The digital revolution: Blockchain and Artificial Intelligence in International Arbitration

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Abstract

The increasing number of transactions taking place on the Ethereum blockchain network and across the digital landscape, including in the metaverse, will certainly lead to disputes. The underlying question is how these new and somewhat unorthodox disputes will be resolved. This article seeks to examine how both artificial intelligence (AI) and blockchain-based, crowdsourced arbitration will tackle these disputes. Specifically, it looks at how international arbitration will adapt to these technologies. AI and blockchain technologies, which already depend on each other, could also be linked in the context of dispute resolution. First, the article will consider how both technologies could represent opportunities or benefits to arbitration in this new technological landscape. Second, it will examine whether AI and blockchain arbitration are currently able to withstand the challenges considered in the article, or whether AI and blockchain arbitration will need to be improved to stem the oncoming tide. The paper will first consider the opportunities and benefits offered by AI and blockchain arbitration and examine, in the second part, the flaws and challenges associated with AI and blockchain arbitration.

Discipline: LAW
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On 9 December 2022, over 1.933 million transactions were completed on the Ethereum blockchain network[1]. This staggering figure is in line with the 250 million transactions which occurred on this network in 2018 (Buchwald, 2020, p. 1369). Equally, the rate of growth for ecommerce in 2023 is expected to be around 8.9 % bringing worldwide ecommerce sales to over USD 5.8 trillion[2]. With this volume of transactions, it is inevitable that there will be disputes[3] (Katsh and Rule, 2016, p. 5). A fundamental question is how those disputes will be resolved. Contractual transactions involving complex legal relationships, high stake valued transactions with two or more disputants will most likely be resolved by litigation and online or off-chain arbitration. Blockchain transactions, smart contracts or digital transactions might be resolved by online dispute resolution (ODR[4]) (Wahab, Katsh and Rainey, 2012; Gélinas, 2004, pp. 7-19; Kaufmann-Kohler, 2005, p. 437) mechanisms (Schmitz and Rule, 2019, p. 103).

Traditional arbitration is gradually being disrupted by technological innovations[5] (Sourdin, 2018, p. 1117) particularly crowdsourced blockchain arbitration (Schmitz and Rule, 2019, p. 114; Aouidef, Ast and Deffains, 2021, p. 4) and artificial intelligence (AI) and its variants[6]. This article seeks to examine how artificial intelligence or blockchain crowdsourced arbitration will tackle these new areas of conflict. Both AI and blockchain although interdependent could however be linked together in the dispute resolution sphere. Specifically, the author will observe how international arbitration has adapted to these new ideas. Firstly, the article will reflect on how both technologies could represent opportunities or benefits to arbitration in this

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1 - URL: https://ycharts.com/indicators/ethereum_transactions_per_day, accessed 15 September 2023.

2 - URL: https://www.oberlo.com/statistics/global-ecommerce-sales-growth, accessed 15 September 2023.

3 - It has been estimated that from 3-5% of eCommerce transactions end in a dispute.

4 - ODR is information technology and telecommunications via the internet applied to Alternative Dispute Resolution.

5 - The technology used in the law and in international arbitration may take various forms including supporting technology (tools helping in the performance of certain recurring tasks), replacing technology (tools aiming to replace functions or activities performed by humans), disruptive technology (tools changing the way judges and arbitrators work) and predictive technology (tools assisting or replacing the decision-making process).

6 - In 1956, J. McCarthy coined the term “artificial intelligence” (AI) for the first time during a conference where a group of scientists discussed if machines might be made to be intelligent like human beings. Since then, AI has been defined as a computer program’s ability to perform tasks or reasoning processes that we normally connect with human intellect.

new technology space. Secondly, it will examine whether AI and blockchain arbitration currently stand up to the challenges considered in the article or if AI and blockchain arbitration will need to be improved to stem the oncoming tide. We will first discuss opportunities and benefits of AI and blockchain arbitration and study, in the second part, flaws and challenges associated with AI and blockchain arbitration.

It is worth considering what AI and blockchain arbitration are before discussing their opportunities, benefits, flaws and challenges. Blockchain arbitration resembles conventional arbitration with the exception that it takes place on blockchains like Ethereum (Tirado and Cosio, 2022, p. 4). Kleros project is innovative[7] (Lesaege, George, and Ast, 2019, p. 3) and an automated opt-in system designated by smart contracts that automatically define how many jurors will decide the dispute. Kleros relies on «game-theoretical economic incentives» (Aouidef, Ast and Deffains, 2021, p. 4) and leverages the technologies of crowdsourcing and blockchain (*ibid.*; Lesaege, George, and Ast, 2019). The confidentiality of the process is guaranteed[8] (Aouidef, Ast and Deffains, 2021, p. 2) and Kleros arbitrators (called jurors[9]) remain anonymous. In the same vein, Aragon Network provides a decentralized plug-in arbitration platform which handle disputes that cannot be resolved by smart contracts alone[10]. Disputes are resolved by incentivized guardians[11] drafted for each dispute, ready to arbitrate[12]. Aragon also relies on game-theory principle[13]. AI can be defined as a software which can "for a given set of human-defined objectives, generate outputs such as content, predictions, recommendations, or decisions influencing the environments they interact with"[14].

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7 - Kleros describes its project as "an autonomous organization, implemented on Ethereum, that works as a decentralized third party to arbitrate disputes in every kind of contract, from very simple to highly complex ones" (Lesaege, George, and Ast, 2019, p. 3).

8 - Kleros asserts that its system is secured. Only the selected arbitrators and parties have access to the details of the arbitration proceedings.

9 - Kleros uses the term jurors rather than arbitrators.

10 -URL: https://aragon.org/aragon-court, accessed 25 September 2023.

11 -Aragon use the terms guardians rather than arbitrators. Aragon proposes arbitration to settle the disputes.

12 - https://aragon.org/aragon-court, accessed 25 September 2023.

13 -For discussion about game theory in blockchain arbitration. Lesaege, George, and Ast, 2021, p. 2 and Metzger, 2019, p. 94.

14 -See the proposed European Artificial Intelligence Act definition as of 25 September 2023. URL: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52021PC0206&from=EN, accessed 25 September 2023

Opportunities and benefits

AI is deployed to increase both the efficiency and quality of the arbitral process (Eidenmuller and Varesis, 2020, p. 49). The opportunities can already be seen in blockchain-based arbitration employed by private businesses to resolve simple legal disputes (Ast and Lesaege, 2021, p. 34) which are faster and efficient. This section will probe those efficiencies. With a view to examining the opportunities and benefits presented by AI and blockchain, this section will consider in turn the following elements: AI as a tool assisting human arbitrator and parties; AI as tool for arbitrators' selection; blockchain and AI for the automation of bulk disputes; particularities of blockchain decision making / Kleros and Aragon appeal systems, and AI arbitrator.

AI tools assisting human arbitrators and parties

AI applications can handle certain aspects of the procedure for complex cases[15]. Arbitrators and parties may utilise them for organizing case management conferences and hearings. AI applications also deliver legal data from citations to full legal briefs[16], allow effortless navigation through parties' submissions or legal arguments and identify cases that have been overturned or criticized[17]. AI-based tools can smoothen arbitrators' workload in documents and facts handling. Other applications specialize in decision-analysis and outcome estimate[18]. They use quantitative prediction through access to a large pool of data that has been accurately classified (Eidenmuller and Varesis, 2020, p. 60).

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15 -A start-up developed AI-based virtual assistants for scheduling meetings and appointments. See Steve O'Hear, Julie Desk, an 'AI virtual assistant' that helps you schedule meetings and more, scores €2.5M funding, URL: https://techcrunch.com/2017/06/01/julie-desk-an-ai-virtual-assistant-that-helps-you-schedule-meetings-and-more-scores-e2-5m-funding, accessed 25 September 2023.

16 -Forbes, URL: https://www.forbes.com/profile/ross-intelligence/?sh=3185ffa81e85, accessed 25 September 2023.

