

**LEGAL AND POLICY CONCERNS WITH BLOCKCHAIN-BASED ARBITRATION**

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*The increase in disputes is a natural consequence of the boom in blockchain-based transactions. Arbitration, owing to its unique and revolutionary characteristics, emerges as a lucrative platform for resolving these disputes. However, blockchain-based arbitration also creates some unprecedented challenges, which deserve a detailed enquiry. Accordingly, in this paper, it is argued that blockchain’s fundamental characteristics of decentralization, pseudonymity, and irreversibility lead to concerns over the invalidity of the arbitration agreement, recognition and enforcement procedure, due process, and independence and qualifications of the arbitrator(s). The presence and scope of these concerns varies based on the type of blockchain-based arbitration platform used. However, the central claim is that most of these issues cannot be resolved without major architectural changes to blockchain, which would compromise its very fundamental characteristics. Simultaneously, it is claimed that there are some legal issues, such as seat, governing law, and jurisdiction, which can be avoided through awareness and proactiveness of the contracting parties. Finally, it is argued that the current state of blockchain-based arbitration does not allow the usage of AI-based arbitrators due to their cognitive and meta-cognitive limitations. Thus, regardless of the form of blockchain-based arbitrators used, human arbitrators are necessary.*

**Key Words:** *Blockchain, International Arbitration, Dispute, On-Chain, Off-Chain*

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## I. INTRODUCTION

Blockchain has been touted as the one of the most revolutionary technologies of the 21<sup>st</sup> Century. It sees unprecedented relevance with over 250,000 daily transactions,<sup>1</sup> and a perpetually increasing multi-sectoral deployment by private and public agencies.<sup>2</sup> Moreover, the market capitalization for cryptocurrencies, its most popular application, has crossed \$2 trillion.<sup>3</sup> However, as commercial transactions increase, so will the frequency and volume of disputes. Arbitration, owing to its efficiency and global reach, offers a lucrative medium for dispute resolution. But the peculiarities of blockchain while interacting with arbitration, which is relatively decentralized itself, creates unprecedented legal and policy challenges. This warrants a detailed enquiry over the nature and scope of these challenges.

Accordingly, in this paper, it is argued that blockchain's fundamental characteristics of decentralization, pseudonymity, and irreversibility lead to concerns over the invalidity of the arbitration agreement, recognition and enforcement, due process, and independence and qualifications of the arbitrator. The presence and scope of these concerns varies based on the type of blockchain-based arbitration platform used. However, the central claim is that most of these issues cannot be resolved without major architectural changes to blockchain, which would compromise its fundamental characteristics. Simultaneously, it is also argued that there are some legal issues, like seat, governing law, and jurisdiction, which can be avoided through awareness and proactiveness on the part of the contracting parties.

This paper contributes to existing literature in the following ways: (1) it provides clarity to the nature of relationship between arbitration and blockchain; and (2) as most of the current literature focuses on general types of blockchain-based arbitration, this paper focuses on concerns emerging from specific types of arbitration. In this process, concerns, like due process and qualification of arbitrators, are also discussed more extensively and for both on-chain and off-chain types of blockchain-based arbitration. Therefore, this paper is especially useful to policy-makers, practicing arbitrators and lawyers, parties transacting on the blockchain, and developers of blockchain-based arbitration dispute resolution platforms.

This paper is structured in the following way: In Chapter I, the characteristics and operation of blockchain and its two most significant applications- cryptocurrencies and smart contracts- are explained. In Chapter II, the relationship between blockchain and arbitration is deconstructed. Focusing on arbitration for blockchain, rather than blockchain for arbitration, the focus is on the origin of disputes on blockchain platforms, the benefits of using arbitration for settling them, the types of blockchain-based arbitration, and their manner of operation. In Chapter III, the legal and policy challenges associated with 'off-chain' and 'on-chain' arbitration, respectively, are explored.

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<sup>1</sup> 'Blockchain Charts' (*Blockchain.com*) <<https://www.blockchain.com/charts>> accessed 14 February 2022.

<sup>2</sup> Lesa Moné 'Which Governments are Researching CBDCs Right Now?' (*Consensys*, 6 April 2021) <<https://consensys.net/blog/enterprise-blockchain/which-governments-are-using-blockchain-right-now/>> accessed 14 February 2022.

<sup>3</sup> Arjun Kharpal, 'Cryptocurrency market value tops \$2 trillion for the first time as ethereum hits record high' (*CNBC*, 6 April 2021) <<https://www.cnbc.com/2021/04/06/cryptocurrency-market-cap-tops-2-trillion-for-the-first-time.html>> accessed 14 February 2022.

## II. UNDERSTANDING BLOCKCHAIN, CRYPTOCURRENCIES, AND SMART CONTRACTS

Simply put, blockchain is an open and distributed ledger system that records transactions amongst parties permanently, verifiably, and efficiently.<sup>4</sup> While its mainstream introduction to the world was through Bitcoin in 2009, its operation is dependent on decades-old technology: public-private key encryption, consensus mechanisms, and peer-to-peer networks.<sup>5</sup> The unique combined application of these technologies imbues blockchain with the characteristics of decentralization, transparency, pseudonymity, and immutability.<sup>6</sup>

Every node in the network must authenticate every transaction through a ‘consensus mechanism’, thus eliminating the need for any central authority. This authentication happens through ‘time-stamping’ the hash of the block, which serves as temporal proof of the data. Through an interconnected singular chain, the hash of every block also contains the data of the previous block. The hash algorithm makes the data inside a block impenetrable/immutability by preventing its alteration. The ledger, which acts as a database, is transparently and openly accessible for public viewership.<sup>7</sup>

A blockchain may be public/permission-less or private/permissioned depending on the parties eligible to maintain the shared ledger and participate in the consensus mechanism. In the former, anyone in the world can be involved in these processes, however, in the latter only a finite number of pre-defined participants can.<sup>8</sup> Consequently, public blockchains exhibit the characteristics of *decentralization*, *transparency*, and *pseudonymity* to a greater extent.

Cryptocurrencies are digital currencies that operate on blockchains, using their protocols and exhibiting their characteristics.<sup>9</sup> The European Commission has defined it as a digital representation of value, which is not issued by a public authority or attached to a fiat currency, but is accepted by persons as an electronic medium of exchange, store of value, and/or unit of account.<sup>10</sup> While Ethereum is the blockchain, Ether is the cryptocurrency that operates on it.

