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Blockchain and the Inevitability of Disputes: The Role for Online Dispute Resolution

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> I loved the Internet. But 25 years later, I see the words "the blockchain is the new Internet" scrolling down Twitter and I want to shake my news feed by the scruff of the neck and growl: Have you people learned nothing?![1]

I. INTRODUCTION

Blockchain seems to be everywhere these days. It is touted as the new foolproof technology, which can be used for everything from cryptocurrencies, through land registries to identity cards and health records.[2] Enthusiasts have predicted that it will bring about deep change, ensuring data security and identity authentication, while doing away with traditional intermediaries.[3]

With blockchain we are told that it is the "new internet,"[4] an application that will change the way we transact—strengthening commitments and ensuring seamless execution.[5] At the same time, and at an alarming frequency, we hear about mass scale fraudulent schemes attacking cryptocurrency exchanges, resulting in the

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1. Andrew Leonard, *The Blockchain Is a Reminder of the Internet's Failure*, ONE ZERO (Dec. 5, 2018), https://medium.com/s/love-hate/the-blockchain-is-a-reminder-of-the-internets-failure-b16c58d70413.

2. Daniel J. Neally & Maria L. Hodge, *Blockchain in the Courts*, 5 CTR. FOR L., SCI. & INNOVATION 1 (2018).

3. Aaron Wright & Primavera De Filippi, *Decentralized Blockchain Technology and the Rise of Lex Cryptographia* 1, 48-49 (2015), available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2580664.

4. *Mark Fenwick, Wulf A. Kaal & Erik P.M. Vermeulen,* LEGAL Education in the Blockchain Revolution*, 20 VAND. J. ENT. & TECH. L. 351 (2017); Rich Daly***,*** Blockchain: Wall Street's Most Game-Changing Technology Advance Since the Internet*, FORBES (July 11, 2016), available at: https://www.forbes.com/sites/richdaly/2016/07/11/blockchain-wall-streets-most-game-changing-technology-advance-since-the-internet/#4810e88f4d87.*

5. Jean Bacon et al., *Blockchain Demystified*, 10 (2017), available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3091218 (Feb. 28, 2019).

loss of many millions of dollars.[6] Aside from fraud, other problems abound, resulting from misunderstandings between transacting parties, loss of passwords and privacy risks, to name a few.[7]

The gap between the promise of an infallible, dispute-less environment and the inevitable reality of having to deal with disputes in the blockchain setting lies at the heart of this paper. It is, we contend, impossible to enjoy high levels of human interaction without generating conflict.[8] The inevitability of disputes is enhanced in a potentially lucrative environment of innovation and complexity, such as the blockchain.[9] In such settings, unexpected developments are bound to occur, and expectations of interacting parties are likely to differ. Indeed, this was our experience with the internet of the 1990s as the e-commerce setting began to flourish. Initially, disputes were not the focus of attention and avenues of redress were difficult to come by.[10] Over time it became clear, that for e-commerce to evolve there needed to be trust by users, and for trust to be sustained, e-commerce platforms needed to institutionalize avenues for addressing and preventing disputes.[11] These processes have come to be known as "online dispute resolution" (or ODR).[12] The lessons learned from the evolution of ODR are slowly penetrating the blockchain arena, as some entities are developing ODR tools and processes that are tailored to this environment.[13] At the same time, for ODR to be adopted and used, some of the underlying assumptions driving the design and adoption of blockchain technology need to be relaxed, as they are in tension with the tenets of dispute systems design: recognizing the inevitability of conflict, understanding trust as a human construct, and assigning weight to individual needs alongside group ideology.[14]

This article establishes its main theses in the following order. Part II provides background on the history and evolution of the blockchain, highlighting its dominant applications and its principal features. We discuss governance and trust on blockchain, finding that despite a rhetoric of disintermediation and distribution of power, there are still some players that enjoy more power than others in the blockchain setting. Furthermore, we highlight the governance choices that can shape the extent to which power is concentrated, accountability is established, and avenues of redress are available. In Part III we briefly discuss the history of ODR and describe the leading ODR schemes that have emerged for the blockchain setting, illuminating similarities and distinctions among them. Despite growing interest in ODR for

6. Michael Matthews, *List of Bitcoin Hacks (2012-2016)*, STEEMIT, availabl at: https://steemit.com/bitcoin/@michaelmatthews/list-of-bitcoin-hacks-2012-2016 (last visited Apr. 14, 2019); Anna Irrera, *More Than 10 Percent of $3.7 Billion Raised in ICOs Has Been Stolen: Ernst & Young*, REUTERS (Jan. 22, 2018), available at: https://www.reuters.com/article/ico-ernstyoung/more-than-10-percent-of-3-7-bln-raised-in-icos-has-been-stolen-ernst-young-*id*; Nathaniel Popper, *As Bitcoin Bubble Loses Air, Frauds and Flaws Rise to Surface*, N.Y. TIMES (Feb. 5, 2018), available at: https://www.nytimes.com/2018/02/05/technology/virtual-currency-regulation.html.

7. Bacon et al., *supra* note 5, at 16-49.

8. ETHAN KATSH & ORNA RABINOVICH-EINY, DIGITAL JUSTICE: TECHNOLOGY AND THE INTERNET OF DISPUTES (2017).

9. Kevin Werbach, *Trust, But Verify: Why the Blockchain Needs the Law*, 33 BERKELEY TECH. L.J. 489, 496-97 (2018).

10. Wright & De Filippi, *supra* note 5, at 47.

11. *Id.* at 48-50.

12. ETHAN KATSH & JANET RIFKIN, ONLINE DISPUTE RESOLUTION: RESOLVING CONFLICTS IN CYBERSPACE (2001).

13. *See infra* Part III.

14. *Id.*

blockchain, the use of these initiatives has yet to spread. We explore the various barriers that stand in the way of ODR for blockchain gaining momentum in Part IV.

II. BLOCKCHAIN: SOME BACKGROUND

A. History and Evolution

In the brief history of blockchain, its evolution, much like the technology itself, can be described as including several building blocks. The first stage in the development of blockchain had to do with the development of bitcoin a decade ago. Despite its recent emergence, bitcoin is based on prior works, developed as early as the 1990s. One such work is the Paxos Protocol, which drew on the legislative model employed in ancient Greece as an inspiration for a distributed database.[15] The idea was to do away with traditional third-party intermediaries, and create alternative structures for ensuring the credibility of information.[16]

The concept of a chain of data blocks was developed over time, but it took several years before a mature vision materialized. Beyond the need for technology to advance and mature, the impetus for the development of bitcoin was, to a large extent, the 2008 recession and rising distrust of financial institutions and other intermediaries.[17] Thereafter, in 2009, Satoshi Nakamoto, an individual whose identity has still not been established, described bitcoin in his white paper.[18] The white paper delineated a decentralized currency in a global environment that builds trust without reliance on traditional trust-building institutions.[19]

The principal design challenge for bitcoin was how to create a distributed, decentralized database in which anyone could access the data, add to the data, and broadcast the data, while ensuring the accuracy of the database and the authenticity of users' identity.[20] These challenges were met by creating a ledger of past financial transactions that is public and open, but is protected from unauthorized access, mistakes, and abuse, through cryptography and a complex architecture of incentives and required tasks.

Users who wish to add transactions to the ledger use private key encryption to authenticate their identity and to allow for the authorization of transactions.[21] Miners verify the transaction by solving a hash puzzle (an algorithmic cryptographic function).[22] Hash puzzles are used as "proof of work" (POW).[23] While miners solve the hash puzzle, the blocks await confirmation for ten minutes. During this time blocks containing information on all pending transactions are broadcast to all miners. For each block, a miner solves the hash puzzle. This is meant to serve two

15. Leslie Lamport, *The Part-Time Parliament,* 16 ACM TRANSACTIONS ON COMPUT. SYS. 133, 135-37 (1998).

16. *Id.* at 155-57.

17. Kurt Fanning & David P. Centers, *Blockchain and Its Coming Impact on Financial Services*, 27 J. CORP. ACCT. & FIN. 53, 54 (2016).

18. Satoshi Nakamoto, *Bitcoin: A Peer-to-Peer Electronic Cash System* (2009), available at: https://bitcoin.org/bitcoin.pdf (last visited Feb. 28, 2019).

19. *Id.* at 1-2.

20. *Id.* at 8.

21. Werbach, *supra* note 11, at 503-04; J. H. Witte, *The Blockchain: A Gentle Four Page Introduction*, CORNELL U. LIBR. 2 (Dec. 6, 2016), available at: http://arxiv.org/pdf/1612.06244.

22. Werbach, *supra* note 11, at 504-05.

23. *Id.*

goals. First, miners are incentivized to work by being paid in bitcoin for solving the puzzle.[24] Since the puzzle is computationally expensive it also serves to deter abuse by miners.[25] In addition, because hash values uncover whether data was tampered with, the puzzle promotes a second goal, that of ensuring the authenticity of the data.[26] After the puzzle is solved, other miners verify POW and, if approved, the block is added to the chain and maintained by "nodes"—computers on which a copy of the ledger is kept.[27] Since there are multiple nodes receiving information on transactions from different miners asynchronously, there need to be measures in place to ensure that transactions are recorded consistently by all nodes. To that end, blocks are time stamped and in case of conflicting transactions, the earlier transaction prevails and the longest chain (that with the most POW built into it) wins.[28] A consensus protocol is in place to ensure that nodes become consistent by choosing the longest chain.[29] "Orphan blocks" ("Uncle" in Ethereum) that do not appear in the correct chain are discarded by those nodes which chose the "wrong" chain. The orphan blocks return to the pool of transactions waiting to be processed.[30]

Alongside miners and nodes, developers are also key players, because they create the protocol and maintain the blockchain. They also advance additional implementations, and so they impact the entire community. They are incentivized by the expansion of their work's popularity, as well as the growth of the community and, consequently, of their stake. But overall, there needs to be a better system of incentives for long-term development of protocols.[31]

To date, bitcoin presents the most successful use case of blockchain technology and represents the single most significant stage of its evolution, resulting in the spread of cryptocurrencies.[32] At the same time, bitcoin's limitations became increasingly apparent over the years, as mining power became concentrated in few hands and as some community members demonstrated that bitcoin is not the immutable setting it was promised, when they instituted code changes referred to as "hard forks" and broke off to create their own competing cryptocurrency environment.[33]

The limitations of bitcoin helped spur the second important milestone in the evolution of blockchain—the expansion of blockchain use and applications beyond

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24. *Id.* at 506; Nakamoto, *supra* note 20, at 4, 8. The founders of bitcoin created a cap on the amount of bitcoin that can be issued as payment for miners in the amount of 21 million bitcoins. *See Important Bitcoin Basics and How it All Works: Things You Need to Know*, BITCOIN.COM, available at: https://www.bitcoin.com/you-need-to-know (last visited Apr. 14, 2019).

