THE SYMPHONY OF SMART CONTRACTS & BLOCKCHAIN ARBITRATION: AUTOMATING JUSTICE IN DECENTRALIZED SYSTEMS

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ABSTRACT

Blockchain technology is regarded as one of the foremost & disruptive innovations of the present day. In the meantime, smart contracts recorded on a blockchain allow all or portions of an agreement to be implemented autonomously in response to specified triggering circumstances. A handful believe that as smart contracts become more comprehensive and self-executing, we may enter a new age of conflict resolution without the intervention of an impartial third-party (conciliator, mediator, arbitrator) or even a dispute-free ecosystem. Conversely, it is argued that disagreements are unavoidable. The issue at hand is not if disputes crop up, instead what forms of dispute resolution shall work most effectively for addressing disputes resulting in the realm of blockchains along with smart contracts. Although not the only mechanism, it is argued that arbitration is particularly well-suited for several kinds of disputes and, if tailored to the particular necessities and wants of the clients, blockchain and smart contract users, could play an essential function in this developing ecosystem.

Keywords: Blockchain, On-chain Arbitration, Smart Contracts, Decentralized Justice System, Disintermediation, Oracles, Self-Executing, Kleros & Online Dispute Resolution (ODR)

LITERATURE REVIEW

The authors conducted a comprehensive literature review to examine the intricate dynamics between Blockchain Arbitration & Smart Contract execution. The following sources delve into various aspects of the execution implications, decentralized judicial systems and the concerns around this shift.

The authors found the article titled ***Smart Contract Dispute Resolution: The Inescapable Flaws of Blockchain-Based Arbitration***[1] insightful. It addresses the several challenges of using decentralized arbitration aided by smart contracts. The paper further onto highlight concerns relating to enforceability and jurisdictional issues when blockchain arbitration is administered. It questions whether blockchain-based systems can truly replace traditional legal mechanisms already set intact. This article provides a sharp critique of these limitations but it leaves room to consider as to the avenues of future innovations and hybrid models which might bridge the gap between technology & legal enforcement.

The article titled ***Blockchain and the Law: The Rule of Code***[2] provides a detailed account of the intersection between blockchain technology and legal frameworks. They argue that blockchain enhances transparency and decentralization. On the contrary, it challenges domestic regulatory framework in practice pertaining to contract enforcement & dispute resolution. This book dives into the issue of efficacy of smart contracts and the primal role of arbitration in resolving blockchain disputes. It additionally provides accounts on tension between code-based governance and legal oversight of the same.

The brief titled ***Crypto Transaction Dispute Resolution***[3] evaluates the position of blockchain and automated justice in resolving disputes in cryptocurrency transactions. It looks into the limitations of traditional legal frameworks in handling blockchain-based conflicts and proposes innovative resolution frameworks. While this article provides valuable insights into emerging dispute resolution methods, it is very limited and orthodoxically focuses on theoretical

[1] *Michael Buchwald, Smart Contract Dispute Resolution: The Inescapable Flaws of Blockchain-Based Arbitration, 168 U. Pa. L. Rev. 1369 (2020),* http://www.jstor.org/stable/45467490.
[2] *Primavera De Filippi & Aaron Wright, Blockchain and the Law: The Rule of Code (Harv. Univ. Press 2018),* https://doi.org/10.2307/j.ctv2867sp.
[3] *Wulf A. Kaal & Craig Calcaterra, Crypto Transaction Dispute Resolution, 73 Bus. Law. 109 (2017),* https://www.jstor.org/stable/26419193.

frameworks which leaves several gaps for further discussion on practical implementation and real-world case studies.

The authors referred to ***Smart Contracts and the Cost of Inflexibility***[4] as it critically examines the scope & usage of smart contracts while emphasizing its cases of failure. He argues that while automation enhances efficiency in general, it leads to the lack of built-in discretion which causes inefficiencies in unforeseen circumstances. It provides a nuanced perspective to the reader on the trade-off between automation and adaptability.

The article titled ***Blockchain, Smart Contracts und Datenschutz: Risiken und Grenzen Blockchain-Basierter Smart Contracts***[5] delves into the overlaps between smart contracts & data protection laws in EU legal framework. The paper provides information regarding blockchain's immutability conflicts with the GDPR's right to erasure. The paper raises several significant legal and ethical concerns. Additionally, it provides the lacunas in smart contracts relating to privacy regulations.

The article titled ***Smart Contract Dispute Resolution***[6] critically assesses the mechanisms for resolving disputes arising from smart contracts. There is a thorough examination of the limitations of traditional legal remedies in a decentralized environment and evaluation of arbitration as a viable alternative. The analysis includes smart contract clauses, E-Arbitration and blockchain peripherals. While Kaulartz acknowledges the efficiency of blockchain-based arbitration, there is no discussion about the need for hybrid models that integrate legal oversight to ensure fairness and enforceability.