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<sup>4</sup> Marco Iansiti & Karim R. Lakhani, ‘The Truth About Blockchain’ (2017) 95(1) Harvard Business Review 118, 118-119; Nevena Jevremović, ‘2018 In Review: Blockchain Technology and Arbitration’ (*Kluwer Arbitration Blog*, 27 January 2019) <<http://arbitrationblog.kluwerarbitration.com/2019/01/27/2018-in-review-blockchain-technology-and-arbitration/>> accessed 14 February 2022.

<sup>5</sup> Primavera De Filippi & Aaron Wright, *Blockchain and the Law: The Rule of Code* (HUP 2018) 14-20.

<sup>6</sup> Filippi (n 5) 33-46.

<sup>7</sup> Darshan Bhora & Aisiri Raj, ‘Blockchain Arbitration – The Future of Dispute Resolution Mechanisms?’ (*Cambridge International Law Journal Blog*, 16 December 2020) <<http://cilj.co.uk/2020/12/16/blockchain-arbitration-the-future-of-dispute-resolution-mechanisms/>> accessed 14 February 2022; ‘The Blockchain Industry Applications and Legal Perspectives’ (2018) Nishith Desai Associates, 3 <[http://www.nishithdesai.com/fileadmin/user\\_upload/pdfs/Research%20Papers/The\\_Blockchain.pdf](http://www.nishithdesai.com/fileadmin/user_upload/pdfs/Research%20Papers/The_Blockchain.pdf)> accessed 14 February 2022.

<sup>8</sup> C. Mohan, ‘State of Public and Private Blockchains: Myths and Reality’ (International Conference on Management of Data, Amsterdam, July 2019); Dominique Guegan, ‘Public Blockchain versus Private blockchain’ (2017) Centre d’Economie de la Sorbonne, 2-5 <<https://halshs.archives-ouvertes.fr/halshs-01524440/document>> accessed 14 February 2022; Nishith Desai Associates (n 7) 5-6.

<sup>9</sup> Riikka Koulu, ‘Blockchains and Online Dispute Resolution: Smart Contracts as an Alternative to Enforcement’ (2016) 13(1) SCRIPTed <<https://script-ed.org/article/blockchains-and-online-dispute-resolution-smart-contracts-as-an-alternative-to-enforcement/>> accessed 14 February 2022.

<sup>10</sup> Prof. Dr. Robby Houben & Alexander Snyers, ‘Cryptocurrencies and blockchain’ (2018) European Union Policy Department for Economic, Scientific and Quality of Life Policies, 66

Smart contracts are self-executing electronic instructions encoded and saved as software on blockchains.<sup>11</sup> The transactions involve the transfer of digital assets between multiple parties, with at least one-party depositing said asset into the smart contract pre-performance.<sup>12</sup> Contingent on the occurrence of a pre-determined event, the asset is then automatically and irreversibly redistributed amongst contracting parties.<sup>13</sup> This distribution is based on a formula pre-determined by the parties, and fed into the code, thus eliminating the need for a middleman. They benefit from typical blockchain properties like decentralized, in that the ledger is publicly accessible, and immutability, in that unauthorized alteration of data is extremely difficult.<sup>14</sup> Due to these properties and their self-enforcement, smart contracts facilitate transactions in low-trust environments.<sup>15</sup> Conceptually, smart contracts exist as a spectrum, as basic as a digital value exchange to as complex as a distributed autonomous society. The scope of this paper is limited to these types: digital value exchange, smart rights and obligation, basic smart contract, and multi-party smart contracts. Finally, it must be noted that smart contracts may not count as legal contracts in every jurisdiction.<sup>16</sup> However, this is a separate enquiry beyond the scope of this paper.

### III. UNDERSTANDING THE RELATIONSHIP BETWEEN BLOCKCHAIN AND ARBITRATION

The relationship between blockchain and arbitration is symbiotic: not only is blockchain a means for facilitating and enhancing typical arbitration processes, but arbitration is also an efficient means for resolution of disputes arising out of blockchain-based transactions.

#### A. BLOCKCHAIN FOR ARBITRATION

Blockchain, especially in combination with other technologies such as Artificial Intelligence and the Internet of Things, can radically streamline various arbitral processes.<sup>17</sup> As an immutable and decentralized ledger, blockchain can be used to manage and assess evidence.<sup>18</sup> Along with AI, it can aid case management by not only indelibly recording all case files and but also automatically arranging, indexing, and hyperlinking all exhibits,

<<https://www.europarl.europa.eu/cmsdata/150761/TAX3%20Study%20on%20cryptocurrencies%20and%20blockchain.pdf>> accessed 14 February 2022.

<sup>11</sup> ‘Smart Contracts’ (*Blockchain Hub*) <<https://blockchainhub.net/smart-contracts/>> accessed 14 February 2022; Ibrahim Shehata, ‘Smart Contracts & International Arbitration’ (2018), <[https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=3290026](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3290026)> accessed 14 February 2022.

<sup>12</sup> Ameer Rosic, ‘Smart Contracts: The Blockchain Technology That Will Replace Lawyers’ (*Blockgeeks*) <<https://blockgeeks.com/guides/smart-contracts/>> accessed 14 February 2022.

<sup>13</sup> *Ibid*; *Blockchain Hub* (n 11).

<sup>14</sup> Filippi (n 5) 33-46.

<sup>15</sup> Donata Freiin von Enzberg, ‘Blockchain – A Suitable Tool for Arbitration?’ (*Taylor Wessing*) <<https://iot.taylorwessing.com/blockchain-a-suitable-tool-for-arbitration/>> accessed 14 February 2022; Shehata (n 11) 1-3.

<sup>16</sup> For instance, in India, the requirement of digital signature certificates under S. 35A, Information Technology Act, 2000 may create an impediment to their legal recognition. See: STA Law Firm, ‘India: The Enforceability Of Smart Contracts In India’ (*Mondaq*, 13 December 2019) <<https://www.mondaq.com/india/contracts-and-commercial-law/874892/the-enforceability-of-smart-contracts-in-india>> accessed 14 August 2022.

<sup>17</sup> Jevremović (n 4).

<sup>18</sup> Sophie Nappert & Hafez Virjee, ‘Introduction to Blockchain’ (*DELOS Dispute Resolution*, 26 September 2019) <<https://delosdr.org/index.php/2019/09/26/introduction-to-blockchain-smart-contracts/>> accessed 14 February 2022; Madhvendra Singh, ‘Blockchain & AI: Is the Cocktail Right for Conduct of Arbitration?’ (*Bar and Bench*, 23 April 2020) <<https://www.barandbench.com/columns/policy-columns/blockchain-ai-is-the-cocktail-right-for-conduct-of-arbitration>> accessed 14 February 2022.

references, and awards. In fact, the immutability and decentralization of Blockchain render it tamper-proof, which makes all information stored on it extremely cyber-secure.<sup>19</sup> The Beijing Internet Court has been using blockchain for this purpose since September, 2018.<sup>20</sup> Moreover, as a database for awards, this authenticity aids enforcement by eliminating the need for certification/signatures under Article IV, New York Convention, 1958 (“NYC”), which has been a hotbed for unscrupulous usage.<sup>21</sup>

Since these emerging technologies merely augment existing arbitral processes, this relationship is less controversial and challenging to address. Accordingly, it is beyond the primary scope of this paper.

