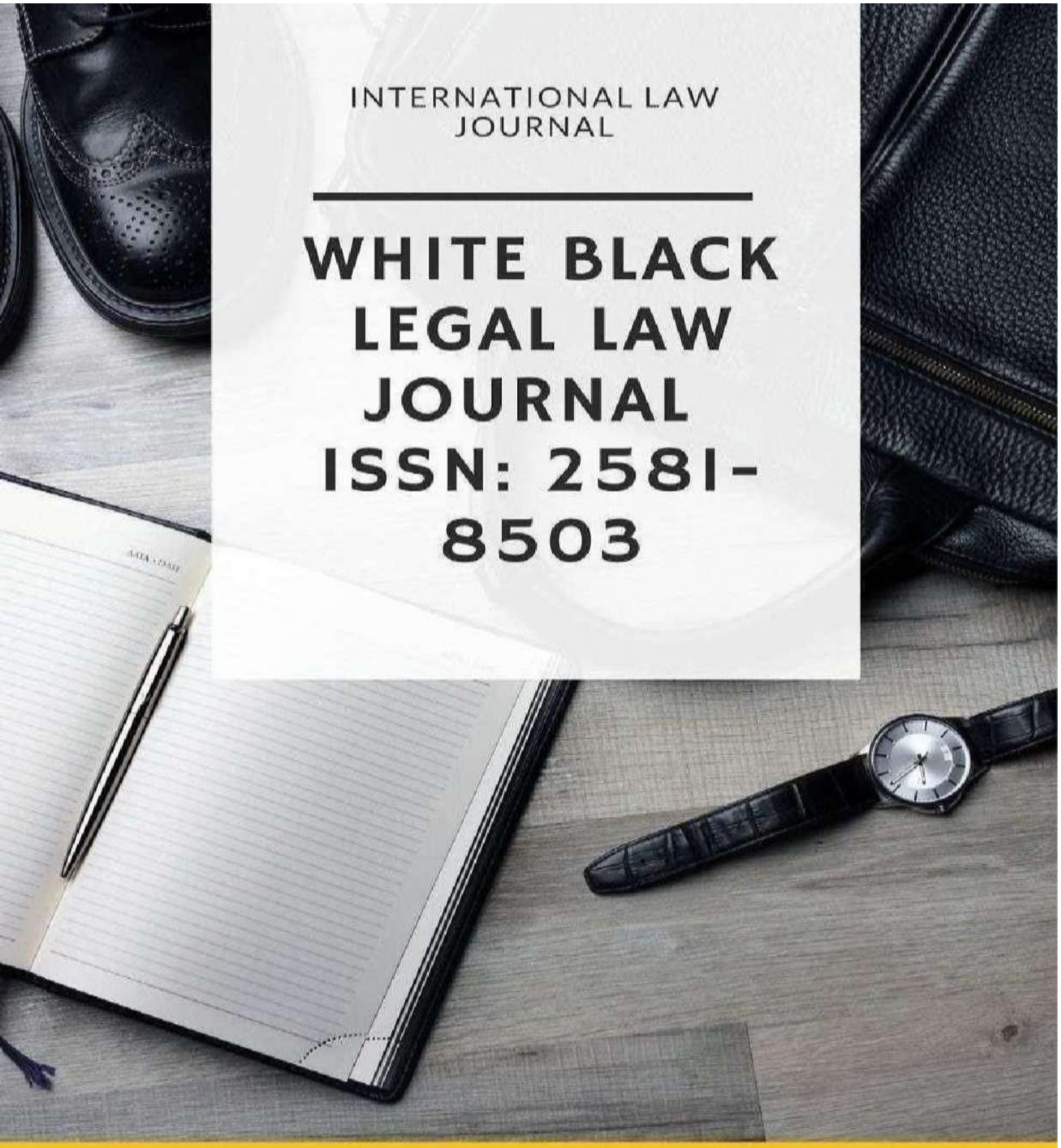

INTERNATIONAL LAW JOURNAL

WHITE BLACK LEGAL LAW JOURNAL

ISSN: 2581-8503

Peer - Reviewed & Refereed Journal

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www.whiteblacklegal.co.in
Volume 3 Issue 1 | April 2025 ISSN: 2581-8503