25. *Id.* at 8.

26. Werbach, *supra* note 11, at 491-493.

27. Bacon et al., *supra* note 7, at 12; Nakamoto, *supra* note 20, at 3.

28. *Id.* at 16.

29. *Id.* at 13, 21-24; Joshua A.T. Fairfield, *Smart Contracts, Bitcoin Bots, and Consumer Protection*, 71 WASH. & LEE L. REV. ONLINE 35 (2014).

30. Jack Frankenfield, *Orphan Block (Cryptocurrency)*, INVESTOPEDIA (APR. 11, 2018), available at: https://www.investopedia.com/terms/o/orphan-block-cryptocurrency.asp.

31. *Difference Between On-Chain and Off-Chain Governance*, MEDIUM.COM (June 5, 2018), available at: https://medium.com/@BLMPNetwork/difference-between-on-chain-and-off-chain-governance-c881cd3e6374; Bacon et al., *supra* note 7, at 89.

32. Massimo Bartoletti & Livio Pompianu, *An Empirical Analysis of Smart Contracts: Platforms, Applications, and Design Patterns*, CORNELL U. (Mar. 18, 2017), available at: https://arxiv.org/pdf/1703.06322.pdf.

33. Bacon et al., *supra* note 7, at 21, 34.

cryptocurrencies. This development is most commonly associated with the establishment of Ethereum in 2015.[34] Ethereum emerged six years after bitcoin and its founder, the then 19-year old Vitalik Buterin, sought to expand the use of blockchain beyond cryptocurrencies (although Ethereum did introduce its own "Ether" coin)[35] to the realm of "smart contracts"[36] or "distributed autonomous organizations" (DAOs)—entities that operate through smart contracts.[37] Ethereum established a broad community of users and processed a high level of daily transactions.[38] Approximately 200 million known transactions were made between 2013-2017 (excluding transactions made in private blockchains), transferring value of roughly $100,000 a day.[39] Ethereum seemed to incorporate some of the lessons of the bitcoin experience by expanding beyond currencies and adopting a more centralized structure than bitcoin through its core developer group.[40] Millions of dollars were raised through Initial Coin Offerings (ICOs) on Ethereum, and in May 2016 The DAO was introduced. The platform would allow anyone to pitch an idea and receive funding from the platform, thereby democratizing access to investments for individuals.[41] Soon thereafter, in June of 2017, a hacker found a coding loophole that allowed him to steal $70 million within hours.[42] In an attempt to address its vulnerability, the system performed a rollback which sought to erase the attack and its consequences, signaling above all that the immutability of transactions on blockchain was no longer an absolute truism.[43] A "hard fork" followed resulting in a new Ethereum Classic (ETC).[44] To make matters worse for The DAO, the Securities and Exchange Commission issued a ruling in 2017 that The DAO's offering was subject to the laws and regulations governing initial public offerings, and therefore The DAO and its investors may have violated federal securities laws.[45] The DAO has since been terminated, but it continues to impact current uses of blockchain.[46]

Around the same time, we also started seeing a growing interest in use of blockchain technology by public entities.[47] Estonia and Sweden, for example, have been

34. Vitalik Buterin, *A Next Generation Smart Contract & Decentralized Application Platform*, ETHEREUM WHITE PAPER (2015), available at: http://blockchainlab.com/pdf/Ethereum_white_paper-a_next_generation_smart_contract_and_decentralized_application_platform-vitalik-buterin.pdf.

35. *Id.* at 13.

36. *Id.* at 1.

37. *Id.* at 23-24.

38. Bartoletti & Pompianu, *supra* note 34, at 6.

39. *Id.*

40. Buterin, *supra* note 36, at 13, 27-28.

41. Adam J. Sulkowski, *Blockchain, Law, and Business Supply Chains: The Need for Governance and Legal Frameworks to Achieve Sustainability*, SSRN 9 (May 13, 2018), available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3205452.

42. Samuel Falkon, *The Story of the DAO – Its History and Consequences*, THE STARTUP (Dec. 24, 2017), available at: https://medium.com/swlh/the-story-of-the-dao-its-history-and-consequences-71e6a8a551ee.

43. *Id.*

44. Bacon et al., *supra* note 7, at 34-35. Ethereum classic, like Ethereum from which it split, is a public blockchain. *See* https://ethereumclassic.org/ (last visited on April 19, 2019).

45. Report of Investigation Pursuant to Section 21(a) of the Securities Exchange Act of 1934: The DAO (July 25, 2017), available at: https://www.sec.gov/litigation/investreport/34-81207.pdf; Jay Clayton, *Statement on Cryptocurrencies and Initial Coin Offerings*, U.S. SEC. & EXCH. COMM'N (Dec. 11, 2017), available at: https://www.sec.gov/news/public-statement/statement-clayton-2017-12-11.

46. Falkon, *supra* note 44.

47. This is not to be confused by the question whether the blockchain itself is public or private (which has nothing to do with whether the entity establishing it is public or private). On a Public blockchain

leading efforts to introduce blockchain technology into state infrastructure by experimenting with blockchain-based data registries, land registries, and official e-currencies (and more).[48]

A new generation of private blockchain entities also emerged in recent years, promising to remedy the scalability and pace problems that were associated with transactions on Bitcoin and Ethereum.[49] These include the NEO, EOS and IOTA, to name a few.[50] We have yet to see how they perform, but some of them are already exhibiting a more mature approach towards blockchain's limitations and fallibility, and, consequently, are embracing the need to think systematically about online dispute resolution.[51]

B. Principal Characteristics

Blockchain is premised on several core features, all of which work together to allow for the coordinated and decentralized creation of a secure and anonymous database of transactions. To achieve this end, blockchain technology is premised on the following characteristics: it is decentralized, it is immutable, and it is anonymous.[52] While, as we describe below, these traits are typically seen as essential to blockchain, in reality the degree to which they exist has varied. Below we elaborate on these issues by addressing the following questions: How do each of these characteristics contribute to the nature of blockchain? How do these characteristics interact with one another? And to what degree are these characteristics inherent to blockchain?

1. Decentralization

Blockchain is premised on the idea of removing the middleman and allowing for transactions to be executed and documented in a decentralized and distributed fashion.[53] This is achieved by distributing the functions that were performed in the past by a single entity, such as a bank, to multiple actors (e.g., users, nodes and

anyone can access and propose transactions, anyone can contribute computing power and broadcast network data, and all transactions are broadcast publicly. In a private blockchain, on the other hand, only safelisted participants can join the network, contribute computing power, and contribute to the data. *See* Bacon et al., *supra* note 7, at 25-26; Vitalik Buterin, *On Public and Private Blockchains,* ETHEREUM: BLOG (Aug. 6, 2015), available at: https://blog.ethereum.org/2015/08/07/on-public-and-private-blockchains/.

48. Neally & Hodge, *supra* note 4, at 5-7.

49. Buterin, *On Public and Private Blockchains*, *supra* note 49. Buterin stated in his blog: "Given all of this, it may seem like private blockchains are unquestionably a better choice for institutions." *Id. See also* Marc Pilkington, *Blockchain Technology: Principles and Applications*, *in* RESEARCH HANDBOOK ON DIGITAL TRANSFORMATIONS 225, 225-26 (F. Xavier Olleros & Majlinda Zhegu eds., 2016); MANAV GUPTA, BLOCKCHAIN FOR DUMMIES 14, 17 (2d ed., 2018); Scott A. McKinney et al., *Smart Contracts, Blockchain, and the Next Frontier of Transaction Law*, 13 WASH. J.L. TECH. & ARTS 313 (2018).

50. Sulkowski, *supra* note 43; Simon Boehme & Amy Wan, Summary of Proposed EOS Dispute Resolution Services (Dec. 2018) (unpublished manuscript) (on file with authors).

51. Amy Wan, *EOS Shows Transparency is Essential in Resolving Smart Contract Disputes*, MEDIUM (June 22, 2018), available at: https://medium.com/sagewise/eos-shows-transparency-is-essential-in-resolving-smart-contract-disputes-6755b19312d1.

52. GUPTA, *supra* note 5, at 18-19; Valentina Gatteschi et al., *Blockchain and Smart Contracts for Insurance: Is the Technology Mature Enough?*, FUTURE INTERNET (2018); Wright & De Filippi, *supra* note 5, at 2, 13, 20.