INTRODUCTION

A decentralized system has been made possible by smart contracts, which have been essential in revolutionizing blockchain technology throughout time. Due to its effective data security administration features, the World Economic Forum acknowledged in its report that by 2027 at least 10% of the world's GDP will be held on blockchains.[7] Smart contracts may be used to

[4] *Jeremy M. Sklaroff, Smart Contracts and the Cost of Inflexibility, 166 U. Pa. L. Rev. 263 (2017),* http://www.jstor.org/stable/45154933.
[5] *Paulina Jo Pesch, Blockchain, Smart Contracts und Datenschutz: Risiken und Grenzen Blockchain-Basierter Smart Contracts, in Smart Contracts 13 (Martin Fries & Boris P. Paal eds., 2019),* http://www.jstor.org/stable/j.ctvn96h9r.5.
[6] *Markus Kaulartz, Smart Contract Dispute Resolution, in Smart Contracts 73 (Martin Fries & Boris P. Paal eds., 2019),* http://www.jstor.org/stable/j.ctvn96h9r.8.
[7] *World Economic Forum, Report: Building Blockchains for a Better Planet. (September 2018),*

enforce completely automated legal commitments without the need for third parties. Blockchain-based smart contracts are prone to a number of challenges, such as non-transactional conflicts, off-chain oversight concerns, and on-chain disputes, much like traditional contracts. We are currently in the early stages of developing an on-chain dispute resolution mechanism.[8]

An on-chain smart contract is made up of a self-executing program that, despite the help of an outsider, autonomously carries out the conditions of the parties' agreements, eliminating no room for human error or dispute. Conversely, smart contracts do not completely remove the chance of conflict. Implementing a dispute adjudication process that oversees the digital interactions outlined in these smart contracts is consequently essential.[9]

Blockchain transactions don't have a centralized controller for data retention and are entirely transparent. This guarantees the authenticity and safety of the information sent to it since each transaction is encrypted and hence traceable. Eliminating the need for third-party middlemen, smart contracts on the blockchain enable automated legal obligations to be enforced by themselves. Conventional dispute resolution procedures now have the issue of being unable to validate a significant proportion of overseas small-value claims. The idea of "blockchain arbitration," is whereby arbitrators have developed to address this issue, aiming to leverage blockchain methodology in order to validate smart contracts & implement automation its implementation via triggering the arbitration provision as per the agreement in the event of disagreement.[10]

In order to achieve the quick, easy, and economical settlement of conflicts, blockchain-based innovation and arbitration work together in a harmonious fashion. Nonetheless, there remains controversy around the enforceability and legal recognition of blockchain arbitration around the globe in multiple jurisdictions deduced through major judicial decisions and reasonings.[11]

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https://www3.weforum.org/docs/WEF_Building-Blockchains.pdf

[8] *Christoph Salger, Decentralized Dispute Resolution: Using Blockchain Technology and Smart Contracts in Arbitration, 24 Pepp. Disp. Resol. L.J. 65 (2024),* https://digitalcommons.pepperdine.edu/cgi/viewcontent.cgi?article=1547&context=drlj

[9] *Max Raskin, Smart Contract Dispute Resolution: The Inescapable Flaws of Blockchain, 168 U. Pa. L. Rev. 1343 (2020),* https://scholarship.law.upenn.edu/cgi/viewcontent.cgi?article=9702&context=penn_law_review.

[10] *Sophie Nappert, From Smart Contract Litigation to Blockchain Arbitration, a New Decentralized Approach to Dispute Resolution, 12 J. Int'l Disp. Settlement 558 (2021),* https://academic.oup.com/jids/article/12/4/558/6414874.

[11] *Mark Giancaspro, Arbitration in Smart Contracts Disputes – A Look into the Future, (2023).*

The apprehensions continue to persist within certain jurisdictions with regards to blockchain in the judicial system while on the contrary progressive nations have made bold moves to give recognition to blockchain arbitration and smart contract usage, ushering a new trend in the legal domain.

CRITICAL ANALYSIS

I. ADVENT OF ON-CHAIN ARBITRATION & SMART CONTRACTS

The phrase "on chain" arbitration refers to a variety of methods & ideas. These vary from merely improving present "off chain" processes by allowing case papers to be communicated and stored on blockchains, to significant departures from established systems of dispute resolution, on the opposite end of the gamut. It may take several forms and, to some degree, overlaps with on-chain implementation.[12]

i. **Oracles:** Although not exactly arbitration, with a smart contract, it is feasible to identify a limited range of potential conflicts which are usually addressed by referring to datasets from an external data source. As an instance, an issue about items not being delivered may be handled by reviewing records in a transportation company's repository.[13]

ii. **Multi-signature transactions:** A common kind of on-chain procedure, this is usually utilized when a cryptocurrency asset is employed as the payment and allows for the binary issue of whether or not the exchange should occur. In the simplest sense, cryptocurrency assets are held in a wallet that can be accessed using 3 keys, two of which are necessary to conduct a transaction.[14] When there is no disagreement, the 2 parties may perform this swap utilizing its keys/passcodes; however in case of conflict escalation, an outside entity will determine if the transaction should be made using this key.

iii. **On chain arbitration algorithms and applications:** Several efforts have been rendered to move the conventional arbitral procedure (which continues to hinge heavily on email as well as to a lesser extent, tangible correspondence, nevertheless certain organizations are gradually