SMART CONTRACTS AND BLOCKCHAIN ARBITRATION: A NEW ERA OF DIGITAL JUSTICE

AUTHORED BY - AGNES AMALA ANITHA T

Abstract

The metamorphosis of blockchain technology with smart contracts has given another dimension to ADR as opposed to existing ones of dispute resolutions. Traditional arbitration is an excellent way of finding a solution to conflicts but is unduly mingled with so many delays and costs, jurisdictional conflicts, enforcement problems, etc. Such a break from the traditional ways has given way to a new model between the decentralized platforms and smart contracts- the so-called 'blockchain arbitration, scenery envisioned on its efficiencies, automation of access across the globe. Included in these are the important self-executing dispute clauses, lesser dependence on intermediaries, and a corruption-proof record of the proceedings. The open question, however, is still: Are these decentralized mechanisms of justice legally viable? Thus, this analysis in this research paper will consist of hundreds of technical details regarding smart contracts, such as referring to arbitration platforms like Kleros, Aragon Court, or OpenLaw all existing based on blockchain technology. This critical analysis will scrutinize the legal consequences that arise from this novel type of dispute resolution through enforcement possibilities under the New York Convention, jurisdictional ambiguity due to no physical seat, procedural fairness issues, and data privacy concern majorly by the General Data Protection Regulation (GDPR) scope.

A doctrinal and comparative legal methodology is adopted for the analysis of international arbitration framework with national arbitration laws adjusted to some key jurisdictions like the European Union, the United States, Singapore, and India. Instead, it proposes a hybrid model of digital arbitration with the procedural guarantees developed by traditional legal systems while marrying the advantages of the decentralization and automation of blockchain. The paper ends by calling important legal reforms and strong regulatory frameworks that would support the evolution of blockchain arbitration into a legitimate, enforceable, and fair resolution mechanism for global disputes in an increasingly digital world.

Keywords; Blockchain arbitration, smart contracts, digital dispute resolution, alternative dispute resolution (ADR), decentralized justice

Introduction

Arbitration is typically considered a haven of solace for disputing parties; however, this is institutionalized, regulated by procedural rules, and requires the intervention of a human arbitrator to resolve the dispute. The very process of traditional arbitration is quite costly, time-consuming, and rather complex when it comes to the jurisdictional aspect, particularly in cases of cross-border digital transactions. In sharp contrast, blockchain arbitration promises instant automated decision-making without boundaries and without being dependent on a central control through the use of smart contracts and DAOs.[1]

Self-executing computer programs are smart contracts. Their terms come into force after meeting certain predetermined criteria. A smart contract with arbitration clauses can thus trigger an arbitration mechanism or dispute resolution protocol through blockchain-powered platforms corresponding to events stipulated in the arbitration contract.[2] Adjudication might be carried out through anonymous jurors or algorithmic processes. Good examples of the performance of blockchain arbitration without traditional courts have been showcased by platforms like Kleros and Aragon Court. However, such bright sides come with their own legal problems especially in terms of jurisdiction, enforcement, procedural fairness, and data protection.

Hence, the paper examines the hybrid model. The hybrid model would be a model of a dispute resolution that brings about the benefits of using blockchain while ensuring that some of the basics of due process and enforceable juridical justice are retained. Realistic justice, which is already on its way, can hold a lot of promise, but it must be candid enough to say that there are outstanding challenges in the regulatory framework with which these must grapple.

[1] Reuben, R. C. (2004). Democracy and dispute resolution: the problem of arbitration. *Law and contemporary problems*, *67*(1/2), 279-320.
[2] Koulu, R. (2016). Blockchains and online dispute resolution: smart contracts as an alternative to enforcement. *SCRIPTed*, *13*, 40.

