 May 2016) New Zealand Law Society <www.lawsociety.org>.

Andreas Guadamuz and Chris Marsden "Blockchains and Bitcoin: Regulatory Responses to cryptocurrencies" (7 December 2015) First Monday Peer-Reviewed Journal on the Internet <www.firstmonday.org>.

Martin Hiesboeck "Blockchain is the most disruptive invention since the Internet itself - not just in finance" (6 April 2016) Digital Doughnut <www.digital doughnut.com>.

George Howard "'Bitcoin For Rock Stars' A Year Later: An Update From D.A. Wallach On Blockchain And the Arts Part 1" (25 September 2015) Forbes <www.forbes.com>.

IBM Institute for Business Value "Device democracy: Saving the future of the Internet of Things" (2015).

Institute of International Finance "Getting Smart: Contracts on the Blockchain" (May 2016) IIF.

"Internet Society (ISOC)" Techopedia <www.techopedia.com>.

Ian Johnston "Bitcoin voted one of 2014's worst investments as value plummets" (24 December 2014) Independent <www.independent.co.uk>.

Andy Knackstedt "Transport Agency clarifying passenger transport rules for Uber drivers" (29 April 2016) New Zealand Transport Agency: National Office.

Timothy Lee "This Senate hearing is a Bitcoin lovefest" (18 November 2013) The Washington Post <www.washingtonpost.com>.

Natasha Lomas "Everledger Is Using Blockchain To Combat Fraud, Starting With Diamonds" (June 2015) Techcrunch <www.techcrunch.com>.

"Market Capitalization" chart (6 August 2016) Blockchain Info <www.blockchain.info>.

John McCrone "Uber's liquid ride: why it's ignoring NZ laws" (2 July 2016) The Press <www.stuff.co.nz>.

Michael Milnes "Blockchain: A Tech Trend for Business Lawyers in 2016" (15 December 2015) Linked in <www.linkedin.com>.

Jo Moir "Uber could be banned if it doesn't comply with the law: Transport minister" (9 August 2016) Stuff <www.stuff.co.nz>.

Kim Nillson "The missing MtGox bitcoins" (19 April 2015) WizSec Bitcoin Security Specialists <www.blog.wizsec.jp>.

Carmen Nobel "Mobile Banking for the Unbanked" (13 June 2011) Harvard Business School Working Knowledge <www.hbswk.hbs.edu>.

OECD "Competition Assessment Toolkit" (2015) OECD Directorate for Financial and Enterprise Affairs <www.oecd.org>.

DJ Pangburn "The Humans Who Dream of Companies That Won't Need Us" (19 June 2015) Fast Company <www.fastcompany.com>.

Mark Pascall "Blockchains, Smart Contracts and Ethereum for Dummies (an introduction)" video online <www.ethereum.nz>.

Daniel Patrascu "Road Traffic History - Before the Streets Got Swamped" (6 November 2009) Auto Evolution <www.autoevolution.com>.

Morgen Peck "The Uncanny Mind That Built Ethereum" (14 June 2016) Backchannel <www.backchannel.com>.

"Red Traffic Laws" Wikipedia <www.en.wikipedia.org>.

"The Rise of Blockchain" (20 November 2015) PaymentsNZ <www.paymentsnz.co.nz>.

Francesca Sales "Congress questions blockchain security amid ransomware news" (18 March 2016) Tech Target Serach CIO <www.serchcio.techtarget.com>.

Laura Shin "Nasdaq Unveils Blockchain-Enabled Platform Linq, Announces 6 Inaugural Clients" (27 October 2015) Forbes/Personal Finance <www.forbes.com>.

Fran Strajnar "Beyond Blockchains: Enterprise Solution Designs" EthereumNZ <www.ethereum.nz>.

Nick Szabo "The Idea of Smart Contracts" (1997) Nick Szabo <www.szabo.best.vwh.net>.

Interview with Don Tapscott, CEO Tapscott Group (Rik Kirkland, McKinsey & Company, "How blockchains could change the world", May 2016) <www.mckinsey.com>.

Mark Taylor "Blockchain is more than the second coming of the internet" (7 June 2016) Raconteur <www.raconteur.net>.

Sheel Tyle and Mohit Kaushal "The Blockchain: What It Is and Why It Matters" (13 January 2015) Brookings Institution <www.brookings.edu>.

Kyle Torpey "The United States Is Falling Behind in Bitcoin Regulation" (25 April 2016) Bitcoin Magazine <www.bitcoinmagazine.com>.

Christopher Woolard "London FinTech Week 2016 - Innovation in RegTech" (25 July 2016) Financial Conducts Authority <www.FCA.org.uk>.

Christopher Woolard "UK FinTech: Regulating for innovation" (23 February 2016) Financial Conducts Authority <www.FCA.org.uk>.

Jeevan Vasagar "Uber banned in Berlin on passenger safety grounds" (15 August 2014) Financial Times <www.ft.com>.

Verisart <www.verisart.com>.

"W3C Activities Related to the US 'Framework for Global Electronic Commerce'" W3 <www.w3.org>.

"What is a technical protection measure (TPM?)" Ministry of Business, Innovation and Employment <www.mbie.govt.nz>.

"Who we are" Internet Society <www.internetsociety.org>.

Joon Ian Wong "Dark Markets Grow Bigger and Bolder in Year Since Silk Road Bust" (6 October 2014) Coindesk <www.coindesk.com>.

The World Bank "Overview" WorldBank <www.worldbank.org>.

I Newspapers

Sophie Curtis "Visa uses bitcoin's blockchain technology to cut paperwork out of car leasing" The Telegraph (online ed, 28 October 2015).

Nicole Hong "Silk Road Creator Found Guilty of Cybercrimes" *Wall Street Journal* (United States, 4 February 2015).

Christopher Ingraham "How the FBI just made the world a more dangerous place by shutting down Silkroad 2.0 and a bunch of online drug markets" The Washington Post (United States, 6 November 2014).

Paul Vigna "5 Things About Mt Gox's Crisis" *Wall Street Journal* (United States, 25 February 2014).

Benjamin Weiser "Man Behind Silk Road Website Is Convicted on All Counts" *New York Times* (New York, 4 February 2015).

Word Count (excluding Contents, Bibliography and Footnotes):
15,000.