53. *Id.* at 2.

miners), and allowing users to perform each of these roles (if they have the technological skills and the required hardware).[54] Specifically, in standard monetary transactions, it is our bank that verifies our identity and the fact that we have the funds we committed to transfer and is also the entity documenting that such transfer takes place. In a bitcoin transaction, on the other hand, it is the joint efforts of miners and nodes that ensure that the individual transferring funds does indeed have them, that the correct person receives the funds, and that the transaction is recorded and documented so that the record kept on all computers is identical.[55]

By distributing power and authority among millions of computers, blockchain technology assumes that there is no one entity that can be corrupted or attacked.[56] These traits also safeguard against intermediaries' negligence or incompetence in performing their role, guaranteeing the accuracy of the account of transactions.[57] By having multiple copies of the ledger saved on numerous computers, there is no one source that can be attacked or revised.[58] In addition, the verification of transactions by miners who have to be diligent in solving the hash puzzle and the review of the solution to the puzzle by the other miners assures the accuracy of the transactions.[59] The consensus protocol serves to ensure that multiple, distributed copies of the ledger result in a single authoritative ledger, documenting the transactions, which are transparent and publicly available, thus allowing for broad monitoring.[60]

2. Immutability

Blockchain ledgers are touted as being immutable; once blocks are approved, the chain of data is assembled and becomes irreversible.[61] Where other types of databases could be altered or manipulated, here, we are told, the log created is stable and unchangeable.[62]

In those cases where smart contracts are entered into, the immutability is also connected with the execution of transactions, as the covenants or agreements that are typically subject to interpretation and discretion are documented in code and result in automatic, non-discretionary execution.[63] Execution typically results in the transfer of assets, data or funds, and is recorded, becoming part of the immutable ledger.[64] The unequivocal outcome promises to ensure performance and eliminate uncertainty.[65] Indeed, this quality, which is associated with blockchain, is part of

54. Gatteschi et al., *supra* note 54, at 2-3.
55. *Id.* at 3; Richard M. Weber, *An Advisor's Introduction to Blockchain*, 72 J. FIN. SERV. PROF'LS 49, 50 (2018); Pilkington, *supra* note 51.
56. Wright & De Filippi, *supra* note 5, at 5-6.
57. McKinney et al., *supra* note 51, at 316-17.
58. MIT Technology Review Editors, *A Glossary of Blockchain Jargon*, MIT TECH. REV. (Apr. 23, 2018), available at: https://www.technologyreview.com/s/610885/a-glossary-of-blockchain-jargon/.
59. Wright & De Filippi, *supra* note 5, at 7, 21-22.
60. Gatteschi et al., *supra* note 54, at 3.
61. Weber, *supra* note 57, at 50.
62. *Id.* at 51.
63. Gatteschi et al., *supra* note 54, at 4-5.
64. *Id.*
65. McKinney et al., *supra* note 51, at 316.

what makes this setting "trustless;" it allows for absolute strangers, often anonymous or pseudonymous parties, to engage with one another, transact and transfer funds, with all such interactions being documented immutably.[66]

3. Anonymity

Blockchain allows for anonymous and pseudonymous exchanges. This is made possible while ensuring the security and integrity of data by using private key encryption.[67] Such encryption allows for the verification of the identity of the person involved. While anonymization is often critiqued as tolerating illegal activities to take place,[68] the obfuscation of identity is significant on blockchain for several reasons.

First, anonymity ensures that miners and nodes do not take parties' identity into account when verifying a block.[69] Second, if identity is disclosed on a public blockchain, the data that can be accumulated on any given individual using the blockchain can be extensive and sensitive. Since a blockchain is immutable, the potential harm to individual privacy is substantial.[70] Finally, as governments are increasingly doing away with cash payments, the cryptocurrency arena may provide a space in which individuals can spend money without disclosing their identity and incurring a cost to their individual privacy.[71] Those in favor of anonymity recognize the problematic implications for criminal activity, but believe that the benefits outweigh the challenges, and advocate that crime be dealt with through measures other than eliminating the possibility of making private transactions through blockchain.[72]

These three basic qualities of blockchain—decentralization, immutability and anonymity—all work together and reinforce each another to create the delicate balance that allows for the removal of intermediaries. Trust in entities and individuals is substituted with fixed processes, complex cryptography and immutable documentation.[73] At the same time, a close look at those blockchain entities that are already in operation reveals that these qualities are less absolute than they are typically described, and reality is often more nuanced than it appears at first blush.

C. Governance and Dispute Resolution

Blockchain has become synonymous with a decentralized structure for the immutable documentation of information gathered in anonymous (or pseudonymous) transactions. At the same time, the governance structure behind blockchain entities often reveals that these qualities are less pronounced than they are touted to be. For one, blockchain governance can be more centralized, providing a key role to core developers and miners, with less voice to users.[74] This approach may indeed make

66. Alan Cohn, Travis West & Chelsea Parker, *Smart After All: Blockchain, Smart Contracts, Parametric Insurance, and Smart Energy Grids*, 1 GEO. L. TECH. REV. 273, 279 (2017).
67. Pilkington, *supra* note 51, at 229-31.
68. Werbach, *supra* note 11, at 491, 526; Witte, *supra* note 23, at 4.
69. Pilkington, *supra* note 51, at 229-30; McKinney et al., *supra* note 51, at 319-20.
70. GUPTA, *supra* note 51, at 20; Gatteschi et al., *supra* note 54, at 8; Werbach, *supra* note 11, at 531.
71. Weber, *supra* note 57, at 51; *see also* Witte, *supra* note 23.
72. Werbach, *supra* note 11, at 526; Gatteschi et al., *supra* note 54, at 13.
73. Id., at 10; Wright & De Filippi, *supra* note 5, at 12.
74. McKinney et al., *supra* note 51, at 320.

sense in an environment in which there is rapid technological advancement and understanding the issues at stake requires substantial technological knowledge, which users may not have.[75] This governance structure, associated among others with Bitcoin, is termed "off chain governance" in that questions related to governance (e.g., remuneration to miners, or software updates) are resolved off blockchain with limited transparency towards users, who are typically less involved.[76]

Some of the decisions made as part of blockchain governance have to do with "forking." The idea behind forking is that when the consensus protocol does not resolve contradictions between blocks recorded on different nodes, some nodes can break off the chain and start their own separate ledger.[77] They would share the same past up to the point of breaking off, but continue different paths thereafter. This is called a "hard fork." Several high-profile cases have highlighted the ways in which forking may detract from blockchain's claims of decentralization and immutability, but at the same time may have provided a much-needed avenue of redress in a setting priding itself for not having anyone in control.[78] One such well known incident is the Ethereum hack mentioned above, where a coding error allowed a hacker to drain $70 million from The DAO's funds. In response, Ethereum's software was updated to prevent the hacker from withdrawing the funds. Since this was done with the support of the creator of Ethereum, a majority of users complied with the change and updated the software.[79] However, a minority refused to sacrifice the immutable nature of the code and broke off to create "Ethereum Classic."[80]

Forking is used both as a dispute prevention and resolution mechanism. In terms of dispute prevention, forking and the consensus protocol are used as part of the operation of the blockchain to agree on which blocks to add to the chain.[81] Usually this works, and nodes are able to agree on an identical log.[82] Where a hacker has jeopardized the integrity of the log, a hard fork can be used to "undo" the transaction and provide redress for those users who were harmed by the hacker. But this results in a new dispute regarding the means for resolving the dispute, including the deeper consequences of how problems are handled on blockchain: who gets to decide and what are the options for addressing such problems.

Another type of problem that can arise with respect to the integrity and immutability of the record is the lack of distribution of computational power. In Bitcoin, for example, all of the computational power is concentrated among a small number of entities.[83] This creates the risk of a "51% attack," meaning that those controlling over half of the computational power can decide to approve their own thread of transactions, which will override other threads. The attack is possible because those with more computational power will have more proof of work and therefore prevail

75. Avital Mentovich, J.J. Prescott & Orna Rabinovich-Einy, Is Implicit Bias Inevitable? Courts, Technology and the Future of Impartiality 19-20 (unpublished manuscript) (on file with authors).

76. Bacon et al., *supra* note 7, at 24-25, 29, 103.

77. Weber, *supra* note 57, at 52.

78. Sulkowski, *supra* note 43, at 9.

79. Jakub J. Szczerbowski, *Transaction Costs of Blockchain Smart* Contracts, 16 L. & FORENSIC SCI. 1, 3 (2018); McKinney et al., *supra* note 51, at 321-23; Bartoletti & Pompianu, *supra* note 34; Bacon et al., *supra* note 7, at 32.

80. Bacon et al., *supra* note 7, at 35, 102.

81. *Id.* at 20-21.

82. *Id.* at 12.

83. Bartoletti & Pompianu, *supra* note 34*,* at 4.

according to the consensus protocol.[84] While this was considered a theoretical risk in the past, these attacks have become more frequent, especially with respect to small coins that have attracted fewer miners where computational power is easier to control. There have been technological solutions put forth to address this problem,[85] but the message seems to be a deeper one. From both the forking and 51% incidents we see that immutability is a design choice that comes at a cost; in some instances, reversing transactions might actually increase trust in the system, as was the case with the Ethereum hack.[86] Also, the 51% attack demonstrates that all systems are vulnerable. While these vulnerabilities can be detected over time and addressed, a new vulnerability will ultimately surface. Often these vulnerabilities emerge in the form of disputes, and the existence of dispute resolution avenues can assist not only in addressing particular disputes, but in preventing future problems from arising by providing a broader, more systemic solution.

On-chain governance means that decisions on how to run the blockchain are reached through online voting, representing a modern version of direct democracy.[87] EOS is one example of such a governance structure, where voting results are governed by software and executed automatically.[88] The development of on-chain governance was, to a large extent, a response to the problems and forking-type solutions that unmoored the blockchain environment in the last few years.[89] While these new structures have been accompanied by problems of their own, they have also recognized the need for addressing disputes, by setting up an arbitration body.[90] The arbitration body assembled by EOS reached a decision that drew much attention where it decided to freeze a transaction suspected as fraudulent, and return the funds. This decision was criticized, among other things, for the lack of transparency of the operation of the arbitrator, and its centralized character, both which challenged the arbitration body's legitimacy.[91]

Aside from governance-related issues, other problems can (and do) arise between the transacting parties themselves regarding the execution and interpretation of smart contracts, or between users and their "wallets," which are new intermediaries that operate in this environment to provide users with storage services for their cryptocurrency.[92] Parties may, for example, dispute the amount of money they have in their wallet, or, as often happens, may lose their password and be unable to access

84. Bacon et al., *supra* note 4, at 46 (showing that this concern just materialized recently). *See also* Mike Orcutt, *Once Hailed as Unhackable, Blockchains Are Now Getting Hacked*, MIT TECH. REV. (Feb. 19, 2019), available at: https://www.technologyreview.com/s/612974/once-hailed-as-unhackable-blockchains-are-now-getting-hacked/.

