Review Article

Examining the Legal Interface of Block Chain Technology, Smart Contracts and Online Arbitration

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Abstract

The rapid evolution of digital technologies has fundamentally disrupted traditional arbitration processes, introducing new complexities and opportunities at the intersection of blockchain technology, smart contracts, and online arbitration. This study examines the legal and practical challenges arising from the integration of blockchain technology, smart contracts, and online arbitration. The research addresses the problem of adapting traditional dispute resolution frameworks to decentralized automated agreements that transcend national borders. Using doctrinal analysis and comparative review of legal sources, case studies, and real-world platforms, the study identifies key types of smart contracts and evaluates on-chain and off-chain arbitration models. Findings highlight both the efficiency and transparency offered by blockchain-based dispute resolution, as well as persistent issues such as jurisdictional uncertainty, enforceability, technical vulnerabilities, and privacy risks. The results underscore the need for clear legal standards, technical safeguards, and the adoption of advanced technologies. The study recommends promoting interoperability, specifying governing law in smart contracts, and leveraging AI and off-chain execution systems to enhance the robustness and adaptability of digital dispute resolution.

Keywords: Legal interface, blockchain, arbitration, online, smart contracts, technology, dispute resolution, artificial intelligence.

1. INTRODUCTION

The traditional format and conduct of arbitrations are currently being disrupted by technological innovations, particularly digitalization, artificial intelligence (AI), and blockchain technology. One of the most significant developments in recent years has been the incorporation of digital technologies into arbitral practices. Innovations such as virtual hearings, online filings, digital evidence management, and AI-powered tools have revolutionized traditional arbitration, enhancing its accessibility, speed, and security. [1] Arbitration is a form of Alternative dispute resolution, which is a compendium of services and strategies, including mediation services, facilitating dispute resolution between parties that might otherwise lead to litigation. [2]

Online arbitration, also known as e-arbitration, virtual hearings or electronic arbitration, can be defined as an arbitration in which all aspects of the proceedings are conducted online.[3] Blockchain technology refers to a decentralized digital ledger system that securely records transactions across multiple computers, ensuring that a recorded transaction cannot be altered retroactively

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[1] Anisha B.et al (2025). "The Evolution of Arbitration in the Digital Era: Opportunities and Challenges". International Journal for Multidisciplinary Research (IJFMR). Volume 7, Issue 3, E-ISSN: 2582-2160. Available at www.ijfmr.com. Last visited 11/15/2025.
[2] Law, K. M. (2013). "Best technology practices of conflict resolution specialists: A case study of online dispute resolution at united states universities" (Order No. 3613218). Available from ProQuest Dissertations & Theses Global. (1511455396). Retrieved from https://www.proquest.com/dissertations-theses/best-technology-practices-conflict-resolution/docview. Last visited 11/15/2025.
[3] Salar A. (2023). "E-Mediation and E-Arbitration: Harnessing Technology for Efficient Dispute Resolution". Internet Lawyer Blog. Pg 1. Available at E-Mediation and E-Arbitration: Harnessing Technology for Efficient Dispute Resolution — Internet Lawyer Blog — June 19, 2023. Last visited 11/15/2025.

Citation: MBAH-NJEI ACHA Patience (2026). Examining the Legal Interface of Block Chain Technology, Smart Contracts and Online Arbitration. *Sch Int J Law Crime Justice,* 9(2): 66-82.

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without the consensus of the network, providing transparency and security.[4] This technology eliminates human error because they are decentralised and secured through mathematical algorithms. Hence, there's minimal risk that the e-award will be set aside for fraud, material mistake or imperfect form. [5] This article discusses the significance of online arbitration to disputes resulting from smart contracts by delving into the criteria of smart contracts and the role of blockchain technologies.

