

BLOCKCHAIN, BUSINESS SUPPLY CHAINS, SUSTAINABILITY, AND LAW:
THE FUTURE OF GOVERNANCE, LEGAL FRAMEWORKS, AND LAWYERS?

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ABSTRACT

Blockchain technology has been hailed as the next disruptive leap forward in data sciences. Most legal scholarship related to the topic has focused on its relevance to finance, but it could revolutionize business supply chains. Specifically, blockchain-enabled solutions are expected to improve the reliability of data related to supply chains and to help businesses eliminate fraud, inefficiencies, waste, and harms to people and the environment.

Despite the surrounding hype, this paper will explain why the promise of distributed electronic ledgers will only be realized in the context of effective governance and legal frameworks. This paper draws upon scholarly articles and the opinions of entrepreneurs actively engaged in bringing blockchain-enabled technologies to market to arrive at two sets of related conclusions. First, that the benefits of the technology (including its potential to help businesses prosper while eliminating societal and environmental harms) will only be realized in the context of enabling frameworks of law. Second, the author articulates how the role of the legal profession vis-à-vis business clients will evolve in the era of blockchain-enabled business supply chain optimization.

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INTRODUCTION

Blockchain technology—essentially a form of distributed electronic record-keeping allegedly immune to forgery and errors—is being hailed as the next disruptive leap forward in data sciences, on par with the advent of the Internet itself.¹ It is most commonly associated with cryptocurrencies such as Bitcoin,² and legal scholarship to date, including much of what is cited in this paper, has mostly focused on the impact of blockchain in the world of finance.³ It is vital, therefore, to clarify: This paper does not deal with Bitcoin or other cryptocurrencies.

Rather, this paper examines blockchain, the underlying technology that enables cryptocurrencies such as Bitcoin, and its potential to impact supply chains. Supply chains are defined as the means by which inputs arrive at a business to create value, including the means by which products arrive to consumers.⁴ This paper examines the benefits, risks, and consequences of blockchain technology being applied in this context, including those that arise for legal professionals serving business clients.

Early deployments of blockchain technology to facilitate reliable record-keeping in business enterprises have tested its potential in combatting both fraud and theft, as well as its potential in assuring quality in a supply chain context.⁵ Blockchain technology has reportedly functioned well, for example, in the context of authentication of inventory in the timber industry, in which illegal sales are estimated to total \$51–152

¹ See Laura Shin, *How The Blockchain Will Transform Everything From Banking To Government To Our Identities*, FORBES (May 26, 2016), <https://www.forbes.com/sites/laurashin/2016/05/26/how-the-blockchain-will-transform-everything-from-banking-to-government-to-our-identities/#17ed4cfc558e>.

² Scott J. Shackelford & Steve Myers, *Block-by-Block: Leveraging the Power of Blockchain Technology to Build Trust and Promote Cyber Peace*, 19 YALE J. L. & TECH. 334, 338–39 (2017).

³ See *infra*, Section IV.A. and accompanying notes.

⁴ See Steve LeMay, Marilyn M. Helms, Bob Kimball & Dave McMahan, *Supply chain management: the elusive concept and definition*, 28 INTL. J. LOGISTICS MGT., 1429–32 (2017).

⁵ See Heather Clancy, *The blockchain's emerging role in sustainability*, GREENBIZ (Feb. 6, 2017, 1:15 AM), <https://www.greenbiz.com/article/blockchains-emerging-role-sustainability>. But see Steve Banker, *Blockchain In The Supply Chain: Too Much Hype*, FORBES (Sept. 1, 2017), <https://www.forbes.com/sites/stevebanker/2017/09/01/blockchain-in-the-supply-chain-too-much-hype/#4e4510f9198c> (suggesting that while this technology has the potential to prevent thefts and combat cybersecurity issues, it is still relatively new and in beta stages and is likely to experience several challenges while maturing).

billion annually.⁶ Other illustrative blockchain applications in the context of supply chains include examples such as proof-of-provenance, or tracing the geographic source of a product, an area in which fraud and counterfeiting cause losses to businesses that authentically source from specific locations.⁷ Another example includes certification of good environmental and labor practices, the violation of which negatively affects not only human life and health and ecological life support systems, but also, similarly, causes losses for businesses that adhere to higher standards.⁸ In all of these cases, improved record-keeping allows companies to gain more efficient traceability and reduce loss and theft while societies and governments benefit from increased tax revenues, reduced corruption, and—especially when blockchain is coupled with certification schemes and transparency—environmental benefits from encouraging sustainable practices.⁹

However, high profile hacks suggest that some blockchain applications can be as unhackable as the Titanic was unsinkable.¹⁰ Based on limitations, some argue that blockchain is, at best, a solution in search of a problem, while others write it off as simply overhyped.¹¹ Even if the technology works flawlessly, fundamental problems include human fallibility and corruption when creating the underlying records and

⁶ Boris Döder & Omri Ross, *Timber Tracking: Reducing Complexity of Due Diligence by Using Blockchain Technology* 1, 3 (Univ. of Copenhagen Dept. of Computer Sciences, Working Paper, Aug. 8, 2017), available at <https://ssrn.com/abstract=3015219>.

⁷ Phil Taylor, *EY partners with EZLab on blockchain wine security project*, SECURING INDUSTRY (Apr. 18, 2017), <https://www.securingindustry.com/food-and-beverage/ey-partners-with-ezlab-on-blockchain-wine-security-project/s104/a4014/#.WvenBogvw2w>.

⁸ See Jochem Verberne, *How can blockchain serve society?* WORLD ECONOMIC FORUM (Feb. 1, 2018), <https://www.weforum.org/agenda/2018/02/blockchain-ocean-fishing-sustainable-risk-environment/>.

⁹ See *Id.* Another application arguably related to supply chains is the enabling of peer-to-peer energy contracts, such that local entities can buy-and-sell energy to each other from local sources such as rooftop solar panels. See Mike Butcher, *Power Ledger deploys first blockchain-based P2P energy trading system in Chicago*, TECH CRUNCH (May 3, 2018), <https://techcrunch.com/2018/05/03/power-ledger-deploys-first-blockchain-based-p2p-energy-trading-system-in-chicago/>. However, that topic could merit its own dedicated article, as mentioned in the foregoing discussion of polycentric governance, *infra*, Section IV.B.

¹⁰ Swati Khandelwal, *Hackers Stole \$32 Million in Ethereum; 3rd Heist in 20 Days*, THE HACKER NEWS (July 19, 2017), <https://thehackernews.com/2017/07/ethereum-cryptocurrency-hacking.html>.

¹¹ See Joseph Young, *Blockchain is Overhyped and Not Quite Applicable: VC Andrew Parker*, THE COINTELEGRAPH (Mar. 23, 2017), <https://cointelegraph.com/news/blockchain-is-overhyped-and-not-quite-applicable-vc-andrew-parker>.

enforcing consequences.¹² As elaborated upon herein, this is sometimes known as “the last mile problem”; even if a record-keeping scheme is flawless, at either end there remains the problem of human fallibility or indifference.¹³

This leads some to argue that the true potential of blockchain technology can only be realized when coupled with effective governance. According to one perspective, “[w]holly divorced from legal enforcement, blockchain-based systems may be counterproductive or even dangerous.”¹⁴ This is somewhat in tension with what blockchain evangelists call “trustless trust.”¹⁵ Some question the premise that blockchain-based systems can bypass any kind of public or institutional governance.¹⁶ A closely related question is whether uses of blockchain technology will result in a new subset of law—or whether they can function in the absence of legal frameworks.¹⁷ This is because blockchain’s potential role in supply chain optimization could go beyond matters such as proof-of-provenance and certification. As discussed herein, blockchain could be used for sustainability data reporting, self-executing digital contracts, and devices that can be controlled over the Internet.

This paper will proceed as follows: We must begin with a simple description of how blockchain functions. The paper will then proceed to evaluate the promise and then the perils of blockchain in the context of

¹² See *The great chain of being sure about things*, THE ECONOMIST (Oct. 31, 2015), <https://www.economist.com/news/briefing/21677228-technology-behind-bitcoin-lets-people-who-do-not-know-or-trust-each-other-build-dependable>.

¹³ Author’s conversation with Miko Matsumura [co-founder of Evercoin] (June 20, 2018 [2:03PM]) (on file with the author).

¹⁴ Kevin D. Werbach, *Trust, But Verify: Why the Blockchain Needs the Law*, BERKELEY TECH. L. J., 1, 1 (forthcoming 2018).

¹⁵ Reid Hoffman, *Why the Blockchain matters*, WIRED UK (May 15, 2015), <https://www.wired.co.uk/article/bitcoin-reid-hoffman>.

¹⁶ Blockchain Workshops, *Thinking Through Law and Code, Again - Lawrence Lessig - COALA's Blockchain Workshops - Sydney 2015*, YOUTUBE (Jan. 6, 2016), <https://www.youtube.com/watch?v=pcYJTibhYF0>.

¹⁷ See Aaron Wright & Primavera De Filippi, *Decentralized Blockchain Technology and the Rise of Lex Cryptographia* 1, 4 (Mar. 12, 2015), available at <https://ssrn.com/abstract=2580664>. See also Lawrence J. Trautman, *Is Disruptive Blockchain Technology the Future of Financial Services?* 69 CONS. FIN. L.Q. REP., 232, 240-41 (2016) (discussing how smart contracts will change current law); Max Raskin, *The Law and Legality of Smart Contracts*, 1 GEO. L. TECH. REV. 305, 308, 311, 321-25 (2017) (discussing smart contracts and their legal basis); Kevin Werbach & Nicolas Cornell, *Contracts Ex Machina*, 67 DUKE L. J., 313, 316-19 (2017) (discussing blockchain foundation and if smart contracts apply).

business supply chains. Among the limitations, we will examine how, as with other advancements related to data, such as the Internet itself and mobile devices, a more powerful tool related to information does not necessarily improve outcomes. Sound governance (including the deliberate setting of clear, measurable, and enforceable outcomes) is necessary if the potential of blockchain is to be realized. We finally move on to the key question of whether blockchain applications are likely to obviate the need for lawyers and legal frameworks, as some have prognosticated. Although it is debatable whether blockchain adoption will result in a new practice area, and while some functions will be streamlined, legal framework and lawyers will retain their essential roles in a blockchain-enabled business environment. This paper concludes by describing how the role of attorneys will evolve in a blockchain-enabled business environment.

I. BLOCKCHAIN BASICS

Stated simply, blockchain is a form of record-keeping.¹⁸ It is a digital ledger distributed among nodes in a network, meaning that no one central authority controls the data.¹⁹ Rather, “everyone can maintain a copy of a dynamically-updated ledger, but all those copies remain the same, even without a central administrator or master version.”²⁰ At least one author has employed the analogy of a giant shared spreadsheet, in that several people all see it, any of them could change it, and everyone can see both the past and current changes to it.²¹ It is typically characterized as “a digital, tamper-proof record of information, accessible to everyone.”²² As astutely pointed out by Aaron Wright and Primavera De Filippi, it is an “incremental improvement” over earlier steps since the late 1970s in encryption, peer-to-peer applications, consensus mechanisms, and decentralized, distributed data storage.²³ As they optimistically put it, the combination of these technologies provides “a way for people to agree on a particular state of affairs and record that agreement in a secure and verifiable manner.”²⁴

¹⁸ See generally Marco Iansiti & Karim R. Lakhani, *The Truth About Blockchain*, 95 HARV. BUS. REV., Jan.–Feb. 2017.

¹⁹ *Id.*

²⁰ Werbach, *supra* note 14, at 3.

²¹ MELANIE SWAN, BLOCKCHAIN: BLUEPRINT FOR A NEW ECONOMY, at xi (2015).

²² Verberne, *supra* note 8, at 3.

²³ Wright & De Filippi, *supra* note 17, at 4–8.

²⁴ *Id.* at 5.

Ironically, the short-term hype and speculation about cryptocurrencies may be exaggerated, while the long-term impact on business (especially supply chains) may be underappreciated and epochal.²⁵ However, to explore why that may be true, as we will in the next section, we must first understand the two means by which the underlying technology may be implemented. Blockchains can be public or private; a public blockchain—or permission-less or ‘unpermissioned’ ledger—has no single owner and allows anyone to add information or hold a copy of the record, making permission-less blockchains censorship-resistant and hard to hack.²⁶ Cryptocurrencies such as Bitcoin and Ether from Ethereum are examples of public blockchains. Private blockchains (permissioned ledgers) are created for private groups to share information or transactions; Hyperledger from Linux Foundation and Corda from the R3 financial services consortium are two examples.²⁷ Distributed private ledgers could track transactions across and between enterprises without the overhead of a central system. According to Goldman Sachs, this market opportunity could be worth \$2.5–7 billion annually.²⁸ Some authors, such as Carla Reyes, prefer to use the term DLT (distributed ledger technology) as a term that encompasses both varieties of blockchain applications: both the decentralized (or permission-less) variety and the private (or permissioned) variety.²⁹

Moving up through a spectrum of complexity, smart contracts use blockchain ledgers to create “self-executing” agreements: a series of “if-then” conditions that purportedly remove some of the human discretion involved in contracting.³⁰ By combining smart contracts, a Distributed

²⁵ Iansiti & Lakhani, *supra* note 18 (describing the vast potential of the blockchain as a “foundational technology” which will only be fully realized over the long-term).