Research Problem

The increasing dependence of blockchain and smart contracts has started to make changes in the nature of contract formation and dispute resolution. Historical types of alternative dispute resolution (ADR), such as arbitration or mediation, would depend heavily on institutions, human judgement, and various procedural provisions of law, all of which could make the process lengthy, expensive, and difficult to enforce. On the contrary, blockchain arbitration provides a completely decentralized, automated, and self-executing model of approaching dispute resolution that negates any dependence on intermediaries. However, there exists a plethora of very crucial commercial legal issues such as jurisdictional ambiguity, enforceability problems, regulatory vacuums, and procedural fairness questions. The research explores whether blockchain arbitration can be fitted within an international arbitration framework and what subsequently legal reforms are needed to affect such mainstreaming.

Objectives of the Research

The paper has the following objectives:

1. To ontological analysis of smart contracts and arbitration-based platforms on blockchain hold in dispute resolution.
2. To identify most important challenges concerning cybersecurity, procedure, and jurisdiction on the blockchain arbitration.
3. To evaluate the extent to which arbitration through the medium of blockchains is enforceable under international law instruments
4. To articulate a comparative analysis of blockchain arbitration in terms of jurisdictions
5. To provide a balanced regulatory reform that establishes a hybrid system of enhanced efficiency and legal oversight for the resolution of disputes.

Research Questions

These are the legal questions that this research aims to answer:

- What is the mechanism of functioning of blockchain arbitration and what are its legal implications?
- Will smart contracts be considered as the continuation of arbitration agreements in the resolution of disputes?
- What are the jurisdictional, enforcement, and procedural fairness concerns, if they exist?

- To what extent can blockchain arbitration be squeezed within the parameters of the current international fraternity of arbitration?
- What can be said from the development of recommendations for the regulation of decentralized dispute resolution systems globally?

Methodology

This study carried out doctrinal legal research along with comparative legal analysis and case studies. Dr doctrinal research entails study on international treaty relating to arbitration i.e., New York Convention: UNCITRAL Model Law with regard to applicability to blockchain arbitration. Analysis of national arbitration laws in the most significant jurisdictions (e.g. EU, U.S., Singapore, India) will be done to study their recognition of smart contract dispute resolution. Comparative legal study seeks to assess the difference in regulations among jurisdictions concerning blockchain arbitration and smart contracts against conventional arbitration procedures and decentralized mechanisms for arbitration. The practical study consists of examining blockchain arbitration platforms that can be assessed through Kleros, Aragon Court, and Open Law with regard to their legal validity and enforceability. Moreover, the study will analyse the court decisions and arbitration awards on smart contract disputes. Prescriptive legal study will be applied in order to formulate proposals for legal reform measures and best practices that will help to minimize further hurdles in blockchain arbitration.

The relevance of Legal Research:

The contributions for improving information on digital justice and dispute settlements are as follows: -

1. Filling the empty spaces within international law research once the feasibility of arbitration through blockchain is brought up.
2. Setting up a hybrid system of law with such procedural safety measures accompanied by efficiencies given by blockchain.
3. Pushing through changes in courts and arbitration institutions about the legal acknowledgment of awards arising out of blockchain systems.
4. Giving thoughts about privacy-preserving technology (zero-knowledge proofs, confidential smart contracts, etc.) that balance transparency and privacy regarding arbitration.

5. Bridging the gap between smart contract automation and legal justice for the effectiveness and accessibility of any kind of dispute resolution under law.

Blockchain arbitration and smart contracts-

Share your thoughts here. Smart contracts are self-executing contracts with the terms of the agreement between buyer and seller completely specified within source code.[3] The smart contract enforces itself when certain predefined conditions are met. Since these are executed on a blockchain, the contract is free of an intermediary, and every action- transfer of assets or payment, or anything else- would be there in an immutable record. So, the contract is decentralized, never open for counter-claims; hence, it will be a blessing that is believed to support all kinds of business ventures in the digital economy. On the other hand, it is assumed that in these unusual cases of smart contract grievances, traditional laws will hardly be of any timely or effective assistance in enabling an expedient remedy. Hence the origins of this idea: Blockchain arbitration being this radically new means of dispute resolution suitably housed in decentralized systems. Instead, arbitration under Blockchain establishes decentralized platforms that normally are rule-based and customarily implemented by community juries or automatic decision-making mechanisms.[4] Kleros and Aragon Court, for example, provide platforms that allow both parties to agree in advance to submit any dispute for resolution according to blockchain procedures.[5] The processes through which crowd-sourced jurors work, token-based voting, and evidence submission in cryptographic form constitute a decentralized system of justice that operates without centralized control.[6]