17 -Ross Intelligence, URL: https://www.rossintelligence.com/features, accessed 25 September 2023.

18 -ArbiLex is a data analytics startup that works as a predictive data analytics tool that leverages Bayesian machine learning to help practitioners to complement their intuition in resolving arbitration cases, URL: https://www.forbes.com/sites/frederickdaso/2020/02/04/arbilex-a-harvard-law-school-legal-tech-startup-uses-ai-to-settle-arbitrations/?sh=20b741fe52c5, accessed 25 September 2023; Ravel Law uses natural language processing technologies to mine published case opinions, providing a wealth of information that helps litigators quickly uncover new insights and build specific arguments for use in court; Solomonic assists in evaluating settlement patterns, fining tune litigation tactics and enhancing estimates and predictions in arbitrations, URL: https://www.solomonic.co.uk/, accessed 25 September 2023. See Frederick Daso, ArbiLex, A Harvard Law School Legal Tech Startup, Uses AI to Settle Arbitrations. *Forbes*, 4 February 2020. URL: https://www.forbes.com/sites/frederickdaso/2020/02/04/arbilex-a-harvard-law-school-legal-tech-startup-uses-ai-to-settle-arbitrations/?sh=20b741fe52c5, accessed 15 September 2023.

Similarly, parties can rely on AI-drafted arbitration clause[19] and human arbitrators might receive better drafted and legally reasoned parties' submissions particularly in cases where parties are not represented by experienced counsel (Bento, 2018). These two seemingly different and varied tasks seem to be within the accomplishments of the current AI-technologies, but it remains to be seen how AI will accomplish the more formidable challenges of international arbitration. It might also increase chances of success or estimate expected damages or probable costs. Parties would benefit from enhanced legal representation and human arbitrators may render an improved award with the benefit of AI-powered analytical skills and improved review skills which may ultimately better arbitral proceedings and reduce the uncertainty inherent to dispute resolution process.

AI for arbitrators' selection

Parties choose arbitration for its flexibility, the enforcement of the award but mainly because they can elect 'their arbitrators'. Arbitrators' selection is a challenging exercise at best as the selected arbitrators will pass judgment on the parties' dispute. Finding the arbitrator can be a delicate exercise[20]. Such a process cannot be left to intuition alone and precision is critical (Karim, 2019). Parties and their counsel usually rely on the word of mouth, use their contacts or AI tools such as Arbitrator Intelligence[21] and Global Arbitration Review Arbitrator Research Tool[22]. AI tools can successfully facilitate the arbitrators' selection. But is it more effective? If users expressed initial scepticism (Rogers, 2018), both paying-fee services have gained momentum, recognition and acceptance (Karim, 2019).

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19 -The American Arbitration Association's ClauseBuilder tool is designed to assist companies develop clear and effective arbitration agreements. URL: https://www.clausebuilder.org, accessed 25 September 2023.

20 -There are various criteria considered including expertise or technical knowhow, professional experience, language skills, legal background, nationality pursuant to the arbitration clause.

21 -This information aggregator collects data aims at liberating 'the arbitrator's selection from the 19th century's telephone and introduce it to the 21st century's data-driven analytic solutions. It issues reports incorporating arbitrators' track records enabling users to make more predictable appointments based on arbitrators' document production rulings, efficiency and fairness of case management, duration of the proceedings, questions, and quality of the legal reasoning in awards.

22 -GAR ART allows users to research arbitrators' approach and delivers raw data. It identifies arbitrators based on procedural preferences, curriculum vitae, speeches, users' feedback as well as arbitrators' specialization, experience, technical expertise and, sometimes, the decisions rendered. It includes arbitrator's own responses on their procedural preferences and practices as well as counsel's names who have appeared before them with whom they have sat on arbitration panels. URL: https://globalarbitrationreview.com/tools/arbitrator-research-tool/faq, accessed 25 September 2023.

Blockchain and AI for the automation of bulk disputes

Since 1990s, eBay Resolution Centre has been resolving e-commerce disputes. eBay handles bulk disputes through online arbitration based on a learning system and big data with a high degree of automation (Barnett and Treleaven, 2018). eBay was successful thanks to a revolutionary ODR system that only arbitrates small disputes involving simple legal issues. Similarly, Modria.com is a get out-of-the-box process that automatically resolves simple and time-consuming disputes with a configurable case management. In the same vein, Kleros and Aragon also arbitrate a maximum of small disputes in a minimum of time and limited cost[23].

Moreover, arbitral institutions manage cases, oversee arbitral proceedings and ensure that repetitive procedures are homogenised. The International Online Dispute Resolution Centre (eBRAM) provides a striking example on how technology can best serve dispute resolution procedure. Since 2018, eBRAM has adopted state-of-the-art technologies[24] to resolve cross-border commercial and trade disputes worldwide[25]. The World Intellectual Property Organization provides a dispute resolution system for domain names[26]. Since 2019, all arbitrations under the rules of the Arbitration Institute of the Stockholm Chamber of Commerce are administered from its digital platform[27]. Institutions simplify processes, making them even mundane. But even that mundane aspects are changing. The goal is to ensure the predictability in as far as the procedure is concerned so that parties can trust the result[28].

Businesses like eBay, Kleros or Aragon have a daring approach whereas mainstream arbitral institutions may appear more hesitant to embrace

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23 -Kleros ICO Arbitration on the Blockchain, Federico Ast interview by The Crypto Lark, 13 March 2018. URL: https://www.youtube.com/watch?v=sVCOH3br4ZI, accessed 25 September 2023

24 -eBRAM platform uses technologies including AI, blockchain, cloud and soft robotics. URL: https://ebram.org/overview.html, accessed 25 September 2023.

25 -Hearings are conducted through video conferencing in a secure environment and parties will receive a final, binding, and enforceable award via the eBRAM platform.

26 -The procedure initiated by email facilitates the exchange of documents electronically and offers a video conference system for meetings. URL: https://www.wipo.int/amc/en/arbitration/, accessed 25 September 2023.

27 -As soon as the request for arbitration is submitted, the SCC assigns a specific site to this arbitration file including a database, archiving system, access to the calendar with the dates and deadline. URL: https://sccarbitrationinstitute.se/en, accessed 25 September 2023.

28 -Judicial Arbitration and Mediation Services, Inc published in 2018 a draft set of rules for disputes arising out of smart contracts.

blockchain or AI fully[29]. The reason for this different posture could be the complexity of the disputes which they engage in. Businesses arbitrate a maximum of small disputes[30] in a minimum of time and at a lower cost and often without the reference to the law[31]. Thus, businesses provide easier access to arbitration for e-commerce disputes involving consumers and small businesses (Sims, 2018). Those disputes usually involve simple debt claims. Nevertheless, multifaceted disputes can often involve several parties with several contracts and bring into play complex economic considerations but also empathy and other human factors that can hardly be translated into simple equations. Disputes in traditional arbitration are decided pursuant to the law but also on intricate facts whereas blockchain arbitration is limited to simple legal disputes[32].

At this junction, predictive AI does not yet bring a satisfactory solution for complex legal disputes. But AI and blockchain arbitration will need to handle complex facts and intricate legal issues to settle the dispute if they intend to deal with a wider pool of disputes that will not fail to arise in the Ethereum. Although technology has evolved considerably, predictive AI is still not able, to this day, to read, predict or feel emotions with precision (Argerich, Noodt Taquela and Jorge, 2020). Kleros website indicates that Kleros arbitration mechanism is restricted to small claims, ecommerce, insurance, finance disputes. Small disputes can be seen as simple legal issues like a debt claim which is accepted or denied. This shows that crowdsourced arbitration is still restricted to debt claims[33], at least for now. The future will tell whether machines will be able to understand the subtle strategies and tactics deployed by the parties in international arbitration.