²⁶ Michèle Finck, *Blockchains: Regulating the Unknown*, 19 GERMAN L. J. NO. 4 665, 670 (2018).

²⁷ Todd Benzes, *Tech and Banking Giants Ditch Bitcoin for Their Own Blockchain*, WIRED (Dec. 17, 2015), <https://www.hyperledger.org/news/2015/12/17/wired-tech-and-banking-giants-ditch-bitcoin-for-their-own-blockchain>.

²⁸ James Schneider et al., *Blockchain: Putting Theory into Practice*, GOLDMAN SACHS EQUITY RESEARCH REPORT (May 24, 2016), <https://www.unlock-bc.com/news/2017-05-25/blockchain-putting-theory-into-practice>.

²⁹ Carla Reyes, *Conceptualizing Cryptolaw*, 96 NEB. L. REV. 4, 8–12 (2017) (discussing DTL and the Bitcoin blockchain).

³⁰ Raskin, *supra* note 17, at 309–311. Some call into question characterizing such arrangements as truly qualifying as either smart or contracts. See Finck, *supra* note 26, at 6. Jeremy Sklaroff clarifies that “decentralized code-only contracts are part of a decades-long quest

Autonomous Organization (DAO) could use blockchain technology to encode arrangements of debt, equity, and governance,³¹ effectively creating an enterprise that would be to some extent run on auto-pilot. In Section IV.B. and IV.C. of this paper we will return to examining the implications of smart contracts and DAOs for attorneys.

II. BLOCKCHAIN'S POTENTIAL

Despite blockchain and Bitcoin earlier being nearly synonymous with each other, Bitcoin's near-synonymy with cryptocurrency, and the association of these buzzwords with the infamous online black market Silk Road,³² blockchain has lately emerged as a data sciences innovation with massive potential to disrupt all of commerce.³³ Of the new technologies comprising the Fourth Industrial Revolution, blockchain has been said to show "the most promise for radical disruption."³⁴ While others have identified blockchain as furiously overhyped, there is, at the least, a consensus that blockchain's full potential to alter the business world lies ahead.³⁵

A. Supply Chain Optimization and Sustainability

A major aspect of business that could be improved—in the interest of the firm, its stakeholders, and public policy—would be supply chain

to eliminate supposed inefficiencies in traditional written agreements. Electronic data interchange (EDI), a contracting technology from the 1970s . . . successfully reduced some transaction costs while preserving efficient forms of contractual flexibility. Smart contracts are indeed more technologically sophisticated than EDI. Smart contract scripting languages offer a broader range of operations and greater scalability." Jeremy M. Sklaroff, *Smart Contracts and the Cost of Inflexibility*, 166 U. PA. L. REV. 263, 263 (2017) (discussing Bitcoin and the transformation of smart contracts).

³¹ Philip Boucher, *How blockchain technology could change our lives*, EUR. PARLIAMENTARY RES. SERV., (Feb. 2017), [http://www.europarl.europa.eu/RegData/etudes/IDAN/2017/581948/EPRS_IDA\(2017\)581948_EN.pdf](http://www.europarl.europa.eu/RegData/etudes/IDAN/2017/581948/EPRS_IDA(2017)581948_EN.pdf); Vitalik Buterin, *Bootstrapping A Decentralized Autonomous Corporation: Part I*, BITCOIN MAG. (Sep. 19, 2013), <https://bitcoinmagazine.com/articles/bootstrapping-a-decentralized-autonomous-corporation-part-i-1379644274/>.

³² See Shackelford & Myers, *supra* note 2, at 338–39; see also Mitchell Hyman, *Bitcoin ATM: A Criminal's Laundromat for Cleaning Money*, 27 ST. THOMAS L. REV. 287, 295, 97 (2015).

³³ Sarah Underwood, *Blockchain Beyond Bitcoin*, 59 COMM. OF THE ACM, no. 11 (Nov. 2016), at 15.

³⁴ Verberne, *supra* note 8, at 2.

³⁵ See SWAN, *supra* note 21, at xi.

optimization related to sustainability. First, as already discussed, enterprises could prosper by eliminating waste, loss, and inefficiency; deliberate supply chain fraud alone has been characterized as “an epidemic” costing a typical business 5% of its revenue, or an aggregated total global loss of \$3.7 trillion per year.³⁶ Second, some consumers, investors, and employees care about the origins and health and environmental impacts of the products and services of firms with which they are involved;³⁷ uncertainty, ambiguity, deliberate obfuscation, and outright fraud persist in this arena.³⁸ Third, some businesses see an opportunity in reliably meeting these demands from consumers.³⁹ Fourth, environmental degradation is an existential threat to civilization,⁴⁰ meaning that efficient and environmentally benign supply chains are consistent with good public policy.

Both market mechanisms involving consumer choice and regulatory restrictions can only work if information is both available and reliable; otherwise, asymmetries of information remain one of the widely

³⁶ David Landsman, Marcus Puschke, Lilliana Grbic, & Stephanie Overby, *3 Ways to Fight Fraud, Waste, and Abuse in the Supply Chain*, INQUIRY NO. 138, SAP CENTER FOR BUS. INSIGHT (2015), <https://dam.sap.com/mac/download/a.htm?k=nExPgsAJyXnxwllJS7AwSIOvHOEHOBbyOOUyuPAmXPswlXSHA&c=67> (citing data from *Report to the Nation on Occupational Fraud and Abuse*, ASS’N OF CERTIFIED FRAUD EXAMINERS (2014), <http://www.acfe.com/rtnn/docs/2014-report-to-nations.pdf>).

³⁷ According to a 2015 Nielsen poll, 66% of global consumers were willing to pay more for environmentally sustainable products; 72% of millennials expressed such a preference. Bruce Watson, *The troubling evolution of corporate greenwashing*, THE GUARDIAN (Aug. 20, 2016), <https://www.theguardian.com/sustainable-business/2016/aug/20/greenwashing-environmentalism-lies-companies>.

³⁸ Even defining the boundaries of what constitutes misleading and deceptive greenwashing can be a challenge. *See Id.*

³⁹ For example, Unilever has promoted the results of an international study of 20,000 adults in five countries which found that 33% were choosing to purchase goods from brands that they believed were “doing social and environmental good.” Press Release: *Report shows a third of consumers prefer sustainable brands*, UNILEVER (May 1, 2017), <https://www.unilever.com/news/press-releases/2017/report-shows-a-third-of-consumers-prefer-sustainable-brands.html>. More than one in five (21%) of the people surveyed said they would “actively choose brands if they made their sustainability credentials clearer on their packaging and in their marketing,” representing an unrealized opportunity of €966 billion out of a €2.5 trillion total market for sustainable goods. *Id.*

⁴⁰ Economic losses related to extreme weather have increased by 86% to \$129 billion over the last 10 years and the global population is projected, by 2030, to need 40% more water than the planet can sustainably supply. Virginie Helias, *Why the future of consumption is circular*, WORLD ECON. F. (Jan. 15, 2018), <https://www.weforum.org/agenda/2018/01/future-consumption-circular-economy-sustainable/>.

acknowledged reasons for market failures.⁴¹ More broadly, as already mentioned, better tracking of goods and material can improve efficiency and reduce theft, loss, or spoilage.⁴² Reducing such costs and related negative externalities is clearly in the interest of both business and public policy. Blockchain's applications for improving supply chains so as to achieve greater sustainability include the following, as briefly mentioned above.

Proof-of-provenance is a concern for businesses (or entire regions) that suffer as a result of goods whose loci of production are fraudulently labeled.⁴³ For example, counterfeit Italian wines cost the economy of Italy two million Euro in 2015; a blockchain-enabled proof-of-provenance experiment has proven to be successful in this context.⁴⁴ A similar application has succeeded in the context of the olive oil industry.⁴⁵

Closely related to simply proving the geographic origin of a product is assuring that its means of production minimized harm to people and the environment. The tuna industry has successfully experimented with blockchain-enabled tracking that verifies fish are caught without the use of forced labor and with minimal bycatch.⁴⁶ Illegal fishing is a \$23 billion cost to the \$2.5 trillion ocean economy; a platform called Global Fishing Watch is attempting to address this.⁴⁷ Separately, a partnership of the

⁴¹ See Joseph E. Stiglitz, *Markets, Market Failures, and Development*, 79 AM. ECON. REV. no. 2, 197, 197–202 (May 1989).

⁴² Philip Boucher, *How blockchain technology could change our lives*, EUR. PARLIAMENTARY RES. SERV., (Feb 2017), [http://www.europarl.europa.eu/RegData/etudes/IDAN/2017/581948/EPRS_IDA\(2017\)581948_EN.pdf](http://www.europarl.europa.eu/RegData/etudes/IDAN/2017/581948/EPRS_IDA(2017)581948_EN.pdf).

⁴³ John Palfreyman, *Proving Provenance with Blockchain*, IBM GOV'T INDUSTRY BLOG (Mar. 17, 2016), <https://www.ibm.com/blogs/insights-on-business/government/proving-provenance-with-blockchain/>.

⁴⁴ Taylor, *supra* note 7, at 2–3.

⁴⁵ Kristoffer Just Peterson, *Blockchain in supply chain: Identification of opportunities with blockchain as a platform of traceability, information and documentation sharing regarding Extra Virgin Olive Oil (EVOO)*, (thesis, IT U. OF COPENHAGEN) (2017), https://www.researchgate.net/publication/320559685_Blockchain_in_supply_chain_Identification_of_opportunities_with_blockchain_as_a_platform_of_traceability_information_and_documentation_sharing_regarding_Extra_Virgin_Olive_Oil_EVOO.

⁴⁶ See *From shore to plate: Tracking tuna on the blockchain*, PROVENANCE (July 15, 2016), <https://www.provenance.org/tracking-tuna-on-the-blockchain>.

⁴⁷ *Id.*; but see Gus Lubin, *Satellite watchers busted an illegal fishing vessel, and they're coming for others around the world*, BUSINESS INSIDER (Nov. 1, 2016), <https://www.businessinsider.com/global-fishing-watch-catches-illegal-fishing-vessel-2016-11> (explaining some downfalls with Global Fishing Watch's attempt).

World Wildlife Fund, ConsenSys, TraSeable, along with fishing company Sea Quest Fiji, tested a blockchain-enabled application that allows consumers to scan a product and see when and where the fish was caught and by what means.⁴⁸ In the context of conflict minerals (raw material purchased from parties associated with unsavory and illicit forms of violence), blockchain-enabled proof-of-ethical-sourcing of diamonds has similarly functioned well.⁴⁹

In these cases, once a record (the certification) is generated, it is distributed across a network.⁵⁰ As explained above, and just as with a record of a cryptocurrency transfer, each movement of a certified good through the supply chain (or chain of custody) is accompanied by an update in the distributed ledger.⁵¹ Companies have recently started offering enterprise-grade blockchain solutions,⁵² of whom many focus on proof-of-provenance and supply chains.⁵³ Illustrations of how blockchain-enabled solutions function together have been produced by Josh Nussbaum of Blockchain Project Ecosystem, Lawrence Lundy-Bryan of Token Ecosystem Map, and Jordan Odinsky of Logistics Market Landscape.⁵⁴ These processes enhance the credibility of the certification later in the supply chain.⁵⁵ Combined with other trends such as green

⁴⁸ Verberne, *supra* note 8, at 3.

⁴⁹ *Promise and Peril: Blockchain, Bitcoin and the Fight Against Corruption*, TRANSPARENCY INT'L (Jan. 31, 2018), https://www.transparency.org/news/feature/blockchain_bitcoin_and_the_fight_against_corruption.

⁵⁰ See Palfreyman, *supra* note 43, at 2 (providing a simple explanation accompanied by a helpful visual representation).

⁵¹ See Werbach, *supra* note 14, at 11 (explaining the function of a ledger in blockchain technology).

⁵² See Elena Mesropyan, *30 Companies Providing Enterprise-Grade Blockchain Solutions*, MEDICI (Feb. 19, 2017), <https://gomedici.com/companies-providing-enterprise-grade-blockchain-solutions/>.

⁵³ See *e.g.*, Palfreyman, *supra* note 43, at 1.