## B. ARBITRATION FOR BLOCKCHAIN [OR BLOCKCHAIN-BASED ARBITRATION]

### 1. Origin of Disputes

There is a misconception that since smart contracts automatically and irreversibly perform the pre-determined conditions of the parties, they eliminate any potential for disputes.<sup>22</sup> However, the uniqueness of blockchain actually creates new avenues for disputes.<sup>23</sup> These emerge largely due to code’s three ontological characteristics. Firstly, the *ruleishness* of code means that rules defined by the designer and programmer are mechanically applied, strictly defining the possible limits and character of actions. The obligation can only be coded so long as it is reducible to the ‘if this, then that’ sequence.<sup>24</sup> Secondly, the *immediacy* of code implies that while the act of execution is swift, the acts of creation and interpretation are prior to execution, which may happen any time after the moment of source-code generation.<sup>25</sup> Thirdly, *opacity* emerges due to the technical nature of gap imposes a knowledge and interpretative gap between users and developers, at both the front-end interface and back-end infrastructure level.<sup>26</sup>

<sup>19</sup> Ibid; Prakarsh & Shruti Mishra, ‘Demystifying the cryptic Relationship between Blockchain and Arbitration’ (*NALSAR’s Tech Law Forum*, 31 October 2020) <<https://techlawforum.nalsar.ac.in/demystifying-the-cryptic-relationship-between-blockchain-and-arbitration/>> accessed 14 February 2022.

<sup>20</sup> Sophie Hunter, ‘China’s innovative Internet Courts and their use of blockchain backed evidence’ (*ConflictOfLaws.net*, 28 May 2019) <<http://conflictflaws.net/2019/chinas-innovative-internet-courts-and-their-use-of-blockchain-backed-evidence/>> accessed 14 February 2022; Ana Alexandre, ‘Chinese Internet Court Employs AI and Blockchain to Render Judgement’ (*Cointelegraph*, 25 April 2019) <<https://cointelegraph.com/news/chinese-internet-court-employs-ai-and-blockchain-to-render-judgement>> accessed 14 February 2022

<sup>21</sup> Marike R. P. Paulsson, ‘The Blockchain ADR: Bringing International Arbitration to the New Age’ (*Kluwer Arbitration Blog*, 9 October 2018) <<http://arbitrationblog.kluwerarbitration.com/2018/10/09/blockchain-adr-bringing-international-arbitration-new-age/>> accessed 14 February 2022.

<sup>22</sup> Charlie Morgan, ‘Will the Commercialisation of Blockchain Technologies Change the Face of Arbitration?’ (*Kluwer Arbitration Blog*, 5 March 2018) <<http://arbitrationblog.kluwerarbitration.com/2018/03/05/topic-to-be-confirmed/>> accessed 14 February 2022.

<sup>23</sup> James Rodgers, Harriet Jones-Fenleigh & Adam Sanitt, ‘International Arbitration Report’ (2017) North Rose Fullbright Issue 9, 21-22 <<https://www.nortonrosefulbright.com/en-in/knowledge/publications/ea958758/arbitrating-smart-contract-disputes>> accessed 14 February 2022.

<sup>24</sup> Lawrence Diver, ‘Interpreting the Rule(s) of Code: Performance, Performativity, and Production’ (2021) MIT Computational Law Report, 5-6 <<https://law.mit.edu/pub/interpretingtherulesofcode>> accessed 3 February 2022.

<sup>25</sup> Lawrence Diver, ‘Computational Legalism and the Affordance of Delay in Law’ (2021) 1(1) Journal of Cross-disciplinary Research in Computational Law <<https://journalcrcl.org/crcl/article/view/3/6>> accessed 14 February 2022.

<sup>26</sup> Mireille Hildebrandt, ‘Legal and Technological Normativity: More (and Less) than Twin Sisters’ (2008) 12 *Techné: Research in Philosophy and Technology* 169, 175.

The consequence of these characteristics is the inevitability of disputes on:<sup>27</sup> coding errors causing unforeseen performance-related issues, interpretative discrepancies between the coded and natural language version of a smart contract, inaccuracy of data feed upon which the smart contract execution depends, and the inability of code to capture equitable obligations. Unlike traditional disputes, there is now increased scope for disputes emerging due to actions of non-parties well. More importantly, the inevitable and unique nature of these disputes means that parties will require efficient and innovative redressal mechanisms.

## 2. Benefits of Arbitration

Given the inevitability of disputes, arbitration emerges as much more lucrative redressal option than litigation due to its unique benefits. Since contracting parties are often globally located, arbitration provides them with the flexibility and control to pre-determine the venue, seat, governing law, document disclosure, and format of proceedings.<sup>28</sup> It enables more efficient dispute resolution, with as much as 75% time being saved as compared to traditional means.<sup>29</sup> Further, enforcement through arbitration is far easier,<sup>30</sup> whether through automatic ‘on-chain’ enforcement or ‘off-chain’ enforcement through the NYC that has 166 contracting states.<sup>31</sup>

It also generates greater investor confidence because arbitration is removed from the anti-cryptocurrency rhetoric and policy-stances that is typically adopted by regulators and courts.<sup>32</sup> This is especially since cryptocurrencies are currently operating in the ‘shadows of the law’- in terms of either being criminalized or completely unregulated.<sup>33</sup> Moreover, transacting blockchain ideologues will not compromise the decentralization and anonymity that underlies blockchain by subjecting themselves to centralized and public court-structures.<sup>34</sup>

## 3. Type/Form of Arbitration and Manner of Operation

A blockchain-based arbitration mechanism could work through either humans or algorithmic decision-making. In the latter, an algorithm trained on legal reasoning, through

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<sup>27</sup> Rodgers (n 21); Olivier Marquais, ‘Introduction to Programmable Contracts: A Dispute Resolution Perspective’ (*Law Gazette*, September 2018) <<https://lawgazette.com.sg/feature/introduction-to-programmable-contracts-a-dispute-resolution-perspective/>> accessed 14 February 2022.