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29 - Users can choose between arbitration facilitated by digital platforms or prefer online arbitration from A to Z proposed by arbitral institutions or private businesses. If the past standard favored a mixed procedure with digitalization limited to the management of the file, the exchange of documents or virtual meetings while keeping a more traditional element with the notification of the arbitral award by more traditional means, the current trend is moving towards online arbitration from A to Z with notification of the award to the parties by dematerialized means. URL: https://www.ebay.com/help/buying/resolving-issues-sellers/resolving-issues-sellers?id=4011&st=3&pos=1&query=Resolving%20issues%20with%20sellers&intent=dispute%20resolution&lucenceai=lucenceai&docId=HELP1057, accessed 25 September 2023.

30 - Small disputes can be seen as simple legal issues like a debt claim which is accepted or denied. Bigger disputes may involve complex legal issues often with more than two parties and several contracts that bring into play complex economic considerations.

31 - See section below, "Particularities of blockchain arbitration: Kleros and Aragon arbitration system".

32 - See Kleros Justice Protocol Explainer. URL: https://www.youtube.com/watch?v=NuSps_2wMQ4, accessed 25 September 2023.

33 - Kleros website indicates that its mechanism is restricted to small claims, ecommerce, insurance, finance disputes.

Particularities of blockchain arbitration: Kleros and Aragon arbitration systems

This section will consider the particularities of blockchain arbitration including its decision making and Kleros and Aragon appeal system.

Kleros jurors assess evidence submitted by the parties and cast their vote in isolation (Aouidef, Ast and Deffains, 2021, p. 14). Jurors are incentivized to decide with the majority and are rewarded with Pinakion when they vote with the majority based on the SchellingCoin (Ast and Lesaege, p. 38). Conversely, a minority vote will cause the minority jurors to lose their investment (Aouidef, Ast and Deffains, 2021, p. 14). The disclosure of evidence and opportunity for advocacy are sparse to say the least (Buchwald, 2020, pp. 1369). Kleros and Aragon solely rely on the parties' evidence that they see fit and jurors have limited mechanism to compel further evidentiary submissions. Parties have little opportunity to clarify their arguments and respective positions. Additionally, jurors receive very little training or guidance for rendering a decision (*ibid*.).

It is obvious from the above that jurors are not chosen for their legal knowledge or expertise. Their decisions are not based on the law or legal precedents which ultimately reduce the costs and increase the speed in Kleros and Aragon's decision making. The disputants get a decision based on majority and the SchellingCoin. At this junction, it is important to clarify that Kleros and Aragon's arbitration is significantly different from traditional arbitration.

Are disputants given a fair opportunity to present their case in Kleros and Aragon's systems? Despite the efficiency and cost effectiveness, one may wonder if the decision made on financially incentivized majority voting scheme does really serve the disputants' interests. Buchwald argues that 'pairing this lack of structure with financial incentives renders the system deeply flawed' (*ibid*.). Narozhny submits that "compliance to due process requirements is a built-in feature of the protocol " (2019, p. 182). Kleros jurors or Aragon guardians only consider an imperfect set of evidence for their decision making. It is true that parties can submit evidence, but the disputants have no option to file sequential evidence which may ensure an opportunity to respond to the evidence and arguments submitted to the other side (Tirado and Cosio, 2022, p. 4). Although private entities like Kleros cater for simple debt claims, disputants might benefit from an improved consideration of their respective legal arguments and intended positions. Even e-commerce disputants might still benefit from the opportunity to have their contract fully analysed or the negotiation stage documentation, if any, considered. Ultimately, all parties should have a fair opportunity to present their case. The author shares the view that even if Kleros arbitration encompasses due process certain areas of due process really need improvement (*ibid*.).

Let us now turn to Kleros and Aragon appeal systems. Both decisions can be appealed (Aouidef, Ast and Deffains, 2021, p. 28). Both appeals are self-contained in both mechanisms. The number of jurors increases exponentially with appeals; equally charged fees[34] (Tirado and Cosio, 2022, p. 4; Lesaege, George, and Ast, 2019) increase with the number of appeals[35] (Karki and Aragon, 2017). Kleros argues that it deters unmeritorious appeals and avoids the 'unnecessary duplication of effort and high costs' required by having many jurors consider every case while providing 'a defence against an attacker bribing the jurors' (Aouidef, Ast and Deffains, 2021, p. 28).

Both mechanisms are representative of blockchain arbitration and include an appeal system whereas traditional commercial arbitration does not encompass an appeal. Traditional awards rendered in commercial arbitration are binding on the parties and cannot be appealed. Kleros and Aragon appeal system is in line with the United Nations Commission on International Trade Law proposal for an appeal system in investment arbitration[36]. One might ask if it is warranted to have an appeal system in blockchain arbitration? What is the real benefit for this appeal system? Some opines that it is a 'costly mass review' intending "to improve decisional accuracy through an increased sample size, as well as deter parties from engaging in frivolous appeals " (Buchwald, 2020, p.1391). It should not be forgotten that parties challenging an award can ask a national court to review said award pursuant to the Convention on the Recognition and Enforcement of Foreign Arbitral Awards (the New York Convention)[37]. Even if this review does not equate an appeal, it may provide comfort to disgruntled parties. Ultimately, it is a matter of choice for the disputants: with or without an appeal mechanism. If parties want arbitration with an appeal, then blockchain arbitration is the answer.

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34 -It is calculated as cost of appeal = arbitrator's fees x number of jurors.

35 -Aragon appeal is rendered by an initial five-jurors panel, the second review is submitted to the "Prediction Market" for which all jurors must post a bond a rule on the merits and the matter can be examined by the Aragon "Supreme Court" which consists of nine pseudonymous jurors with the highest reputational ranking.

36 -United Nations Commission on International Trade Law Working Group III, Possible Reform of Investor-State Dispute Settlement, Appellate mechanism and enforcement issues, 12 November 2020, A/CN.9/WG.III/WP.202. URL: https://uncitral.un.org/en/working_groups/3/investor-state, accessed 25 September 2023.

37 -A challenge of an award is not an appeal. It can be found under the 1996 Arbitration Act. At the time of writing this paper, the 2024 Arbitration Act shall replace the 1996 Arbitration Act. Its Parliamentary approval is underway.

AI arbitrators

A controversial application is the use of AI-arbitrator instead of human arbitrators. AI-based programmes mimicking the work of human arbitrator are already available[38]. If AI can successfully replace human arbitrator, one should question the AI's influence on awards. If AI arbitrator replaces human arbitrator entirely, this implies that the award will be exclusively drafted by AI and AI will assume the decision making.

Some argue that AI can advantageously replace human arbitrators. An AI arbitrator only sees facts and facts alone. Emotion, ego and feelings are not part of the equation. No unconscious bias based on emotion. AI-arbitrators are supposed to be bias free[39] (Cohen, 2015, p. 57; Cohen and Nappert, 2017). A 'robot' (AI system) can deliver 'more dispassionate or emotion-free decisions' so it would be less vulnerable to challenges on grounds of conflict of interest or bias (Wei and Moser, 2020, p. 215-244). AI-arbitrators are not prone to the cognitive errors of human arbitrators which may negatively impact their decisions. AI-arbitrators are likely to reach rational decisions easily. It is a matter of time for AI to replace human arbitrators. This statement might appear strong. Arbitrators and arbitration users may already use AI in arbitration cases[40] (Bayraktaroğlu-Özçelik and Özçelik, 2021). However, arbitration users should have the choice between human arbitrators or AI-arbitrators if we want to retain the arbitration spirit that is based on parties' autonomy and parties' choice to submit their dispute to arbitration.