⁵⁴ Artur Safaryan, *Blockchain projects aiming to reinvent the Supply Chain: Landscape Map*, HACKERNOON (Nov. 9, 2017), <https://hackernoon.com/blockchain-projects-aiming-to-reinvent-the-supply-chain-landscape-map-cf28ba9557d1>

⁵⁵ Margaret D. Fowler, *Linking the Public Benefit to the Corporation: Blockchain as a Solution for Certification in an Age of "Do-Good" Business*, 20 VAND. J. ENT. & TECH. L. 3, 881, 913 (2018).

consumerism,⁵⁶ some have suggested that blockchain will increase our ability to solve the world's sustainability problems.⁵⁷

Prognostications from 2015–2016, or the early adoption phase of blockchain, have largely proven correct as start-ups have deployed and tested applications of blockchain.⁵⁸ According to Euroclear and Oliver Wyman, early experiments with cryptocurrencies were to precede disruptive innovations and niche applications, with long-term mass adoption following in about 2025.⁵⁹

According to a recent report by McKinsey & Company, there is reason to believe that blockchain could be adopted and scaled more rapidly, and have material impact on commerce between 2020 and 2022.⁶⁰ The firm identified several dozen nascent use cases.⁶¹ However, McKinsey concluded that most of blockchain's initial \$80–110 billion impact would be related to record-keeping in both the finance and insurance industries, where most of early venture capital and established financial institutions' investments were made.⁶² Ironically, therefore, it can be said that large and centralized institutions are pushing the adoption of this decentralized approach to data.⁶³ Other sources have independently concluded that blockchain is poised to move from experimental to mainstream adoption between the immediate future and a time horizon of five to ten years, or roughly 2023–2028.⁶⁴

⁵⁶ See William Young, Kumju Hwang, Seonaidh McDonald, & Caroline J. Oates, *Sustainable Consumption: Green Consumer Behaviour when Purchasing Products*, 18 SUST. DEV. 20–21 (2010) (discussing micro-purchasing decisions of green consumers).

⁵⁷ Catherine Early, *Blockchain, regenerative farming and mobility as a service: global trends hold key to sustainability*, ECOLOGIST (Feb. 9, 2018), <https://theecologist.org/2018/feb/09/blockchain-regenerative-farming-and-mobility-global-trends-hold-key-sustainability>.

⁵⁸ See Trautman, *supra* note 17, at 232–233.

⁵⁹ Oliver Wyman & Euroclear, *BLOCKCHAIN IN CAPITAL MARKETS: THE PRIZE AND THE JOURNEY*, 12 (Feb. 2016), <http://www.oliverwyman.com/content/dam/oliverwyman/global/en/2016/feb/BlockChain-In-Capital-Markets.pdf>.

⁶⁰ MCKINSEY & CO., *Blockchain Technology in the Insurance Sector: Quarterly Meeting of the Fed. Advisory Committee on Ins. (FACI)*, (Jan. 5, 2017), https://www.treasury.gov/initiatives/fio/Documents/McKinsey_FACI_Blockchain_in_Insurance.pdf.

⁶¹ *Id.* at 1.

⁶² *Id.* at 6–9.

⁶³ *Id.* at 15–16.

⁶⁴ Jay Samit, *4 Technology Trends That Will Transform Our World in 2018*, FORTUNE (Dec. 2017), <http://fortune.com/2017/12/26/4-technology-trends-2018/>.

Despite the potential of blockchain to correct for “imbalances caused by asymmetric information and opaque supply chains,”⁶⁵ a 2016 study found that similar to venture capital, academic publications had focused on the technology’s relevance to finance, with scarcely a mention of its application in the field of supply chains.⁶⁶

Additionally, blockchain could help to track quantities, cost, and impact of materials; Plastic Bank is an example of an application that could help turn supply chains into supply loops.⁶⁷ Other applications, such as Electric Chain, involve decentralized micro-grids so that local producers and consumers can exchange power without intermediaries.⁶⁸ LO3 is a solar energy company that operates with a similar technology supporting the Brooklyn microgrid.⁶⁹ Finally, by tracking emissions against targets and limits, blockchain could help in the monitoring and regulation of climate-altering gases, regardless of whether the governance framework is self-regulation, regulation-by-disclosure, credit trading, or some system of pay-to-pollute.⁷⁰ The significance of blockchain to sustainability reporting is the topic to which we next turn our attention.

B. Potential for Sustainability Reporting

Over 90% of the world’s largest companies publish regular disclosures on their societal and environmental side effects, a practice known as “sustainability reporting, corporate responsibility (CR) reporting, corporate social responsibility (CSR) reporting, citizenship reporting, environmental, societal, and governance (ESG) reporting, or

⁶⁵ Amina Badzar, *Blockchain for securing sustainable transport contracts and supply chain transparency – An explorative study of blockchain in logistics*, Master’s Thesis, Lund University Libraries (2016), 8, <https://lup.lub.lu.se/student-papers/search/publication/8880383>.

⁶⁶ *Id.* at 35.

⁶⁷ *Project Breakthrough*, U.N. GLOBAL COMPACT (2016), 5, <http://breakthrough.unglobalcompact.org/breakthrough-business-models/closed-loop/>.

⁶⁸ Srinivasan Keshav, *How blockchain can democratize green power*, THE CONVERSATION (Jan. 7, 2018), <https://theconversation.com/how-blockchain-can-democratize-green-power-87861>.

⁶⁹ Elizabeth Woyke, *Blockchain Is Helping to Build a New Kind of Energy Grid*, MIT TECH. REV. (Apr. 19, 2017), 2, <https://www.technologyreview.com/s/604227/blockchain-is-helping-to-build-a-new-kind-of-energy-grid/>.

⁷⁰ Tom Baumann, *What Is Blockchain GHG Management*, GHG MANAGEMENT INSTITUTE (Oct. 18, 2017), <http://ghginstitute.org/2017/10/18/what-is-blockchain-ghg-management/>.

triple bottom line (TBL) reporting.”⁷¹ Such information is sometimes published in the financial disclosures of companies, a practice called integrated reporting.⁷²

Sustainability reporting straddles the realms of hard law and voluntary CSR, and for most global companies, remains a largely voluntary practice.⁷³ Sustainability reporting is meant to help companies improve their performance in terms of societal and environmental side effects by bringing the rigor, discipline, and transparency of financial reporting to the realm of externalities.⁷⁴ The general practice, to some extent, has been required by some countries including Denmark, France, and South Africa,⁷⁵ and has been required in the context of specific issues, such as labor conditions, by countries such as the United Kingdom⁷⁶ and sub-national political units like California.⁷⁷

U.S. securities law is relevant to sustainability reporting. The Dodd-Frank Act includes a section that requires reporting of the use of conflict minerals sources from the Democratic Republic of Congo (DRC).⁷⁸ The

⁷¹ Adam Sulkowski & Sandra Waddock, *Beyond Sustainability Reporting: Integrated Reporting is Practiced, Required and More Would be Better*, 10 U. ST. THOMAS L. J. 1060, 1061 (2013).

⁷² *Id.* at 1063.

⁷³ *Id.* at 1063–1067.

⁷⁴ See JOHN ELKINGTON, CANNIBALS WITH FORKS: THE TRIPLE BOTTOM LINE OF 21ST CENTURY BUSINESS 70–94 (1998) (describing the concept of corporate sustainability and presenting the concept of the quantifying and reporting on a firm’s “Triple Bottom Line” of economic prosperity, environmental impacts, effects on society, and steps being taken to improve these impacts).

⁷⁵ For comparative overviews, see U.N. Econ. Comm’n for Europe, *Supporting Frameworks for Corporate Environmental Reporting*, U.N. Doc. ECE/CEP/AC.10/2009/7 (June 19, 2009). See also Thomas P. Lyon & John W. Maxwell, *Greenwash: Corporate Environmental Disclosure Under Threat of Audit*, 20 J. ECON. & MGMT. STRAT. 3–9 (2011). French rules have been criticized for lacking penalties for non-compliance. Lucien J. Dhooge, *Beyond Volunteerism: Social Disclosure and France’s Nouvelles Regulations Economiques*, 21 ARIZ. J. INT’L & COMP. L. 441, 445 (2004).

⁷⁶ Modern Slavery Act 2015, c.30, § 54(4) (Eng.).

⁷⁷ California Transparency in Supply Chains Act of 2010, CAL. CIV. CODE § 1714.43(a)(1).

⁷⁸ See Dodd–Frank Wall Street Reform and Consumer Protection Act § 1502, 15 U.S.C. § 78m(p) (Supp. V 2011). The goal of these requirements is to allow consumers and investors to make informed decisions as to their involvement with companies that could be complicit with human rights abuses in their supply chains originating in the DRC. See *id.* at § 1502(a); Conflict Minerals, 77 Fed. Reg. 56,274, 56,275 (Sept. 12, 2012) (to be codified at 17 C.F.R. pts. 240 & 249b). In 2012, the SEC finalized Rule 13p-1, requiring all companies that file reports to perform due diligence and report on Form SD the origin of certain minerals in their products if those

Securities and Exchange Commission (SEC) has issued guidance on disclosing climate change risks for publicly traded companies, but it does not appear to be an enforcement priority.⁷⁹ There are also arguments that, even in the absence of legislation and regulations, the concept of materiality in the context of American investor protection law (the common law principle that a firm should disclose anything that changes the total mix of information that a reasonable investor would care about) obliges firms to track and publish sustainability data.⁸⁰

However, despite sustainability reporting becoming commonplace, and to various degrees mandated in some jurisdictions, there are several limitations and problems with the practice. First, some criticize the practice itself, either because it may discourage firms from engaging in some parts of the world,⁸¹ or—as one of its early champions has declared—it has failed to adequately disrupt the status quo.⁸² Second, firms and their consultants can, to some extent, game the system of sustainability reporting—technically meeting requirements and market expectations while actually misrepresenting the truth or suppressing or otherwise misleading regulators, consumers, and other stakeholders.⁸³ Witness Volkswagen’s outright and massive fraud, in terms of both creating systems to mislead emissions testing equipment and then crowing about their green credentials in their marketing and sustainability

minerals originated in the DRC or adjoining countries. Conflict Minerals, 77 Fed. Reg. at 56,275, 56,362, 56,356.

⁷⁹ See Commission Guidance Regarding Disclosure Related to Climate Change, Securities Act Release No. 9106, Exchange Act Release No. 61469, FR-82, 75 Fed. Reg. 6290 (Feb. 8, 2010); see also 17 C.F.R. § 229.101(c)(1)(xii) (2011). In the wake of the SEC’s guidance on climate change, the Commissioner clarified, “I can only conclude that the purpose of this release is to place the imprimatur of the commission on the agenda of the social and environmental policy lobby, an agenda that falls outside of our expertise and beyond our fundamental mission of investor protection.” John M. Broder, *S.E.C. Adds Risk Related to Climate To Disclosure List*, N.Y. TIMES (Jan. 27, 2010), <https://www.nytimes.com/2010/01/28/business/28sec.html> (quoting Commissioner Kathleen L. Casey).

⁸⁰ Sulkowski & Waddock, *supra* note 71, at 1070–1072.

⁸¹ Marcia Narine, *From Kansas to the Congo: Why Naming and Shaming Corporations Through the Dodd-Frank Act’s Corporate Governance Disclosure Won’t Solve a Human Rights Crisis*, 25 REGENT U. L. REV. 351, 351–52, 392 (2012).

⁸² John Elkington, *25 Years Ago I Coined the Phrase “Triple Bottom Line.” Here’s Why It’s Time to Rethink It*, HARV. BUS. REV. (June 25, 2018), <https://hbr.org/2018/06/25-years-ago-i-coined-the-phrase-triple-bottom-line-heres-why-im-giving-up-on-it>.

⁸³ Sulkowski & Waddock, *supra* note 71, at 1077–1078.

reporting: the misleading of investors constituted its own basis for prosecution and fines, and yet, even with the threat of these sanctions, the fraud was committed.⁸⁴ As it turns out, there is reason to believe that Volkswagen is hardly alone in not fully disclosing everything that it should; various studies have found high rates of non-compliance with a simple requirement like disclosing environmental fines.⁸⁵ Third, there is the failure or inability of systems to reliably track and aggregate data, especially in the context of complex multinational supply chains.⁸⁶

It is with regard to these last two problems listed above that blockchain technology could contribute to a solution. Namely, as explained in the preceding sections, it addresses both the technological problem of tracking and aggregating data across large systems, plus the limitations of human systems in terms of auditing and verification. As Scott Shackelford and Steve Myers have written, “the history of finance would be an open book, potentially being a boon to sustainability and the Corporate Social Responsibility (CSR) movement.”⁸⁷ First, as described above, the technology allows a record to irrevocably be attached and to follow a unit.⁸⁸ Once a block of data is created and linked in a chain, it becomes impossible to alter or erase.⁸⁹ Second, the distributed nature of the record in effect means it is effectively continually third-party audited.⁹⁰ Assuming that the original record is 100% reliable, then blockchain technology would be a component of a vision of the future articulated by one of the earliest proponents of blockchain technology. Namely, where sustainability data is not limited to a reporting exercise, but rather instantly and universally accessible, and where the end-user of product can zoom-in on fully transparent systems, seeing realities and side effects from the

⁸⁴ Charles Riley, *Why Volkswagen can't ignore new diesel cover-up claim*, CNN MONEY (May 4, 2018, 1:18PM), <https://money.cnn.com/2018/05/04/investing/volkswagen-winterkorn-diesel-scandal-legal/index.html>.

⁸⁵ David W. Case, *Corporate Environmental Reporting as Informational Regulation: A Law and Economics Perspective*, 76 U. COLO. L. REV. 379, 410 (2005).

⁸⁶ Palfreyman, *supra* note 43; Alanna Petroff, *Carmakers and big tech struggle to keep batteries free from child labor*, CNN TECH (May 3, 2018, 2:16 PM), <https://money.cnn.com/2018/05/01/technology/cobalt-congo-child-labor-car-smartphone-batteries/index.html>.

⁸⁷ Shackelford & Myers, *supra* note 2, at 379.