85. *See*, *e.g.*, Alyssa Hertig, *Blockchain's Once-Feared 51% Attack Is Now Becoming Regular*, COINDESK (June 8, 2018), available at: https://www.coindesk.com/blockchains-feared-51-attack-now-becoming-regular.

86. Werbach, *supra* note 11, at 550-51.

87. *Id.*; Gatteschi et al., *supra* note 54, at 9.

88. *ECAF Rules of Dispute Resolution*, ECAF, https://eoscorearbitration.io/home/governance/ (last visited Feb. 25, 2019) [hereinafter *ECAF Rules of Dispute Resolution*].

89. *See* Werbach, *supra* note 11, at 548-49.

90. *Id.* at 547-48.

91. Wan, *supra* note 53.

92. Orna Rabinovich-Einy & Ethan Katsh, *The New New Courts*, 67 AM. U. L. REV. 165, 176 (2017); Orna Rabinovich-Einy & Avital Mentovich, *Right of Access and Access to Justice in the Courts of the 21st Century* 4, 7-8 (forthcoming 2019).

their e-wallet.[93] Complex questions relating to the ability to inherit cryptocurrencies arise when family members do not have access to the deceased's password.[94] All of these problems need to be addressed in a systematic and structured way by providing dispute resolution avenues. Indeed, EOS's arbitration system has been flooded with many of these types of disputes but has yet to provide effective redress for parties.[95] In the following section we describe the emergence of online dispute resolution mechanisms some twenty years ago in the e-commerce setting and the more recent attempts to introduce such processes into the blockchain arena.

III. ONLINE DISPUTE RESOLUTION FOR BLOCKCHAIN

A. ODR, Some Background

Large scale online dispute resolution (ODR) processes emerged in the 1990s. As the ban on commercial activity on the internet was lifted, the population of users increased rapidly, and number of disputes grew.[96] The internet had been invented in 1969 but for more than twenty years, users had been few and were located either at universities or in the military. Domain names, which were worthless at the beginning of the 1990s became by 2000, both valuable, and the subject of growing numbers of disputes.

The rapid growth of e-commerce disputes online could be attributed to several factors. For one, transactions occurred between strangers, often from different countries and cultures, who had to overcome linguistic, cultural and legal differences.[97] In addition, the fast pace of internet communication and the thin nature of interaction and communication were often fertile ground for misunderstandings and escalation.[98] Finally, complexity and innovation inevitably generate problems, and the online arena at that time was both innovative and complex.[99]

Given the nature of these disputes, traditional avenues of dispute resolution—courts and their alternatives—both of which required physical presence, were not a viable solution for the vast majority of online disputes. These were disputes over low sums of money in which parties were physically distant from one another, and could not be resolved face-to-face. However, it turned out that the very technology that made traditional dispute resolution processes inaccessible, could also provide the basis for developing new, innovative and accessible avenues of redress. These processes were what we now term ODR, and initially were online equivalents of traditional alternative dispute resolution (ADR) processes, such as negotiation, mediation and arbitration.[100]

93. Witte, *supra* note 23, at 2-3.

94. Gatteschi et al., *supra* note 54, at 3-4.

95. TELEGRAM, https://t.me/eosarb (last visited Apr. 16, 2019) (public chat room for discussing the EOS Blockchain system).

96. Rabinovich-Einy & Katsh, *supra* note 94, at 187-88; *see also* Rabinovich-Einy & Mentovich, *supra* note 94, at 9, 11-12.

97. Rabinovich-Einy & Katsh, *supra* note 94, at 187-88.

98. *Id.* at 169; Rabinovich-Einy & Mentovich, *supra* note 94, at 19-20.

99. Rabinovich-Einy & Katsh, *supra* note 94, at 167-69, 171. *See also* Rabinovich-Einy & Mentovich, *supra* note 94, at 9-10, 16, 19, 21-22.

100. Rabinovich-Einy & Katsh, *supra* note 94, at 176-78, 181, 212; *see* Rabinovich-Einy & Mentovich, *supra* note 94, at 3-4, 6.

Over time, ODR providers came to appreciate the opportunities embedded in the new medium and shifted their focus from trying to mimic familiar processes from the offline setting to developing new processes which presented new opportunities for addressing conflict. These new opportunities emerged from the unique qualities of ODR: it was offered online, it relied on the intelligence of the machine (the "fourth party"), and it created a digital trail.[101] These characteristics made ODR much more accessible and efficient and, being freed of the limitations of human capacity and in-person meetings, allowed ODR processes to handle extremely large numbers of disputes. In fact, eBay's ODR system is able to handle the unfathomable number of 60 million disputes a year.[102]

But beyond the added efficiency and capacity, the shift to ODR also opened up opportunities for enhancing fairness and justice. Through appropriate design and careful study of dispute resolution data, processes could be made more accessible to, and understandable by, parties belonging to traditionally disempowered groups, offering them structured language and menus with prescribed options, as well as allowing them time to phrase their responses, and consult with an expert.[103] Whether these new opportunities will result in increased voice and just outcomes is yet to be seen, but there is some indication that appropriate design and ongoing monitoring could help overcome some of the traditional dispute resolution world's most entrenched problems.[104] Also intriguing are the new opportunities for using the dispute resolution data that is automatically captured in ODR to learn about the sources of recurring disputes and engage in dispute prevention—activity designed to prevent such problems from recurring without waiting for a complaint by the aggrieved party. A proactive approach to dispute prevention therefore could improve redress for parties who fail to complain, often those belonging to social groups most affected by financial and other barriers that stand in the way of airing disputes.[105]

During the last few decades, ODR's reach has extended beyond e-commerce and disputes generated online in interactions on private platforms to the public sector and disputes that arise in the face to face context. ODR is no longer a last resort, used for low value disputes between strangers where courts and ADR are unavailable, but is often the first choice for those individuals whose lives are increasingly taking place online in a broad range of settings, in their disputes with individuals, companies, and public entities.[106]

It should come as no surprise that the blockchain setting, used most commonly for cryptocurrency transactions, would become a candidate for ODR. In the following section, we describe some of the leading enterprises developing ODR for blockchain and smart contracts, highlighting commonalities across the various platforms, as well as some of the distinct features of each of these entities.

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101. Rabinovich-Einy & Katsh, *supra* note 94, at 168-69; Rabinovich-Einy & Mentovich, *supra* note 94, at 15-16.

102. Rabinovich-Einy & Katsh, *supra* note 94, at 168-69, 187, 201; Rabinovich-Einy & Mentovich, *supra* note 94, at 15-16.

103. Rabinovich-Einy & Katsh, *supra* note 94, at 203; Rabinovich-Einy & Mentovich, *supra* note 94, at 17, 21-22.

104. Rabinovich-Einy & Mentovich, *supra* note 94, at 17, 21-22.

105. *Id.* at 17-18; Rabinovich-Einy & Katsh, *supra* note 94, at 209.

106. Rabinovich-Einy & Mentovich, *supra* note 94, at 10, 12, 17-19.

B. Emergence of ODR Mechanisms for Blockchain

Despite early promises for a dispute-free environment in which transactions are irreversible and executed automatically, eventually it began to be asked "what about dispute resolution?"[107] Experience with blockchain-based endeavors in recent years has shown that blockchain, as any other area of human engagement in a rapidly evolving complex setting, is bound to generate misunderstandings, conflict and unforeseen circumstances. Within a few years, entrepreneurs started seeing the potential of ODR for the blockchain arena, because ODR is conducted online from afar, and allows for flexible design and a global reach. Below is a description of some of the principal systems and processes that emerged in the last couple of years for blockchain dispute resolution.[108]

1. Kleros

The Kleros "arbitration" system is meant to address smart contract-related disputes.[109] The Kleros process can be activated once a dispute arises in the execution of a smart contract, freezing fund transfers under the smart contract until the conflict is resolved.[110] For this to occur, the parties must pre-select Kleros as a dispute resolution provider in their smart contract and agree upon some basic features of the resolution process—the Kleros sub-court in which the dispute will be addressed, the number of jurors, etc.[111]

The design of the dispute resolution system developed by Kleros emulates some of the characteristics of the design of the blockchain environment. Kleros is premised on crowdsourcing—using the wisdom of the crowds—and game theory.[112] The resolution itself is reached through jury voting.[113] Jury members are incentivized to participate and to vote together with the majority through a mechanism similar to the "Schelling Token."[114] The funds for covering the jurors' pay must be deposited for the dispute resolution process to commence. Parties need to agree as to who bears the costs; the system is agnostic to whether one of the parties, all parties, or a third party pays.[115] If a party believes the contract was breached, he or she needs to approach Kleros and send it all evidence (secured through public key encryption).

Jury members are anonymous and nominate themselves. Therefore, incentives need to be put in place to ensure that such anonymous jurors resolve the dispute in a fair and honest manner. This goal is realized through the use of tokens and a

107. *10 Things Blockchain Isn't*, CRYPTO BEGINNERS, https://www.cryptobeginners.info/blog/10-things-blockchain-isnt/ (last visited Feb. 28, 2019).

108. Descriptions are mostly based on information contained in these enterprises' white papers, websites, and, in some cases, on interviews conducted with their founders.

109. *The Blockchain Dispute Resolution Layer*, KLEROS, https://kleros.io/ (last visited Apr. 16, 2019).

110. *Id.*

111. Federico Ast, *Kleros, A Protocol for a Decentralized Justice System*, MEDIUM (Sept. 11, 2017), https://medium.com/kleros/kleros-a-decentralized-justice-protocol-for-the-internet-38d596a6300d.