2. Smart Contract Dispute Resolution

Smart contract dispute resolution is the term used to describe alternative dispute resolution (ADR) measures for transactions that use smart contracts. This concept seeks to resolve disputes involving blockchain activities across borders using blockchain technology and smart contracts. [6] This is performed once you purchase goods or services using a decentralized application (dApp). You'd find the dispute transaction button on the dApp, and a smart contract would execute dispute resolution actions. The blockchain network would select a group of mediators, arbiters, or judges based on their expertise. They would pass their votes for judgment, and a smart contract would execute whatever action the group voted for. [7]

2.1. Definition of Smart Contracts

According to Clack, Bakshi and Braine, a smart contract is an automatable and enforceable agreement, automatable by computer, though some parts may require human input and control, and enforceable either by legal enforcement of rights and obligations or via tamper-proof execution of computer code.[8] When the smart contract is executed, the software protocol creates an immutable (unchangeable) record of the transaction, linking it to the block of prior transactions in that blockchain. The cryptographic links between each block

make it virtually impossible to go back and edit or delete prior transaction data. [9]

A drinks vending machine is a straightforward, early example embodying the characteristics of a Smart Contract. When money is paid, an irrevocable action is put in motion. Money is retained, and a drink is vended. The transaction cannot be stopped in the middle of the process. The terms are, in a sense, embedded in the hardware and software that run the machine. [10] However, this process is not flawless. For instance, what if one changed his mind after inserting the dollar and wants to get chocolate instead of a soft drink, or what if one changed his mind and did not want anything anymore? An even more intriguing question: what if the vending machine fails to perform its obligation to dispense the candy bar? These are the sort of upheavals we could equally witness among smart contracts. [11] In general terms, the term smart contract is used to describe the automation of legal contracts, portraying a legal contract that could be expressed and implemented in software in whole or in part.[12] It is a collection of code (its functions) and data (its state) that resides at a specific public address on a distributed ledger technology, typically written in a programming language such as Solidity or JavaScript.[13] All in all, the basic idea behind smart contracts is to map a contract as program code. The programme code runs for the duration of the contract and automatically performs actions, in particular payment transactions, when certain conditions arise. [14]

2.2. Types of Smart Contracts

The word "smart contract" was first introduced as a concept by Computer scientist and cryptographer

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[4] Editorial (2024) "Integrating Arbitration and Blockchain Technology for Modern Dispute Resolution" Laws Learnt website. pg.3. Available at Integrating Arbitration and Blockchain Technology for Modern Dispute Resolution - Laws Learned. Last visited 29/06/25

[5] Purdue Global Law School (2023). "A Look at the Use of Blockchain Technology in the Arbitration Process". Purdue Global website. pg.3. Available at https://www.purduegloballawschool.edu/blog/news/blockchain-arbitration. Last visited 29/06/25

[6] Rakesh S. (2024) "Smart Contract Dispute Resolution: What It Is and How It Works". Investopedia. Pg. 1. Available at Smart Contract Dispute Resolution: What It Is and How It Works. Last visited 11/15/2025.

[7] ibid

[8] Clack B. et al., (2016) "Smart Contract Templates: foundations, design landscape and research directions". Cornell University. Pg 1. Available at<https://arxiv.org/abs/1608.00771>. Last visited 11/15/2025.

[9] HS Blog. (2023). "Are Smart Contracts Legal Contracts?". HS blog. Pg 4. Available at Are Smart Contracts Legal Contracts? - Harris Sliwoski LLP. Last visited 18/11/2025.

[10] Norton Rose Fulbright (2017). "Arbitrating Smart Contract disputes". Norton Rose Fulbright. Pg 1. Available at Arbitrating Smart Contract disputes | Global law firm | Norton Rose Fulbright. Last visited 16/11/2025.

[11] Shehata, I. M. N. (2018) "Smart Contracts & International Arbitration," Kluwer Arbitration Blog. Pg 6. Available at https://www.academia.edu/38626542/Smart_Contracts_and_International_Arbitration?source=swp_share. Last visited 16/11/2025.

[12] Chakraborty R et al., (2023), Op. cit, pg 51

[13] BDO (2019) "Understanding Smart contracts". BDO. Available at *Crypto-Part-3-smart-contracts-External-version.pdf. Last visited 16/01/2026

[14] Klaus E. and Robert G., (2018) 'Smart Contracts' Neue Zeitschrift für Baurecht und Vergaberecht 3.