Generally, these characteristics underline speed, automation, and internationalism concerning anything that could be termed blockchain-based arbitration. A smart contract clause would render the arbitration commencement instantly, or the arbitration may commence directly in accordance with the contract where enforcement of any extra-award would also be assured under smart contract provisions. But this newfound perspective raises a number of questions relating to valuation of traditional arbitration. With no formal hearings, absent legal

[3] Ortolani, P. (2019). The impact of blockchain technologies and smart contracts on dispute resolution: arbitration and court litigation at the crossroads. *Uniform law review*, *24*(2), 430-448.
[4] MARIQUE, E. (2021). A legal study on the limits of the roles and regulatory tools of public authorities and digital platforms.
[5] Zhuk, A. (2023). Applying blockchain to the modern legal system: Kleros as a decentralised dispute resolution system. *International Cybersecurity Law Review*, *4*(3), 351-364.
[6] Kapoor, A. (2022). LEGAL AND POLICY CONCERNS WITH BLOCKCHAIN-BASED ARBITRATION. *NUJS Journal on Dispute Resolution*, *2*(2).

representation for participants, and no appeals-all of which might otherwise have served as a pillar for traditional arbitration- the anonymity and decentralization bring substantive questions about procedural fairness.

Legal Challenges and Procedural Concerns

It is no doubt revolutionary in its concept for putting in place a fresh paradigm of arbitration for dispute resolution, but it harbours certain legal and procedural challenges which the current laws are likely to displace or at least affect in their operations. The prominent issues of confusion concern the jurisdiction.[7] Traditional arbitration is, indeed, bound by a legal seat indicating its procedure and the court under the jurisdiction of its dispute resolution. On a wider or better global basis, such arbitration is defined as borderless and decentralized; often conceptualized without a clearly specified geographical seat, if any. All of those bring up questions as to whether national laws apply and to which courts the supervisory jurisdiction would be held.[8]

Enforcement, again, is yet another major issue. As is, the New York Convention (1958) sets up conditions under which arbitral awards can be enforced internationally; however, the convention includes a lot of inference which can only be inferred from a properly structured arbitration agreement and some form of institutional oversight, neither of which conditions would prevail in decentralized arbitration.[9] Courts will deem awards less enforceable that are proffered thricely through some automated and/or anonymous processes without such procedures being expected to conform to accepted norms of due process. However, procedural fairness due to due process still remains. Legal representation is provided to parties as opposed to oral hearing, while cross-examination is substituted by code-run procedures and lay jurors. Users, indeed, may be assured speedy arbitration but at the cost of perhaps infringing the foremost principles of having fair arbitration. The parties may not know they're giving up the right to appeal or may not have an adequate grasp on the functional rules contained within the smart contract.[10]

[7] Michaelson, P. (2020). Arbitrating disputes involving blockchains, smart contracts, and smart legal contracts. *Dispute Resolution Journal*, *74*(4), 89-133.
[8] Ortolani, P. (2019). The impact of blockchain technologies and smart contracts on dispute resolution: arbitration and court litigation at the crossroads. *Uniform law review*, *24*(2), 430-448.
[9] Chevalier, M. (2021). From smart contract litigation to blockchain arbitration, a new decentralized approach leading towards the blockchain arbitral order. *Journal of International Dispute Settlement*, *12*(4), 558-584.
[10] Oliveira, N. B. (2023). The role of international arbitration in resolving cross-border smart contract disputes: opportunities and challenges. *PQDT-Global*.