<sup>28</sup> James Rodgers, ‘International Arbitration Report’ (2018) North Rose Fullbright Issue 10, 26 <<https://www.nortonrosefulbright.com/en-fr/knowledge/publications/cae35319/cryptocurrencies-and-arbitration-a-match-made-in-heaven>> accessed 14 February 2022; ‘The Rise of Blockchain Arbitration?’ (*Aceris Law*, 3 March 2018) <<https://www.acerislaw.com/the-rise-of-blockchain-arbitration/>> accessed 14 February 2022.

<sup>29</sup> Ibrahim Shehata, ‘The Marriage of Artificial Intelligence & Blockchain in International Arbitration: A Peak into the Near Future!’ (*Kluwer Arbitration Blog*, 12 November 2018) <<http://arbitrationblog.kluwerarbitration.com/2018/11/12/the-marriage-of-artificial-intelligence-blockchain-in-international-arbitration-a-peak-into-the-near-future/>> accessed 14 February 2022.

<sup>30</sup> Shehata (n 11) 13; Rodgers (n 23) 22-23.

<sup>31</sup> Bhora (n 7).

<sup>32</sup> Rodgers (n 28) 26.

<sup>33</sup> Orna Rabinovich-Einy & Ethan Katsch, ‘Blockchain and the Inevitability of Disputes: The Role for Online Dispute Resolution’ (2019) 2019(2) *J of Dispute Resolution* 47, 73.

<sup>34</sup> Michael Buchwald, Smart Contract Dispute Resolution: The Inescapable Flaws of Blockchain-based Arbitration <[https://scholarship.law.upenn.edu/cgi/viewcontent.cgi?article=9702&context=penn\\_law\\_review](https://scholarship.law.upenn.edu/cgi/viewcontent.cgi?article=9702&context=penn_law_review)> accessed 14 February 2022.

statutes and precedents, decides the dispute.<sup>35</sup> The algorithm can only respond to features and conditions reflected in its design.<sup>36</sup> One method of addressing this is by consciously designing apparent ambiguity into the system. However, this is inherently limited to the model and degree of adaptivity utilized.<sup>37</sup> Additionally, it does not reflect within the internal logic of the machine, resulting in possible absurdities. This is because, unlike traditional legal interpretation, code-based decision-making does not allow for contextual flexibility through a process of legal contestation over the meaning of ambiguous terms.<sup>38</sup> Therefore, this enables decision-making only for deterministic and trivial notions, not decisions over complex ideas like good faith and reasonableness.<sup>39</sup>

Moreover, in machine learning, algorithms cannot be trained on future data, as this does not exist. Therefore, the proxy is for them to be trained on data which closely approximates distribution of future data.<sup>40</sup> However, the assumption that this leads to accurate predictions about future data is incorrect. This is demonstrated by the ‘Goodhart Effect’, which argues that once a description of a state of affairs is considered a prediction, it becomes a method of organizing and coordinating behaviour.<sup>41</sup> The result is that these predictions are inapplicable because the regulated individuals have changed their behaviour based on its prior declaration.

Therefore, until AI evolves to mimic human reasoning in this regard, this form of arbitration is unscalable. Even then, there is abundant literature highlighting the challenging need for developing objective and unprejudiced decision-making,<sup>42</sup> along with meta-cognition,<sup>43</sup> in AI.

Consequently, mainstream blockchain-based arbitration necessarily involves human arbitrators. All blockchain-based transactions, once executed, are irreversible. Therefore, the only means of ensuring any post-performance adjudication is by pre-coding a smart arbitration clause/agreement.<sup>44</sup> Most blockchain-based transactions work through some form

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<sup>35</sup> Daniel Drummer & Dirk Neumann, ‘IscodeLaw? Current legal and technical adoption issues and remedies for blockchain-enabled smart contracts’ (2020) 35(4) *Journal of Information Technology* 337, 352; von Enzberg (n 14).

<sup>36</sup> Geoffrey Bowker & Susan Star, *Sorting Things Out: Classification and Its Consequences* (The MIT Press 2000) 8-9.

<sup>37</sup> Diver (n 25) 8-9.

<sup>38</sup> Lucas Introna, ‘Hermeneutics and Meaning-Making in Information Systems’ in R.D. Galliers and W.L. Currie (eds.), *The Oxford Handbook of Management Information Systems: Critical Perspectives and New Directions* (Oxford University Press 2011) 233; De Filippi (n 5) 202-204.

<sup>39</sup> Pietro Ortolani, ‘The impact of blockchain technologies and smart contracts on dispute resolution: arbitration and court litigation at the crossroads’ (2019) 24(2) *Uniform L R* 430, 438.

<sup>40</sup> Mireille Hildebrandt, ‘Code Driven Law. Scaling the Past and Freezing the Future’ in Simon Deakin and Christopher Markou (eds), *Critical Perspectives on Law and Artificial Intelligence* (Hart Publishers 2020) 73-74.

<sup>41</sup> Marilyn Strathern, ‘“Improving Ratings”: Audit in the British University System’ (1997) 5(3) *European Review* 305, 310-318.

<sup>42</sup> Ninareh Mehrabi, Fred Morstatter, et al, ‘A survey on bias and fairness in machine learning’ (2019) ARXIV <<http://arxiv.org/pdf/1908.09635v2>> accessed 14 February 2022; Drummer (n 30) 352-353; Charvi Rastogi, Yunfeng Zhang, et al, ‘Deciding Fast and Slow: The Role of Cognitive Biases in AI-assisted Decision-making’ (2020) ARXIV <<https://arxiv.org/abs/2010.07938>> accessed 14 February 2022; Kimberly Houser, ‘Can AI Solve the Diversity Problem in the Tech Industry: Mitigating Noise and Bias in Employment Decision-Making’ (2019) 22 *Stan Tech L Rev* 290.

<sup>43</sup> José María de la Jara, Daniela Palma & Alejandra Infantes, ‘Machine Arbitrator: Are We Ready?’ (*Kluwer Arbitration Blog*, 4 May 2017) <<http://arbitrationblog.kluwerarbitration.com/2017/05/04/machine-arbitrator-are-we-ready/>> accessed 14 February 2022.