Nick Szabo during the mid-1990s.[15] He proposed turning contract clauses into code and embedding them in software or hardware to make the contracts self-executing, reducing contracting costs among parties, and avoiding unintentional discrepancies during the execution of the contract.[16] This contract is a computerised code that executes on the blockchain and holds a set of protocols. Its purpose is to automate the contracting process and enable monitoring and enforcement of contractual promises with minimal human intervention. [17]

Smart contracts today also find their origin in Ricardian Contracts, a concept published in 1996 by Ian Grigg and Gary Howland as part of their work on the Ricardo payment system to transfer assets. [18] The terms of a smart contract are encrypted using cryptography; hence, no one can change the contents of a contract. The immutability offered by blockchain makes sure that a copy of the contract is stored on every node associated with the network, ensuring a backup version of the contract.[19] The parties involved must be convinced on contractual specifics, violation of contract conditions, accountability for contract breach, and external verification data sources, and then put it on the blockchain as a smart contract to automate contract execution on behalf of the signatories.[20] There are various types of smart contracts. An example of a smart contract is the issuance of new crypto assets through an Initial Coin Offering (ICO). When the conditions defined in the smart contract are met (for example, validation of the payment of certain cryptocurrencies, etc.), the smart contract executes the pre-defined actions including issuance of new crypto assets as specified in the ICO. [21]

2.2.1. Off-Chain Contracts

These are smart contracts whose code is executed by the client rather than the miners, requesters, endorsers, or harvesters.[22] Many smart contracts proposed use-cases assume that the smart contract will receive information or parameters from resources that are not on the blockchain itself so-called off-chain resources.[23] One should be cognizant of the fact that miners verify that an oracle's input is allowed technically, that sufficient funds are available and that any resulting transactions are legitimate, but they do not confirm the validity of the data feed or if it matches the values of the source data outside of the DLT.[24] It is equally worth mentioning that oracles are trusted third parties that retrieve off-chain information and then push that information to the blockchain at predetermined times.[25] They are external independent services; parties that engage in smart contracts can specify to carry out the data input (for example, an event or condition) for activating the smart contract algorithm and executing the transaction.[26] Simply put, they are the interface between the real world and the smart contract, which is called an oracle.[27] Nevertheless, off-chain dispute resolution methods involve traditional legal mechanisms adapted to the unique challenges of smart contracts. These mechanisms offer a more familiar and established framework for resolving smart contract disputes. [28] On the other hand, 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. [29]

2.2.2. Smart Legal Contracts

Smart legal contracts are legal contracts, parts or the entirety of which are intended to operate on a digital platform. It may contain natural language clauses, as in a traditional contract and 'smart clauses', which are codified, machine-readable expressions of contractual obligations, that enable them to be automated. [30] There

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[15] Julen P. and Stella M. (2022) "Decrypting Crypto: Smart Contracts". Georgetown University. Available at Smart Contracts. Last visited 15/01/2026

[16] Kaur, R. et al., (2022). Smart Contracts: The Self-Executing Contracts. 10.1201/9781003203957-4. Available at https://www.researchgate.net/publication/362589769_Smart_Contracts_The_Self-Executing_Contracts. Last visited 15/01/2026

[17] BDO (2019) Op. cit. pg 2.

[18] Skadden A. et al., (2025) « An Introduction to Smart Contracts and Their Potential and Inherent Limitations". Skadden, Arps, Slate, Meagher & Flom LLP and Affiliates. Available at An Introduction to Smart Contracts and Their Potential and Inherent Limitations. Last visited 15/01/2026

[19] Chakraborty R. et al., (2023), Op. cit, pg. 51

[20] ibid pg. 55

[21] BDO (2019) Op. cit. pg 2.

[22] Chakraborty R. et al., (2023), Op. cit, pg. 51

[23] Skadden A. et al.,(2025) Op. cit. pg. 7

[24] BDO (2019) Op. cit. pg. 4.