112. KLEROS, *supra* note 111.

113. *Id.*; Ast, *supra* note 113.

114. Clement Lesaege & Federico Ast, *Teaching with Technology White Paper* 1 (2018), https://kleros.io/assets/whitepaper.pdf.

115. *Id.* at 7-8.

random jury selection process.[116] As jurors sign up they start off in the general court and are then assigned to specific sub-courts (e.g., e-commerce, insurance, transport) based on their credentials.[117] Each sub-court has its own rules and requirements regarding costs, number of jurors, and number of active tokens required.[118] Each token owner can sign up to a maximum of one sub-court in which they have an activated token and in this way they are incentivized to sign up to the sub-court which handles matters in which they have the most expertise.[119] Each juror is paid for her work and therefore has an economic interest to serve as a juror. In order to vote, the juror is required to deposit a token termed "PNK."[120] The more tokens a juror deposits, the more likely she is to be selected as a juror.[121] The number of times a juror has been selected determines the number of votes the juror receive as well as the number of tokens he or she will gain or lose with the redistribution of tokens after the jurors have voted (gain and loss are determined depending on whether the juror has voted with the majority of jurors or not).[122] Since inactive jurors do not deposit tokens, they cannot be selected. Also, tokens play a crucial role in preventing fraud and attempts to influence the outcome of the case.[123]

Each contract details the voting options for the jurors as well as what would be the operative consequences of voting for each of the options (transfer of funds, etc.).[124] Jurors receive the evidence, weigh it and reach a decision in accordance with the rules of the particular court in which the case is being decided (parameters such as time to resolution, voting options and possibilities for communication with the parties vary across courts).[125] After weighing the evidence, jurors commit to voting for one of the parties and must justify their decision. Voting is performed through a hash that contains the vote, salt (a random figure that enhances randomness), and an Ethereum address of the juror so as to make each juror's vote unique and prevent fraud among jurors.[126] Once jurors have made a decision, they may not alter their vote, but their decision, at this point, is still concealed from the other jurors. After voting has ended, each juror reveals his or her vote and salt, and a Kleros smart contract verifies that this indeed matches the manner in which the juror voted.[127] Jurors who do not reveal their vote are punished twice as much as they would be for voting incoherently.[128] Only after all jurors have put in their votes and their voting has been verified, will the votes become transparent so that jurors will

116. *Id.* at 5.
117. *Id.* at. 10.
118. *Id.*
119. *Id.* Requiring jurors to choose between subcourts incentivizes them to choose the subcourts they are the most qualified for. If they were able to choose every subcourt, there would be a concern that some would choose all of them to maximize their arbitration fees from their tokens.
120. Lesaege & Ast, *supra* note 116, at 4.
121. *Id.* at 4, 9. Theoretically, it is possible for the same juror to be selected twice for a single dispute, but such a scenario is highly unlikely.
122. *Id.* at 5.
123. *Id.* at 8. Coins protect the system against malicious attacks and provide proper incentives for jurors. If jurors were simply drawn randomly, a malicious party could create a large number of addresses to be drawn several times per each dispute. In addition, pinakion provides jurors with an incentive to vote honestly by making incoherent jurors pay part of their deposit to coherent ones.
124. *Id.* at 4.
125. Ast, *supra* note 113.
126. Lesaege & Ast, *supra* note 116, at 6-7.
127. *Id.* at 7.
128. *Id.* at 8-9.

not influence or be influenced by other jurors' decisions.[129] All votes are counted and the smart contract will be executed in accordance with the decision that represents the highest number of votes.[130] Tokens will be redistributed among the jurors depending on whether they voted with the majority or not. The assumption is that whomever did not vote with the majority either signed up for a sub-court in which they have insufficient expertise, did not weigh the evidence properly, or did not attempt to reach an accurate decision (were bribed).[131]

Parties may appeal the decision (several times!); each time the number of jurors will be doubled plus one. The party appealing the decision will need to deposit the funds to cover the appeal. Since costs grow exponentially with the increase in the number of jurors, this is expected to inhibit parties from appealing repetitively.[132] The final decision is automatically enforced as part of the smart contract, as is the payment for the cost of the arbitration (borne by the losing party).[133]

Kleros offers a rights-based dispute resolution process, which results in a binary, dichotomous resolution in favor of one party and against the other. The process by which such resolution is reached is one that aggregates the votes of a large crowd of jurors, who are operating within a structure that aims to ensure the integrity of the voting process through a tokenized incentive structure and additional measures. As we shall see, these principles shape several of the endeavors in the blockchain ODR sphere, perhaps because the elements that underlie this approach resemble some of the basic notions that have given rise to blockchain technology—the desire for more democratic and decentralized decision making, and for automatic enforcement of decisions reached.

2. Juris

Juris offers an open code dispute resolution system using blockchain and Juris tokens (JRS).[134] The Juris framework operates where the parties adopted the Juris code in their smart contract. Once a dispute arises, the parties can freeze the contract and access the system through the Juris dashboard. The parties are referred to a multi-step dispute resolution process, starting with "SELF Mediation"—a selection of tools, including mediation, that can help parties reach a consensual agreement.[135]

If parties are unable to resolve the dispute through consensual processes, they can turn to a "SNAP" (Simple Neutral Arbitrator Pool) judgment.[136] SNAP is a

129. Ast, *supra* note 113.
130. *Id.*
131. *See generally* Lesaege & Ast, *supra* note 116.
132. Furthermore, there are incentives for jurors to provide reasoned decisions that would further inhibit appeals. *See id.* at 8 (stating that "If a verdict is appealed, jurors of the appealed level are not paid. (but they are still affected by the dispute due to token redistribution). This incentivizes jurors to give explanations of their rulings. When proper explanations are given, parties are less likely to appeal as they have more chance to be convinced that a decision is fair").
133. *Id.*
134. *Teaching with Technology White Paper* 27*White Paper Version 2.0*, JURIS JURIS 3 (Sept.. 18, 2018), available at: https://drive.google.com/file/d/1318klGEYL4g02VudL-C-BCnvpKujTnbF/view.
135. *Id.* at 16-17.
136. *Id.* at 17.

process through which parties receive a judgment by neutral jurors who anonymously vote on the case.[137] The group of jurors also provides a brief opinion on the case.[138] After receiving the jurors' decision, the parties may return to the SELF stage and reach a consensual agreement.[139] During this phase the parties have a timeframe for supplying necessary details regarding the case, after which the case brief is sent to jurors with JRS tokens, for review.[140] As part of their vote, jurors are required to provide one of three justifications as well as a brief reasoning.[141] All judgements remain concealed until the deadline for submission. After this time the information becomes public and a discussion among SNAP jurors ensues, and legal experts actively participate by asking questions, providing relevant information and justifications.[142] Following this stage, another vote takes place, with jurors justifying their votes and providing reasoning.[143] Following the vote, each legal expert is assigned to a consensus group and each group forms a "final opinion." These opinions are transferred to the parties, and they can rely on them in returning to the consensual tools.[144]

Finally, the binding PANEL (Preemptory Agreement for Neutral Expert Litigation) judgment stage is meant for complex disputes that require the input of the most experienced jurors (High Jurists) or for those disputes in which parties would like to reach a legally binding award under the N.Y. Convention.[145] While this avenue is more costly than SNAP, it can provide parties with an award that is not only legally binding but enforceable worldwide. All materials from the SNAP phase will be available for the jurists at this stage and the decision makers may request additional information before rendering their decision. The decision must be reached within thirty days and once rendered, the smart contract between the parties will be rescinded, and the award will be automatically enforced.[146]

The system engages jurors of three levels—high jurists, good standing jurists and novice jurists.[147] High jurists are professional arbitrators with experience on the platform. They decide the lengthiest cases, which are the most rewarding. Good standing jurists are jurors who contribute to the platform and can vote on SNAP cases. They can advance to the rank of high jurist by obtaining higher ratings. Novice jurists are new users who can participate in discussions and evaluate SNAP but cannot decide cases. Juris has a reputational system for jurors, which evaluates the quality of their decision making.[148]

Juris, as we can see, employs tokenized juror voting, but also leaves room for consensual party to party dispute resolution efforts, structuring a tiered resolution system that ultimately results in a legally binding and enforceable award.

137. *Id.*
138. *Id.*
139. *Id.*
140. JURIS, *supra* note 136, at 30.
141. *Id.* at 31.
142. *Id.*
143. *Id.*
144. *Id.* at 16-17.
145. *Id.* at 33.
146. JURIS, *supra* note 136, at 34.
147. *Id.* at 18.
148. *Id.* at 41.