<sup>44</sup> Michael Buchwald, ‘Smart Contract Dispute Resolution: The Inescapable Flaws of Blockchain-based Arbitration’ (2020) 168 *University of Pennsylvania L R* 1369, 1381-1382.

of an escrow mechanism, wherein the buyer deposits the consideration with a trusted third-party. This situation is maintained until the buyer either validates the seller's performance, or initiates a dispute using an assigned technical function.<sup>45</sup> Once dispute is initiated, the smart contract's performance freezes until final adjudication. The means of enforcing the award issued hereon separates the process into "on-chain" and "off-chain" arbitration.<sup>46</sup>

### 1. *On-Chain Arbitration*

The award is enforced directly on the blockchain, without the need for any state intervention.<sup>47</sup> At the outset, it must be noted that under the present design of the smart contracts that underlie on-chain arbitration, it is possible to only include digital assets. However, theoretically, it is possible to digitally represent physical assets through a token.

The decision-making can be made through two different methods:<sup>48</sup> (a) online arbitration: arbitrators selected by the parties or the platform resolve the dispute, though the adopted procedures may deviate from traditional arbitration; and (b) crowd-sourced models: decision is made by a majority vote of pseudonymous juries, operating on token-based incentivize structures.

#### a) *Online Arbitration*

The specific procedure for conducting the arbitration can occur based on: the incorporation of typical arbitral rules, or any general pre-determined agreement of the parties, or the arbitral rules adopted by the platform. The engagement between the parties may not necessarily be contemporaneous, with potentially significant gaps in correspondence. Moreover, the identity of the arbitrator and the parties may be unknown to each other even during the dispute resolution process.<sup>49</sup> Since the award is rendered by participant actions not directly on the platform, there needs to be a bridge between said award and its enforcement through the platform. This is achieved through an "oracle", which is an external reference point for establishing real-world facts within the smart contract.<sup>50</sup> Therefore, the arbitrator's

<sup>45</sup>Filippi (n 5) 76; Buchwald (n 44) 1385-1386; Ortolani (n 39) 432-434.

<sup>46</sup> Note: All AI enabled blockchain-based arbitration is necessarily 'on-chain', but 'on-chain' arbitrations can occur without the use of AI too.

<sup>47</sup> Bhora (n 7); Katarzyna Szczudlik, "'On-chain" and "off-chain" arbitration: Using smart contracts to amicably resolve disputes' (*newtech law*, 4 June 2019) <<https://newtech.law/en/on-chain-and-off-chain-arbitration-using-smart-contracts-to-amicably-resolve-disputes/>> accessed 14 February 2022.

<sup>48</sup> Dan Jewel, Victor Coci & Philip Kelly, 'Disputes & Distributed Ledger Technology: A contract, no matter how smart, still needs to be legal and enforceable in the real world' (*DLA Piper*, 21 December 2020) <<https://www.dlapiper.com/en/uk/insights/publications/2020/12/disputes-distributed-ledger-technology/>> accessed 14 February 2022.

<sup>49</sup> For instance, the identity of parties is known in Datarella's Code Legit Project but the default in Open Law's Open Court is for parties to remain anonymous and even the arbitrator's name is not given. Moreover, in both these platforms, the dispute resolution is not contemporaneous, *see*: Open Law, 'Open Court: Legally Enforceable Blockchain-Based Arbitration' (*Consensys*, 18 October 2018) <<https://media.consensys.net/opencourt-legally-enforceable-blockchain-based-arbitration-3d7147dbb56f>> accessed 14 February 2022; 'World's First Smart Contract Based Arbitration Proceedings Conducted' (*Trustnodes*, 17 July 2017) <<https://www.trustnodes.com/2017/07/17/worlds-first-smart-contract-based-arbitration-proceedings-conducted>> accessed 14 February 2022; 'Code Legit White Paper on Blockchain Arbitration' (Datarella) <[https://docs.google.com/document/d/1v\\_AdWbMuc2Ei70ghITC1mYX4\\_5VQsF\\_28O4PsLckNM4/edit#heading=h.p2owquwx39n](https://docs.google.com/document/d/1v_AdWbMuc2Ei70ghITC1mYX4_5VQsF_28O4PsLckNM4/edit#heading=h.p2owquwx39n)> accessed 14 February 2022.

<sup>50</sup> Koulu (n 9).

award acts as an “oracle”, i.e., external information fed into the smart contract, wherefrom the code automates execution of the award.<sup>51</sup>

*b) Crowd-Sourced Models*

Currently, different platforms based on the crowd-sourced model have emerged: Kleros, JUR, and Aragon Network Jurisdiction.<sup>52</sup> While largely similar, they differ on the specific juror-incentivization strategies, levels of legal enforceability, and specialization of tribunals.<sup>53</sup>

The nature of disputes is limited to issues on the malfunctioning of smart contract, like coding bugs. However, they do not cover human error behind a smart contract dispute.<sup>54</sup> On these issues, once the buyer initiates the dispute, the specification of relief sought varies, depending on the platform, from proposal/counter-proposals to mere selection of pre-coded relief options.<sup>55</sup> The decision-making is done by ‘jurors’, who are pseudonymous participants on the same network that actively volunteer as candidates by submitting cryptocurrency/tokens. On receipt of token deposits from a large pool of volunteers, the selection occurs either through randomized lotteries or proportionate to the size of one’s deposit.<sup>56</sup> Each platform allows disputants only one opportunity to express their statement of facts and legal entitlements through a textbox. There are no further rebuttals or clarifications, even from the jurors. The discovery process on every platform is optional and voluntary, with even jurors having no mechanism to compel production.<sup>57</sup>

Decisions are reached using a majority-voting scheme, wherein the deposited tokens of selected jurors are used as a financial incentive, with the minority voters losing some/all of their tokens. Jurors are expected to decide based on what other people think is fair, rather than through any analytical legal framework. Every platform allows dissatisfied parties the opportunity to appeal, with the cost and finiteness differing.<sup>58</sup> For instance, Kleros offers infinite appeals with each appeal doubling in cost, while Aragon offers two rounds of appeal with the cost proportionate to the reputation and size of the jury.<sup>59</sup> On final determination, the smart contract unfreezes and distributes assets accordingly.<sup>60</sup>

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<sup>51</sup> Ortolani (n 39) 439-440; Julien Fouret, Dyalá Jiménez et al, ‘ICC Dispute Resolution Bulletin: Robots Replacing Arbitrators’ (2018) International Chamber of Commerce Issue 1, 30 <<https://www.jdsupra.com/legalnews/robots-replacing-arbitrators-smart-87851/>> accessed 14 February 2022.

<sup>52</sup> Rabinovich-Einy (n 33) 59-71; Buchwald (n 44) 1385.

<sup>53</sup> Buchwald (n 44) 1385-1393; Darcy W E Allen, Marta Poblet & Aaron Lane, ‘The Governance of Blockchain Dispute Resolution’ (2020) 25 Harvard Negotiation L R 75, 89-95.