[12] *Christoph Salger, Decentralized Dispute Resolution: Using Blockchain Technology and Smart Contracts in Arbitration, 24 Pepp. Disp. Resol. L.J. 65 (2024).*
[13] *Amy J. Schmitz & Colin Rule, Online Dispute Resolution for Smart Contracts, 2019 J. Disp. Resol. 103 (2019).*
[14] *Nikolaj Ignatieff Schwartzbach, An Incentive-Compatible Smart Contract for Decentralized Commerce, ARXIV:2008.10326 (2020),* https://arxiv.org/abs/2008.10326.

transitioning to online systems) to a distributed ledger and incorporate it with additional applications or smart agreements.[15]

a) ***Datarella's Codelegit*** project developed an open-source firmware technology that includes its own version of "Blockchain Arbitration Rules" for deployment in smart contract systems.

b) ***Kleros*** functions as a distributed ledger of Ethereum which relies on the employment of voluntary "juries" that are encouraged by the fee distribution to reach the withdrawal threshold. It attempts to create uniform code (using ERC tokenizations) for arbitral clauses within decentralized apps. Kleros was purportedly employed in a hybrid arbitral procedure resulting in a verdict that was enforceable in the Mexican judicial system.[16]

c) ***Aragon*** is a platform that creates smart contractual DAOs on Ethereum chain & professes to uphold the Aragon Network Jurisdiction, which is an arbitration mechanism to aid resolution of disputes amongst DAOs with its participants.

Blockchains and decentralized records include arbitration "modules" or "layers." Certain systems facilitate the incorporation of custom "modules" or "stages" that provide arbitration into a decentralized or a distributed ledger.

a) ***Hedera Hashgraph*** is a decentralized record of transactions that allows arbitration to be included in smart contracts. Arbitrators may modify the algorithm to fix errors or even undo the entire transaction.

b) ***Jur*** is an encrypted blockchain platform that supports resolution of disputes via smart contract "modules," that include arbitration.[17]

c) ***COTI*** is a blockchain geared at facilitating payments, which features an arbitration mechanism built around "juries" that are rewarded with fees payable in the native cryptocurrency.

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[15] *Clifford Chance, Arbitration for Cryptoasset and Smart Contract Disputes (2022),* https://www.cliffordchance.com/content/dam/cliffordchance/briefings/2022/01/arbitration-for-cryptoasset-and-smart-contract-disputes.pdf.
[16] *Kleros: A Socio-Legal Case Study of Decentralized Justice, 37 Ohio St. J. on Disp. Resol. 55 (2022).*
[17] *Jur, Official Website. (2025),* https://jur.io/.

Enforcement of Arbitral Awards

Despite recent improvements and exposure, the cryptocurrency industry is still in its early stages, which means that challenges stemming from efforts to execute arbitral rulings involving cryptoassets are just now emerging. Nevertheless, there have been a few cases of unsuccessful efforts to regulate rewards.[18]

The nations that retain strong prohibitions on the possession and transfer of cryptoassets might decline to acknowledge arbitral decisions pertaining to crypto disputes, as well as awards based in cryptocurrencies or requiring the disposal of cryptoassets, on public policy grounds. In **Gao Zheyu v. Shenzhen Yunsilu Innovation Development Fund**[19] the Shenzhen People's Court overturned an arbitral ruling requiring the defendant to pay losses for failing to perform a transaction of a specific quantity of Bitcoin. The monetary losses accounted for in "¥ - Yuan" of comparable value, although this award was deemed invalid on general policy grounds that its execution might enable cryptocurrency flow and trading with fiat currency, which is against present Chinese law.

Yet, there have been implementation issues in places that do not prohibit cryptocurrency. In ***Court of Appeal of Western Central Greece (No. 88/2021)***[20] the bench declined to uphold an arbitral award ordering the repayment of Bitcoin financing towards applicant on public policy sphere, stating worries that digital currencies lack recognition as currencies, pose danger to the entities who employ them and possibly encouraging tax avoidance and deceit, among other social problems. In **Payward Inc. v. Chechetkin**[21] the English commercial court declined to impose an arbitral judgment issued under the dispute resolution clause within a cryptocurrency trading platform's conditions of usage.

The usage of obscure and online-exclusive arbitration platforms/mechanisms eventually attracts several regulatory concerns unrelated to the innovative technical or legal nature of digital currency assets. In the infamous ***NET-ARB Ruling***[22] the court declined to uphold a repayment decision for Bitcoin loans granted by "net-Arb" which is a US-based online

[18] *Amy J. Schmitz & Colin Rule, Online Dispute Resolution for Smart Contracts, 2019 J. Disp. Resol. 103 (2019),* https://scholarship.law.missouri.edu/cgi/viewcontent.cgi?article=1726&context=facpubs.
[19] *Gao Zheyu v. Shenzhen Yunsilu Innovation Development Fund Enterprise (L.P.) & Li Bin, 2018 Yue 03 Min Te No. 719 (Shenzhen Interm. People's Ct. 2018) (China).*
[20] *Court of Appeal of Western Central Greece, No. 88/2021.*
[21] **Payward Inc. v. Chechetkin**, *[2023] EWHC 1780 (Comm) (Eng.).*
[22] *Amsterdam Court of Appeal, Jan. 29, 2019, ECLI:NL:GHAMS:2019:192 (Neth.).*

arbitration firm. The arbitration agreement had several especially burdensome restrictions, such as unilaterally referring the case to arbitration after the default occurred & requiring the party to submit notice within a week of receipt if it wished to be present in the ADR process. The defendant didn't have notice of the same and therefore contested its execution in Amsterdam wherein the bench declined to sustain the award based on public policy considerations.