On the other hand, present very serious threats to the privacy and confidentiality, that is, traditional arbitration where it is by discretion and confidential operations in all regards of blockchain towards one scope, being complete transparency. Such undertakings are actionable offenses of law, starting from private laws such as the GDPR. Any data produced with respect to the dispute to be stored indefinitely on chain may lead to unlawful disclosures of sensitive commercial information or personal data without safeguards being put in place. This synopsis highlights the need for proper balance in the regulation of blockchain arbitration between innovation and base law principles. Until such time that reform or hybrid frameworks adequately contemplate these considerations, it may be expected that blockchain arbitration will not increasingly be so viewed as a valid form of dispute resolution in the mainstream.

Comparative Legal Approaches

Diverse jurisdictions offer legal treatment dealing with smart contracts and blockchain arbitration and tend to give rise to issues such as how the technology interface, recognition under law, and regulatory clarity are. A comparative approach between developments within Europe, the United States of America, Singapore, and India allows for an aspiration at completion against the demerits of the localized laws against the international legal framework on decentralized dispute resolution.

European Union

The lively mechanism is administrated in the digital domain as regards crypto-assets through the MICA regulation and Digital Services Act, where what seems to be governed will definitely be in cryptocurrencies and digital platforms but not in blockchain.[11] One end of the common law spectrum is the arbitral procedure itself with the Brussels Regulation-direct taxation by domestic laws modelled largely on the UNCITRAL Model Law; dispersion in the other procedural systems is based on the understanding of enforcement of awards arising out of decentralized arbitration platforms through formalized arbitral institutions with established arbitration seats. Similarly, the compliance issues with which the General Data Protection Regulation raises centre around the structure of blockchain upon certain grounds for data erasure and confidentiality in arbitration.

[11] Ferreira, A., & Sandner, P. (2021). Eu search for regulatory answers to crypto assets and their place in the financial markets' infrastructure. *Computer Law & Security Review*, *43*, 105632.

United States

Smart Contracts find recognition under Law in the USA through the Uniform Electronic Transactions Act and the Electronic Signatures in Global and National Commerce Act.[12] Similarly, although the statutes are indeed to be construed for the most part as approving a digital contract-not interfering at all with anything used herein regarding-arbitration under a blockchain, the probable application of awards nominally arising from such arbitration would lean towards the FAA, thus ""encouraging private settlement of disputes, as long as it is accountable to due-process safeguards". The Courts have been conspicuously slow in achieving ground on this point, particularly due to the focus on due process safeguards, clear consent to arbitration clauses, and an identifiable governing law-the last aspect being fairly tricky in decentralized environments.

Singapore

Singapore is one of the leading countries in arbitration and digital innovations today. In addition to the provisions on electronic transactions in the Electronic Transactions Act with regard to digital contracts,[13] the Singapore International Arbitration Centre (SIAC) is also researching models for blockchain arbitration.[14] These complications arise because the Arbitration Act and International Arbitration Act relate to UNCITRAL Model Law, while the recent rules are inclined more favourably toward institutional arbitration. Nevertheless, Singapore's appetite for regulatory innovation will probably turn it into the experimental platform for blockchain arbitration under the regulated sandbox approach.

India

Government of the India has adopted a valid digital contract under which it would implement the provisions as provided by the Information Technology Act, 2000 and thereafter promote arbitration via the Arbitration and Conciliation Act, 1996. The changes in this Act were made to enable harmonization with international standards. Considering all the legal unresolved matters, Indian arbitration law does not contain concepts on blockchain arbitration, however,

[12] Alsheyab, M. S. A. (2023). Legal recognition of electronic signature in commercial transactions: A comparison between the Jordanian electronic transactions law of 2015 and the United Arab Emirates electronic transactions and trust services law of 2021. *International Journal for the Semiotics of Law-Revue internationale de Sémiotique juridique*, *36*(3), 1281-1291.

[13] Song, J. Y. L., & Tan, E. (2024). Beyond traditional contracts: the legal recognition and challenges of smart contracts in Malaysia and Singapore. *JL, Mkt. & Innovation*, 323.