[25] Skadden, Alps et al., (2025) Op. cit. pg. 7

[26] BDO (2019) Op. cit. pg. 3.

[27] Markus K. and Jörg H., (2016) 'Smart Contracts - Anwendung der Blockchain Technologie' Computer und Recht 619.

[28] Adhip R. (2025) Op. cit. pg. 5

[29] Max R.,(2020), Smart Contract Dispute Resolution: The Inescapable Flaws of Blockchain, 168 U. Pa. L. Rev.1343, available at https://scholarship.law.upenn.edu/cgi/viewcontent.cgi?article=9702&context=penn_law_review. Last visited Last visited 19/1/2026

[30] Herbert S. F. (2024) "Smart legal contracts". Herbert Smith Freehills. Pg 1. Available at https://share.google/48F0LsaxOnoWFS8DR . Last visited 17/1/2026

are legal guarantees for smart contracts. They follow the format seen in contracts: "If this occurs, then this will occur."[31] Smart clauses are written in computer code to execute or implement specified rights and obligations automatically, as agreed between parties. These clauses 'talk' to external data sources - which can range from industrial sensors to interest rates - detecting events that update contractual conditions, notify parties, or trigger execution. [32] Legal smart contracts provide more openness between contracting entities than traditional documents because they are stored on blockchain and cannot be altered.

To create some smart legal contracts, the parties involved work on the smart contract code or their software developers do until they settle on the terms and conditions of the agreement. [33] Parties can agree on a method to automate a contractual obligation, which is then incorporated into the contract as machine-readable code, making the contract a smart legal contract (SLC). [34] Contracts are executed by the parties using digital signatures. If certain conditions are met, such as paying a debt when a predetermined date is reached, smart legal contracts may operate on their own. If stakeholders don't comply, there may be serious legal ramifications. [35] A key feature of SLCs is a blockchain-based ecosystem for digitising and linking specific contract and policy-driven business processes. [36] Smart legal contracts transform commercial relationships by offering more transparent ways to manage contractual relationships. However, their legal integration requires careful consideration to ensure the protection of the parties' rights and guarantee legal certainty. [37]

2.2.3. Decentralized Autonomous Organizations (DAOs):

A DAO is a blockchain-based system that enables people to coordinate and govern themselves mediated by a set of self-executing rules deployed on a public blockchain, and whose governance is decentralised (that is, independent from central control).[38] Dispute resolving platforms are composed of decentralized autonomous organizations(DAOs) or consensus protocols, so there is no single party that can independently affect the decision.[39] The first reference to Decentralized Autonomous Organization (DAO) only emerged in the 1990s to describe multi-agent systems in an internet-of-things (IoT) environment or nonviolent decentralised action in the counter-globalisation social movement. However, the modern meaning of DAOs can be traced back to the earlier concept of a Decentralized Autonomous Corporation (DAC), coined a few years after the appearance of Bitcoin. [40]

DAOs are democratic organisations with voting powers granted by a smart contract. Most definitions of DOA tend to focus more on their distinctive characteristics. First, they enable people to coordinate and govern themselves online. [41] A decentralised autonomous organisation, or DAO, is a blockchain-based entity with a shared goal under collective governance. There is no such thing as an executive or president. Instead, the organization's operations and the distribution of assets are governed by blockchain-based principles that are incorporated into the contract's code. One example of this kind of smart contract is VitaDAO, which uses technology to power a community dedicated to scientific inquiry. [42]

And like all smart contracts, DAOs are open source. They're visible to all members and non-members of the DAO; bugs can be fixed, and suggestions can be pitched to the DAO by anyone. [43] Afterall, the term "organization" is generally understood to refer to an entity comprising multiple people acting towards a common goal, rather than a legally registered organisation. [44] Decentralized justice is a paradigm shift in dispute resolution that drifts away from typically hierarchical legal systems towards distributed, technology-driven systems that embrace blockchain, smart contracts, and networks of communities. [45] A DAO source code is deployed in a blockchain with smart contract capabilities, like Ethereum arguably always a public blockchain.[46] However, DAO's smart contract