<sup>54</sup> Buchwald (n 44) 1392-1393; Rabinovich-Einy (n 33) 59-71; Allen (n 53) 89-95.

<sup>55</sup> Buchwald (n 44) 1385-1387; Rabinovich-Einy (n 33) 59-71; Allen (n 53) 89-95.

<sup>56</sup> Buchwald (n 44) 1389-1390; Rabinovich-Einy (n 33) 59-71; Allen (n 53) 89-95.

<sup>57</sup> Buchwald (n 44) 1388-1389; Rabinovich-Einy (n 33) 59-71; Allen (n 53) 89-95.

<sup>58</sup> Buchwald (n 44) 1391-1392; Rabinovich-Einy (n 33) 59-71; Allen (n 53) 89-95.

<sup>59</sup> For Kleros, see: Federico Ast et al, ‘Kleros Dispute Revolution: The Kleros Handbook of Decentralized Justice’ (2019) 35 <<https://perma.cc/DA9N-ZL7R>> accessed 14 February 2022; For Aragon, see: Tatu Kárki, ‘Aragon Network Jurisdiction Part 1: Decentralized Court’ (*Aragon Blog*, 18 July 2017) <<https://aragon.org/blog/aragon-network-jurisdiction-part-1-decentralized-court-c8ab2a675e82>> accessed 14 February 2022.

<sup>60</sup> Bhora (n 7).

## 2. *Off-Chain Arbitration*

Once the smart contract is frozen, the dispute redressal happens through traditional methods, with some procedural aspects automated. However, the enforcement does not happen automatically and directly on the blockchain, with the need for state intervention.<sup>61</sup>

# IV. LEGAL AND POLICY CONCERNS WITH BLOCKCHAIN-BASED ARBITRATION

## A. OFF-CHAIN ARBITRATION

Since off-chain arbitration necessarily depends on the state and courts for enforcement of its awards, all existing legal requirements must be strictly complied with. The following are the main areas of legal concern, along with the steps parties themselves can adopt to circumvent limitations.

### 1. Validity of the Arbitration Agreement

Article II, NYC stipulates that a valid arbitration agreement must be ‘in writing’, which an agreement signed by the parties or contained in letters/telegrams. In blockchain, the signatures are electronic, which aren’t recognized in most arbitration statutes, and nature of transacting is such that there is no automatic scope for written agreements through letters/telegrams.<sup>62</sup> The 2006 UNCITRAL Recommendations suggested that the term ‘telegram’ in Article II(2) include electronic means of communication. While this would legitimize smart arbitration clauses, its enforcement requires adoption by domestic legislatures through appropriate amendments to their arbitration statutes.<sup>63</sup> This invalidity naturally affects the enforceability of awards rendered on blockchain-based transactions.

However, some jurisdictions have adopted this amendment in their domestic arbitration statutes.<sup>64</sup> Moreover, pursuant to the UNCITRAL Model Law on Electronic Commerce, 1996, some states have adopted the ‘functional equivalent approach’.<sup>65</sup> This means that if the form of communication substantially fulfils the traditional role of handwriting, such as evidence of intention and identification, then it is binding.

In jurisdictions where such amendments or interpretations don’t exist, parties can evade risks by using ‘Ricardian Contracts’, which are smart contracts that have both a natural

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<sup>61</sup> Robert Coffey & Peter Stewart, ‘Arbitrating disputes arising out of smart contracts’ (*Arbitration Journal*, 16 March 2020) <<https://journal.arbitration.ru/analytics/arbitrating-disputes-arising-out-of-smart-contracts/>> accessed 14 February 2022; Jewel (n 48).

<sup>62</sup> Bhora (n 7); Paulsson (n 21).

<sup>63</sup> Recommendation regarding the interpretation of article II, paragraph 2, and article VII, paragraph 1, of the Convention on the Recognition and Enforcement of Foreign Arbitral Awards, 1958 (2006) <[https://uncitral.un.org/en/texts/arbitration/explanatorytexts/recommendations/foreign\\_arbitral\\_awards](https://uncitral.un.org/en/texts/arbitration/explanatorytexts/recommendations/foreign_arbitral_awards)> accessed 14 February 2022.

<sup>64</sup> See *India*: Ritika Bansal, ‘Enforceability of Awards from Blockchain Arbitrations in India’ (*Kluwer Arbitration Blog*, 21 August 2019) <<https://tinyurl.com/83kkcb5h>> accessed 14 February 2022.

<sup>65</sup> See *USA*, where the functional equivalence approach has been recognized federally through the Uniform Computer Information Transactions Act and the Uniform Electronic Transactions Act: W. Harry Thurlow, ‘Electronic Contracts in the United States and the European Union: Varying Approaches to the Elimination of Paper and Pen’ (2001) 5.3 EJCL <<https://www.ejcl.org/53/art53-1.html>> accessed 14 February 2022.

language and coded version.<sup>66</sup> This ensures that the natural language version *per se* satisfies the ‘in writing’ requirement.

## 2. Seat, Governing Law, and Jurisdiction

When concluding a smart arbitration clause, parties may not select the seat, governing law, and jurisdiction. Since parties are likely to be globally located, the risk of satellite disputes over these issues only increases.<sup>67</sup> This must be addressed by appropriate pre-selection of the seat, choice-of-law clauses, and forum selection clauses.

The seat of an arbitration (‘lexarbitri’) controls the legal framework governing the conduct of arbitration. It determines the procedural law (‘curial law’), the ensuing ‘arbitration-friendliness’ of the selected jurisdiction, the finality of the award, its enforceability, and the arbitrability of the subject-matter.<sup>68</sup> It only provides an outline of detail of relevant procedure, with specifics provided by arbitral rules chosen by parties.

The governing substantive law will determine the validity of smart contracts and the relevant digital asset being transferred.<sup>69</sup> If the dispute is litigated, then the chosen court determines the applicable procedural law, and the general attitude towards arbitration and blockchain applications. Accordingly, parties must select a seat, governing law, and court after considering these factors.

However, the validity of exclusive forum selection clauses is not guaranteed, contingent on factors like the structure of the website and the individual’s demonstrable knowledge of the terms.<sup>70</sup> Additionally, some courts may reject the governing law if it was chosen to evade otherwise applicable laws or its application violates public policy.<sup>71</sup> Therefore, parties must be mindful that the chosen law and forum is enforced outside selected methods.