Process of On-Chain Enforcement

Certain arbitration rules in the above-mentioned precedents had an "on chain" implementation mechanism. This is a significant topic for the cryptocurrency industry as a whole since it might lay the basic query as to the "immutability" of blockchain which may be rectified, or transactions refunded in case of the event of disputes over ownership, fraud, error, breach of contract. Currently, "on chain" implementation alternatives vary from allowing arbitrator to directly function or amend a smart contract to an enforcement procedure that is outside of the authorities of national judicial systems.

A possible solution is for the arbitrator to be granted such authority to retrieve cryptoassets out of the escrow and multi-signatory profiles, and to change codes of the smart contract. Nonetheless, in order to execute such powers properly, the arbitrator must have both coding and legal competence. A more complicated form involves miners or nodes reflecting awards (or court rulings) on a blockchain. This reflects such framework upon which EOS arbitration mechanism rests upon.[23] This concept was recently tried again in ***Tulip Trading v Bitcoin***[24] whereby the claimant requested that British court force software engineers to change various Bitcoin ledgers in order to reclaim ownership of pillaged Bitcoin.

If an award is placed simply into a blockchain, it raises various legislative and policy questions, such as if that judgment is executed immediately "on chain" has the res-judicata impact, if arbitrators must provide causes, and whether domestic arbitration legislation prevails.

[23] *World Economic Forum, Dispute Resolution: Blockchain Based Transactions 10 (2020),* https://www3.weforum.org/docs/WEF_WP_Dispute_Resolution_for_Blockchain_2020.pdf.
[24] *Tulip Trading Limited v Bitcoin Association & Ors EWCA Civ 83 [2023].*

II. LEGAL RECOGNITION, CHALLENGES & TENABILITY – AN INDIAN PERSPECTIVE

(i) Interoperability of the Indian Contract Act (1872) & Smart Contracts

ICA is a quintessential bedrock of Indian contract law. **§10** of the ICA[25] states that "all agreements are contracts if they contain the free consent of parties willing to contract, for a legally recognized consideration, and with an object." Simply put, for an agreement to be effective under the Contract Act, it has to include an offer, acceptance, along with consideration. Smart contracts, in their encoded structure, contain elements of offer and acceptance in the form of electronic currencies (in this case, Ethereum), which are primarily manifested in acknowledging the conditions and restrictions of using a specific service platform that facilitates transactions. In contrast, establishing the factor of consideration is more challenging.

A relevant question to explore is whether ICA would acknowledge a cryptocurrency such as Ethereum as legal consideration - since the recognition of cryptocurrencies despite the absenteeism of any regulation has remained a contentious topic in India. **§2(d)** of the ICA[26] requires a reciprocal promise or deed by the promisee for consideration to be legitimate. In ***RBI v. Internet & Mobile Association of India***[27] the apex court has overturned the Reserve Bank of India's prohibition on cryptocurrencies, which prohibited banks and fiscal organizations from providing facilities to people or enterprises involved in cryptocurrency transactions. This approach allows us to decide if cryptocurrencies are genuine consideration and has established a pro-blockchain arbitral order in India via the usage of smart contracts.

(ii) Requirements of digital signatures, verification of individuals and concerns regarding the implementation of smart contracts in blockchain-based arbitration order

§5 along with **§10** of the Information Technology Act of 2000 ("IT Act") identify 'electronic signatures' as being simultaneously legally acknowledged and requiring the government of India to adopt appropriate laws for the method and structure of the same, among other things.[28] Furthermore, contracts with digital signatures may be entered as evidence under **§65B** of the

[25] *The Indian Contract Act, No. 9 of 1872, § 10.*
[26] *The Indian Contract Act, No. 9 of 1872, § 2(d).*
[27] *Reserve Bank of India v. Internet & Mobile Ass'n of India, (2020) 10 SCC 274 (India).*
[28] *The Information Technology Act, No. 21 of 2000, § 5, § 10.*

Indian Evidence Act, 1972.[29] Furthermore, under **§36** and **§48** of the Arbitration and Conciliation Act of 1996 ("Arbitration Act"), any application for the execution of an arbitral ruling must contain "original copy" of such judgments.[30] In truth, local verdicts under **§36**, **§3** of the Stamp Act read with **Schedule I** under **Article 12**[31] requires stamping when in "writing." Nevertheless, it becomes unclear if any such stamping may be necessary for "electronic means". Even with these laws in place, the blockchain arbitration order presents some extra issues.