[14] Ho, D., & Boo, L. (2023). Arbitration. *Singapore Academy of Law Annual Review of Singapore Cases*, *24*, 57-109.

keeping in mind the current digitization along with an efficient IT industry within the country, it would most probably be a fertile ground for adopting blockchain arbitration in the future. Other practical problems like those of digital literacy, regulatory clarity, and judicial recognition of smart contract-based awards remain impediments for faster adoption.\

Thus, while some jurisdictions, such as Singapore and the U.S., have advanced quite far in terms of accepting digital legal regimes, none of these jurisdictions has given acceptance accorded to or conferred entire legal force to arbitration by blockchain technology. Hereby, absence of these above said jurisdictions and standard regulations showed how immeasurably great an immediate international cooperation and reform were needed in the legal arena to fill the gap between profiteering technology advancement and legal acceptability regarding decentralized dispute resolution.

Case Studies and Platform Analysis: Kleros, Aragon Court, and OpenLaw

If you really want to know the effectiveness and use of blockchain in arbitration, you have to look at some of the decentralized platforms leading the way in providing such services. In this category, Kleros, Aragon Court and OpenLaw are the first-generation blockchain arbitration platforms that differ in their unique mechanisms of governance and legal consideration.

Kleros

Kleros is a private decentralized arbitration protocol on the blockchain of Ethereum.[15] As a theory for crowdsourcing jurors, it enables the random selection from holders of the Kleros token for resolving a dispute, thus considering all evidence presented by litigants and voting it out. To this end, in order to encourage jury members to act in good faith, Kleros requires that jurors stake its native token to vote in deciding the case, receiving a penalty in case of malicious voting. Kleros is specifically targeted at e-commerce, freelancing engagements, insurance claims, and DAO governance. However, even though it recognizes decentralization and transparency as its basic values, Kleros is not in partnership with any formal law. Kleros arbitration decisions cannot be enforced under any of the existing arbitration frameworks like the New York Convention, denying its broader utility for high-value commercial disputes.

[15] Zhuk, A. (2023). Applying blockchain to the modern legal system: Kleros as a decentralised dispute resolution system. *International Cybersecurity Law Review*, *4*(3), 351-364.

Aragon Court

The Aragon Court is an arbiter of disputes that relates to digital organizations as part of the Aragon DAO ecosystem. Similar to Kleros, jurors are created from the shareholding of the jury in a platform's tokens (ANT) by which the jurors would decide governance-related issues within a DAOs that are otherwise construed as violations of the agreements concerned. While this environment is new, it applies to very niche, internal blockchain-native disputes, such as those it currently has under it. It has no binding effect under national arbitration rules and greatly relies on volitional compliance by the parties involved. Much like Kleros, enforcement and due process issues also prove undermining for Aragon.[16]

OpenLaw

Openlaw is attempting to combine a smart contract with the possibility of legal enforceability. It comprises assignable tools to form legally binding contracts interspersed with smart contract clauses. While it is somewhat different in approach to Kleros or Aragon, OpenLaw actually supports hybrid models by which legals can supplement blockchain-built automated execution features. OpenLaw is manifestly written with much more compatibility to modern legal systems that applied OpenLaw contracts would subject to the law of a given country, thus their enforceability dependent on the courts of that country, balance maintaining delicate between the automated execution and legal validity for novel constructs. But, again, OpenLaw does not have any built-in mechanism for settling disputes but relies on the outside mechanisms for that purpose.[17]

These case studies illustrate the growing experimentation in blockchain arbitration. While platforms like Kleros and Aragon offer decentralization and efficiency, they currently lack legal enforceability. OpenLaw's hybrid approach demonstrates a potential path forward, integrating smart contract logic with traditional legal safeguards.

Proposals for Legal Reform and Hybrid Models

Evidently, a fundamental legal reform would be required to make blockchain arbitration comprehensible and executable within the legacy law frameworks. Today, arbitration laws and

[16] Esposito, M., Tse, T., & Goh, D. (2024). Decentralizing Governance: Exploring the Dynamics and Challenges of Digital Commons and DAOs. *Available at SSRN 5048235*.
[17] Herian, R. (2018, December). Legal recognition of blockchain registries and smart contracts. EU Blockchain Observatory and Forum.

international treaties, such as the New York Convention, do not cater for this decentralized, code-based kind of dispute resolution. A hybrid arbitration procedure, therefore, one that will take swiftness of functioning through a blockchain and marries this with face-validity legitimacy of traditional legal systems, would seem a prudent way forward.