## 3. Enforcement

Some jurisdictions have made the reciprocity reservation under Article I, NYC. Therefore, they only enforce foreign awards rendered in contracting states recognized by their government.<sup>72</sup> In off-chain arbitration, the award is rendered on the blockchain platform and then distributed to the computer resources of the parties located in different countries. Therefore, the arbitral award is not *per se* rendered in any one country, which confounds enforcement in such jurisdictions. The problem is less severe for countries that adopt a functional equivalence interpretative approach, but other may have to enact appropriate legislations or amendments. In line with common principles of private international law,<sup>73</sup> private blockchains, recognition of the executing country can be based on, depending on the

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<sup>66</sup> Shehata (n 11) 14.

<sup>67</sup> Rodgers (n 23) 22-23; Jewel (n 48).

<sup>68</sup> Blackaby Nigel, Constantine Partasides, et al, *Redfern and Hunter on International Arbitration* (6<sup>th</sup> edn, OUP 2015) 171-175; Shehata (n 11) 15-16; Rodgers (n 23) 22-23.

<sup>69</sup> Nigel (n 68) 185-188; Marquis (n 27).

<sup>70</sup> Ortolani (n 39) 447-448.

<sup>71</sup> Nadia Hewett, Jenny Cieplak & Sheila Warren, ‘Bridging the Governance Gap: Dispute resolution for blockchain-based transactions’ (2020) World Economic Forum White Paper, 10-11 <[http://www3.weforum.org/docs/WEF\\_WP\\_Dispute\\_Resolution\\_for\\_Blockchain\\_2020.pdf](http://www3.weforum.org/docs/WEF_WP_Dispute_Resolution_for_Blockchain_2020.pdf)> accessed 14 February 2022.

<sup>72</sup> See India: Bansal (n 64).

<sup>73</sup> Lord Collins of Mapesbury & Professor Jonathan Harris, *Dicey, Morris & Collins on the Conflict of Laws* (15<sup>th</sup> edn, Sweet & Maxwell 2018).

context, the nationality of either of the contracting parties or the place of performance or location of the asset. However, in public blockchains, this identification is extremely difficult, and therefore, enforcement will not be possible without architectural changes to the blockchain platform.

#### 4. Due Process Concerns

The arbitral process typically functions based on the arbitral rules ('lexarbitri') chosen by the mutual consent of the parties.<sup>74</sup> These rules are adopted by specialist arbitral institutions with the necessary knowledge, expertise, and incentive in arbitration.<sup>75</sup> However, in off-chain arbitration there is no uniformity in the lexarbitri across all blockchain dispute resolution platforms. Some of these off-chain dispute resolution platforms have attempted to develop template rules for parties, to co-opt into their agreements, based on the typical arbitral rules, like LCIA or ICC. However, this isn't standard and most platforms establish rules without any reference to proper sources, or leaves this completely to the parties.<sup>76</sup> This allows them to adopt unconscionable terms, and opt-out of the fundamental protections, such as equal treatment of parties or presentation of case,<sup>77</sup> conferred by the pre-existing typical arbitral rules.

##### B. ON-CHAIN ARBITRATION

Theoretically, all the aforementioned legal concerns are applicable here too. However, practically, these are irrelevant because the self-execution of on-chain arbitration makes the platform 'a self-regulated professional guild'.<sup>78</sup> Moreover, even when the award is challenged before a court and set aside, it will not be enforceable due to the irreversibility of the transaction and pseudonymity of parties. Therefore, the focus for on-chain arbitration is more pertinent for policy concerns that emerge from its operation.

#### 1. Due Process Concerns

##### Right to Proper Presentation of Case

It is well-settled in arbitration law that every party must have a right to proper presentation of their case.<sup>79</sup> An oral hearing is an essential part of this right, and can only be excluded in limited circumstances, depending on the complexity of the dispute and whether the applicable law permits.<sup>80</sup> The point here is that even the decision to pursue a documents-only arbitration is a conscious one, not imposed by default. However, in all crowd-sourced models, there is an automatic exclusion of oral hearings. Additionally, it is crucial for proper presentation that parties counter each other with arguments and evidence, and that they

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<sup>74</sup> Nigel (n 68) 166-176.

<sup>75</sup> Ibid.

<sup>76</sup> Consensys (n 49).

<sup>77</sup> Nigel (n 68) 356-359.

<sup>78</sup> Winston Maxwell & Gauthier Vannieuwenhuysse, 'Benefits and Challenges of Robotized Arbitration' (*Bloomberg Law*, 14 April 2018) <<https://news.bloomberglaw.com/business-and-practice/benefits-and-challenges-of-robotized-arbitration-1>> accessed 14 February 2022.

<sup>79</sup> Jeffery Waincymer, *Procedure and Evidence in International Arbitration* (1<sup>st</sup>edn, Kluwer Law International 2012) 760-790; Nigel (n 68) 356-358.

<sup>80</sup> Nigel (n 68) 400-403; David J. A. Cairns, 'Oral Advocacy and Time Control in International Arbitration' (2010) <<https://tinyurl.com/c44sfk56>> accessed 14 February 2022; Angelina Joy & Mahathi U, 'Due Process and Waiver of the Oral Hearing Right' (*RMLNLU Arbitration Blog*, 12 January 2021) <<https://tinyurl.com/47tc2yfy>> accessed 14 February 2022; Perry Zirkel & Andriy Krahmal, 'Creeping Legalism in Grievance Arbitration: Fact or Fiction?' (2001) 16(2) *Ohio State J on Dispute Resolution* 243.

respond to the questions/clarifications of the arbitrators.<sup>81</sup> But crowd-sourced models do not permit communication between arbitrators and any participation from parties beyond their submission of the initial statement of facts.

#### Inability to compel discovery

The discovery on crowd-sourced models is limited to self-imposed production. Consequently, disclosed evidence relates to those that either positively reflect on the submitting party or discredit the opposing party's claims. While these are necessary, they are insufficient because they exclude "the smoking gun" evidence that incriminates the submitting party.<sup>82</sup> As introduced in the preceding sub-section, this problem can exist with online arbitration models too (which are similar to off-chain arbitration, with the main difference being the nature of enforcement), if the arbitration clause is not governed by arbitral rules that empower the arbitrator to compel production of evidence.