For starters, since smart contracts used in blockchain-based transactions are created in a self-driven and programmed fashion, the necessity for digital signatures remains unmet in terms of contractual enforceability. Furthermore, under both contract law and the Arbitration Act, identifying parties remains a critical aspect of contract and arbitration agreement enforcement, particularly under the requirements of the Evidence Act in conjunction with **§ 7(4)(a)** and **§ 8** of the Arbitration Act.[32] For a system based on coded party confidentiality, it becomes impossible to determine who the dispute is between in relation to smart contract violation or termination, posing a problem under parts of the Arbitration Act. Third, the obligation to stamp domestic arbitral awards in "writing" adds a difficulty to the blockchain arbitral order. Finally, it is crucial to highlight that the New York Convention under **Article IV**[33], among which India is a member, does not need signature or party recognition as basic conditions for arbitral decisions as far as form or substance is concerned.

In addition, **§17** of Registration Act[34] stipulates that domestic awards be recorded whenever they impact immovable property rights. Solely an award that has been stamped which is registered may be brought to the Court for execution. This implies that providing direct blockchain accessibility to the executing Court is insufficient, since this award must initially be appropriately stamped or registered. Immediate access to domestic awards might be granted for the intent of verifying the initial award when stamping and registering the paperwork. A replica of such award which is officially stamped or registered might be regarded "original" for the purposes of filing a request pursuant to **§36** of the A&C Act. Court's direct access is

[29] *The Indian Evidence Act, No. 1 of 1872, § 65B.*
[30] *The Arbitration and Conciliation Act, No. 26 of 1996, § 36, § 48.*
[31] *The Indian Stamp Act, No. 2 of 1899, § 3, Schedule I Art. 12.*
[32] *The Arbitration and Conciliation Act, No. 26 of 1996, § 7(4)(a), § 8.*
[33] *Convention on the Recognition and Enforcement of Foreign Arbitral Awards, 1958, art. IV.*
[34] *The Registration Act, No. 16 of 1908, § 17.*

required where execution application of the overseas award is lodged.

(iii) Post-arbitral proceedings are incongruous to authoritative smart contracts

Several provisions of the Arbitration Act supply for post-arbitral procedures. These include the processes that begin once an arbitral award has been issued. **§ 33** in addition to **§ 34** of the Arbitration Act address the rectification and comprehension of the awards of arbitration (which includes the creation of supplementary awards) as well as motions to set aside arbitral decisions. **§ 33** contains measures that may be used to revise, alter, or add interpretations to these verdicts via restarting the arbitral procedure (typically for a month). **§ 34** allows judges to put aside awards in specific domains such as party incompetence, patent illegalities, public-policy violations & beyond.[35]

It is essential to duly point that there is still a significant gap amongst arbitral decisions issued during blockchain arbitration processes versus such post-arbitral actions. For example, after an arbitral ruling is issued under the blockchain system, the smart contract's contract-ware initiates the activities contained therein. Notably, such a system fails to accommodate for the modification, correction, or addition of construction to such verdicts under the conditions outlined **in § 33** of the Arbitration Act, since contract fulfillment comes before any such appeal. Furthermore, as one would expect, the automatic fulfillment of smart contracts in relation to the arbitral ruling leaves no space for any party to appeal the verdict. Effectively, there is no accommodations for any changing consensus of parties post the passage of the arbitral judgment under a blockchain arbitral order, and such a mechanism might be considered to violate independence of parties.

(iv) Advent of Kleros & Application of composite blockchain arbitral orders

In the event that a disagreement arises in the course of execution of a contract that is deployed in Ethereum, the Kleros 'arbitration' method is one that may be engaged. This system will freeze any financial transfers that are governed by the smart contract till the disagreement is addressed. It is a dispersed method using blockchain arbitration for the resolution of conflicts under smart contracts via the nomination of jurors, costs, etc. as prerequisites to admitting such issues within the conflict settlement clause of a smart contract. To put it another way, such a

[35] *The Arbitration and Conciliation Act, No. 26 of 1996, § 33, § 34.*

system would be considered to be an example of Online Dispute Resolution, a form of a method of dispute resolution that has been acknowledged as being viable by the **WG III** of **UNCITRAL**. India remains a member of UNCITRAL and has passed the Arbitration Act on the foundation of the UNCITRAL paradigm. The following begs discussion of the necessity to formally acknowledge ODR networks in India, particularly since the same phenomenon has been accepted as per the UNCITRAL framework.[36]

According to the Kleros system, certain crucial properties need to be noticed. The system combines the experience of the masses (crowdsourcing), game theory & jury polling for settlement of conflicts via chosen jurors stimulated via remuneration as arbitrators & recruited by the offering of PNK tokens. While this structure offered a place for ODR within the aforementioned process, the ruling of a Mexican Court modified the nature of arbitral awards rendered under the Kleros method as put forth above. Thereunder, an arbitrator in conventional arbitration integrated Kleros' arbitral award into his own arbitral award - the exact component of the standard arbitrator's decision that the Court clearly accepted.