⁸⁸ *See Id.* at 340–43.

⁸⁹ *See Id.*

⁹⁰ *See Id.*

most local to the most global levels.⁹¹ Data sciences are beginning to provide the tools (though not the mental habits and incentives) to be able to access information instantly and universally—and, in the opinion of one of its original champions, this is exactly the direction in which sustainability reporting must evolve to function as a constructively disruptive tool.⁹²

In this paper, we have primarily outlined the potential of blockchain technology in the context of supply chains and sustainability reporting. Specifically, this was to establish a foundation of basic knowledge to enable an informed discussion of the relatively unexplored question (in this context) of whether and how legal frameworks will remain relevant to realizing the benefits mentioned above. However, part of realizing the benefits for businesses and the rest of society necessitates an appreciation of the risks and limitations of the technology, the topic to which we next direct our attention.

III. REASONS TO TEMPER EXPECTATIONS OF BLOCKCHAIN

In this section we will explore the limitations of blockchain as applied to improving supply chains so as to eliminate waste and harms to people and the environment. This will add heft to our thesis that business supply chains are most likely to be optimized and made more environmentally sustainable when blockchain-enabled solutions are married to legal frameworks, along with sound policy goals and political will.

A. *Unhackable Like the Titanic was Unsinkable, and Even Less Green?*

In mid-2016, over \$67.4 million of \$250 million committed to a blockchain-based cryptocurrency was stolen; the “DAO hack,” as it came to be known, suggested that blockchain applications may not always be as

⁹¹ Adam Sulkowski, *20 Years Ago He Gave Cannibals Forks. Now John Asks: Where's the Disruption?*, HUFFINGTON POST (July 10, 2017, 10:32 AM), https://www.huffingtonpost.com/entry/20-years-ago-he-gave-cannibals-forks-now-john-asks_us_59637fabe4b085e766b51450.

⁹² *Id.*

secure as many believed.⁹³ However, what is more interesting is that the platform could not distinguish between the thefts (it was actually a massive number of small outflows) and legitimate uses. Due to a fault in one line of code, the platform allows the culprit(s) to withdraw funds (accumulated from other uses), the way a thief may withdraw cash from an ATM.⁹⁴ Further, to stop the theft, Ethereum had to split the DAO (“executing a hard fork”) which, he acknowledged, seems to run counter to a bedrock principle of how blockchain is supposed to work.⁹⁵ To an outside observer, this may appear to be proof that blockchain applications are neither as secure (nor the code as immutable) as some believe. Some would counter that, because the hacking occurred at the level of digital wallets and smart contracts, it is better to think of the failures as analogous to the theft of a conventional wallet, in that the theft of one’s wallet does not lead reasonable people to conclude that conventional currencies and one’s ATM cards are fundamentally invalid and untrustworthy concepts.⁹⁶ Regardless of the degree to which the DAO hack (and others) have kindled some healthy skepticism in blockchain applications, it is noteworthy that the identity (or identities) of those responsible for the DAO heist, as of the end of 2018, is (or are) still unknown.⁹⁷

Advances in quantum computing could mean that blockchain encryption in public blockchains will be increasingly vulnerable.⁹⁸ Even absent advances in quantum computing, some point to past and current breaches and prognostications about the rate of future hacks as part of a larger warning to be skeptical of claims that any online system will remain

⁹³ Matthew Leising, *The Ether Thief*, BLOOMBERG, (June 13, 2017), <https://www.bloomberg.com/features/2017-the-ether-thief/>.

⁹⁴ *Id.*

⁹⁵ *Id.*

⁹⁶ Correspondence E-mail withfrom Prof. Kai-Lung Hui, Hong Kong University of Science and Technology, to author June (June. 25, 2018) (on file with author), (expanding upon a conversation on June June. 21, 2018)..

⁹⁷ Leising, *supra* note 93.

⁹⁸ Divesh Aggarwal, Gavin K. Brennen, Troy Lee, Miklos Santha & Marco Tomamichel, *Quantum attacks on Bitcoin, and how to protect against them*, CORNELL UNIVERSITY LIBRARY (Oct. 28, 2017), <https://arxiv.org/abs/1710.10377> (as cited in *Quantum Computers Pose Imminent Threat to Bitcoin Security*, MIT TECH. REV. (Nov. 8, 2017), <https://www.technologyreview.com/s/609408/quantum-computers-pose-imminent-threat-to-bitcoin-security/>). Then again, others counter that if quantum computing evolves to such a point, then all encryption systems will fail, constituting one of several doomsday scenarios that, while possible, are somewhat pointless to contemplate. Hui, *supra* note 96.

100% secure.⁹⁹ Even if encryption stays a step ahead of codebreaking, there are other potential vulnerabilities related to permission-less blockchains, including the non-zero probability that someone can amass enough power in a network to validate fraudulent records.¹⁰⁰ Legal mandates could set minimum reasonable standards of care for coders and institutions to protect them from future accusations of being careless.¹⁰¹

Besides lingering doubts related to hackability, another bedrock question of any new technology is whether the side effects of the cure are worse than the harm it is attempting to curb. Bitcoin alone has been consuming more energy than Ireland, and was anticipated to surpass the energy demand of New Zealand.¹⁰² It turns out that widely distributing records and the related programming needed to confirm the validity of

⁹⁹ According to Piper: “Despite blockchain’s reputation for high-level security, virtual currency providers using the platform have been hacked. Tokyo-based bitcoin exchange Mt. Gox, for example, was forced into bankruptcy after a \$460m security breach in 2014. As blockchain currencies and smart contracts grow in popularity, hacks will increase. . . . A growing concern, though, is that blockchain may be built on a digital house of cards. Late last year, a study by the Global Risk Institute found there was a one in seven chance that the key cryptography tools that thwart hacks will be broken by 2026, with a 50 per cent chance that that would happen by 2031. The result could be an internet with no data encryption and blockchain codes that can be cracked in a couple of minutes.” Arthur Piper, *Blockchain and Smart Contracts*, INTERNATIONAL BAR ASSOCIATION (Aug. 25, 2017), <https://www.ibanet.org/Article/NewDetail.aspx?ArticleUid=e64618b4-02bc-4e57-a5a6-3167027de3f9>.

¹⁰⁰ See Roger A. Grimes, *Hacking bitcoin and blockchain*, CSO (Dec. 12, 2017, 3:45 AM), <https://www.csoonline.com/article/3241121/cyber-attacks-espionage/hacking-bitcoin-and-blockchain.html>. See generally Theodore Kinni, *Tech Savvy: How Blockchains Could Transform Management*, MIT SLOAN MGMT. REV. (May 12, 2016), <http://sloanreview.mit.edu/article/tech-savvy-how-blockchains-couldtransform-management>.

¹⁰¹ The alternative is to allow the common law to evolve and for courts to determine over time what constitutes an appropriate standard of care in this context—the obvious disadvantage being that retroactively a judge may divine and apply a higher standard than a programmer may anticipate. Reference redacted to preserve anonymity of the authors in the review process.

¹⁰² Alex Hern, *Bitcoin’s energy usage is huge – we can’t afford to ignore it*, THE GUARDIAN (Jan. 17, 2018, 10:15 AM); <https://www.theguardian.com/technology/2018/jan/17/bitcoin-electricity-usage-huge-climate-cryptocurrency>.

transactions requires a tremendous amount of electricity.¹⁰³ This has soured some green business advocates on the notion that blockchain-enabled solutions could make supply chains more environmentally sustainable.¹⁰⁴ However, as with the hackability question, this problem is arguably surmountable with the large-scale adoption of emissions-free sources of energy.¹⁰⁵ Another solution that retains the benefits of blockchain technology while reducing its demand for electricity is to move away from proof-of-work cryptography to other cryptographic methods.¹⁰⁶ Companies such as Apple have shown that it is possible to source electricity to meet their massive needs for energy for data storage requirements.¹⁰⁷ To be completely zero net impact, of course, the entire technology industry has the remaining challenge of figuring out how to source, construct, and dispose of the electronics themselves in a way that does not involve toxic materials and polluting energy sources.

B. *Who Generates the Original Record?*

Arguably, certification has been conflated with confirmation; no matter how allegedly tamper-proof it may be, data verification is only useful if the original record is reliable. Or, put another way: “garbage in, garbage out.”¹⁰⁸ Nothing about blockchain technology eliminates conventional problems of establishing the nature of reality at the origin of a supply chain.¹⁰⁹ In other words, when a certification is first created—at the point where an individual inspects and certifies that a labor abuse or environmental harm is not being committed—how can anyone be sure the certifying individual has not been bribed or coerced? Take, for instance, the context of cobalt mined in the Democratic Republic of Congo.¹¹⁰ Even

¹⁰³ *Id.*

¹⁰⁴ Joseph Young, *Bitcoin Mining Costs More Electricity Than Houses, But it's a Non-Issue*, COIN TELEGRAPH (Feb. 14, 2018), <https://cointelegraph.com/news/bitcoin-mining-costs-more-electricity-than-houses-but-its-a-non-issue>.

¹⁰⁵ *Id.*

¹⁰⁶ *Id.* For an explanation of proof-of-work cryptography, see Shackelford & Myers, *Block-by-Block: Leveraging the Power of Blockchain Technology to Build Trust and Promote Cyber Peace*, 19 YALE J.L. & TECH. 334, 386 (2017).

¹⁰⁷ Keshav, *supra* note 68.

¹⁰⁸ Just, *supra* note 45.

¹⁰⁹ Victoria Louise Lemieux, *Trusting Records: Is Blockchain Technology the Answer?*, 26 RECORDS MGMT. J. 110, 128 (2016).

¹¹⁰ Annie Kelly, *Children as young as seven mining cobalt used in smartphones, says Amnesty*, THE GUARDIAN (Jan. 18, 2016, 7:02 PM), <https://www.theguardian.com/global->

if the chain of custody is tracked perfectly and certification is validated along the value chain, how can anyone be sure that, in the middle of an ocean or a remote jungle, the certifying individual at the source was not tricked, mistaken, coerced, or corrupted?

Based on conversations with entrepreneurs with start-ups using blockchain to certify responsible supply chains, it seems that this is an acknowledged challenge—sometimes called “the last mile problem” with certification schemes.¹¹¹ The ultimate solution offered by these individuals is the hope that autonomous sensing equipment and artificial intelligence will develop to a point that non-corruptible and 100% reliable hardened equipment will take the place of human inspectors and certifiers.¹¹² Until then, one of the necessary remaining roles of conventional frameworks—both regulatory agencies and, for example, the discovery process in civil litigation—is to provide a means of detecting, deterring, and punishing fraud.

C. *Self-Executing is Not the Same as Self-Enforcing*

The other reason to temper expectations in blockchain’s potential to optimize business supply chains is that observers seem to have conflated execution and enforcement.¹¹³ Consequences sometimes still have to be enforced in the real world by employing the assistance of entities beyond the parties to a contract. Legal frameworks will still be needed (as they are now) to resolve disputes over whether obligations are fulfilled or excused. Lawyers do not execute contracts; they have and will continue to help clients finalize details of what is agreed upon and figure out what should happen when the unexpected occurs.¹¹⁴ Conventional dispute resolution frameworks are unnecessary in a majority of cases, yet will

development/2016/jan/19/children-as-young-as-seven-mining-cobalt-for-use-in-smartphones-says-amnesty.

A. ¹¹¹ *Author’s conversation with Tatjana Solodnovnikova [Founder, Product Manager – CertifyIt] (Feb. 28, 2018 [7:30PM]) (on file with author). As Miko Matsumura has summarized the problem, blockchain has “solved the problem of third person trust but not first or second person trust,” or, put another way, that one cannot necessarily trust the original record nor one’s self. Matsumura, supra note 13.*

¹¹² See Solodnovnikova, *supra* note 111. See also Just, *supra* note 45.

¹¹³ See, e.g., Wright & De Filippi *supra* note 17, at 24.

¹¹⁴ See Raskin, *supra* note 17.

always be needed as a backstop precisely because, despite the best of intentions and careful planning, the unexpected does happen.¹¹⁵ One could argue that law seems to be nonessential or obsolete as long as things work, but that it turns out to be essential when plans fail. Then, even the staunchest libertarians will want public legal institutions, for example, to defend against fraud or to assert what they perceive to be their property rights.¹¹⁶

D. Certifications Only Matter if Someone Cares

A key assumption made by those who believe that blockchain-enabled certifications can “green” supply chains is that someone—typically consumers—will notice and care and actually base their purchase decisions on whether a product or service has been certified. This can be a problematic assumption, and the problem is compounded when industry groups establish their own (and easier-to-meet) certification standards that compete with activist-generated certifications.¹¹⁷ In an extreme vision of the future—one that imagines conventional legal frameworks as entirely obsolete and completely replaced by the rules programmed into code—there would be no role for, say, the U.S. Department of Agriculture to set boundaries and standards to clarify what a term and a certification such as “organic” actually means. Even when certification standards are set by a non-industry entity, not every consumer actually bases purchase decisions on certification.¹¹⁸

The best answer to this dilemma from entrepreneurs with blockchain-enabled certification solutions is that the consumer is not their client; rather, they are pitching their services to retailers such as Walmart.¹¹⁹ Recently, retailers such as Walmart have stepped-up efforts to ensure that their products are reliably sourced as, for example, organic.¹²⁰ So, somewhat ironically, one massive source of support for the

¹¹⁵ *Id.*

¹¹⁶ FRIEDRICH HAYEK, *THE ROAD TO SERFDOM* 45 (1994).