Is this lack of context, empathy and emotions that make it the perfect arbitrator? Nappert opined that human emotions may lead to outcomes contrary to the ideal of justice (2018, p. 20-26). Others argue that AI-arbitrators, due to their lack of emotional intelligence, should not make the decision, but only act as a guide for human arbitrators (De la Jara, Palma and Infantes, 2017). The absence of emotional processing can be a definite handicap. Ultimately, the disputants will have to decide whether they desire robot arbitrators or human arbitrators to settle their disputes. Fully AI-powered arbitrators cannot think outside the box and create new outcome since they cannot do anything other than what they are trained to do. They can only mimic or combine existing legal patterns to achieve what appears to be a 'new' output for particular cases. According to Lord Mustill, 'in making his award, the arbitrator creates new

38 -Tyler Technologies' Modria settles eBay-typed disputes with an algorithm that provides users with answers to their disputes according to pre-programmed rules. URL: https://www.tylertech.com/products/Modria, accessed 25 September 2023.

39 -Refer to discussion below in "Ethical guarantees".

40 -This issue is discussed above See: "AI tools assisting human arbitrators and parties".

rules, which he then applies retrospectively to the original bargain [and] in the absence of established norms, the arbitrator exercises a creative function, acting as a social engineer' (1987, p. 161). Arbitrators can create new doctrines although there is no precedent system in arbitration. New legal interpretation is crucial in the development of law to fill the gap or adapt the rules to instantly changing socio-economic background. Given that an AI-arbitrator will stick to pre-existing rules and past data in the algorithm, an award created by an AI-arbitrator may fall short in generating the openness and flexibility necessary to develop rules and standards in international law (Halis Kasap, 2021).
The present section discussed how AI and crowdsourced blockchain arbitration have significantly changed to the paradigm in international arbitration. They certainly provide costs reductions and time savings. With crowdsourced blockchain arbitration, businesses have successfully democratised arbitration that is now used for e-commerce disputes involving consumers and small businesses and uncomplicated legal claims. Although this is an interesting change, arbitration users might feel reluctant to embrace fully AI-based arbitration or crowdsourced blockchain arbitration. The elements considered above cannot overshadow flaws and challenges which will be examined next.

Flaws and Challenges

No matter how positive the promise of blockchain and AI seems, there are concerns associated with AI-powered arbitrator or crowdsourced blockchain arbitration. This section will discuss inherent flaws and challenges of blockchain and AI connected to jurors' selection, ethical guarantees, *lex arbitri* and prohibition, consent to AI and crowdsourced blockchain arbitration, and enforcement of arbitral decision.

Jurors' selection

Kleros jurors are not selected for their legal knowledge, their independence or impartiality[41] (Bishop and Reed, 1998, pp. 398-401) or their expertise. Jurors buy Kleros crypto-token (Pinakion) to demonstrate their availability[42] (Aouidef, Ast and Deffains, 2021, p. 9). This is the sole criteria. The probability of being drawn as a juror is proportional to the number of tokens a juror will stake (*ibid*; Ast and Lesaege, 2021). Kleros argues that anonymity protects jurors

41 -Impartiality relates to the state of mind and refers to favouritism or prejudice shown by an arbitrator toward a party or the matter in dispute.

42 -Staking Pinakion signals availability to be drawn as a juror; users that do not stake Pinakion will not be drawn. This prevents inactive jurors from being selected.

from intimidation, retaliation and the temptation to bribe. This is a heavy charge against traditional arbitration. Kleros opines that this mechanism guarantees an honest vote. Narozhny asserts that the design of the 'Kleros dispute resolution process complies with all core principles of due process' (2019, p. 184) including independence and impartiality. While the author acquiesces Narozhny's assertion, the intended objectives are not entirely met. In traditional arbitration, arbitrators are only good as the last award issued and this too serves as an adequate check on undue influence. One may wonder if selecting arbitrators based on the tokens does not go against the very essence of arbitration and may not necessarily meet the parties' needs. If we condition the juror's state of mind to the gain of tokens, will they not be more interested in the acquisition of Pinakion than in their mission to decide the dispute? The Kleros arbitrators' selection is inherently dependent on candidates buying Pinakion. Arbitration laws recognize the independence of arbitrators as an essential quality (Blackaby *et al.*, 2015, p. 229). Conflict of interests should be avoided at all costs (Potin and Ogunseitan, 2020, pp. 29-53). If Kleros wishes to gain further acceptance, its protocol should include a requirement for jurors to disclose conflicts of interest within the guiding principles governing traditional arbitration[43].

Ethical guarantees

Like humans, AI can be prejudiced (Rejcek, 2017; Sela, 2018, p. 115; Bayraktaroğlu-Özçelik and Özçelik, 2021). The data used to train the AI, in any field, might have been 'contaminated' with human prejudices[44] (Van Harten, 2010, p. 433). AI systems are actually 'learning' human biases and gradually drift away from being completely free of bias (Knight, 2017). AI learns to do things itself rather than being taught by programmers. AI-powered machine choses the inferences it would make from particular occurrences in the judgments as well as the weight it would assign these occurrences in predicting the outcome. Will AI-powered arbitrators be less likely to raise conflict of interest or prejudice? Their decision-making process, presumably, would arguably be less polluted by human flaws of prejudice, illogicity, or simply mood swings. Safeguard will then prove necessary.

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43 -Article 6 of the European Convention on Human Rights reaffirms the right to a fair trial and to an 'independent and impartial tribunal' (emphasis added).

44 -In investment arbitration, there are opinions that arbitral tribunals tend to be excessively favourable to foreign investors over host states. If AI machine learning is fed on traditional international investment arbitration data, it might perpetuate such claimed investor favouritism, thus, leading to the scenario that investors might receive favourable results in a disproportionate number of cases in the future.

AI programmes are data-hungry: the larger the sample data, the more accurate the model's predictive value[45] (Scherer, 2019, p. 554). AI needs to be trained through a huge volume of accurately classified data to work in any steps in arbitration. Awards are not easily accessible to non-parties since arbitration is private and often confidential[46]. Assuming awards were made available, the sheer volume of published awards is limited and might not be sufficient to create an accurate pattern for legal decision-making. Awards rendered in international investment disputes are often published[47] whereas awards rendered in commercial arbitration are seldomly published[48]. In terms of volume, there might not be enough data input for AI to work effectively in international arbitration. There is, quantitatively speaking, not a large sample for 'machine arbitrators' to learn from.

Additionally, AI might have difficulty in dealing with rapid policy changes making previous data learned by AI become outdated very quickly. While some policies can change gradually, step-by-step in order for everyone have a reasonable time to adapt, many policies rather change swiftly. In investor-state arbitration, the famous judgment of *Achmea* case[49] was a game changer causing a major shift in intra-European investment policy. Additionally, the growing concern in interests such as environmental demands or human rights compliance, to quote a few, make it necessary for policymakers to evaluate and make reforms of investment treaty regime, which means that AI-powered arbitrators should have the ability to constantly update not only case law or regulation data but also other national and international policy changes relating to arbitrations.

From the technical side, the decision-making mechanisms of AI algorithms often function in a 'black box' which makes the algorithm opaque even to

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45 - Scherer opined that the four Vs of Big Data are system-inherent limitations which in turn represent major difficulties and raise wide-reaching concerns. She analysed that four Vs of Big Data (Volume, Variety, Velocity and Veracity).

46 - Awards are seldomly published in international commercial arbitration. Selected redacted awards or summaries are published by some arbitral institutions.

47 - International Settlement Centre Investment Dispute and Permanent Court of Arbitration websites publish investment awards in full or partly redacted.

48 - Most arbitral institutions do not publish awards without the prior written consent of the parties and/or the arbitrators (Singapore International Arbitration Centre, London Court International Arbitration and Hong Kong International Arbitration Centre). Other arbitral institutions like the International Chamber of Commerce and Stockholm Chamber of Commerce restrict the publication of awards to certain circumstances. Extracts of selected awards will be published without the parties or the arbitrators' names, and facts that may identify the matter in a redacted form.

49 - S*lovak Republic v. Achmea B.V.*, Case No. C-284/16, CJEU, 6 March 2018. URL: https://curia.europa.eu/juris/document/document.jsf?docid=199968&doclang=EN, accessed 25 September 2023.

savvy programmers, let alone legal professionals and laypeople (Rich, 2016, p. 886; Burrell, 2016, p. 10). It could be difficult to find reasoning or establish a causal link between a specific input and a specific outcome ruled by AI arbitrators and vice versa. As a result, enforcement of AI-powered award might be jeopardised if the decision-making process is inexplicable and/or unreasoned.