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'31 Hedera (2025) "Types of Smart Contracts". Hedera. Available at Types of smart contracts | Hedera. Last visited 15/01/2026

32 Herbert S. F. (2024). Op. cit. pg 2.

33 Hedera (2025) Op. cit, pg 3.

34 Herbert S. F. (2024). Op. cit. pg 2.

35 Hedera (2025) Op. cit, pg 3

36 Herbert S. F. (2024). Op. cit. pg 4.

37 Noneva-Z. Y. (2024). Smart Legal Contracts and Their Implications in Digital Era. 669-676. 10.31410/ERAZ.2024.669.

38 Hassan, S. et al., (2021). Decentralized Autonomous Organization. Internet Policy Review. 10. 10.14763/2021.2.1556.

39 Ahlawat, M. & Chopra, G. (2025). Pg. 4.

40 Hassan, S. et al., (2021). Op ci pg 11

41 Singh, M., & Kim, S. (2019). Blockchain technology for decentralized autonomous organizations. In Advances in Computers (Vol. 115, pp. 115–140). Elsevier.https://doi.org/10.1016/bs.adcom.2019.0 6.001

42 Beutel, T. et al., (2025). Digital Democracy in Decentralised Autonomous Organisations. 10.1007/978-3-032-03273-7_3.

43 Hedera (2025) Op. cit, pg 3.

44 El Faqir, Y., et al., (2020). An overview of decentralized autonomous organizations on the blockchain. Proceedings of the 16th International Symposium on Open Collaboration, 1–8. https://doi.org/10.1145/3412569.3412579. Last visited 18/1/2026

45 Ahlawat, M. & Chopra G. (2025). Pg. 3

46 Sieh, Y. et al., (2018). Bitcoin and the rise of decentralized autonomous organizations. Journal of

code specifies the rulesfor interaction among people although it is unclear to what extent there may be other governance mechanisms that can affect or overrule such code.[47] In contrast to traditional courts or arbitration organisations, decentralised justice systems share the power and decision-making with a network, frequently relying on decentralised autonomous organisations (DAOs), cryptoeconomic incentive mechanisms, or crowdsourced juror pools to resolve conflicts.[48] In modern liberal democracies, and increasingly in a digital democracy setting, they can provide for useful solutions in more complex settings.[49] All in all, the term "DAO" can serve as a mantra for change in governance. Being aware of such perspectives on DAOs is arguably important to fully grasp the reality of DAOs as they are complex, socio-technical, algorithmic systems. [50]

2.2.4. Application Logic Contracts:

Application-based code that usually keeps up with multiple other blockchain contracts makes up application logic contracts, or ALCs. It permits device-to-device interactions such as blockchain integration and the Internet of Things. These are signed between computers and other contracts rather than between people or organisations like other kinds of smart contracts. [51] The application is distributed over different nodes. The client front-end connects to one of the nodes and send all the database requests to it. [52] ALCs are integral to decentralized applications (DApps) and enable complex logic and workflows within these applications. Unlike Smart Legal Contracts, which enforce legal terms, or DAOs, which govern organizations, ALCs manage interactions between different smart contracts and external systems. [53] The concept of this logic-based smart contracts may also be called declarative smart contracts, because while imperative languages, especially procedural languages, are mostly used to code smart contracts in current blockchain platforms, declarative languages, in

particular logic-based rule languages, are better considered to better represent and reason upon ALCs.[54] In a broader blockchain ecosystem, ALCs connect DApps to external data sources through oracles, bridging the gap between on-chain and off-chain data. This functionality allows applications to access real-world data and trigger blockchain-based actions in response, expanding the potential of what smart contracts can achieve. [55]