¹¹⁷ See Tad Mutersbaugh, *Fighting Standards with Standards: Harmonization, Rents, and Social Accountability in Certified Agrofood Networks*, 37 *ENV'T. AND PLANNING A* 2033, 2033–51 (2005).

¹¹⁸ *Id.*

¹¹⁹ Solodnovnikova, *supra* note 111.

¹²⁰ Robert Hackett, *Walmart and 9 Food Giants Team Up on IBM Blockchain Plans*, *FORTUNE* (Aug. 22, 2017), <http://fortune.com/2017/08/22/walmart-blockchain-ibm-food-nestle-unilever-tyson-dole/>.

deployment of decentralized technology are large centralized institutions such as mega-retailers.¹²¹ As mentioned above, and in the ultimate twist of irony, the very best spur to blockchain-enabled solutions for supply chain certification would be government mandates that claims to investors and consumers be validated using distributed ledger technology; a world, as some have predicted or recommended, where decentralized solutions are coopted by centralized authorities.¹²²

E. *Humans—Our Mindsets and Goals—Are Still the Key*

Even the greatest champions of blockchain highlight the essential role of the human factor in optimizing the benefits of the technology. Jonathan Verberne notes that “...beyond radical transparency, automation, smart contracting and elimination of uncertainty and blind trust, only the vision and ingenuity of people and partnerships can realise the true potential of blockchain technology for our wellbeing, future prosperity, and enterprise.”¹²³ The thesis of this section and the foregoing content on law was articulated by professors Mainelli and Milne as follows: “[a]chieving all the potential benefits from mutual distributed ledgers will require board level buy-in to a substantial commitment of time and resource [sic], and active regulatory support for process reform, with relatively little short-term payoff.”¹²⁴

In this regard, blockchain is neither a panacea nor a *sine qua non* for sustainability-related problems in business supply chains. Remarkably, as advances in technology and connectivity have accelerated, so has growth in the awareness that our goals and ultimately mindsets are really the level where innovation is most needed if larger systemic problems are to be solved.¹²⁵ In management literature, Peter Senge gets the earliest credit for highlighting this need, referring to the concept of a fundamental shift

¹²¹ This is an echo of the irony touched upon earlier: that large centralized financial institutions are among the largest source of bleeding-edge investment into blockchain applications. See discussion *supra* Section II.A.

¹²² See Reyes, *supra* note 29, at 405–07.

¹²³ Verberne, *supra* note 8.

¹²⁴ Michael Mainelli & Alistair Milne, *The Impact and Potential of Blockchain on Securities Transaction Lifecycle* 1 (SWIFT Inst. Working Paper No. 2015–007, 2016), available at <http://ssrn.com/abstract=2777404>.

¹²⁵ See, e.g., Su-San Sit, *Mindset is biggest barrier to blockchain*, SUPPLY MGMT. (Mar. 13, 2018), <https://www.cips.org/supply-management/news/2018/march/invest-in-blockchain-or-risk-falling-behind-ceos-warned/>.

of mindset as *metanoia*, a precondition for solving big problems in learning organizations.¹²⁶ A literature stream in management about the key role of business leaders in catalyzing fundamental shifts of awareness and culture with stakeholders is widely seen as having been sparked by Ed Freeman.¹²⁷ Better access to data only matters inasmuch as individuals and organizations actually care, pay attention, are not deceived, and use information when they choose how to act.¹²⁸ As events and trends in the new millennium have shown, we have better access to information than ever, yet there are enormous and widespread failures in human capacities to recognize misinformation, and to care about and act upon meaningful data that serve the goals of sustainable production and consumption.¹²⁹

Now that we have reviewed the limitations of technology, we will review available literature and consider whether legal institutions will likely remain relevant in a blockchain-enabled world before evaluating foreseeable implications for lawyers with business clients.

IV. WILL LAWYERS AND LEGAL FRAMEWORKS REALLY BE RENDERED OBSOLETE?

A. *Rumors of the obsolescence of law are greatly exaggerated*

The potential implications of blockchain technology for the law has spurred a range of analyses since 2015, with a variety of issues raised and opinions proffered.¹³⁰ Some suggest that both the law and attorneys will be rendered largely obsolete or irrelevant.¹³¹ Marco Iansiti and Karim Lakhani go so far as to argue that lawyers will be part of an entire genus of professional services that will be rendered unnecessary.¹³² Conversely,

¹²⁶ Peter M. Senge, *THE FIFTH DISCIPLINE: THE ART AND PRACTICE OF THE LEARNING ORGANIZATION* 13 (1990). Additional reference removed to preserve anonymity of authors in the review process.

¹²⁷ R. Edward Freeman, *STRATEGIC MANAGEMENT: A STAKEHOLDER APPROACH* 1 (1984). Additional reference removed to preserve anonymity of authors in the review process.

¹²⁸ Additional reference removed to preserve anonymity of authors in the review process.

¹²⁹ Cathy O'Neil, *Big-Data Algorithms Are Manipulating Us All*, *WIRED* (Oct 18, 2016, 7:00 AM), <https://www.wired.com/2016/10/big-data-algorithms-manipulating-us/>.

¹³⁰ See Mark Fenwick, Wulf A. Kaal, & Erik P. M. Vermmeulen, *Legal Education in the Blockchain Revolution* 3 (Univ. of St. Thomas (MN) Legal Studies Research Paper No. 17-05, 2017), available at

https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2939127.

¹³¹ *Id.*

¹³² Iansiti & Lakhani, *supra* note 18, at 120.

there is the debate over whether a new body of law will emerge, and whether blockchain-enabled solutions could become another tool of centralized authorities.¹³³ Another way of characterizing forecasts is to distinguish between those foreseeing a greater degree of obsolescence of law as we know it, and those holding that legal frameworks will remain relevant and necessary. Ultimately, there is a nascent consensus, persuasively based on lessons of recent history, that existing legal institutions will, for the foreseeable future, adapt and will be needed to provide a framework for, among other things, enforcing consequences.¹³⁴ We will return to the following themes in the next section, IV.B., to explore the implications for attorneys.

Mark Fenwick, Wulf Kaal, and Erik Vermeulen have clearly articulated how a combination of technologies—including but not limited to blockchain—threaten the current role of attorneys and law firms.¹³⁵ Their reasoning is largely based on the observation that existing training and structures do not prepare attorneys and organizations to be agile and adaptable.¹³⁶ Further, they cite others who see most roles for attorneys being automated¹³⁷ by technologies such as blockchain.¹³⁸ It is not difficult to imagine some due diligence functions being rendered obsolete. For example, the role of attorneys reviewing real estate ownership documentation prior to a sale would be unnecessary if ownership was recorded on blockchain.¹³⁹ According to one estimate, blockchain could save between \$2–4 billion in costs related to human effort and errors in just the arena related to title insurance.¹⁴⁰ However, their ultimate thesis is that the education and role of lawyers can be tweaked, saving at least a

¹³³ See Wright & De Filippi, *supra* note 17, at 48.

¹³⁴ Michèle Finck, Carla L. Reyes, and Kevin Werbach have, to date, provided detailed synopses and articulations of this emerging scholarly consensus. See, respectively, Finck *supra* note 26, Reyes *supra* note 29, and Werbach *supra* note 14.

¹³⁵ Fenwick et al., *supra* note 130, at 6.

¹³⁶ *Id.* at 5.

¹³⁷ See, e.g., John O. McGinnis & Russell G. Pearce, *The Great Disruption: How Machine Intelligence Will Transform the Role of Lawyers in the Delivery of Legal Services*, 82 FORD. L. REV. 3041, 3041 (2014).

¹³⁸ See, e.g., Benjamin Barton, *The Lawyer's Monopoly — What Goes and What Stays*, 82 FORD. L. REV. 3067, 3069–70 (2014).

¹³⁹ Michael Nofer, Peter Gomber, Oliver Hinze, & Dirk Schiereck, *Blockchain*, 59 BUS. & INFO. SYS. ENG'G. 183, 185 (2017).

¹⁴⁰ Schneider, *supra* note 28, at 4–5.

select few from total obsolescence.¹⁴¹ Deal-making and other tasks that require ambiguity and flexibility (including, as Nick Szabo would put it, translating the “wet code” of human norms into the “dry code” of programming languages) still leaves room for human attorneys.¹⁴²

Wright and De Philippi have suggested that a “lex cryptographia” will emerge, consisting of “rules administered through self-executing smart contracts and decentralized (autonomous) organizations.”¹⁴³ However, a thorough reading of their article does not propose substantive details and actually provides historical precedent and arguments for why conventional regulation is likely to continue in a blockchain-enabled world. Like other scholars, Wright and De Philippi review the scholarly debate between professors Frank Easterbrook¹⁴⁴ and Lawrence Lessig¹⁴⁵ over whether “cyberlaw”¹⁴⁶ is truly a separate field of law, or just a context in which generalizable principles are applied. Wright and De Filippi also explain why the blockchain “is—and will fundamentally remain—a regulatable technology” because of centralized chokepoints.¹⁴⁷ They point out that this is a task that has been facilitated by the recent concentration and centralization of Internet services.¹⁴⁸

Kevin Werbach’s review of the history of the theory and practice of regulation of the Internet further lends credibility to the view that some amount of regulation is possible, desirable, and inevitable in the coming age of blockchain.¹⁴⁹ Simply put, the law has always won; it has incorporated every disruptive technology for the sharing of ideas and value in the history of humanity.¹⁵⁰ Witness the cyber-libertarian manifesto,¹⁵¹

¹⁴¹ See Fenwick et al., *supra* note 130, at 34–35.

¹⁴² Nick Szabo, *Wet Code and Dry*, UNENUMERATED (Aug. 24, 2008), <http://unenumerated.blogspot.com/2006/11/wet-code-and-dry.html>.

¹⁴³ Wright & De Filippi, *supra* note 17, at 4.

¹⁴⁴ See Frank H. Easterbrook, *Cyberspace and the Law of the Horse*, 1996 U. CHI. LEGAL F. 207, 207–8, 210 (1996).

¹⁴⁵ See Lawrence Lessig, *The Law of the Horse: What Cyberlaw Might Teach*, 113 HARV. L. REV. 501, 502 (1999).

¹⁴⁶ Wright & De Filippi, *supra* note 17, at 47.

¹⁴⁷ *Id.* at 51.

¹⁴⁸ JACK GOLDSMITH & TIM WU, WHO CONTROLS THE INTERNET? ILLUSIONS OF A BORDERLESS WORLD 65–68 (2006).

¹⁴⁹ Werbach, *supra* note 14, at 30–36.

¹⁵⁰ See *id.* at 31.

¹⁵¹ See John Perry Barlow, *A Declaration of the Independence of Cyberspace*, ELECTRONIC FRONTIER FOUNDATION (Feb. 8, 1996), <https://www EFF.org/cyberspace-independence>.

scholarly musings,¹⁵² and actions to assert sovereign-less zones of the 1990's.¹⁵³ On the contrary: instead of the Internet providing a haven from government oversight and control, it became a channel *of* oversight¹⁵⁴ and control,¹⁵⁵ or, at worse, a weapon of manipulation¹⁵⁶ and war.¹⁵⁷ The Internet has been tamed and consolidated and controlled.¹⁵⁸ Once we accept the historical fact that what was once deemed as impossible to regulate is now regulated, it becomes only natural to speculate how a blockchain-enabled world could be governed by legal structures.¹⁵⁹ A more thorough analysis of how various authorities and jurisdictions are attempting to categorize and regulate blockchain-based activities is outside of the scope of this paper, but is an area that promises to continue to be fruitful for future research and writing.

Although Max Raskin's analysis is limited to smart contracts, his conclusions about the role of law in the age of blockchain are generalizable.¹⁶⁰ He notes that the role of self-executing smart contracts is a form of preemptive self-help that should not be discouraged by legislatures or courts.¹⁶¹ However, he concludes that government and conventional legal frameworks will be needed to intervene and prevent enforcement of unconscionable contracts(or, more broadly, arrangements that are against sound public policy)¹⁶² and that adopting existing

¹⁵² See David R. Johnson & David G. Post, *Law and Borders: The Rise of Law in Cyberspace*, 48 STAN. L. REV. 1367, 1367 (1996).

¹⁵³ See GOLDSMITH & WU, *supra* note 148, at 66.

¹⁵⁴ See EVGENY MOROZOV, THE NET DELUSION 296 (PublicAffairs 2011).

¹⁵⁵ See Jonathan Zittrain, *Internet Points of Control*, 44 B.C. L. REV. 653, 673 (2002).

¹⁵⁶ See *The Latest: McMaster: Russian meddling beyond dispute*, POLITICO (Feb. 17, 2018, 8:07 AM), <https://www.politico.com/story/2018/02/17/mcmaster-russian-meddling-beyond-dispute-416848>.