The utilisation of AI arbitrators can suffer risk of bias due to their input data, which may cause doubt of the robustness and trustworthiness of AI-powered arbitrations. According to research in various fields including psychology and cognitive science, humans frequently fail to act logically and their rationality heavily depends on biases which are – factors which appear to be irrelevant to the merit of our choices but affect them nonetheless (Tversky and Kahneman, 1974, p. 1124). It is acknowledged that arbitrators, judges, and juries bring hidden prejudices to their responsibilities that they are often unaware of (Bennett Marrow, Mansi and Kuyan, 2020, p. 35). Therefore, one may wonder how AI is expected to overcome inherent flaws of human beings. Will AI be immune from the influence of unrelated external variables?

To complete this overview of ethical guarantees, one should look at corruption and how AI can prove relevant. Nappert suggests drawing assistance from 'AI in considering and deciding allegations of corruption' and from 'an algorithm programmed to recognise red flags in a given set of factual circumstances, and to determine the percentage chance of corruption being, or not being, present' (2018, p. 26). The treatment of allegations of corruption remains unsatisfactory. Arbitrators regularly avoid dealing with corruption allegations[50]. Gaillard argued that arbitrators oscillated between '*vertu affichée et inaction pratique*'[51] (2017, p. 810). Should AI assist in the handling of allegations of corruption and in recognising red flags, then AI would be a useful tool and avoid delays in having to wait for the recognition or enforcement of the award

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50 - *The Valeri Belokon v. Kyrgyz Republic* case illustrates this. URL: https://www.italaw.com/sites/default/files/case-documents/italaw8476.PDF, accessed 20 September 2023. The arbitral tribunal decided that it could not itself venture beyond the view of the host state's courts and that 'an international tribunal [...] cannot, in the absence of concrete and decisive evidence, consider identical allegations as proven by the host state'. In 2017, the Paris Cour d'Appel found that there was 'serious, precise, and concurring evidence' of money laundering practices and set aside the award. According to the Court, the recognition or enforcement of the award would otherwise result in Mr. Belokon benefiting from the proceeds of criminal activities, which was a 'manifest, actual and concrete' violation of international public policy. The Cour de Cassation confirmed that the conformity of arbitral awards with French international public policy could be subject to a 'maximalist review' by the annulment judge, Cour de cassation, Chambre civile 1, 23 mars 2022, n° 17-17981. URL: https://www.italaw.com/sites/default/files/case-documents/italaw8476.PDF, accessed 25 September 2023.

51 - Declared virtue and practical inaction.

by national courts and their control of awards (*ibid*.).

Lex arbitri[52] and prohibition

Some legal instruments contain a presumption in favour of human arbitrators. The English 1996 Arbitration Act refers to the death of an arbitrator. Articles 11(1) and 12(1) of the United Nations Commission on International Trade Law Model Law on International Commercial Law refers to a person[53]. But the New York Convention does not prohibit AI arbitrators, nor does it expressly require arbitrators to be human[54]. However, AI was not yet a fashionable topic when it was drafted and signed. If there is no express exclusion, it can be assumed that AI arbitrator could come within the remit of the definition. Nevertheless, certain arbitration laws expressly exclude non-human arbitrators[55]. These legislations take a firm stance and require that AI cannot act as an arbitrator by establishing explicit prohibitions which can be considered obsolete in the time of the metaverse. The uncertainty of whether AI arbitrators are accepted could result in confusion and generate statutory settings for AI arbitrators that are under-inclusive. Interestingly, the European Parliament has recently proposed to give a legal status to robots, categorizing them as 'electronic persons' and holding them responsible for their acts or omissions[56]. This type of regulation arguably allows parties to appoint algorithms as arbitrators, even in countries that require human arbitrators.

Are parties willing to trust these new robot entities? The issue of trust can be approached from the perspective of the proposed European Artificial

52 -The law of the seat of arbitration.

53 -They require that (i) no person shall be precluded by reason of his nationality from acting as an arbitrator, unless otherwise agreed by the parties and (ii) when a person is approached in connection with his possible appointment as an arbitrator, he shall disclose any circumstances likely to give rise to justifiable doubts as to his impartiality or independence.

54 -Article II (2) of the New York Convention contemplates that a tribunal can be a corporate or legal entity, instead of a person or persons. URL: https://newyorkconvention1958.org/index.php?lvl=cmspage&pageid=10&menu=626&opac_view=-1, accessed 25 September 2023.

55 -In French law, AI cannot replace human arbitrator and prohibits the appointment of a computer as an arbitrator. The 2018-2022 Justice Programming Law confirms that AI cannot operate alone, it can only serve as a support for human intervention. Other legislations contain a similar prohibition. In other countries such as Egypt, Iceland, China and Vietnam, their arbitration laws only establish norms that only humans can satisfy.

56 -European Parliament Resolution, 2018/C 252/25. URL: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX%3A52017IP0051&rid=9, accessed 25 September 2023.

Intelligence Act (the draft AI Act[57]) which encompasses obligations for providers depending on the level of risk. Even though the draft AI Act does not directly refer to arbitration, the use of AI in arbitration ranging from translation by a machine translation tool[58], machine learning AI tool allowing the identification of relevant documents by an algorithm[59], the use of AI by adjudicators for its decision making (Morel de Westgaver, 2023) and the ultimate AI arbitrator may impact fundamental rights and the administration of justice. They raise concerns of due process, transparency, fairness which may in turn question the enforcement of the award. The use of certain AI systems in the administration of justice can be easily associated with high-risk (*ibid*.; Nappert, 2018, p. 26) and will fall within the ambit of the draft AI Act. If arbitrators use AI for their decision making, it might be considered as a delegation of their mandate. At the very least, arbitrators disclose it and the parties made aware of this delegation of mandate following the same approach when arbitrators use tribunal secretaries. The arbitrator's mandate is of *intuitu personae* nature. It is therefore expected that arbitrators do not to delegate parts of their mission to an AI system without the parties' consent. Arbitrators will therefore need to examine if they can use them and if they are compatible with their mandate (Morel de Westgaver, 2023).

Consent to AI and crowdsourced blockchain arbitration

The parties' consent to arbitration is paramount. Users' consent to blockchain arbitration is given when they agree to the Kleros smart contract[60]. The same applies for Aragon mechanism.

Is an AI arbitrator what the parties want when they submit their dispute to

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57 -At the time of writing this paper, the European AI Act was still a draft AI Act. URL: https://eur-lex.europa.eu/resource.html?uri=cellar:e0649735-a372-11eb-9585-01aa75ed71a1.0001.02/DOC_1&format=PDF, accessed 25 September 2023, and https://www.europarl.europa.eu/news/en/press-room/20231206IPR15699/artificial-intelligence-act-deal-on-comprehensive-rules-for-trustworthy-ai, accessed 14 February 2024.

58 -Inadequate translation may impact the quality of evidence and jeopardize the integrity of arbitral proceedings.

59 -In the *Pyrrho Investments Ltd v MWB Property Ltd* case, an English court approved expressly the use of predictive coding technology in the electronic disclosure process (known as Technology Assisted Review - TAR). See *Pyrrho Investments Ltd v MWB Property Ltd* [2016] EWHC 256 (Ch), 16 February 2016.