3. Jur

Jur's dispute resolution mechanism is premised on the creation of a decentralized voting system that draws on the wisdom of the crowds and tokenization. Users use tokens for voting and are encouraged to align their votes with what they predict the majority vote will be.[149] There are different types of smart contracts that can be used, structuring differently who can vote and how such vote is structured.[150] Blockchain technology is used to process the votes and tokens are used to incentivize voters to vote in line with what they predict will constitute the majority vote.[151]

There are two modes of voting for resolving disputes—open and closed voting. Open votes are employed where no expertise is required. In such a vote, all token-holding users may evaluate the case and vote.[152] Those voters who voted early enough to generate a majority vote and voted in line with such majority vote will receive the tokens of those voters who were in the minority.[153] Minority voters are sanctioned by losing their tokens to those voters who predicted the direction in which the majority of votes would sway.[154]

As we can see, the incentive structure is such that rational voters are supposed to vote only when their confidence level in their ability to predict the majority vote exceeds fifty percent.[155] Voting is transparent and Jur employs various mechanisms to ensure that such transparency does not thwart the incentive structure, such as placing a cap on the gap between the majority and minority votes (as a function of the percentage of votes cast).[156] Since voters would like to gain tokens and avoid a loss, it is expected that in those instances in which expertise is required, only voters who possess such expertise will participate in the vote.[157] This layer of voting requires no fee, but the complainant must put forth a stake of one percent or more of the value of the contract when setting forth their proposal for resolution.[158] If the complainant receives the majority of the votes, then the stake will be returned to him or her and he or she will receive an award.[159] If, on the other hand, the complainant is in the minority, then his or her voting stake will be lost and passed on to the majority voters.[160] It is presumed that the incentive structure motivates voters to cast their vote to promote a fair and just resolution at zero cost.[161]

The cases that are resolved in a closed vote ("closed hub") are those that require expertise and involve a legal question.[162] A hub is a closed setting in which only JUR token-holders with special expertise or qualifications may vote.[163] An admin sets up the hub and determines the precise voting process, including the required

149. *Id.*
150. *Id.* at 16.
151. *Id.* at 8-9.
152. JURIS, *supra* note 136, at 15.
153. *Id.* at 44.
154. *Id.*
155. *Id.*
156. *Id.* at 45.
157. *Id.* at 60-61.
158. JURIS, *supra* note 136, at 45.
159. *Id*.
160. *Id.*
161. *Id.* at 53.
162. *Id.* at 21.
163. *Id.* at 48.

number of votes.[164] Any user can create a hub, but it is the complainant's prerogative whether to use the open layer or a closed hub for the resolution of their dispute.[165] Only voters with tokens stored in wallets that are attached to the hub may participate in a closed vote.[166] Naturally, the closed nature of the hub setting and the smaller number of participants, make the hubs more vulnerable to fraud, manipulation, or the influence of concentrated power. Therefore, the admin may determine a maximum number of tokens per participant, and each voter's maximal number of tokens cannot exceed a maximal portion of the overall number of tokens in the hub.[167] In addition, the rules place a cap on the value of the disputed amount in relation to the number of tokens participating in the vote so as to ensure that the risk associated with the vote does not exceed the value of the prize.[168]

In summary, through its reliance on the two options for tokenized voting entered into by the parties to the dispute through smart contracts, Jur believes it is able to create an "unbreakable voting system,"[169] a system that is decentralized, whose outcome can be automatically enforced without having to resort to courts.

4. Aragon

Aragon draws on dispute resolution mechanisms as a means of consensual governance of a decentralized app. Aragon's ANT tokens allow their holders to vote on the future development of the app, making the establishment and operation of a decentralized body simpler and smoother on the blockchain.[170]

The idea is for parties to deposit collateral for the execution of the smart contract between the parties, and create mechanisms for the resolution of disputes in the form of digital adjudication.[171] Aragon's court, much like national courts, will have jurisdiction over those organizations that have entered into smart contracts on the Aragon platform.[172] Past decisions will be fed into an archive and the expectation is that over time the jurors will gain reputational credit and their decisions will become more consistent.[173]

In order to become a juror, one must agree to a code of conduct, which refers to instances in which one or both parties try to influence the voting process.[174] When initiating a claim, the complainant's fees are a function of the overall reputation of the jurors voting on the case.[175] The procedure begins with the parties submitting statements and evidence. There is a ruling phase where the claim may be rejected immediately, or the jurors may decide that the contract should be updated, or that collateral should be re-allocated between the parties, or that the claim should be flagged for further review for foul play by one or more of the parties.[176] These

164. JURIS, *supra* note 136, at 44.
165. *Id.* at 48.
166. *Id.* at 49.
167. *Id.* at 48.
168. *Id.*
169. *Id.* at 8.
170. ARAGON, https://aragon.org/ (last visited Apr. 16, 2019).
171. *See* JURIS, *supra* note 136.
172. *Id.*
173. *Id.*
174. *Id.*
175. *Id.*
176. *Id.*

decisions are reached by majority vote of the jurors.[177] If at least one juror chooses the latter option, then jurors selected from the review court will review the conduct of the jurors who did not flag the case, to see whether there has been any foul play and the jurors failed to report one or more of the parties, contrary to their obligations.[178] The outcome of the review can be either a finding that the case was wrongfully flagged, that the case was rightly flagged and the claim is rejected because both parties attempted to bribe the jurors, or that the case was rightly flagged and the case will be decided in favor of the party who did not attempt to bribe the jurors.[179] If the jurors did not flag parties who tried to bribe them, they will lose their reputation.[180] Parties may appeal, but for each appeal the overall weight of the jurors' reputation must be doubled.[181]

Here, as in other cases, jurors vote on disputes in a tokenized system that incorporates various incentive structures to ensure that the voting process is fair. Aragon also sends a clear message to jurors as to what is expected of them through the code of conduct they commit to. An enforcement mechanism which draws on the prisoner's dilemma works alongside the code in driving jurors to report bribery attempts by parties.

5. Sagewise

Sagewise offers a technological infrastructure for addressing disputes related to smart contracts. The platform draws on blockchain technology, dispute resolution, and cryptocurrencies, to offer a product that freezes the execution of a flawed smart contract (e.g., coding error, security issues, contract does not reflect parties' wishes) and allows for a dispute resolution process to take place.[182] The application can be applied to a wide variety of smart contracts, including supply contracts, financial contracts, contracts relating to digitized assets, and consumer contracts.[183]

The mechanism through which Sagewise is employed is quite straightforward. Parties are required to include in their smart contract the "Sagewise SDK," a coded contractual clause which is the equivalent of the traditional dispute resolution clause.[184] The Sagewise SDK performs three important functions—it activates the dispute resolution process, it freezes the smart contract, and it ultimately allows for the enforcement of any resolution reached through its contract upgrade feature.[185]

Sagewise operates as a facilitator through the SDK, where it can allow a delay in the smart contract around certain functions, so as to allow the parties to communicate through text or email to ensure that their expectations are met.[186] When the contract is generated, time locked periods (sometimes referred to as "road

177. JURIS, *supra* note 136.
178. *Id.*
179. *Id.*
180. *Id.*
181. *Id.*
182. James Sower, *Sagewise Pioneers Dispute Resolution for Smart Contracts*, ICO CROWD (July 21, 2018), http://icocrowd.com/sagewise-pioneers-dispute-resolution-for-smart-contracts/.
183. JD Alois, *Sagewise Pitches Dispute Digital Resolution Protocol for Blockchain Based Smart Contracts*, CROWDFUND INSIDER (Feb. 19, 2018), https://www.crowdfundins*id*.er.com/2018/02/128595-sagewise-pitches-dispute-digital-resolution-protocol-blockchain-based-smart-contracts/.
184. JURIS, *supra* note 136, at 3.
185. *Id.*
186. *Id.*

bumps") can be created around key activities ("key code points") so as to allow the parties to verify the code and its impact.[187] An additional layer of protection is offered for those instances in which an unexpected dispute arises regarding a coding error or some other unforeseen event, and allows for freezing the smart contract.[188] A combination of freezing the contract, time blocks, and alerts which warn the users from continued execution of the contract allow the parties to prevent its execution prior to the occurrence of the impending default.[189]

Beyond freezing the smart contract, the Sagewise product allows the parties to amend the contract and resolve the dispute through a resolution process conducted via a smart contract. By pressing the SDK button on their mobile app, parties can activate a dispute resolution process.[190] As a first step, parties are given an opportunity to resolve the dispute on their own by amending the code, changing the terms of the contract and the like. This interaction takes place while the execution of the smart contract has been put on hold and, if they are successful, they can amend the contract and proceed with its execution.[191] Otherwise, the smart contract will move on to the next phase involving a human third-party facilitator, and expert advice on choosing a dispute resolution provider among those offered through Sagewise.[192] This stage involves payment with Sagewise tokens by the complainant. Sagewise does not itself provide dispute resolution services, it serves as a gateway to what will be in the future a marketplace of ODR providers.[193] Parties may agree in advance on a particular provider, and may also change their initial selection should, for example, such provider no longer be active. The dispute resolution provider may also reject the acceptance of a given dispute under certain circumstances. Where it has accepted the dispute, such provider is granted full control over the smart contract, and therefore the resolution reached through the provider can be optimized and seamlessly enforced by creating a new smart contract.[194] To enjoy continued access to, and control over, the smart contracts on Sagewise, the dispute resolution providers will have to deposit Sagewise tokens.[195]

The various steps for dispute resolution can be defined as parameters on the SDK, or the site default will prevail. Such parameters include "ResolutionServiceID," which defines the selected dispute resolution provider, choice of law, choice of process, language, and the like.[196] "SelfDisputeResolutionEnabled" states whether parties can attempt to resolve the dispute on their own under the contract.[197] The "ArgumentVotingTimeout" parameter determines the period of time after which a party will be considered non-responsive to a resolution vote.[198]

187. *ConsenSys/Smart-Contract-Best-Practices*, GITHUB, github.com/ConsenSys/smart-contract-best practices/search?utf8=%E2%9C%93&q=speed%2Bbumps&type= (last visited Feb. 24, 2019).
188. JURIS, *supra* note 136, at 13.
189. *Legal Business Infrastructure for Blockchain & Smart Contracts (All Verticals)*, SAGEWISE, https://www.sagewise.io/use-cases/ (last visited Apr. 16, 2019).
190. JURIS, *supra* note 136, at 4.
191. *Id.* at 12.
192. *Id.* at 20.
193. *Id.* at 2.
194. *Id.* at 22.
195. *Id.*
196. JURIS, *supra* note 136, at 15.
197. *Id.*
198. *Id.*

And finally, the "CountActivationThreshold" parameter defines criteria for activating the dispute resolution function.[199]

In conclusion, Sagewise recognized the need for effective dispute resolution and prevention in the blockchain setting and has developed the technical infrastructure to realize this goal. In its white paper, Sagewise envisions a future in which it may expand beyond providing tools for dispute resolution to the realm of rulemaking that will guide the crypto-community in structuring its transactions.