¹⁵⁷ See Kim Zetter, *Inside the Cunning, Unprecedented Hack of Ukraine's Power Grid*, WIRED (Mar. 3, 2016, 7:00 AM), <https://www.wired.com/2016/03/inside-cunning-unprecedented-hack-ukraines-power-grid/>.

¹⁵⁸ See Marshall Brown, *Humanitarian Blockchain: Coding For A Humane, Sustainable World* Marshall Brown, FORBES (Feb.18 2018, 11:40 AM), <https://www.forbes.com/sites/marshallbrown/2018/02/15/humanitarian-blockchain-can-we-code-for-a-humane-sustainable-world/#5bba119b6f3d>.

¹⁵⁹ Marina Fyrigou-Koulouri, *Blockchain Technology: An Interconnected Legal Framework for an Interconnected System*, 9 CASE W. RESERVE J.L. TECH. & INTERNET 1, 8 (2018).

¹⁶⁰ Raskin, *supra* note 17, at 305.

¹⁶¹ *Id.*

¹⁶² *Id.* at 340.

frameworks to new blockchain-enabled technologies is possible and will encourage their adoption.¹⁶³

Michele Finck has outlined an excellent typology of regulatory approaches already adopted in similar contexts.¹⁶⁴ Finck and Kevin Werbach agree that innovators gain the certainty provided by a regulatory framework.¹⁶⁵ Finck urges a flexible and co-regulatory approach, citing successful examples of governments explicitly allowing the sandboxing (or experimentation in specified contexts) of blockchain applications.¹⁶⁶ If nothing else, regulation could at least provide a common lexicon and settled terminology.¹⁶⁷ For example, Angela Walch pointed out that it is not yet completely resolved whether a blockchain is the same as a distributed ledger,¹⁶⁸ nor, as Werbach pointed out, is it even settled whether one should write “blockchain” or “block chain.”¹⁶⁹ Certainty is a good thing, and co-regulation was a constructive phenomenon in the context of the Internet;¹⁷⁰ as Werbach has highlighted, “[i]f anything, the innovators stand to lose the most by delaying government involvement in adopting reasonable solutions.”¹⁷¹

As Shackelford and Myers summarize, “blockchain regulation is happening at various levels and through various modalities beyond black letter law, including, to use Professor Lawrence Lessig’s nomenclature, norms, markets, and code, as well as self-regulation, and multilateral collaboration, all of which can contribute to enhancing critical infrastructure cybersecurity through blockchains.”¹⁷² Shackelford and

¹⁶³ *Id.* at 340–41.

¹⁶⁴ *See* Finck, *supra* note 26.

¹⁶⁵ *See generally* Werbach, *supra* note 14.

¹⁶⁶ *Id.* at 2.

¹⁶⁷ *See* Angela Walch, *The Path of the Blockchain Lexicon (and the Law)* 36 REV. BANKING & FIN. L. 713, 728–30 (2017).

¹⁶⁸ *Id.* at 719.

¹⁶⁹ Werbach *supra* note 14, at 1 n.1.

¹⁷⁰ *See* Kevin Werbach, *The Song Remains the Same: What Cyberlaw Might Teach the Next Internet Economy*, 69 FLA. L. REV. 887, 888–89 (2017).

¹⁷¹ *Id.* at 889.

¹⁷² Shackelford & Myers, *supra* note 2, at 368. *See also* Scott J. Shackelford and Amanda N. Craig, *Beyond the New “Digital Divide”: Analyzing the Evolving Role of National Governments in Internet Governance and Enhancing Cybersecurity*, 50 STAN. J. INT’L L. 119, 119 (2014) (finding national governments are increasingly seeking to secure their critical infrastructure throughout regulation that may have global impact). *See generally* Adam J.

Myers' articulation of the concept of polycentric governance is defined by three characteristics, which, to enthusiasts of the federal system of shared governance in the United States, will seem intuitive—the difference is that the similar features of governance are emerging in the world of blockchain without the equivalent of a constitutional convention.¹⁷³ First, polycentric governance is defined by a multiplicity of autonomous decision centers, at different levels and with different methods, with more-or-less shared goals.¹⁷⁴ Second, it is defined by an institutional and cultural framework, whose principles are seen as useful in terms of the nature of the collective choice aggregating mechanism.¹⁷⁵ The third defining characteristic is "spontaneous order generated by evolutionary competition between the different decision centers' ideas, methods, and ways of doing things," and where the relevant information for decision-making is public.¹⁷⁶ A precondition of polycentric systems is the reality that the governed consent, participate, and continue to see the governance systems as useful and legitimate.¹⁷⁷

Carla Reyes builds upon several of the lines of reasoning above to perhaps most thoroughly articulate a vision of "crypto-legal structures."¹⁷⁸ She foresees governments building elements of regulation into code with international structures developing as well.¹⁷⁹ Significantly, Reyes explains that beyond self-execution, predictive technology and autonomous interaction could enable law, expressed as code, to learn and adapt, on its own, endogenously, in the course of its operation.¹⁸⁰ Besides reducing the lag time typically associated with legislating, regulating, or adjudicating cases, this phenomenon actually could result in a body of

Sulkowski, *Cyber-Extortion: Duties and Liabilities Related to the Elephant in the Server Room*, U. ILL. J.L. TECH. & POL'Y 19, 33–60 (2007) (examining the duties and potential liabilities of businesses that fail to protect themselves from cyber-extortionists).

¹⁷³ See Shackelford & Myers, *supra* note 2, at 369–74.

¹⁷⁴ *Id.* at 372 (citing Vincent Ostrom & Elinor Ostrom, *A Behavioral Approach to the Study of Intergovernmental Relations*, 359 ANNALS OF THE AM. ACAD. POL. SOC. SCI. 138–40 (1965)).

¹⁷⁵ *Id.*

¹⁷⁶ *Id.*

¹⁷⁷ See Shackelford & Myers, *supra* note 2, at 372.

¹⁷⁸ See Reyes, *supra* note 29, at 400–01.

¹⁷⁹ *Id.* at 405.

¹⁸⁰ *Id.* at 413.

substantive rules that actually deserve their own moniker and to be recognized as a discrete subset of law.¹⁸¹

Interestingly, Reyes does not delve deeply into the potential due process problems presented by the possibility of self-revising law-in-code.¹⁸² Presumably, the answer to any such objection is that code can be programmed with procedural safeguards to assure that, for example, humans receive fair notice when software code starts self-editing and trying to play the role of autonomous legislator.¹⁸³ Nevertheless, the ultimate thesis of Reyes' scholarship is that law and government can and should play a constructive role in both driving the adoption of blockchain-enabled technologies and then enforcing the real-world consequences thereof.¹⁸⁴ In this view, legal professionals and institutions do not become obsolete, but rather cooperate with coders to achieve both private and public policy goals.

Last, but-certainly not least, entrepreneurs who are bringing blockchain-enabled applications to market confirm that conventional legal frameworks have a role to play, and a lawless "Wild West" context is not the regulatory environment that they envision as ideal.¹⁸⁵ Rather, echoing the scholarly opinions cited above, entrepreneurs in the blockchain space concur that they prefer a sandboxing approach where regulators stay informed, educated and up-to-speed, and, while open-minded and flexible, are ready to step in and provide certainty and remedies if and when markets fail.¹⁸⁶ This should not be a surprise; as mentioned above, even staunch libertarians see a role for legal frameworks in protecting the rule of law, including property rights, enforcing agreements, and awarding damages when harm and fraud are committed.¹⁸⁷ Now that we have established that legal frameworks will not become obsolete, we move on to the question of how business lawyers will be impacted and how they can adapt to add value in a blockchain-enabled business world.

¹⁸¹ *Id.* at 410.

¹⁸² *See* Reyes, *supra* note 29, at 426–27.

¹⁸³ *Id.*

¹⁸⁴ *Id.* at 445.

¹⁸⁵ Matsumura, *supra* note 13.

¹⁸⁶ *Id.* *See* discussion *supra* Part V.A.

¹⁸⁷ *See* HAYEK, *supra* note 116, at 45.

B. Specific Impacts on Lawyers

Contrary to stereotypes about lawyers being risk-averse and late adopters of new technology, some law firms already started adopting blockchain-enabled innovations as of 2018.¹⁸⁸ A quarter of the 100 largest global law firms joined Enterprise Ethereum Alliance and lawyers' interest in blockchain discernibly grew in 2017.¹⁸⁹ Attorneys worldwide seem to be embracing a perspective that, while lawyers will still have a role for the next few decades,¹⁹⁰ change is happening now inside and outside of firms, and the functions and expectations of attorneys may be changing soon.¹⁹¹ The aim of this section is to summarize and frame the evolving roles of lawyers in a blockchain-enabled world.¹⁹² At the end of this section the concepts and terminology of proactive law—closely related to the scholarship of law-and-strategy—will be employed to help frame the evolving future role of attorneys.

1. Educating Clients on Their Options and Risks

A background risk is simply falling behind and not meeting client expectations.¹⁹³ Previous sections of this paper have reviewed the inherent risks of blockchain-enabled applications, including the risk that the original records entered into a system are faulty, or that even “unhackable”

¹⁸⁸ See Jasmine Ye Han, *How Blockchain Technology Is Transforming the Legal Industry*, BLOOMBERG LAW (Feb. 20, 2018 7:31 AM), <https://bna.com/daily-labor-report/how-blockchain-technology-is-transforming-the-legal-industry>.

¹⁸⁹ *Id.* (The legal industry was one of the fastest-growing industries joining the Wall Street Blockchain Alliance last year, according to founder and chairman Ron Quaranta.)

¹⁹⁰ Piper, *supra* note 99. As summarized by Piper: “Today’s status quo is unlikely to change significantly for another 30 years if their predictions are correct. ‘Unlike the development of the internet, the infrastructure is already in place for blockchain to take off,’ says Joost Linnemann, Attorney-at-law at Kennedy Van der Laan in the Netherlands and IBA Technology Law Committee Membership Officer. In the back offices of banks, for example, blockchain applications are developing quickly. While there’s not likely to be a big bang, he says, at some stage the blockchain era will have arrived. Linnemann is also skeptical about the disappearance of lawyers with the proliferation of smart contracts.”

¹⁹¹ Han, *supra* note 188.

¹⁹² In doing so, this article endeavors to strike a balance between blockchain evangelism and Neo-Luddism.

¹⁹³ Han, *supra* note 188. (According to Holland & Knight partner Joe Dewey, “If clients adopt it and we have to interact with them on it, we will have little choice but to be on board ourselves.”) See also *Id.* (According to Judith Rinearson, partner at K&L Gates, “Blockchain is going to have an impact on how we do business and how we live on a scale similar to the Internet. . . . Clients want lawyers who understand it, and who can help them adapt.”).

systems end up hacked.¹⁹⁴ Some see the list of risks growing over time as attempts arise to scale-up blockchain applications.¹⁹⁵ These risks include that of consensus-building systems breaking down or drastically different regulatory approaches being taken in different jurisdictions.¹⁹⁶

However, even if and when blockchain-enabled applications work flawlessly, they still might not be the best choice for a business client. Ironically, a key implication of a business environment in which blockchain-enabled technologies begin entering mainstream use is that attorneys must be prepared to educate and caution clients when *not* to embrace an application. A prime example is smart contracting. Jeremy Sklaroff points out that smart contract advocates do not envision enhancing human activity, but rather that such contracts will replace “every stage of agreement formation and performance.”¹⁹⁷ As he goes on to argue: shifting away from human-language contracts creates new inefficiencies.¹⁹⁸ In volatile environments or whenever there is uncertainty about an agreement, Sklaroff points out that conventional contracting allows parties to arrive at an enforceable agreement without requiring total and precise prescience by referencing customs.¹⁹⁹ He points out that attorneys can include the right to modify clauses and discretionary language that allows for selectively enforcing breaches.²⁰⁰ Before leaping in to help clients adopt smart contracts, lawyers would be wise to keep in mind Sklaroff’s admonition: “These two forms of flexibility—linguistic ambiguity, and enforcement discretion—create important efficiencies in the contracting process . . . [b]y eliminating this flexibility, smart contracting will impose costs that are more severe and intractable than the ones it seeks to solve.”²⁰¹ A better warning might allow for the possibility that a smart contract is appropriate for some contexts, and suggests that lawyers educate themselves and their clients about the risks and benefits

¹⁹⁴ See *supra* Part I.

¹⁹⁵ See Shackelford & Myers, *supra* note 2, at 373–82.

¹⁹⁶ *Id.* at 373 n.214 (citing Vincent Ostrom & Elinor Ostrom, *A Behavioral Approach to the Study of Intergovernmental Relations*, 359 ANNALS OF THE AM. ACAD. POL. SOC. SCI. 258 (1965)).

¹⁹⁷ Sklaroff, *supra* note 30, at 264.

¹⁹⁸ *Id.* (These stem from three aspects of smart contracts, according to Sklaroff: automation (which demands that every agreement be formed from comprehensively-defined terms), decentralization (which outsources verification to third parties), and anonymity (which by means there is a lack of commercial context to give meaning to terms)).

¹⁹⁹ *Id.* at 282–83.

²⁰⁰ *Id.* at 279–82.

²⁰¹ Sklaroff, *supra* note 30, at 264.

of conventional versus smart contracts, so as to tailor a solution that best serves clients' interests.