Moreover, the pseudonymity and decentralization of blockchain eliminates any third-party involvement, thus rendering the compulsion of any evidence from them impossible.<sup>83</sup> Even architectural solutions like banning third-parties who refuse to comply with discovery orders is not useful because users can simply create new addresses to re-join the platform.<sup>84</sup>

#### Arbitrary decision-making

Crowd-sourced models operate on majority-voting schemes reliant on financial incentive structures. This is problematic on for several reasons. Awards are rendered merely through votes. This is a clear violation of the principles of natural justice that require awards/orders to be reasoned.<sup>85</sup> The financial incentive is cryptocurrencies/tokens, which is extremely volatile. These fluctuations may affect the juror's fidelity to reach optimal arbitral decisions.<sup>86</sup>

Most importantly, this model falsely presumes that decisions reached through majority-voting are necessarily correct. Economic self-interest actually compels jurors to decide based on predictions of their co-jurors' votes, rather than what they believe to be correct.<sup>87</sup> Therefore, the focus shifts on factors like rhetoric and psychology because there isn't any coherent analytical framework that jurors are required to apply. In fact, jurors from different jurisdictions may apply their own laws to each arrive at different yet analytically correct answers.<sup>88</sup> Despite this, they will be penalized, thereby also reducing their incentive to participate. Consequently, similar fact scenarios may lead to different results, based on the predictive analysis and normative groundings of the jurors. Converse to intended objectives, this creates a system that forces jurors to prioritize their well-being over than of the disputants.

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<sup>81</sup> Cairns (n 80).

<sup>82</sup> Buchwald (n 44) 1394-1395.

<sup>83</sup> Bhora (n 7).

<sup>84</sup> Buchwald (n 44) 1401.

<sup>85</sup> Austin Ignatius, 'Securing natural justice in arbitration proceedings' (2012) 20(1) Asia Pac L R 63.

<sup>86</sup> Tonya M. Evans, 'The Role of International Rules in Blockchain-Based Cross-Border Commercial Disputes' (2019) 65 Wayne L R 1, 14-15.

<sup>87</sup> Buchwald (n 44) 1404-1406.

<sup>88</sup> Buchwald (n 44) 1406-1408.

## 2. Qualifications and Independence/Impartiality of the Jurors

On some crowd-sourced platforms, like Kleros, there is no screening of the technical and legal expertise of eligible jurors, while others, like Aragon, use reputational criteria as an indirect means to gauge expertise.<sup>89</sup> However, this reputation is built based on success rates on the platform, thus re-imposing the aforementioned problems of arbitrariness. Moreover, the guaranteed and higher rates of compensation on off-chain platforms will always render those more lucrative for competent arbitrators/jurors.

On online arbitration models, there are concerns over the independence/impartiality of arbitrators because of the limited pool of available candidates.<sup>90</sup> In crowd-sourced models, these concerns emerge when the jurors are selected through the proportionality of their deposited tokens. In both models, present enough incentive, jurors can collude with a party to ensure selection and thereafter vote in their favour. This is especially a problem for private blockchains, where the identity of all network participants is known inter-se.

## 3. Marginalization of Recognition and Enforcement Procedures

In international arbitration, the legality of an award in a jurisdiction depends on its recognition within that national legal system. This entrusts the courts to exercise a ‘gatekeeping’ function, wherein they can legitimately decline recognition of bad awards on limited grounds like public policy and equality.<sup>91</sup> In on-chain arbitration, the self-execution of the award eliminates any scope for the court to exercise this function. The effect of this is that on-chain arbitration can be mischievously used as a means to enforce illegal, unjust, and unconscionable awards.

When the debtor fails to perform the obligations contained in the award, the enforcement procedure applies. The creditor can utilize the coercive machinery of the state to compel performance from the debtor. However, most jurisdictions recognize the need to balance the rights of the debtor and the creditor, by protecting certain interests of the debtor and obligating the creditor to follow stipulated procedure. The effect is that enforcement doesn’t happen immediately, and due time is given to ensure that certain fundamental rights of the debtor are not abrogated. Conversely, on-chain arbitration derogates from this requirement through an instantaneous distribution of assets between the contracting parties, once final determination is made.<sup>92</sup>

## 4. Appeals

Some crowd-sourced platforms provide infinite or a large number of appeals to the first rendered award.<sup>93</sup> This provides an opportunity to parties, especially those that are resource-rich, to frustrate the enforcement of the award through continuous appeals, at least to a point where its effect may not be meaningful anymore.

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<sup>89</sup> Amy J. Schmitz & Colin Rule, ‘Online Dispute Resolution for Smart Contracts’ (2019) 2019(2) *Journal of Dispute Resolution* 103, 118-124.

<sup>90</sup> Jewel (n 48); Szczudlik (n 47); Shehata (n 11) 19-21.

<sup>91</sup> Zhen Er Low, ‘Execution of Judgments on the Blockchain’ (2021) 34(1) *HJLT* 1, 9-13; Ortolani (n 37) 435-436.

<sup>92</sup> Ortolani (n 39) 436-437; Low (n 91) 9-13.

<sup>93</sup> Rabinovich-Einy (n 33) 59-71; Buchwald (n 44) 1391-1392.

## V. CONCLUSION

The relationship between blockchain and arbitration is symbiotic. While blockchain's application to aid arbitration is not controversial, arbitration's application to resolve blockchain-based arbitration is fraught with legal and policy concerns, despite its revolutionary benefits like efficiency, flexibility, and acceptability. Presently, blockchain-based arbitration necessarily requires human arbitrators because of inherent limitations in AI-based arbitrators. The dispute resolution process is operationalized using smart arbitration clauses that operate like escrow mechanisms. But the enforcement of the rendered award may be 'on-chain' or 'off-chain'.

Since off-chain arbitration depends on state machinery for enforcement, it is strictly bound by all legal requirements of arbitration, contract, and technology law in the appropriate countries. There are issues in the validity of the arbitration agreement due to compliance with the "in writing" requirement and the anonymity of contracting parties. Additionally, there is difficulty in ascertaining and pre-selecting the seat, governing law, and jurisdiction. There are due process concerns due to the inconsistency in the *lex arbitri*. Lastly, the decentralized nature of blockchain also confounds enforcement in jurisdictions that have implemented the reciprocity clause.

While these aforementioned legal issues are applicable to on-chain arbitration, self-enforcement of awards practically ensures that they are irrelevant. However, there are novel policy concerns regarding their governance. These are dominant in the crowd-sourced models that face due process concerns because they undermine a party's right to properly present their case, compel discovery, and a reasoned and objective award. They also face issues around the technical qualification and independence of the jurors, and a vexatious appellate mechanism. The online arbitration model face issues around the compelling of discovery and independence of arbitrators. However, both models marginalize recognition and enforcement procedures, which leads to unconscionable and/or illegal outcomes.

The Ricardian Contract is a great example of how parties can proactively address some of these legal concerns. It requires contracting parties to also physically represent their digital contracts, so as to prevent any challenges on the validity of the contract or the arbitration agreement. However, most of these legal and policy concerns emerge due to blockchain's fundamental characteristics of decentralization, pseudonymity, and irreversibility, and therefore cannot be addressed without compromising them.