1. Legal Recognition of Blockchain Arbitration Awards

   At the same time, national arbitration laws require amendment in order to accommodate smart contracts-based arbitration agreements and decentralized platforms. Well-defined statutes on blockchain arbitration, digital jurors, and automated enforcement mechanisms can equally establish the legitimacy of such procedures. Following the same logic of validation given to electronic signatures with instruments such as the UETA and E-Sign Act, blockchain arbitration clauses should be duly recognized as binding agreements.
2. Establishment of Regulatory Sandboxes

   On-the-ground regulatory sandboxes for blockchain-based arbitration should be set aside by various governments, involving in controlled pilot projects under the law. This is already going in place in fintech regulation and could allow the orderly testing of decentralized models whilst also guaranteeing adherence to some key legal principles, such as due process and consent.
3. Collaboration with Existing Arbitral Institutions

   Existing institutions, including SIAC, LCIA, or ICC, could set up arbitration clauses accommodating blockchain use and smart contracts for automating relevant proceedings under human supervision for fairness and review. For example, submission of documents, payment of fees, and appointments of arbitrators could all fall to the smart contract domain, whereas really award decisions would be issued via a regular arbitral tribunal.
4. Standardized Smart Legal Contracts

   Standardization of smart legal contracts, marrying the enforceability of code with words enforceable in law, eventually seals the gap between code and law. Organizations such as the Accord Project and OpenLaw are active in this area. Courts and arbitral tribunals should be encouraged to recognize these instruments, particularly in the case of incorporating dispute resolution clauses.
5. Oracle Governance and Fairness Protocols

   Comprehensively legal frameworks will even engage oracle governance for procedural

fairness because it is the intelligent oracles that bring real-world information to the smart contracts. Multi-party decentralized oracles with verifiable sources of information might mitigate manipulation risks. Similarly, rules on liability should be inclusive of all misfeasances that the oracle could be proved to have committed which could have bearing in an arbitration context. In sum, hybrid models combining the speed and transparency of blockchain with the procedural rigor of traditional arbitration offer the most practical way forward. Legal systems must evolve to accommodate this innovation while safeguarding justice, enforceability, and procedural integrity.

Conclusion

There is indeed a miscalculation that presumes that blockchain arbitration brings up a remedy for any legal troubles since it is at the fence-the legal side. Most importantly, it is a territory between parties that might have made some incidental contact with some form of digital transaction. Hence, another option for an unfairly speedy, perhaps even universal, or almost just fast and cheap resolution for smart contracts by decentralized adjudication is blockchain arbitration. Kleros and Aragon Court are examples of this development in real life, shedding light on those rather dark areas of inquiries that seriously require attention when law and technology meet. These systems, however, are clearly facing barriers in the gray zones of law like jurisdictional certainty, international-wide enforceability by something like the New York Convention, and the due procedural guarantees, like due process and confidentiality. Public blockchains can be made transparent and accountable, but they pose unbearable risks in violation of data protection laws, specifically concerning GDPR.

Future Directions

All these will develop hybrid arbitration models in the future, drawing upon current efficiencies of blockchain technology and even heavier legal backing through more traditional systems. Legal reforms at both the country and international destinations will have to recognize smart contract-related arbitration, define decentralized platforms' role, and set standards for automated dispute resolution that will in turn be enforceable. In this regard, regulatory sandboxes, partnership with institutions, and standards will do a lot in smart legal contracting development. Serious concerns over data integrity, confidentiality, and fairness can also be addressed by developments in privacy-preserving technologies such as zero-knowledge proofs and oracle governance mechanisms. Such instruments will bind self-executing code with the

requirement of being under a legal spotlight, thus ensuring future synchronization of blockchain arbitration with evolving legal standards. To put it simply, blockchain arbitration unfolds a visionary world of decentralized justice into existence. Under appropriate regulation, interdisciplinary collaboration, and continuous advocacy by the rule of law, it can thus resolve paradigm shifts in conflict resolution within the digital society.