The theoretical framework employed in Mexico shows a specific instance of confluence of a national legal system with Ethereum arbitration, whereby it was assured that the existing ***lex arbitri*** was not infringed. Furthermore, the Carrera Report[37] also presented a case for accepting miniature claims, insurance coverage concerns and other similar conflicts referenced Kleros to be deserving acknowledgment inside civil court systems – notably from the aspect of enforcement. It was also recommended in this paper that the selection made by the parties to use blockchain arbitration might be recognized either as a commercial agreement or as an instrument for making decisions ***ex aequo et bono***. As it happens, this Rule has been inserted in **§28(2)** of the Arbitration Act[38] and could assist with implementing the Kleros model, alongside other worldwide law on the same subject. More crucially, this might lead to the formation of a hybrid structure whereby the arbitrators could be compelled to write a Procedural Order that contains a concise explanation of the disagreement and proof to support it. This Order would be sent to Kleros, thereby rendering its judgment based purely on legal

[36] *UNCITRAL Working Group III, Online Dispute Resolution for Cross-Border Electronic Commerce Transactions, A/CN.9/WG.III/WP.165 (2019).*
[37] *Mauricio Virues Carrera, "Accommodating Kleros as a Decentralised Dispute Resolution Tool for Civil Justice Systems: Theoretical Model and Case of Application," (2022)*
[38] *The Arbitration and Conciliation Act, No. 26 of 1996, § 28(2).*

circumstances. The Arbitrator then has to incorporate Kleros' conclusion within their Arbitral Award to control the content of the verdict and declare it in writing.

(v) Challenges in Territorial Determination of Awarding Countries

India has established a reciprocity reservation within **Article I** of NYC[39], that explicitly lays out that overseas awards adjudicated by certain specific Contracting States of the Convention may be implemented in India. As of now, India has gazetted fewer than one-third of all Contracting States under the Convention.

An exception was made in ***Transocean Shipping Agency v. Black Sea Shipping***[40] whereby an Ukrainian award had to be executed in India disregarding major contentions as "Ukraine" wasn't gazetted formally as per the Government of India. Major rationale adopted was a previous gazettation of the USSR which Ukraine was duly an integral part of.

When a smart contract requests arbitration, the dispute resolution company selects arbitrators for the case. These arbitrators are often persons who have utilized service operators for their competence. The arbitral judgment is thereby stored & reflected upon this ledger, whereby duplicates of ruling are mirrored & presented on the parties' systems. Although, arbitral ruling is not to be considered to be issued in a particular state. This raises queries if that award can be implemented in India, provided reciprocity provisions. Concise interpretation of A&C legislation shall indicate that the judgment in question is not to be executed in India as GOI hasn't promulgated the tangible boundaries of the web. Nevertheless, this approach would be considered at odds with India's expanding pro-arbitration standpoint. Adopting every award rendered via blockchain arbitration at the other end, might lead to the intentional manipulation of procedures in order to hinder India from using its reciprocal reservation.

III. CASE STUDY:

Kleros - Decentralized Justice & Blockchain Arbitration

The introduction of decentralized, transparent & unchangeable record-keeping systems via blockchain technology has transformed multiple aspects of existence. The advantages of this decentralization are coupled with a problem with conflict resolution. Environments where legal

[39] *Convention on the Recognition and Enforcement of Foreign Arbitral Awards art. I (1958).*
[40] *Transocean Shipping Agency v. Black Sea Shipping, (1998) 2 SCC 281 (India).*

systems struggle to function at the speed, privacy & complexity required by blockchain transactions are making such solutions impossible. Due to the prevalence of jurisdictional restrictions, exorbitant costs, and drawn-out procedures, traditional courts and arbitral institutions become ineffective in these conflicts. A dispute resolution mechanism that aligns with the decentralized philosophy of blockchain technology is of paramount importance given the growth of our digital economy presently.

Kleros offers solutions to these issues through applying game theory principles, blockchain technology & crowdsourced juries to create an effective, equitable and transparent dispute resolution process. Kleros functions as a decentralized arbitration platform by enabling parties to select a smart contract-based method that guarantees just and enforceable results.[41] Kleros provides a fresh & exciting approach in the sphere of spontaneous dispute resolution by tackling the prevailing drawbacks which usually range from exorbitant fees, unclear jurisdiction, and the inability to enforce decisions in cross-border conflicts.[42]

Kleros's operational framework, legal overview & practical applications are thoroughly examined in this case study. It also looks at important examples that have shown how beneficial the platform is such as "The Mexican Case." This study further goes onto evaluate Kleros's advantages critically. We have evaluated the probable risks and gaps which must be bridged for the network to spread more widely & survive in the long run.

Mechanism & Functioning

Decentralized Dispute Resolution

Kleros is based on the Ethereum blockchain whereby it leverages a native token known as Pinakion (PNK) to ensure and secure its dispute resolution process. This particular system claims to be autonomous, transparent, free of bias which serves as a viable alternative to mechanisms in arbitration. The platform's working is facilitated through an ordered, step-by-step process on how to ensure disputes are resolved efficiently and effectively.