60 -The dispute resolution process would not commence until the smart contract receives pre-determined evidence of mutual unequivocal consent of the parties to arbitrate and if the subject matter fits into the Kleros platform. See Kleros Handbook of Decentralized Justice, URL: https://ipfs.kleros.io/ipfs/QmZeV32S2VoyUnqJsRRCh75F1fP2AeomVq2Ury2fTt9V4z/Dispute-Resolution-Kleros.pdf, accessed 15 September 2023.

arbitration? If parties trust AI arbitrators, then their decision to submit their dispute to AI arbitrators should be facilitated. If the parties do not wish to be heard by a human being who is subject to duties of justice and respect (Argerich, Noodt Taquela and Jorge, 2020), then the question to ask: is it right to prevent the parties from submitting their dispute to AI arbitrators? If relevant arbitration laws do not expressly exclude AI arbitrators, then the parties should have the freedom to submit their dispute to it. However, the challenge lies with the situation where the parties do not agree to submit their dispute to AI arbitrator. In this case, it is simple. Unless all parties agree to have their dispute resolved by AI arbitrators, it cannot work. One possible way would be to follow a multi-tiered approach: (1) if the *lex arbitri* authorises or, at the very least, does not prohibit AI arbitrator then it could authorise the parties to submit their dispute to AI arbitrator if all parties expressly consent to this approach, (2) if all parties cannot consent (either one of the party objects or the defaulting party has not expressly agreed to it), then the *lex arbitri* should prohibit the use of AI arbitrator, and (3) if the *lex arbitri* prohibits human arbitrator, then the use of AI arbitrator should obviously be forbidden.

Enforcement of arbitral decision

The remaining challenge relates to the recognition and enforcement of blockchain award and/or AI and online arbitral awards.

In 2021, Mexican courts enforced an award relying on Kleros blockchain arbitration protocol[61]. This decision brings an interesting perspective to the issue considered above even though the Kleros jurors' decision was only incorporated by reference to a human made award[62] (Chevalier, 2022). This decision highlights the necessity to connect Kleros blockchain award with the Mexican legal order for enforcement purposes. Chevalier (*ibid*.) argued that the human arbitrator in this matter was the bridge between blockchain and national legal order and legitimised the Kleros blockchain award. This is an exciting decision where blockchain technology and human arbitrators work hand in hand. At this point, one may wonder if blockchain award can exist alone on the Ethereum if Kleros wants to spread its wings and settle more intricate cases.

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61 -Kleros Justice Protocol Explainer.

62 -The dispute arose out of a rental estate leasing agreement between natural persons which set out a hybrid process (1) a human arbitrator drafted a procedural order sending the matter to Kleros arbitration process, (2) Kleros jurors issued a decision, and (3) the human arbitrator incorporated the Kleros jurors' decision, which became part of the award. The award, governing the substance of the ruling, indicated the place, date and displayed the arbitrator's name and signature.

Pursuant to the New York Convention, national courts in the country where recognition and enforcement is sought may refuse them, if the award is contrary to the public policy in that country63. Public policy allows a court to protect the integrity of the legal order to which it belongs[64]. Public policy will vary depending on the country in question which continuously evolves to meet the changing needs of political, social, cultural and economic contexts. The interpretation of public policy is variable and differs from countries to countries. National courts will rely on public policy when the core values of a legal system have been deviated from (*ibid*.).

A Dutch decision ruled that arbitral awards rendered online subsequent to an automation process violated Dutch public order[65]. The court noted, on the one hand, that the online arbitration automatically became pending, on the other hand, that the defendant had to send an email to participate in the proceedings, and finally, that the defendant was unaware that a dispute was pending or of the legal grounds for the action. As the defendant had automatically received the awards and he had not had sufficient opportunity to defend his case and this contravened due process[66]. Although this decision does not clearly answer to the question of whether the use of AI for decision-making would imply a violation of such public policy, it provides valuable elements.

An interesting Korean study (Billiet and Nordlund, 2018) concluded that an arbitral award rendered by AI may be set aside for breach public policy for conflict with the 'good morals or other public policy of the Republic of Korea'[67]. Public policy evolves to meet the country particularities, its political, social, cultural and economic needs. This may lead situation where the award is set aside in the country of the place of arbitration but is enforced later in

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63 -Article 5(2)b of the New York Convention.

64 -URL: https://newyorkconvention1958.org/index.php?lvl=cmspage&pageid=10&menu=626&opac_view=-1, accessed 25 September 2023.

65 -Using an online trading platform, X granted bitcoin loans to Y and Y accepted the terms applicable to these loans including the dispute settlement mechanism clause. X obtained several which ordered Y to pay bitcoins. The awards were rendered by the American entity net-ARB, Inc and were signed by the CEO of net-ARB, Inc. The court held that the awards violated the precepts of the New York Convention and Dutch law. The court held that *audi alteram partem* principle was not complied with by the arbitrator since the parties' claims had not been properly heard by the arbitrator. Decision of 29 January 2019 (ECLI:NL:GHAMS:2019:192).

66 -See Jeroen Van Hezewijk, The future is now (or is it?): net-ARB, Inc online award not recognised due to lack of due process, Freshfields Bruckhaus Deringer LLP, 2 May 2019. URL: https://www.lexology.com/commentary/arbitration-adr/netherlands/freshfields-bruckhaus-deringer-llp/the-future-is-now-or-is-it-net-arb-inc-online-award-not-recognised-due-to-lack-of-due-process, accessed 25 September 2023.

67 -Subsection 36(2)2(b) of the 2016 Korean Arbitration Act.

other countries already seen in the past[68]. The enforcement of AI-based award remains far from certain. Arbitration users may also raise ethical concerns because of the absence of human qualities or human emotions, due process arguments based on the impossibility of directly explaining its results or its predictions[69].

If arbitration laws do not authorise AI arbitrators, the court may consider that an AI award might deviate from the core values of the legal system. If the relevant legislation does not expressly prohibit AI entities and the parties agree to an AI arbitrator deciding the dispute, the public policy defence might lead to refusing the recognition of an arbitral award (Ng and Benedetti del Rio, 2019, p. 131). If the parties trust AI, it has been argued that who has authority to stop them from using it, particularly in arbitration where freedom of choice is paramount (Bento, 2018)?

Conclusion

In the words of William Gladston, justice delayed is justice denied (Sourdin and Burstyner, 2016). The objective of ODR and Alternative Dispute Resolution were to provide a quick and efficient dispute resolution mechanism for commercial cross border disputes. Both were successful in providing a conducive environment which parties could tailor to their needs. They aimed to ensure that justice was not delayed nor denied. Arbitration opponents often argue that arbitration is not always meeting its objectives as a cheap and speedy mechanism.

As technology evolves, businesses are already heavily involved in e-commerce and some are already moving onto the Ethereum. The growth of the metaverse involves the adoption of virtual assets and currencies for the masses. The increasing use of these technologies in dispute resolution has changed to the paradigm in the sense that they have successfully democratised arbitration.

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68 -Cour de cassation, Chambre civile 1, 03/23/1994, Hilmarton I, URL: https://www.legifrance.gouv.fr/juri/id/JURITEXT000007032023/ accessed 25 September 2023; US District Court, District of Columbia, 07/31/1996, *Chromalloy Aeroservices and The Arab Republic of Egypt*, URL: https://newyorkconvention1958.org/index.php?lvl=notice_display&id=1139, accessed 25 September 2023; France, Cour d'appel de Paris (1re Ch. C), 09/29/2005, *Direction générale d'aviation civile de l'Emirat du Dubai v. Bechtel*, URL: https://www.labase-lextenso.fr/gazette-du-palais/GP20051215009, accessed 25 September 2023; US District Court, District of Columbia, 03/17/2006, *Termorío SA ESP, et al., Plaintiffs v. Electrificadora del Atlántico SA ESP, et al.*, URL: https://casetext.com/case/termorio-saesp-v-electrificadora-del-atlantico, accessed 25 September 2023; Cour de cassation, 06/29/2007, *Société PT Putrabali Adyamulia c. Société Rena Holding et Société Mnogutia Est Epices*, URL: https://www.legifrance.gouv.fr/juri/id/JURITEXT000017897325/, accessed 25 September 2023.

69 -The 'black box' see above, Section "Ethical guarantees".

However, benefits and opportunities cannot overshadow the flaws and challenges inherent to these systems. Most practitioners and academics seem to suggest that they are developing but not ready. There are substantial issues concerning awards which must be adequately resolved before they can be fully adopted. For example, AI-arbitrators are not yet a viable option but might be in the future.