6. Mattereum

Mattereum is a smart contract enterprise whose mission is to allow for smart contracts to cover physical assets by getting "real world assets on-chain."[200] To that end, Mattereum has developed the "automated custodian" tool—a real world asset's legal owner and registrar.[201] It also incorporates a dispute resolution process premised on off-chain arbitration, relying on independent external arbitrators.[202] Mattereum creates a variety of legal contracts and corresponding smart contracts so as to facilitate common legal transactions, such as the sale, auction, and lease of physical property, as well as the licensing of intellectual property.[203] The parties create a Ricardian contract, which allows for digital performance and uses cryptography to record evidence of the contractual agreement.[204]

If a dispute arises, the parties can turn to arbitration, which is conducted by an independent, external body.[205] Parties can either choose arbitrators from options provided to them, or, if they cannot agree, one will be assigned to them.[206] The costs of the arbitration are included in the fee paid as part of the audit of Mattereum contracts, performed to locate flaws, areas of ambiguity and other potential problems.[207] In this respect, Mattereum not only offers ex-post dispute resolution services, but also engages in active ex-ante dispute prevention efforts.

Mattereum's scope of operation is different than many of the other entities operating in the domain involving blockchain and ODR for several reasons. For one, it attempts to use blockchain for off-chain assets, an ambitious task that expands the scope of disputes that could be handled through ODR for blockchain, much in the same way that the offline-online distinction has become less relevant for ODR in other contexts. Second, Mattereum opts for traditional arbitration as opposed to crowd-sourced jury voting. While such a choice may have its advantages, it also opens up questions regarding the ability to scale and handle mass disputes in the future.

199. *Id.*
200. Vinay Gupta et al., *Smart Contracts. Real Property.* 2-3 (Mattereum, Working Paper), https://mattereum.com/upload/iblock/af8/mattereum_workingpaper.pdf.
201. *Id.* at 2.
202. *Id.* at 20.
203. *Id.* at 16.
204. *Id.* at 9.
205. *Id.* at 20.
206. Gupta et al., *supra* note 202, at 20.
207. *Id.* at 39.

7. RHUbarb

Rhubarb uses smart contracts and RHY tokens for enhancing access to justice and new forms of democratic dispute resolution.[208] RHUbarb has expertise in the dispute resolution arena through its involvement with PeopleClaim, a large ODR provider which focuses on using technology to improve the way dispute resolution mechanisms operate, and to enhance access to justice.[209] PeopleClaim has a large community of users, allowing people to submit claims and have the community resolve them based on the wisdom of the crowds.[210] The process is public, and the parties can invite experts (e.g., lawyers, doctors) from the community to offer feedback on their case.[211]

The RHUbarb mechanism has several layers. One possibility is to conduct "poll verdicts."[212] Conducting polls is a quick, inexpensive and democratic avenue for reaching decisions that are based on a broad consensus. Jurors whose vote was in the minority will lose their tokens.[213] The results of the poll can serve as a binding arbitral decision if the parties chose this option in advance.[214] Otherwise, poll results may assist parties' negotiation or mediation efforts, or be submitted as expert opinion in court or arbitration.[215] There are also "self-funding processes" in which jurors are rewarded for proposing a solution that the parties did not conceive of but ultimately selected.[216]

As stated above, this endeavor benefits from its relationship with PeopleClaim, which has experience with running an ODR platform and resolving disputes online. With the introduction of RHY to PeopleClaim, incentives are enhanced for jurors to both collaborate and innovate in proposing creative resolutions.[217] RHUbarb is interesting in that it connects to ODR processes outside the blockchain arena and examines the ways in which blockchain technology can enhance those resolution efforts that are already taking place online in various contexts, because of its ability to crowdsource jurors and to provide incentives for fair voting through tokens and other means. Like Sagewise and others, it also recognizes the need for consensual processes to operate alongside decision-based ones, and the potential of juror voting to assist in generating creative outcomes that extend beyond the win-lose paradigm.

208. *Our Story*, RHUBARB, https://www.rhucoin.com/our-story.aspx (last visited Apr. 16, 2019).
209. *Id.*
210. *Id.*
211. PeopleClaim has helped over 60,000 businesses and consumers resolve disputes online with the involvement of several thousands of legal professionals, industry domain experts, and consumers who help resolve disputes on its site. *Id.*
212. *Rhubarb Fund ICO—Pre-Sale White Paper*, ICO CROWD 2, 8 (2018), https://www.rhucoin.com/Rhubarb-Fund-ICO-Overview.pdf.
213. *Id.*
214. *Id.* at 9.
215. *Id.*
216. *Id.*
217. *Id.* at 12.

8. Jury Online

Jury Online is a platform that specializes in initial coin offerings (ICOs), bringing together projects and investors and allowing them to transact through smart contracts.[218] Each project contains a detailed roadmap with milestones and timeframes. The investment funds and the tokens are held in trust and are released to the parties when milestones are met.[219] After each milestone is met, there is a period of three days during which parties may file a dispute regarding such step.[220] If a dispute arises as to the transaction, each party can turn to an arbitrator who is an expert in the area and is selected at random to resolve their misunderstanding.[221]

There are a few rules guiding the process. First, only an investor with Jury Online tokens may initiate a claim. Such claim can only be initiated during the time frame created—the three-day period after having reached a milestone. The first dispute is resolved free of charge for the investor.[222] For additional dispute resolution there is a fee that can be paid using the tokens deposited in advance for the purpose of covering these costs.[223] If a dispute does not arise, these funds are returned at the consummation of the transaction.[224]

Once a dispute is filed, the parties have some time for making claims and then the materials are sent anonymously to a group of random arbitrators who decide the case by majority vote within a given period of time.[225] Parties can substitute the unknown group of random jurors with an agreed-upon single arbitrator.[226] All decisions are subject to an appeal.[227]

Each of the arbitrators renders a decision in favor of either the operator or the investor, without being exposed to the other arbitrators' decisions (so as not to be influenced by the majority), and encryption is used to prevent collusion by arbitrators.[228] Each arbitrator is rated on his or her decisions.[229]

Here, as in some of the other projects, blockchain ODR is used for the blockchain context, in this case ICOs. The dispute resolution method draws on crowdsourced jurors or traditional arbitration, by choice of the parties. The platform employs a combination of incentives and structural tools aimed at ensuring the integrity of juror voting and the smooth implementation of resolutions.

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218. JURY.ONLINE 2 (2019), https://about.jury.online/images/jury_online_yellow_paper.pdf.
219. *Id.* at 12.
220. *Id.* at 3-4.
221. *Id.* at 5.
222. *Id.* at 7.
223. *Id.*
224. JURY.ONLINE, *supra* note 220, at 7.
225. *Id.* at 6.
226. *Id.*
227. *Id.* at 2.
228. *Id.* at 3.
229. *Id.* at 6 (stating that "[s]ince judges are rated based on the judgments they pass and are rewarded for their actions, the economic and rating component motivates and forces judges to investigate and resolve disputes fairly and correctly, rather than to randomly pass their verdicts").

9. ECAF

ECAF stands for the dispute resolution and arbitration forum on EOS, a blockchain protocol operated by EOS cryptocurrency.[230] The forum was created as an internal dispute resolution service for the community. Any member of the community may submit a claim by way of an electronic message.[231] Claims can relate to bugs in the smart contract, the hacking of a Ricardian contract, or any other scam.[232] The complainant must also specify the desired remedy, such as freezing the smart contract or the account or canceling EOS tokens.[233] A party may request an emergency measure of protection during the arbitration.[234]

In terms of arbitrators, the default practice is to appoint a single arbitrator per case.[235] Appeals and major cases are heard by a panel of three.[236] Arbitrators must be independent and without conflict of interest.[237] Where such conflict arises during the handling of the case, the arbitrator must withdraw from the case. They are also required to balance power between the parties, allow each side to present its arguments, and respond to its counterpart, as well as to conduct a fair and efficient process, and to document all communications in the case.[238] Within these parameters, the arbitrator has significant latitude to decide on the structure of the arbitration. In certain cases, such as where the dispute involves a party who is not part of the community or involved in the contract, the authority of an external court is considered.[239] Parties are encouraged not to be represented in the proceedings.[240] The rules determine which information relating to the case should be made public, but also allow for exceptions, mainly for privacy considerations.[241] The award can include various remedies such as the cancellation of tokens, the freezing of an account, temporary or ultimate removal from the community, reporting to external bodies, and the like.[242] The award is final but in some extreme cases appeals are allowed.[243]

The significance of the EOS arbitration system is derived from its being an in-house ODR forum that succeeded in attracting an impressive number of claims. However, at the time this article is being written, the future of ECAF seems uncertain. In the past few months ECAF has faced significant challenges to its legitimacy.[244] This crisis arose due to several decisions rendered by ECAF's volunteer

230. *Dispute Resolution & Arbitration*, EOS ALL., https://eosalliance.io/dispute-resolution-arbitration/ (last visited Apr. 16, 2019).
231. *ECAF Rules of Dispute Resolution*, *supra* note 90.
232. *Id.*
233. *Id.*
234. *Id.*
235. *Id.*
236. *Id.*
237. *ECAF Rules of Dispute Resolution*, *supra* note 90.
238. *Id.*
239. *Id.*
240. *Id.*
241. *Id.*
242. *Id.*
243. *ECAF Rules of Dispute Resolution*, *supra* note 90.
244. Amy Wan Lecture, Blockchain and Dispute Resolution, University of Haifa (via Videoconferencing), April 3, 2019).

arbitrators to prevent the transfer of cryptocurrencies on EOS.[245] Since the arbitrators issued these decisions without reasoning, the entire operation of the arbitration body was perceived as non-transparent and illegitimate.[246] In an attempt to regain legitimacy, one of the leaders of EOS approached Amy Wan, co-founder of Sagewise, to design an alternative system.[247] Wan set up a diverse working group, which included Colin Rule (founder of the eBay ODR system) and others who came up with a dispute resolution scheme that would comport with the libertarian values that many EOS community members ascribe to.[248] Unfortunately, to date, there has been no commitment to funding such scheme and there is currently a move within the EOS community to do away with ECAF altogether.[249] It remains to be seen whether ECAF is able to regain legitimacy and maintain its role as EOS's internal dispute resolution body.