[41] *Kleros. How to Enforce Blockchain Dispute Resolution in Court? The Kleros Case in Mexico. Kleros Blog, 2021,* https://blog.kleros.io/how-to-enforce-blockchain-dispute-resolution-in-court-the-kleros-case-in-mexico/.
[42] *The Conundrum of Enforceability of Blockchain Arbitration: Learnings from Kleros. Jindal Global University, 2023,* https://jgu.edu.in/mappingADR/the-conundrum-of-enforceability-of-blockchain-arbitration-learnings-from-kleros/.

Arbitration Process Procedure

(i) Usage Decision Kleros Arbitration

Disputed parties must agree to use Kleros as their dispute resolution mechanism before engaging in any kind of transaction. This is built into smart contracts that further enables disagreements to be resolved automatically, albeit not in a very clear way. In addition, Funds are held in escrow under the terms of the contract and neither side gets access to it until the settlement has been reached. Arbitration clauses in smart contracts guarantee that all parties enter into transactions with established, and thus enforceable, dispute resolution procedures.

(ii) Dispute Initiation

Any contract participant can initiate arbitration through sending Kleros a dispute claim coupled with accompanying paperwork whenever a conflict arises. Following the same, validation of the input takes place and in furtherance the platform initiates the process of dispute settlement. Starting arbitration with a minimal fee helps to ensure objectivity and prevent unfounded claims. This structure guarantees efficient resolution of legitimate problems and discouragement of parties from raising complaints.

(iii) Voting and Jury Selection

Kleros employs a distributed jury selection system by choosing jurors from among PNK token holders who have staked their tokens in categories relevant to disputes. Given the process is weighted based on the amount of tokens staked, jurors are urged to actively engage and make well-informed recommendations. This selection for filtering is done on top of the layer randomized procedures.

Kleros uses game theory to determine fairness wherein jurors who support the majority verdict receive rewards. By discouraging this bias or randomness, the enticement mechanism forces jurors to make logical decisions based on the facts that are provided. The accuracy & integrity of the system are strengthened whenever jurors make decisions that differ from the majority which ultimately result in the loss of some staked PNK.

(iv) Enforcement and Decision

Post the choice establishment, the smart contract automatically enforces the decision. This

requires no need for outside enforcement methods as the escrowed money is disbursed in consonance with the ruling. This procedure is advantageous in terms of cross-border transactions as disputes tend to be solved effectively without relying on conventional methods. These decisions are purely based on smart contracts. Kleros also features an appeals process to guarantee that only conflicts with sound legal merits are provided another avenue. This feature is only accessible with larger stakes and extra costs.

Use-cases & Judicial Affirmations

The Mexican Adoption

The most notable uses of Kleros occurred in Mexico, where a complicated cross-border business issue was settled via the platform. A dispute over the non-fulfillment of contractual commitments emerged between two companies involved in an international service arrangement. Conventional legal approaches would have prolonged the resolution process by requiring expensive litigation and significant jurisdictional obstacles.

Both parties decided to use Kleros to resolve their disagreement rather than conventional arbitration or a legal suit. The case was presented to the platform thereafter, a group of decentralized jurors examined the requisite evidence incl. supporting documentation, transaction records & relevant contractual provisions. On the basis of their niche areas of expertise, the jurors evaluated the findings and came to terms in favour of the claimant who successfully had established that the other party had explicitly broken the terms of the contract.[43]

After this landmark decision, smart contracts automatically enforced the ruling by guaranteeing that the winning party received the money that had been held in escrow. By cutting the resolution time from several months (as in traditional judicial systems) to merely a few days, this was seen as a landmark feat in the judicial systems. This case opined Kleros's capacity to settle international conflicts through amicable means and providing companies with a workable substitute for drawn-out court cases.

[43] *Virues, Mauricio, Sophie Nappert, and Luis Bergolla. Arbitration Tech Toolbox: Is a Mexican Court Decision the First Stone to Bridging the Blockchain Arbitral Order with National Legal Orders? Kluwer Arbitration Blog, 2021,* https://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/.

Market Debate: U.S. Presidential Election Predictions (2020)[44]

In the Omen prediction market , Kleros was instrumental in mediating a disagreement over the 2020 U.S. Presidential Election result.[45] Users had been able to wager on whether Donald Trump or Joe Biden would win in the market. A disagreement over the ultimate settlement of prediction market funds resulted from certain market participants contesting the validity of the results, even as mainstream media outlets declared the election to be in Biden's favour.

Kleros was entrusted with using decentralized arbitration to settle the dispute dealing with significant financial stakes. A panel of jurors therefore heard the case and reviewed numerous sources that included official government pronouncements, records of election certification, and significant press stories that verified Biden's victory.[46] The Kleros jurors concluded to settle the market in line with Biden's electoral victory by using transparent and decentralized decision-making methods.

This case laid out the efficacy of Kleros in handling high-profile and politically sensitive cases by guaranteeing that the ruling was founded on objective evidence rather than personal prejudices and whims. In furtherance to the same, the platform avoided manipulation or excessive delays in dividend distributions through automatic implementation as per the smart contracts. It strengthened public confidence in decentralized governance processes.[47] This was viewed as an effective testament for blockchain-based arbitration helping in its adaptability and acceptance.