Products around us are getting smarter. From our phones to our air purifiers and cars, technology is coordinating and communicating across a growing Internet of Things (IoT) to make our user experience smoother. Application logic contracts are smart contracts catered specifically to this communication between different devices. [56] The use of these types of smart contracts can also be illustrated more clearly in the case of license management. The applicant or owner can generate a license for its product and transfer it to the client with an associated contract. Depending on the license, the client can be a reseller and transfer it to an end-user or just use it for himself/herself. The reselling process is controlled indirectly by the owner of the application by generating the smart contract along with the license. [57] Consequently, these are the smart contracts that make our devices smarter. They are the brains behind the seamless interaction between programs and the blockchain. Essentially, Application Logic Contracts act as the bridge between the blockchain and other software or hardware systems. [58] Ultimately, unlike smart contracts, ALCs are not agreements between humans or organizations but between machines and other contracts. [59]

2.3. Blockchain and Smart Contracts

Blockchain technology has the potential to significantly impact international trade and finance. By enabling secure, transparent and tamper-proof

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Organization Design, 7(1), 1–16. https://doi.org/10.1186/s41469-018-0038-1 Last visited 18/1/2026.

[47] De Filippi, P., & Hassan, S. (2016). Blockchain technology as a regulatory technology: From code is law to law is code. First Monday, 21(12). https://doi.org/10.5210/fm.v21i12.7113. Last visited 18/1/2026.

[48] Ahlawat, M. & Chopra G. (2025). Pg. 4.

[49] Beutel T. et al., (2025). Op. cit. pg. 46.

[50] ibid pg. 45.

[51] Hedera (2025) Op. cit, pg 4

[52] Stancu, A. & Dragan M. (2020). Logic-Based Smart Contracts. 10.1007/978-3-030-45688-7_40. Last visited 18/1/2026.

[53] Jason-F. B. (2024). "From Theory to Practice: Types of Smart Contracts and Applications". Futuric Block. Pg. 3. Available https://futuricblock.com/from-theory-to-practice-types-of-smart-contracts-and-applications/. Last visited 18/1/2026

[54] Florian I. G. et al., "Evaluation of Logic-Based Smart Contracts for Blockchain Systems". European University Institute, Fiesole, Italy. Available https://research.csiro.au/data61/wp-content/uploads/sites/85/2016/08/ruleml16.pdf. Last visited 18/1/2026

[55] Jason-F. B. (2024). Op. cit. pg 3.

[56] Hedera (2025) Op. cit, pg 4

[57] Stancu, A. & Dragan M. (2020). Op. cit. pg 7

[58] Coin Payment Media (2024). "The Different Types of Smart Contracts and Real-World Applications". Coin payment media. Available at https://media.coinpayments.net/consumer-education/types-of-smart-contracts/ . Last visited 15/11/2025

[59] Webmobinfo (2024). "A Technical Analysis of Smart Contracts in Blockchain". Webmobinfo. Pg 5. Available at https://www.webmobinfo.ch/blog/smart-contracts-platforms-in-blockchain. Last visited 18/1/2026

transactions, blockchain can improve trust and efficiency in global trade. [60] One particularly important application of blockchains concerns smart contracts, complex transactions executing payments that depend on programs deployed to the blockchain. [61] A blockchain is a digital record that stores transactions publicly after nodes have verified them. The nodes validate each transaction, and the cryptography hash function secures the transactions. [62] Accordingly, transactions are executed on each node participating in the network as part of their verification of new blocks. [63] Smart contracts on a blockchain network can automate many aspects of trade finance, such as verifying documents and tracking shipments, reducing processing time and costs. [64] A smart contract is a self-executing program that automates the actions required in a blockchain transaction. Once done, these transactions are traceable and cannot be undone. [65] By its nature, a smart contract deployed on a DLT such as a blockchain is unchangeable, irreversible, precise, public and autonomous. Transactions and smart contract details are visible to everyone who has permission to access the DLT. As we earlier mentioned, smart contract dispute resolution is the term used to describe alternative dispute resolution (ADR) measures for transactions that use smart contracts. [66] This is very consequential in the functionality of smart contracts implemented through blockchains.