That said, blockchain arbitration is already used despite its shortcomings including its ethical flaws. Although blockchain arbitration is a viable alternative to conventional arbitration it comes with a price: an affordable and efficient dispute system without any of the safeguards that conventional arbitration can offer. The arbitration community must propose mechanisms which ensure that Non-Fungible Tokens (NFT)[70] (Escalante-De Mattei, 2021) and metaverse users want to submit their disputes to conventional arbitration. Failing that, blockchain-based crowdsourced arbitration will be the only mechanisms NFT and metaverse users will favour to settle their disputes with. Early 2022, Kleros launched a pilot dispute scheme for NFT markets[71].

Conventional arbitration will have to evolve quickly and become truly autonomous (Lew, 2006, p. 182; Vijayan, 2022) while ensuring safeguards. Yes, technology and AI in particular present challenges in terms of bias, lack of empathy, unemotional and unreasoned decisions. But to borrow Nappert's words, 'IA is a field that has historically shown its capacity to be multi-faceted, flexible, and responsive to challenges' (2018, p. 21). So, to conclude this paper on a positive note: both AI and Blockchain arbitration might force the arbitration community to revisit and improve conventional arbitration with a view to creating the new aged conventional arbitration with the positive features of blockchain crowdsourced arbitration but with the safeguards that conventional arbitration can offer.

Nathalie M.-P. POTIN

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70 -Nifty Gateway, an NFT auction house, initiated JAMS arbitration late 2021 for unpaid price of allegedly unsuccessful bid and froze the customer's account containing other NFT valuable. URL: https://www.artnews.com/art-news/news/nifty-gateway-legal-battle-beeple-1234605528/, accessed 25 September 2023.

71 -URL: https://blog.kleros.io/kleros-project-update/, accessed 25 September 2023.

Bibliography

AOUIDEF, Yann, AST, Federico, and DEFFAINS, Bruno. 2021. Decentralized Justice: A Comparative Analysis of Blockchain Online Dispute Resolution Projects. *Frontiers in Blockchain*, vol. 4, 564551. DOI: 10.3389/fbloc.2021.564551.

ARGERICH, Guillermo, NOODT TAQUELA, María Blanca and JORGE, Juan. 2020. Could an Arbitral Award Rendered by AI Systems be Recognized or Enforced? Analysis from the Perspective of Public Policy. *Kluwer Arbitration Blog*, 6 February 2020. URL: https://arbitrationblog.kluwerarbitration.com/2020/02/06/could-an-arbitral-award-rendered-by-ai-systems-be-recognized-or-enforced-analysis-from-the-perspective-of-public-policy/, accessed 25 September 2023.

AST, Federico and LESAEGE, Clément. 2021. Kleros, A Protocol for Decentralized Justice in Kleros IO. *Dispute Resolution: The Kleros Handbook of Decentralized Justice*, p. 34. URL: https://kleros.io/book.pdf, accessed 15 September 2023.

BARNETT, Jeremy and TRELEAVEN, Philip. 2018. Algorithmic Dispute Resolution – The Automation of Professional Dispute Resolution Using AI and Blockchain Technologies. *The Computer Journal,* vol. 61, n°3, pp. 399-408.

BAYRAKTAROĞLU-ÖZÇELIK, Gülüm and ÖZÇELIK Ş. Barış. 2021. Use of AI-Based Technologies in International Commercial Arbitration. *European Journal of Law and Technology*, vol. 12, n°1. URL: https://ejlt.org/index.php/ejlt/article/view/814

BENNETT MARROW, Paul, MANSI, Karol and KUYAN, Steven. 2020. Artificial Intelligence and Arbitration: The Computer as an Arbitrator – Are We There Yet? *74 Dispute Resolution Journal*, vol. 35. URL: https://ssrn.com/abstract=3709032

BENTO, Lucas. 2018. International Arbitration and Artificial Intelligence: Time to Tango? Kluwer *Arbitration Blog*, 23 February 2018. URL: http://arbitrationblog.kluwerarbitration.com/2018/02/23/international-arbitration-artificial-intelligence-time-tango/, accessed 25 September 2023.

BILLIET, Philippe and NORDLUND, Filip. 2018. A new beginning – Artificial intelligence and arbitration. *Korean Arbitration Review*, vol. 26, pp. 27-29.

BISHOP, Doak and REED, Lucy. 1998. Practical Guidelines for Interviewing, Selecting and Challenging Party-Appointed Arbitrators in International Commercial Arbitration. *Arbitration International*, vol. 14, n°4, pp. 395-430. DOI: 10.1093/arbitration/14.4.395

BLACKABY, Nigel, PARTASIDES, Constantine, REDFERN, Alan and HUNTER, Martin. 2015. *Law & Practice of International Commercial Arbitration*. New York: Oxford University Press, pp. 229–303. DOI: 10.1093/law/9780198714248.001.0001

BUCHWALD, Michael. 2020. Smart Contract Dispute Resolution: The Inescapable Flaws of Blockchain-Based Arbitration. *University of Pennsylvania Law Review*, vol. 168, n°5, pp. 1369-1423.

BURRELL, Jenna. 2016. How the machine 'thinks': understanding opacity in machine learning algorithms. *Big Data & Soc.*, vol. 3, n°1. DOI: 10.1177/2053951715622512

CHEVALIER, Maxime. 2022. Arbitration Tech Toolbox: Is a Mexican Court Decision the First Stone to Bridging the Blockchain Arbitral Order with National Legal Orders? *Kluwer Arbitration Blog*, 4 March 2022. URL: http://arbitrationblog.kluwerarbitration.com/2022/03/04/arbitration-tech-toolbox-is-a-mexican-court-decision-the-first-stone-to-bridging-the-blockchain-arbitral-order-with-national-legal-orders/, accessed 25 September 2023.

COHEN, Paul. 2015. Bytes and Prejudice: Technology as a Means to Address Unconscious Bias in Arbitrators. *Journal of Technology in International Arbitration*, vol. 1, n°1, p. 57.

COHEN, Paul and NAPPERT, Sophie. 2017. The March of the robots. *GAR*, 15 February 2017. URL: https://globalarbitrationreview.com/the-march-of-the-robots, accessed 25 September 2023.

DE LA JARA, José María, PALMA, Daniela and INFANTES, Alejandra. 2017. Machine Arbitrator: Are We Ready? *Kluwer Arbitration Blog*, 4 May 2017. URL: http://arbitrationblog.kluwerarbitration.com/2017/05/04/machine-arbitrator-are-we-ready/, accessed 15 September 2023.

EIDENMULLER, Horst and VARESIS, Faidon. 2020. What Is an Arbitration? Artificial Intelligence and the Vanishing Human Arbitrator. *New York University Journal of Law and Business*, vol. 17, p.49.

ESCALANTE-DE MATTEI, Shanti. 2021. NFT Platform Nifty Gateway, Collector Caught in Legal Battle Over Beeple Auction. *ARTnews*, 4 October 2021. URL: https://www.artnews.com/art-news/news/nifty-gateway-legal-battle-beeple-1234605528/, accessed 25 September 2023.

GAILLARD, Emmanuel. 2017. La corruption saisie par les arbitres du commerce international. *Revue de l'arbitrage*, n°3, pp. 805-839. URL: https://kluwerlawonline.com/journalarticle/Revue+de+l%E2%80%99arbitrage/2017.3/REVU2017050

GÉLINAS, Fabien. 2004. Taking stock of ODR: From Concept to Business Reality, in Using Technology to Resolve Business Disputes. *Special Supplement to Bulletin of the International Court of Arbitration*, pp. 7-19.