Lawyers should also be cognizant of the risk of a lack of interoperability between blockchain-enabled systems and between businesses and among law firms.²⁰² This perspective is somewhat in contrast with the view of Aaron Wright when he states that “[w]e can use blockchain as a ‘spine’ to manage the entire legal industry, build more efficient systems, decrease the cost of legal services, and make sure people get the legal services they need[.]”²⁰³ One of the provocative streams of future legal research (if not a subject for litigation in the courts) will be, as in the context of office software developed by Microsoft, whether blockchain-enabled business applications will be a form of legally tolerated natural monopolies in the United States.²⁰⁴

2. If a Smart Contract is Adopted, What Next?

Blockchain applications in the context of supply chains—such as smart contracts—could increase the ability of attorneys with a proactive mindset to prevent disputes and achieve their clients' goals. This is because, as discussed above, the monitoring of contractual compliance and the triggering of consequences—inasmuch as the parties so choose and the technology allows—is accomplished automatically by software code.²⁰⁵ Some point out that automatic consequences are not really a novelty in the world of contracting,²⁰⁶ the difference now is that technology allows more complexity in agreements and the permutations of the outcomes built into the code.²⁰⁷ As Kevin Werbach and Nicolas Cornell argue, this capacity of current technology to capture and self-execute more of an agreement is a value-adding advancement, but clarifies—not obviates—the need for

²⁰² Han, *supra* note 188.

²⁰³ *Id.*

²⁰⁴ See Franklin A. Gevurtz, *Vertical Restraints on Competition*, 54 AM. J. COMP. L. 357, 358–59 (2006).

²⁰⁵ Jonas DeMuro, *7 ways blockchain will change the legal industry forever*, TECH RADAR (Jan. 18, 2018), <https://www.techradar.com/news/7-ways-blockchain-will-change-the-legal-industry-forever>.

²⁰⁶ Piper, *supra* note 99. (As Piper points out: “[A]utomated contracts are not new – that is what a customer’s standing order to pay a monthly mortgage is, for example. The difference with a smart contract is that, once the agreement is in place, the bank cannot decide not to perform it.”).

²⁰⁷ See Werbach & Cornell, *supra* note 17, at 367.

attorneys in formulating promises and enforcing consequences.²⁰⁸ One of the scholars consulted on this article is also one of the founders of a company, OpenLaw, whose technology aims to enable lawyers to form smart contracts and to decrease “the cost and friction of creating, securing, and generating binding legal agreements.”²⁰⁹ One of the implications of a tool like OpenLaw is that “a lot of the scut work lawyers do on a day-to-day basis will presumably go down over time.”²¹⁰ A partner and leader in the real estate group of Holland & Knight is developing a similar platform called ContractCode and agrees with this description.²¹¹ The key implication of such tools for attorneys is that, more than usual, they need to help their clients imagine what outcomes they truly and ideally want, to work-through every conceivable contingency, and to specify, with greater precision and certainty, the consequences that clients want.

3. Property, Perpetual Records, and Privacy

Property is another specific subject area in which lawyers will need to take a more proactive role.²¹² Protecting ownership rights over creative works (including images, audio, and video files, as well as designs, text, and symbols) has been difficult in the digital age.²¹³ Often, even when systems and platforms have evolved to secure property rights (including the right to exclude others from accessing a work and/or the ability to extract value in exchange for access) eventually “end runs” have developed.²¹⁴ Companies plan to offer platforms for registering intellectual property and ‘anchoring’ it using blockchain.²¹⁵ The implication for attorneys—especially in contexts where clients attempt to use independent contractors to generate intellectual property—will be a need to be engaged in the systems by which property is registered.²¹⁶

On the other hand, Benito Arruñada has specifically focused on the impact of blockchain technology on this field of law and has concluded

²⁰⁸ *Id.* at 318.

²⁰⁹ DeMuro, *supra* note 205.

²¹⁰ Han, *supra* note 188.

²¹¹ *Id.*

²¹² DeMuro, *supra* note 205.

²¹³ See Stefan Bechtold, *Digital Rights Management in the United States and Europe*, 52 AM. J. COMP. L. 323, 331 (2004).

²¹⁴ *Id.* at 327–31.

²¹⁵ Han, *supra* note 188.

²¹⁶ *Id.*

that blockchain enthusiasts are the latest generation of technology evangelists to underestimate the value of conventional third party institutions.²¹⁷ As with smart contracts, a key role of lawyers will be to educate clients about their options when choosing between legacy systems and new forms of registering property ownership. An interesting tangent of the property tracking issues is the more general matter of public records, such as titles and deeds,²¹⁸ or certification of certain declarations by an official source of authority.²¹⁹ Currently, notaries public confirm and verify signatures on legal documents, such as deeds and contracts.²²⁰ Blockchain-enabled applications could record-and-preserve such documents as part of a digital ledger that includes timestamps and fingerprints, which could potentially eliminate the stamp of notary public as a necessity.²²¹

Also, closely related to property records (and of key importance to this paper's primary focus on supply chains) is the issue of establishing a chain of custody.²²² Consider for a moment the array of claims that could involve a lawyer that relate to the details of "who gave what to whom under what circumstances." It could involve a criminal case or a civil claim. It could involve opioid-based pain medication moving from a pharmaceutical producer to a pharmacy to point-of-sale to a patient with a prescription who overdoses. It could involve any part that fails and leads to a product liability case. Or, it could involve consumer fraud claims based on false statements about ingredients or labor or environmental issues in the supply chain. Or, it could involve embezzlement or other white-collar crimes. Until now, proving any such claims has typically involved finding a paper trail for each piece of evidence and maintaining records until evidence is presented in court.²²³ Attorneys defending a business client have had a somewhat easier task in challenging assertions and evidence. Digital evidence has, until now, proven to be even more difficult from a chain-of-custody perspective than proving chains-of-

²¹⁷ Benito Arruñada, *Blockchain's Struggle to Deliver Impersonal Exchange*, 19 MINN. J.L. SCI. & TECH. 56, 103–04 (2018).

²¹⁸ As discussed in earlier sections, conventional record-keeping of real estate ownership could be a significant area for disruption. See Nofer, et al., *supra* note 140, at 185.

²¹⁹ DeMuro, *supra* note 205.

²²⁰ *Id.*

²²¹ Han, *supra* note 188.

²²² DeMuro, *supra* note 205.

²²³ *Id.*

custody for physical objects, including, for example, files found on a hard drive, or a device transmitting or receiving data on a Wi-Fi network log.²²⁴ As was discussed in previous sections, a distributed digital ledger creates permanent and transparent records of chain of custody, preserved like a fly in amber, so evidence is never discarded or destroyed.²²⁵ In the context of protracted litigation, testimony on chain of custody will therefore not be necessary (or, at least, would be much more limited in scope), thus creating another efficiency.²²⁶ “Blockchain-based records are admissible as evidence to courts in Vermont. Arizona also enacted a law in 2017 that acknowledged the legality of signatures and contracts secured on blockchain.”²²⁷ The implications for attorneys on this issue, therefore, is to first be even more hawkish in gauging all possible risks created by claims or promises related to claims and services, and to other liability risks arising from the conduct of employees and business leaders, and, second, to warn their clients about the risks that arise from operating in a reality defined by extreme and permanent transparency.²²⁸

Privacy in the age of blockchain possibly presents the most difficult thicket of issues.²²⁹ There are already conflicting interests, obligations, and legal duties, to say nothing of conflicts between jurisdictions.²³⁰ By creating immutable records, both public and private blockchain applications have the potential to offend individuals’ sense of entitlement

²²⁴ *Id.*

²²⁵ According to David Fisher, co-founder of Integra Ledger, “if we sign a contract, now and forever, we will be able to confirm that.” Han, *supra* note 188.

²²⁶ DeMuro, *supra* note 205.

²²⁷ Han, *supra* note 188.

²²⁸ Imagining, and then contemplating and fully appreciating a fully transparent world where secrets cannot be kept from others in the present or from future observers may be facilitated by reading works of science fiction such as Arthur C. Clarke’s and Stephen Baxter’s book *The Light of Other Days*. In what could be the greatest eventual damage to the profitability of certain legal practice areas, potential clients may drastically curtail certain forms of criminal activity and malfeasance in a drastically more transparent world. See ARTHUR C. CLARKE & STEPHEN BAXTER, *THE LIGHT OF OTHER DAYS* (2000).

²²⁹ For an early discussion of the complications in navigating data privacy laws, see Patricia Mell, *A Hitchhiker’s Guide to Trans-Border Data Exchanges Between EU Member States and the United States Under the European Union Directive on the Protection of Personal Information*, 9 PACE INT’L L. REV. 147, 149–52 (1997).

²³⁰ Ravi Antanid, *The Resistance of Memory: Could the European Union’s Right to Be Forgotten Exist in the United States?* 30 BERKELEY TECH. L. J. 1173 (2015). For a skeptical perspective as to whether privacy is even possible in the modern era, see generally Sandra Byrd Petersen, *Your Life s An Open Book: Has Technology Rendered Personal Privacy Virtually Obsolete?* 48 FED. COMM. L. J. 163 (1995).

(or legal rights, in some cases) to be forgotten.²³¹ While the European Union often gets cited as the jurisdiction where privacy is most protected, privacy and privileged access to personal records is required by several federal statutes in the United States.²³² As businesses develop, use, and adopt blockchain-enabled record keeping, attorneys need to be proactive more than ever in investigating and educating their clients about the consequences of their choices with regard to creating records and the possibly permanent implications for others' privacy.

Although this paper has deliberately not focused on Bitcoin and the implications of blockchain for the world of finance, Bitcoin and other blockchain-powered cryptocurrencies will matter in the context of supply chains in that they will become increasingly accepted in transactions. Therefore, attorneys advising business clients need to stay up-to-date and familiar with the multiple ways that cryptocurrencies are perceived.²³³ Just in the United States, various federal regulatory authorities have defined cryptocurrencies in very different ways.²³⁴ For example, the Internal Revenue Service deems cryptocurrencies to be property,²³⁵ while the Securities and Exchange Commission sees fraudulent investments offering cryptocurrency as within its jurisdiction,²³⁶ and FinCEN likewise

²³¹ See Andrew Neville, *Is It a Human Right to Be Forgotten? Conceptualizing the World View*, 15 S. CLARA J. INT'L L. 157 (2017).

²³² See, e.g., The Children's Online Privacy Protection Act of 1998 ("COPPA") 15 U.S.C. §§ 6501-6506 (2000); Gramm-Leach-Bliley Financial Modernization Act, Pub. L. No. 106-102, 113 Stat. 1338 (1999) (codified at 15 U.S.C. §§ 6801-6809 (2000)) (GLBA is also known as the Financial Industries Modernization Act); Health Insurance Portability Act, Pub. L. No. 104-191, 110 Stat. 1936 (codified as amended in scattered sections of 18, 26, 29, 42 U.S.C.); Christopher Rajotte, Andrew Ittleman & Mitchell Fuerst, *Bitcoin Taxation: Understanding IRS Notice 2014-21*, BITCOIN MAGAZINE (Apr. 4, 2014, 9:20 PM), <https://bitcoinmagazine.com/articles/bitcoin-tax-understanding-irs-notice-2014-21-1396660800/>.

²³³ For a partial summary of how various jurisdictions were diverging from each other in their treatment of Bitcoin, and whether to recognize it as something similar to currency, see *id.*

²³⁴ Jai R. Massari, Annette L. Nazareth, Zachary J. Zweihorn, Jeanine P. McGuinness, & Zachary B. Shapiro, *SEC, FinCEN, and CFTC Actions Continue to Paint a Fragmented Regulatory Landscape for Digital Tokens*, DAVIS POLK (Mar. 8, 2018), <https://www.finregreform.com/single-post/2018/03/08/sec-fincen-cftc-actions-continue-paint-fragmented-regulatory-landscape-digital-tokens/>.

²³⁵ INTERNAL REVENUE SERVICE, NOTICE 2014-21, at 2 (Mar. 25, 2014).

²³⁶ Louise Matsakis, *Rest Easy, Cryptocurrency Fans: Ether and Bitcoin Aren't Securities*, WIRED (June 14, 2018, 4:19 PM), <https://www.wired.com/story/sec-ether-bitcoin-not-securities/>.

sees cryptocurrencies as money services businesses.²³⁷ This is not to say that cryptocurrencies may not become a means of exchanging value in mainstream business supply chains, but these developments highlight the importance of lawyers staying abreast of the risks and consequences of using these assets as units of exchange.

C. The Scholarship of Proactive Law: Visualizing the Evolving Role of Attorneys

By combining the take-aways of the previous section with the key insights of the scholarship of proactive law, we arrive at a picture of what skills and activities attorneys should view as their opportunity to add value to the business enterprise. As promised, the scholarship of proactive law can provide us with a means and a model of appreciating the evolving role of lawyers in a blockchain-enabled business environment.