Token Listing Conflicts: The Case of Baer Token[48]

Kleros has been essential in preserving the integrity of the contemporary cryptocurrency ecosystem.[49] It especially plays its part through settling these conflicts involving token listings on exchanges. The Baer token that was proposed for listing on a decentralized exchange is a

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[44] *1/ Case #532 - 2020 US Presidential Election Omen Market.*
[45] *Omen Prediction Market. (2020). Kleros Arbitration and the 2020 U.S. Election Dispute,* https://omen.eth.link.
[46] *Kleros. "Famous Kleros Cases." Kleros Documentation, 2023,* https://docs.kleros.io/products/court/famous-kleros-cases.
[47] *"The Giant Asterisk on Election Betting." The Atlantic, 2024,* https://www.theatlantic.com/technology/archive/2024/10/political-betting-polymarket-disputed-election/680473/.
[48] *Case #16/#62/#89 - Listing of Baer token on Ethfinex.*
[49] *Kleros: Is Crypto-Based Dispute Resolution the Future? Vidhi Legal Policy, 2021,* https://vidhilegalpolicy.in/blog/kleros-is-crypto-based-dispute-resolution-the-future/.

prominent example of the same. It was reported that *"The project's legitimacy was called into question shortly after it was submitted, as allegations of false statements and even fraud by its creators surfaced."*[50]

In order to resolve the disagreement, Kleros jurors were required to decide if the Baer token fulfilled the requirements for listing or if it displayed traits of a fraudulent financial scheme. The documents in this case involved Whitepaper analysis, project team credentials, smart contract audits & on-chain transaction histories. Post the review and analysis, the selected jurors decided against listing the Baer token on grounds of discrepancies in its documentation and a lack of project advancement that was verified in the due course by jurors. Additionally, doubts were also posed on financial sustainability.

This particular ruling protected Investors from possible financial losses through prevention of listing of the coin on exchange. This guarantee and documented cryptocurrency initiative were granted access to trading platforms. This case substantiated that Kleros may serve as a decentralized regulatory agency. Kleros, in furtherance to the same, added to the overall security of the blockchain sector which in turn led to strengthened public confidence in decentralized marketplaces by weeding out fake tokens.

In conjugation, these cases demonstrate Kleros broad applicability in a variety of contexts from cryptocurrency legislation and prediction market governance to commercial contract conflicts. Kleros strives to provide a transparent, effective, and enforceable dispute resolution system by using blockchain-based arbitration which is becoming more and more acknowledged as a cutting-edge substitute against conventional legal methods.[51]

Grounds of Merits & Drawbacks

Merits

Kleros has many benefits, including decentralization, low cost, and transparency. Eliminating the use of intermediaries greatly reduces the cost of arbitration while providing equal opportunities. Use of smart contracts ensures that all rulings are applied automatically, meaning

[50] *The Conundrum of Enforceability of Blockchain Arbitration: Learnings from Kleros. Jindal Global University, 2023,* https://jgu.edu.in/mappingADR/the-conundrum-of-enforceability-of-blockchain-arbitration-learnings-from-kleros/.
[51] *The Giant Asterisk on Election Betting. The Atlantic, 2024.*

the process is efficient and straightforward. Moreover, the fact that blockchain records cannot be altered leads to transparency between participants.

Drawbacks

Legal recognition and accessibility are two of the main issues which hinders its growth and adaptability. The enforceability of the decisions in the conventional judicial system is still in a vulnerable position as it is not bound by traditional legal systems. It also requires users to be familiar with cryptocurrency and blockchain technology, which excludes non-crypto users. Another challenge is strategic voting, where jurors vote based on incentives rather than the merits of the case. All these will be important to Kleros's adoption.

CONCLUSION & SUGGESTIONS

Among the foremost notable benefits of blockchain arbitration is the fact that it eliminates human interference, resulting in a quicker and cheaper dispute resolution. With the distributed ledger, appropriate evidence assessment may be done online, reducing the possibility of unsolicited and disingenuous factual tampering or alteration. Nevertheless, although smart agreements & on-chain arbitration are garnering popularity amongst authorities & professionals all through the globe, they are still in their early phases of implementation and would need a more robust legal framework to establish them it as a viable and well recognized method of dispute resolution alternative. Issues about privacy and enforcement of smart awards remain to arise since blockchain arbitration is a facet of technological growth that enables AI/ML to make self-executing rulings, it remains miles apart before being accommodated and utilized by developing nations.

The advancement shall be seen through a positive light and as a by-product of technological feat. Its adoption will definitely provide a relief to the clogged judicial machinery overflowing with unresolved disputes but it shall not come at the cost of improper and unjust rendering of awards. Effective mechanisms of alterations and amendments to the smart contracts must be incorporated. Appeal & Challenge mechanisms shall be designated to rule out the possibility of wrongful decisions while considering the possibility of mechanical failures. Principles of Natural Justice shall be adhered to while the whole legal framework is being established surrounding the Eco-system.

Especially in emerging economies like India, it's worth the wave to ride on but with precautionary measures, while establishing adequate infrastructure and a skilled environment to bear the repercussions and counter-effects which may arise in the future.

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