The combination of blockchain technology and smart contracts allows for a great deal of flexibility to develop, design, and implement real-world solutions to real-world problems at a lower cost and less time than traditional third-party systems.[67] Blockchains can enable new forms of financing, such as peer-to-peer lending and crowdfunding, which can benefit smaller businesses that may struggle to obtain traditional

financing.[68] A smart contract lives on the blockchain and ensures that the required conditions are fulfilled to meet the user's needs. Anyone connected to the network can see the written code, which is publicly visible in the blockchain. The contract is triggered to execute the digital transaction once the requirements are met by the specified deadline. [69] Blockchain-based crowdsourced arbitration platforms ("BCAPs") have emerged in recent years. Many platforms use some form of crowdsourced decision-making by putting disputes to a public vote. One platform is Rhubarb Fund ('Rhubarb'), which presents itself as a kind of hybrid dispute resolution and investment vehicle. It uses a rapid distributed consensus mechanism (RDCMs) approach where holders of a RHUcoin submit votes as jurors, and the disputing parties can agree to the jury's decision. [70] Today's Smart Contracts are implemented in platforms that rely on what is referred to as distributed ledger technology (DLT) or often blockchain. DLT and blockchain enable parties (for example, counterparties, banks, regulators and/or auditors) to come to a consensus over a shared set of facts. Some DLT platforms can also run programmes on each of the network nodes that use or add to the data on the ledger. Smart Contracts are implemented using these programmes. [71]

The use of blockchain can also reduce the risk of fraud and errors in international trade, which can result in substantial savings for businesses. As blockchain technology continues to mature and gain widespread adoption, it has the potential to revolutionize the way international trade and finance are conducted, providing greater security, transparency, and efficiency.[72] Cybersecurity and technical errors are at the core of most smart contract disputes.[73] These can be manifested in the form of system failures, or events internal to the code, such as errors, bugs or ambiguities within the code

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[60] Muhammad A. (2023). "Impact of technological advancements on International Trade and Finance". Modern Diplomacy. Available at https://moderndiplomacy.eu/wp-content/uploads/2023/10/mdlogo.png . Last visited 15/11/2025

[61] Frassetto, J. et al., (2023), Op. cit. pg 1

[62] Chakraborty R. et al., (2023) "Blockchain: Principles and Applications in IoT". Taylor & Francis Group. SBN: 978-1-003-20395-7 (ebk) DOI: 10.1201/9781003203957. Available at http://taylorandfrancis.com. Last visited 15/1/2026

[63] BDO (2019) Op. cit. pg 3.

[64] Binance Academy (2025). "What Are Smart Contracts and How Do They Work?". BinanceAcademy. Pg 1. Available at What Are Smart Contracts and How Do They Work?. Last visited 15/11/2025.

[65] Investopedia Team (2025) "Smart Contracts on Blockchain: Definition, Functionality, and Applications". Investopedia. Pg 1. Available at Smart Contracts on Blockchain: Definition, Functionality, and Applications. Last visited 11/15/2025.

[66] Rakesh S. (2024). "Smart Contract Dispute Resolution: What It Is and How It Works". Investopedia. Pg 1. Available at Smart Contract Dispute Resolution: What It Is and How It Works. Last visited 11/15/2025.

[67] Singha, A. et al., "Blockchain Smart Contracts Formalization: Approaches and Challenges to Address Vulnerabilities." Computers & Security 88 (2020): 101654.

[68] Hyscaler (2024). "Revolutionary Impact: Blockchain in Finance's Bright Future by 2030". Hyscaler, pg. 2. Available at Revolutionary Impact: Blockchain in Finance's Bright Future by 2030. Last visited 15/11/2025.

[69] Chakraborty R. et al., (2023), Op. cit, pg 51

[70] James M. (2019) Op. cit. pg. 92.

[71] Norton R. F. (2017). Pg 2.

[72] Muhammad A. (2023). Op. cit. pg 5.