HALIS KASAP, Gizem. 2021. Can Artificial Intelligence ('AI') Replace Human Arbitrators? Technological Concerns and Legal Implications. *Journal of Dispute Resolution*, vol. 2021, n°2. URL: https://ssrn.com/abstract=3863136

HOPE, James. 2019. Can a Robot Be an Arbitrator? In: CALISSENDORFF, Axel and SCHÖLDSTRÖM, Patrik (ed.). *Stockholm Arbitration Yearbook*. The Netherlands: Kluwer Law International B.V., pp. 103-111.

KARIM, Sam. QC, 2019. Artificial intelligence: an undiscovered future of arbitration. *International Arbitration Law Review*, vol. 22, n°2, p.51.

KARKI, Tatu and ARAGON, 2017. Aragon Network Jurisdiction Part 1: Decentralized Court. *Aragon Network*, 18 July 2017. URL: https://blog.aragon.org/aragon-network-jurisdiction-part-1-decentralized-court-c8ab2a675e82/, accessed 25 September 2023

KATSH, Ethan and RULE, Colin. 2016. What We Know and Need to Know about Online Dispute Resolution. *South Carolina Law Review*, vol. 67, n°2, 10, p. 5.

KAUFMANN-KOHLER, Gabrielle. 2005. Online Dispute Resolution and its Significance for International Commercial Arbitration. In: *Global Reflections on International Law, Commerce and Dispute Resolution, Liber Amoricum in honor of Robert Briner*. ICC Publishing, Publication 693, pp. 437-456.

KNIGHT, W. 2017. Forget Killer Robots – Bias Is the Real AI Danger. *MIT Technology Review*, 3 October 2017. URL: https://www.technologyreview.com/2017/10/03/241956/forget-killer-robotsbias-is-the-real-ai-danger, accessed 25 September 2023

LESAEGE, Clément, GEORGE, William and AST, Frederico. 2019. *Kleros Short Paper* V1.0.7, p. 3.

LESAEGE, Clément, GEORGE, William and AST, Frederico. 2021. *Kleros Long Paper V.2.0.2*, p.1.

LEW, Julian. D.M. 2006. Achieving the Dream: Autonomous Arbitration. *Arbitration Internationa*l, vol. 22, n°2, p. 179.

METZGER, James. 2019. The Current Landscape of Blockchain-Based Crowdsourced Arbitration. *Macquarie Law Journal*, vol. 19, pp. 81-101.

MOREL DE WESTGAVER, Claire. 2023. Canvassing Views on AI in IA: The Rise of Machine Learning. *Kluwer Arbitration Blog*, 12 July 2023. URL: https://arbitrationblog.kluwerarbitration.com/2023/07/12/canvassing-views-on-ai-in-ia-the-rise-of-machine-learning/, accessed 25 September 2023

MUSTILL, Michael. 1987. The New Lew Mercatoria: The First Twenty-five Years. In: *Liber Amicorum For The Rt. Hon. Lord Wilberforce*. Oxford: Clarendon Press, pp. 149-183.

NAPPERT, Sophie. 2018. Disruption Is the New Black Practical Thoughts on Keeping International Arbitration on Trend. I*CC Dispute Resolution Bulletin*, n°2, pp. 20-26.

NAROZHNY, Dmitry. 2019. Is Kleros Legal, in Kleros IO, 'Dispute Resolution. *The Kleros Handbook of Decentralized Justice*, p. 182. URL: https://kleros.io/book.pdf, accessed 25 September 2023

NG, Irene (Huang Ying) and BENEDETTI DEL RIO, Valeria. 2019. When the Tribunal is an Algorithm: Complexities of Enforcing Orders Determined by a Software under the New York Convention. In: FACH GOMEZ, Katia and LOPEZ-RODRIGUEZ, Ana Mercedes (Eds.). *60 Years of the New York Convention: Key Issues and Future Challenges*. The Netherlands: Kluwer Law International, pp. 121-131.

POTIN, Nathalie M.-P. and OGUNSEITAN, Tunde. 2020. Exploring the Parameters of Conflicts of Interest. In: DIMATTEO, Larry A., INFANTINO, Marta and POTIN, Nathalie M.-P. (Eds.). *The Cambridge Handbook of Judicial Control of Arbitral Awards*. Cambridge: Cambridge University Press, pp. 29-53.

REJCEK, Peter. 2017. The Struggle to Make AI less biased than its creators. *Singularity Hub*, 31 January 2017. URL: https://singularityhub.com/2017/01/31/the-struggle-to-make-ai-less-biased-than-its-creators/, accessed 25 September 2023.

RICH, Michael L. 2016. Machine Learning, Automated Suspicion Algorithms, and the Fourth Amendment. *University of Pennsylvania Law Review*, vol. 164, pp. 871-886.

ROGERS, Catherine. A. 2018. Arbitrator Intelligence: From Intuition to Data in Arbitrator Appointments. *New York Dispute Resolution Lawyer*, vol. 11, n°2. URL: https://nysba.org/app/uploads/2020/03/DisputeResolutionLawyerSpring18.pdf

SCHERER, Maxi. 2019. Artificial Intelligence and Legal Decision-Making: The Wide Open? *Journal of International Arbitration*, vol. 36, n°5, pp. 539-573.

SCHMITZ, Amy and RULE, Colin. 2019. Online Dispute Resolution for Smart Contracts. *Journal of Dispute Resolution*, vol. 2019, pp. 103-125.

SELA, Ayelet. 2018. Can Computers Be Fair: How Automated and Human-Powered Online Dispute Resolution Affect Procedural Justice in Mediation and Arbitration. *Ohio State Journal on Dispute Resolution*, vol. 33, n°1, pp. 91-148.

SIMS, Christine. 2018. Will Artificial Intelligence Take over Arbitration? *Asian Journal of International Arbitration*, vol. 14, n°1, pp.1-13. DOI: 10.54648/aiaj2018001

SOURDIN, Tania. 2018. Judge v. Robot: Artificial Intelligence and Judicial Decision-Making. *University of New South Wales Law Journal,* vol. 41, n°4, pp. 1114-1133. DOI: 10.53637/ZGUX2213

SOURDIN, Tania and BURSTYNER, Naomi. 2016. Justice Delayed is Justice Denied [PrePrint]. 26 January 2016. URL: https://ssrn.com/abstract=2721531, accessed 25 September 2023.

TIRADO, Joe and COSIO, Gabriela. 2022. Lex Cryptographia: Guidelines for ensuring due process in transnational blockchain-based arbitration. *International Bar Association*, 4 March 2022. URL: https://www.ibanet.org/lex-cryptographia-due-process-blockchain-based-arbitration, accessed on 25 September 2023.

TVERSKY, Amos and KAHNEMAN, Daniel. 1974. Judgment under Uncertainty: Heuristics and Biases. *Science*, New Series, vol. 185, n°4157 (27 September 1974), pp. 1124-1131. DOI: 10.1126/science.185.4157.1124

VAN HARTEN, Gus. 2010. Perceived Bias in Investment Treaty Arbitration. In: WAIBEL, Michael *et al.* (Eds.). *The Backlash against Investment Arbitration*. The Netherlands: Kluwer Law International, pp. 433-453.

VIJAYAN, Sneha. 2022. Autonomous Arbitration in the Era of the Metaverse. *Kluwer Arbitration Blog*, 11 March 2022. URL: http://arbitrationblog.kluwerarbitration.com/2022/03/11/autonomous-arbitration-in-the-era-of-the-metaverse/, accessed 25 September 2023

WAHAB, Mohamed Abdel, KATSH, Ethan and RAINEY, Daniel (Eds). 2012. *Online Dispute Resolution: Theory and Practice: A Treatise on Technology and Dispute Resolution*. The Hague: ed. Eleven.

WAQAR, Mahnoor. 2021. The Use of AI in Arbitral Proceedings [PrePrint]. 24 September 2021. URL: https://ssrn.com/abstract=3931233, accessed 25 September 2023.

WEI, Dan and MOSER, Gustavo, 2020. Human arbitrators (The undisputed champion) v Robots (The challenger). *Hong Kong Law Journal,* vol. 50, pp. 215-241.