Proactive law is defined and differentiated from conventional approaches to law in that it sees the lens of legal analysis and role of lawyers as best deployed in planning the future, rather than responding to events in the past.²³⁸ The proactive law perspective does not view law as a set of prohibitions, restrictions, and limitations with which companies and people need to comply.²³⁹ Nor does this conceptualization of law see expenditures on attorneys as a cost factor, a burden, or, strictly speaking, a protective measure for one's own interests to the exclusion of all other parties' interests or needs.²⁴⁰ This framing stands in sharp contrast to the adversarial and backward-looking model which is so dominant in the Anglo-American system.²⁴¹ Overall, proactive law positions law as an

²³⁷ Amy Castor, *FinCEN Deals Major Regulatory Blow to ICOs and Exchanges*, BITCOIN MAGAZINE (Mar. 7, 2018, 11:38 AM), <https://bitcoinmagazine.com/articles/fincen-deals-major-regulatory-blow-icos-and-exchanges/>.

²³⁸ Gerlinde Berger-Walliser, *The Past and Future of Proactive Law: An Overview of the Development of the Proactive Law Movement*, in PROACTIVE LAW IN A BUSINESS ENVIRONMENT 13 (Berger-Walliser & Østergaard eds., 2012).

²³⁹ *Id.*

²⁴⁰ George J. Siedel & Helena Haapio, *Using Proactive Law for Competitive Advantage*, 47 AM. BUS. L. J. 641, 641–44 (2010) (comparing proactive law to the perspective of law and strategy in the United States and how proactive law can help identify sources of competitive advantage).

²⁴¹ Robert A. Kagan, *Adversarial Legalism and American Government*, 10 J. POL. ANALYSIS & MGMT. 369, 369–406 (1991). See Marc S. Galanter, *Reading the Landscape of Disputes: What We Know and Don't Know (and Think We Know) About Our Allegedly Contentious and Litigious Society*, 31 UCLA L. REV. 4, 51 (1983) (providing comparative data on the costs of resources devoted to handling disputes in various countries).

enabling instrument to create success and foster sustainable relationships. All of this has been suggested by other authors using slightly different terminology.²⁴²

To review the take-aways of the immediately preceding section: first, a key function of attorneys will be to educate and help clients decide whether and when to embrace blockchain-enabled solutions. Second, simple tasks—in any domain, including supply chain contracts and documentation related to property—will be automated, but this means more thought in setting up the “if-then” triggers, etc.²⁴³ As a practitioner put it, “lawyers will focus more on complex agreements, and the smart contract triggers embedded in those agreements. Their ability to carefully set forth the rules behind the smart contract coding, and get the agreement to reflect those rules, could become even more relevant.”²⁴⁴ None of this necessarily means lawyers will need to be coders,²⁴⁵ but just as managers need legal astuteness, lawyers will need to have technological astuteness, or enough basic knowledge to be able to communicate and plan and act effectively with software coders.²⁴⁶

Put another way, as Nick Szabo has articulated and as mentioned above in Section IVA., in a world of smart contracts, someone has to help determine and translate the “wet code” of human norms into the “dry code” of software—this will be an aspect of the role of lawyers.²⁴⁷ Some would even add more consequences to come further in the future: if artificial intelligence or machine learning is married to fully transparent and comprehensive records, then programs could reveal patterns or model

²⁴² Constance E. Bagley, *Winning Legally: The Value of Legal Astuteness*, 33 ACAD. MGMT. REV. 378, 380–81 (2008) (proposing a framework for firms to use “legal astuteness” for competitive advantage that included a “proactive approach”).

²⁴³ Han, *supra* note 188.

²⁴⁴ *Id.*

²⁴⁵ Piper, *supra* note 99. However, Piper acknowledges the opinion of a practice group leader that, “[l]awyers are going to have to learn how smart contracts work in practice and what the trigger points are for payments and other transactions – knowledge of which today is usually provided by the client.” *Id.*

²⁴⁶ Han, *supra* note 188. As Bloomberg reporter Han summarized: “Will lawyers need to be coders? Nearly everyone interviewed said no. Instead of being proficient coders themselves, lawyers will work with engineers, Dewey [partner at Holland & Knight] said. But ‘knowing what the process involves and the right questions to ask would be an important skill set[.]’” *Id.*

²⁴⁷ Szabo, *supra* note 142.

the probabilities of outcomes.²⁴⁸ The ability to intuitively spot patterns and warn of foreseeable risks has, until now, been a uniquely human aspect of expertise that is developed over time.²⁴⁹ All of these build to one overarching observation: that the role of attorneys will move “up the value chain” or, in other words, away from glorified scribe work to more creative and demanding tactical and strategic functions.²⁵⁰

Moving on to the mindset that lawyers are well-advised to foster, a key change will be accepting that law and governance is happening in more than one way, and this requires extreme flexibility and an ability to see the same issue from several different perspectives. For example, blockchain—in its application as Bitcoin—has, depending on the jurisdiction, time, and relevant agency, been defined as money, property, and, because it is ultimately software, even speech.²⁵¹

Especially if decentralized sourcing of inputs becomes more commonplace, such as the sourcing of power in blockchain-enabled peer-to-peer sharing networks, then lawyers will need to adapt to a reality where no central authority is completely in charge of providing a key input.²⁵² There are several implications of polycentric governance for lawyers. Lawyers (and the clients they counsel) may need to prepare themselves for a greater degree of transparency and scrutiny and of surrendering complete control than that to which they are currently accustomed.²⁵³ Articulating values and vision and convincing internal and external stakeholders of the merits and legitimacy of goals and systems will be more critical than it is now.²⁵⁴ Overall, rather than command-and-control, telling a story and creating meaning for others to get their buy-in and willing cooperation

²⁴⁸ *Id.*

²⁴⁹ Han, *supra* note 188.

²⁵⁰ This meta-observation on the role of attorneys vis-à-vis their business clients is consistent with other predictions related to the future-of-work, holding that creativity and the ability to see holistic realities will be increasingly valued capacities. See DANIEL PINK, A WHOLE NEW MIND: WHY RIGHT-BRAINERS WILL RULE THE FUTURE (2005).

²⁵¹ See, e.g., CHRISTOPHER WOLF, THE DIGITAL MILLENNIUM COPYRIGHT ACT: TEXT, HISTORY, AND CASELAW 1053–55 (2003); Adam Satariano, *Apple-FBI Fight Asks: Is Code Protected as Free Speech?* BLOOMBERG TECH. (Feb. 23, 2016, 7:55 PM), <https://www.bloomberg.com/news/articles/2016-02-24/apple-fbi-fight-asks-is-code-protected-as-free-speech..>

²⁵² As mentioned in Part III.A., peer-to-peer electric power sharing using a blockchain-enabled platform has begun. See *supra* notes 64 and 65 and accompanying text.

²⁵³ This was discussed *supra* Part IV.C. in the context of sustainability data tracking and transparency.

²⁵⁴ Reference redacted to preserve anonymity of the authors in the review process.

matters more in polycentric, and inherently more transparent, governance systems.²⁵⁵

One particular model from the literature on proactive law can help lawyers re-imagine their role and the function of law.²⁵⁶ The model visualizes law as a medium between a firm and its external context—a medium in which relationships are defined and the limits and consequences of side effects are set.²⁵⁷ In this view, law is like a semi-permeable cell membrane between the internal functions of the firm and the realms of ecological systems and society in which the firm inextricably operates, from which it procures resources, and into which it releases products, services, and side effects such as pollution.²⁵⁸ Blockchain-enabled applications that help firms communicate with external stakeholders can be seen as part of this membrane between the firm and its surrounding environment.²⁵⁹ This view is helpful in summarizing and conceptualizing how blockchain-enabled technologies can be seen as a tool that, in conjunction with a proactive approach to law, can help business leaders and their attorneys to see risks and opportunities and plan and act in a way that achieves outcomes while eliminating objectionable harm.

To recap: the lower-skill functions of lawyers will be automated, blockchain is expected to generally create more transparency and decentralized power, giving the ability to encode norms and strictly-defined outcomes into self-executing contracts. So overall, what do those trends mean in terms of a meta-trend for the role of lawyers? This paper concludes by positing the following: a blockchain-enabled business environment allows lawyers to help firms re-think and commit to their

²⁵⁵ Reference redacted to preserve anonymity of the authors in the review process.

²⁵⁶ Visualizations have been recently encouraged as a way to better convey legal concepts and relationships. See Gerlinde Berger-Walliser, Thomas D. Barton, & Helena Haapio, *From Visualization to Legal Design: A Collaborative and Creative Process*, 54 Am. Bus. L. J., 347, 347–92 (2017).

²⁵⁷ Gerlinde Berger-Walliser, Paul Shrivastava, & Adam Sulkowski, *Using Proactive Legal Strategies for Corporate Environmental Sustainability*, 6 MICH. J. ENVTL. & ADMIN. L. 1, 18–20 (2016).

²⁵⁸ *Id.* at 20.

²⁵⁹ This is especially true of public blockchain-enabled applications. Private blockchain-enabled technologies can be imagined as more limited to the inside of the firm. As explained in Part II., this is because private blockchains can be permissioned, or, in other words, restricted in terms of who has access to the records.

mission and values. Lawyers are well-positioned to help business leaders crystalize what are the duties of the firm and, critically, what is entirely unacceptable; this is a natural consequence of understanding fiduciary duties and the risks and costs of side effects.²⁶⁰ Lawyers, in conjunction with software engineers, can then build non-negotiable minimum requirements dictated by law and values into code. This can be seen as writing the DNA of a firm. Instead of a triple bottom line—the aspiration of business visionaries to further the interests of profit, people, and planet—lawyers could become the co-authors of a firm’s “triple-helix,” to borrow the term and accompanying metaphor from the biological sciences.²⁶¹ The metaphor is apt, in that building company values, duties, norms, and goals into smart contracts governing their supply chain would, at least in theory, mean that a simple code is hardwired into a robust and resilient structure²⁶² to ensure an outcome. This vision is consistent with that of the concept of a DAO, alluded to earlier in the review of blockchain-related literature in Section IV.A., except arguably not quite as radical; rather than completely replacing conventional centralized governance, the metaphor of writing firm DNA should be seen as a logical step in the evolution of formulating and publishing—encoding—a firm’s policies and procedures.

The foregoing speculation on the future role of attorneys in a blockchain-enabled business environment points to potential future areas of research. Unlike previous phases of the ongoing technological revolution, there may be a greater basis upon which to differentiate the body of law that relates to blockchain as separate and distinct from other contexts. At this point in time, it appears that the general common law

²⁶⁰ Reference redacted to preserve anonymity of the authors in the review process.

²⁶¹ This idea was somewhat suggested in an unpublished conference paper by Niels Faber and Henk Hadders, *Towards a blockchain enabled social contract for sustainability - Creating a fair and just operating system for humanity*, First International Conference on New Business Models, Toulouse Business School, Toulouse, France (June 2016), https://www.researchgate.net/publication/303923175_Towards_a_blockchain_enabled_social_contract_for_sustainability_-_Creating_a_fair_and_just_operating_system_for_humanity. The metaphor of the triple helix was recently suggested by John Elkington, the author of *Cannibals with Forks*, who is normally credited with having coined the term “triple bottom line.” ELKINGTON, *supra* note 74.

²⁶² The double helix structure of deoxyribonucleic acid (DNA) is such a robust and efficient system for coding information that data scientists are literally experimenting with encoding and storing data on human-engineered DNA structures. Yaniv Erlich & Dina Zielinski, *DNA Fountain enables a robust and efficient storage architecture*, 355 SCIENCE, 950–54 (Mar. 3, 2017). (Here, the use of the term DNA is intended to serve purely as a metaphor, although it is actually possible to now store, say, a company’s collected policies (its encoded values and rules-of-conduct, or metaphorical DNA) onto actual DNA).

principles of contracting and torts will still be readily adaptable to foreseeable applications of blockchain technology. However, periodic reviews of best practices and disputes and public and private sector responses to unforeseen problems in the deployment of blockchain-enabled applications will be valuable to ascertaining whether a new specialty of law is truly emerging. There is a wealth of interdisciplinary research opportunities related to testing whether the vision of “attorneys writing the DNA of firms” turns out to be substantiated or not. Practitioners and academics in several business disciplines, data sciences, plus the humanities have an opportunity to actively test and observe the process by which firms integrate norms, goals, law, and their own policies into blockchain-enabled applications.

CONCLUSION

This paper has reviewed the basic principles of blockchain technology and its pitfalls and potential as it relates to optimizing supply chains. Undoubtedly it has the potential to increase transparency and trust once a record is created. After reviewing available literature, however, the paper concludes that optimism with regard to blockchain should be tempered with an appreciation for its limitations. Law will not become irrelevant; on the contrary, attorneys will still have a role in translating human intentions into the world of code and the mechanisms for enforcing consequences in physical reality. We have also considered the last mile problem and highlighted the role of law at both the point at which a record is created and the point at which information is accessed. Someone has to create records, and consumers—or else governmental or private sector intermediaries—still have to care enough to actually alter behavior based on information about a product or service. The human element also cannot be underemphasized in the context of blockchain-enabled applications eliminating harmful side effects of business. Such goals can sometimes be expressed through business planning, sometimes through laws, but certainly there is a need for attorneys in translating human norms into code and then resolving disputes and enforcing expectations. Optimism about blockchain technology as a means of optimizing business supply chains should be tempered with a dose of pragmatic realism: it is a tool that must be married to good governance and legal frameworks to maximize its impact.