10. Interim Summary

The blockchain-based ODR projects that have been developed in the last two years recognize the need for dispute resolution avenues on blockchain as well as the potential of the blockchain environment to uniquely serve dispute resolution values and goals, such as democratic decision-making and automatic enforcement of resolutions. Many of these solutions are based on game theory insights and an assumption of rationality, and we have yet to see how well they translate into the dispute resolution arena, which is fraught with cognitive biases and heuristics. Furthermore, many of these projects require that they be actively adopted into the smart contract governing parties' transactions prior to the emergence of a conflict. The question arises as to who will motivate parties to adopt such contracts, and who are the intermediaries in the decentralized blockchain environment who could promote such steps? One solution is that adopted by EOS—creating an in-house system. But what about those that offer ODR externally?

Other questions relate to the nature of dispute resolution services envisioned. Most of these ODR projects rely on juror voting and, in some cases, on traditional human arbitration. To what extent will such jurors and arbitrators be available? How will these efforts scale as blockchain transactions expand? The use of the "fourth party" in the form of automated processes is currently quite limited, certainly when compared with ODR projects in other contexts.

The breadth of dispute resolution processes covered on blockchain also seems constrained, with very few consensual dispute resolution processes being employed. While some endeavors such as Sagewise and Juris offer a broader spectrum of processes, ranging from consensual, interest-based ones to adjudicative rights-based ones, most blockchain ODR projects do not.

245. *Id.*
246. *Id.*
247. *Id.*
248. *Id.*
249. *Id. See also* https://eosauthority.com/polls_details?proposal=decaf_20190111&lnc=en (last visited on April 19, 2019).

IV. BARRIERS TO DISPUTE RESOLUTION ON BLOCKCHAIN

ODR has been successful where its design fulfilled adequate levels of trust, expertise, and convenience and efficiency.[250] If one of these elements is not present, the system will not be used. Blockchain may have expertise built into software, but, as indicated below, at present there is nothing convenient about using the blockchain, and promises of built-in and absolute protections have proven to be false. Indeed, as this paper was being completed, the latest news headline about the blockchain stated that "[o]nce hailed as unhackable, blockchains are now getting hacked."[251] Despite the need for addressing disputes systematically in this context, the need for ODR has yet to be widely recognized and acted upon. In the following sections, we explore some of the reasons why the spread of ODR in the blockchain arena has been delayed.

A. CULTURAL BARRIERS

Blockchain was conceived of in a culture that celebrated disintermediation in the name of democratization and dispersed power. In this environment, the focus is on the group rather than the individual, and, as evidenced from the costs of repetitive hacks and password losses, promoting the group's interest and ideals can justify sacrificing individual rights and interests. In addition, the human factor and the notion of trust are displaced by a strong belief in the immutability of technology and its power to prevent problems and disputes. The blockchain dispute culture is, therefore, in direct tension with the tenets of dispute systems design.

Dispute systems design is the primary framework for analyzing the existing culture of dispute resolution within a given setting as well as for thinking about the ways in which alternative designs could breed different cultures for addressing and preventing disputes. For one, the current thinking about dispute resolution is that conflict is inevitable and an integral part of any human interaction.[252] As we have seen, the blockchain environment touts the immutable nature of transactions conducted there and is premised on a presumption that outcomes are foreseeable and can therefore be dealt with through smart programming in advance. A dispute systems design approach would perceive the blockchain enthusiasts' belief in the ability to overcome conflict through appropriate technology as misguided. It would promote in its place the recognition that problems can never be fully prevented since reality is complex and humans are bound to have misunderstandings.

At the heart of dispute resolution lies the concept of legitimacy, which is ultimately premised on trust—trust in the system, trust in the process, and trust in its fairness—and therefore a willingness to abide by outcomes. In the blockchain context, on the other hand, there is a belief that trust is generated through technology by creating a secure enough environment that trust in anything but the blockchain itself becomes unnecessary. This creates a problem when the technology fails to deliver, as it has, and trust is broken, but no mechanisms for re-establishing it are available.

250. KATSH & RIFKIN, *supra* note 14.
251. Orcutt, *supra* note 86.
252. Werbach, *supra* note 11, at 494.

For dispute resolution processes to be adopted, however, there needs to be a central authority that initiates its adoption, follows its implementation, and ensures that such processes operate in a fair and effective manner.[253] But, as we have seen, such central authority is typically frowned upon in a setting that hails decentralization and the downfall of intermediaries.

Finally, in dispute resolution, knowing the identity of the parties to the dispute is often important for establishing trust, for understanding the context of the dispute and its roots, for devising an appropriate resolution, and for ensuring effective execution. At the same time, blockchain is attractive to many because of the ability to remain anonymous while securing the transaction. While this is not an insurmountable challenge, it nonetheless presents a challenge for the design of effective systems of dispute resolution.

These tensions may seem inherent, but, as we have seen in the description of the evolution of blockchain, there are in fact intermediaries who can make governance decisions, among them decisions that have to do with dispute resolution efforts (bitcoin and Ethereum developers, wallets, and others). To ensure the fairness and effectiveness of such actions, they should be guided by the principles of dispute systems design—ensuring stakeholder participation, the advancement of diverse procedural values alongside substantive fairness, and a commitment to ongoing learning and improvement of the dispute resolution system.

B. Legal Barriers

Another set of barriers has to do with the legal sphere. As a fast evolving, distributed environment that operates across national borders, the blockchain setting has proven to be challenging to regulate, much like other spheres of online activity in the past. Bitcoin and other cryptocurrencies, alongside ICOs, have challenged national regulators, with responses ranging from attempts to stifle such activities to attempts to use such tools by regulators themselves. This is further complicated by the anonymous and pseudonymous nature of many of these exchanges.

In terms of dispute resolution, this has meant that the law is elusive, courts are inaccessible, and even where a court would be available, not only would the costs be prohibitive, but enforcement could be a lost cause. For alternative dispute resolution, the murky state of the law in this domain presents a challenge as well because such processes typically take place in the "shadow of the law" and rely often on the court system for the enforcement of resolutions reached.

Past experience with regulating online experience has shown us that while such developments do pose significant challenges for the law, it is often the case that regulators find a way to enforce the law where they wish to do so. The SEC ruling in the case of Ethereum is one example in the blockchain context. We can expect regulators' sophistication in this area to increase and as the shadow of the law becomes clearer, such clarity will serve to enhance efforts to introduce ODR into blockchain. ODR will then provide a more accessible avenue for addressing disputes than courts, but may ultimately operate in their shadow.

253. Aarni Heiskanen, *The Technology of Trust: How the Internet of Things and Blockchain Could Usher in a New Era of Construction Productivity*, 8 CONSTR. RES. & INNOVATION 66 (2017).

C. Technological Barriers: Is this the 1990s all over again?

In many ways, the history of the internet in the 1990s resembles the developments in the blockchain arena these days. Both contexts exhibit strong distrust of regulation, and a belief that the new environment will be dispute-free, and out of the reach of the state and the law. As a widely circulated article in 1996 claimed,

> Cyberspace radically undermines the relationship between legally significant (online) phenomena and physical location. The rise of the global computer network is destroying the link between geographical location and: (1) the power of local governments to assert control over online behavior; (2) the effects of online behavior on individuals or things; (3) the legitimacy of the efforts of a local sovereign to enforce rules applicable to global phenomena; and (4) the ability of physical location to give notice of which sets of rules apply. The Net thus radically subverts a system of rule-making based on borders between physical spaces, at least with respect to the claim that cyberspace should naturally be governed by territorially defined rules.[254]

A recent, similarly ambitious claim for the blockchain, stated that "blockchain technology is being perceived, by the experts, as the next big revolution after the Internet. Also, much bigger and magnificent than the internet itself. Both in terms of the intricacies of the technology as well as the magnificence of change that it promises to bring in the way we work, live and think."[255]

In spite of these parallel claims, there are clear differences between the development of the internet and that of blockchain. The internet was invented in 1969 and for more than two decades had a limited number of users. It required special skill to master something like email and the public was largely unaware of it. This changed dramatically in the early 1990s as the combination of the world wide web and internet browsers made using the internet convenient. Internet service providers in the mid-1990s opened up access to anyone, and the lifting of a ban on online commercial activity opened up the net to the general population.

Use of the blockchain is being hindered greatly by a lack of trust and convenience. Aside from the numerous thefts, the language used to describe the blockchain is, for non-experts, difficult to understand. There is a learning curve that deters users, by employing terms such as fork, nodes, proof of work, on-chain and off-chain, hash, DAO, smart contracts, and even cryptocurrencies. In other words, what enabled the internet after an initial twenty-five years to rapidly expand is largely missing with the blockchain. If this is true, the blockchain in 2019 is less the internet of the 1990s but more the internet of the 1970s and 1980s.

The challenges facing the blockchain are, almost assuredly, solvable. And there are problems to be solved. There are many areas in which record use and security is poor. For example, electronic health records are now widely used but

254.David. R. Johnson & David Post, *Law and Borders - The Rise of Law in Cyberspace*, FIRST MONDAY (2006), https://firstmonday.org/ojs/index.php/fm/article/view/1310/1230.

255. Apurba Chakraborty, *How Blockchain Promises to Heal Mankind's Chronic Pains*, MEDIUM (Dec. 25, 2018), https://medium.com/altcoin-magazine/how-blockchain-promises-to-fix-the-trust-deficit-in-todays-internet-economy-b210d931f163.

errors are frequently present.[256] Tracing the source of contaminated food or the spread of illness is often difficult.

If one views the blockchain of the future as an advanced, trustworthy database employing advanced, trustworthy forms of online dispute resolution, accelerated growth is likely to occur.

256. Ethan Katsh et al., *Is There an App for That? Electronic Health Records (EHRs) and a New Environment of Conflict Prevention and Resolution*, 74 L. & CONTEMP. PROBS 31 (2011).