[73] McCarthy S. (2025). "Smart Contracts and Arbitration: A Q&A with Sean McCarthy". Arb Tech Blog. Pg 1. Available at Smart Contracts and Arbitration: Expert Q&A with Sean McCarthy — ArbTech | Online Tech & Law Community. Last visited 16/11/2025.

causing it to operate in an unexpected or unintended way.[74] As smart contract transactions grow in number and complexity, disputes emerge coding flaws, unreliable oracles, cyberattacks, or disagreements over whether parties met their obligations in spirit and form.[75] An oracle may also be another smart contract that inputs data to the primary smart contract. It may feed the smart contract with various input types and formats, from different sources such as weather temperature, successful payment, price fluctuations or flights delays. In certain circumstances, oracles may be part of multi-signature contracts where two parties sign a contract for the future release of funds or for the registration of assets only if certain conditions are met. [76]

2.3.1. Programming Languages and Platforms

A smart contract is a group of procedural rules and logic for scenario-response scenarios. Specifically, they are blockchain-based decentralized, trusted shared codes. [77] Various smart contract platforms exist today, such as Ethereum, Cardano, and EOS. These platforms support different programming languages like Solidity, Vyper, and C++, each with its own strengths and weaknesses. Choosing the right platform and programming language depends on factors such as security, ease of use, and the specific requirements of the smart contract.[78] The workflow generally required to settle a dispute is, first of all, the dispute initiation generated when smart contract terms are unfulfilled.[79] Secondly, evidence is made accessible, and its submission is carried out as blockchains store all evidence minimizing tampering or concealment.[80] Thereafter, we move to the process of Juror/arbitrator

selection, which is a prominent characteristic of blockchain dispute resolution.[81] Eventually, evaluation and decision making are carried out through majority participation, honest voting by jurors who are encouraged to participate through rewards such as tokens.[82] Furthermore, decisions are recorded and saved permanently in the blockchain which serves as an authoritative and transparent reference point where enforcement that needs to be done is manual.[83] Finally, the possibility of appeal may usher in fresh phase of adjudication, where the participation of additional jurors and the stakes are usually higher which is meant to bring about fairness and also correction of any possible mistake.[84] Business in particular should consider these carious criteria before selecting a smart contract platform; scalability, security, adoption and ecosystem, cost and efficiency, and interoperability.[85] Nevertheless, different blockchain systems can be utilized to create smart contracts. Two popular systems are Ethereum and Hyperledger Fabric.

2.3.1.1. Ethereum

Ethereum is the most notable example of a blockchain that supports smart contracts leveraged for countless applications including games, auctions and financial products. It is the first and most popular blockchain platform that supported complex smart contracts. [[]] Ethereum is a blockchain-based network that allows developers to build and deploy dApps and smart contracts without third-party interference. It extends the blockchain's capabilities beyond digital currency, enabling programmable agreements and applications across various industries. [86] It remains

[74] Kate A. (2020). Op. cit. Pg. 5

[75] Begaim K. (2025). "Smart Contracts, Kleros, and New Arbitration Platforms: What Already Works and Where Practice is Heading". Arbitration blog. Pg. 1. Available at Smart Contracts, Kleros, and New Arbitration Platforms: What Already Works and Where Practice is Heading. Last visited 16/11/2025.

[76] BDO (2019), Op. cit, pg. 3.

[77] Kaur, R. (2021) "Blockchain Model for Securing IoT Based Data Transmission," International Journal of Grid and Distributed Computing 14 (1): 1045–1055.

[78] Adhip R. (2025) "Dispute Resolution for Smart Contracts: Challenges and Opportunities". WinSavvy pg. 1. Available at Dispute Resolution for Smart Contracts: Challenges and Opportunities. Last visited 16/1/2026

[79] Token Minds Team, "Dispute Resolution on the Blockchain: Benefits & Implementation Guide," TokenMinds Blog https://tokenminds.co/blog/blockchain-development/blockchain-dispute-resolution Last visited 17/1/2026

[80] Meegle "Blockchain Dispute Resolution: An In-Depth Guide," https://www.meegle.com/en_us/topics/web3/blockchain-dispute-resolution Last visited 17/1/2026

[81] Maahi A. (2024) "From Social Contracts to Smart Contracts: Navigating Decentralization, Blockchain, and Kleros Arbitration," The Contemporary Law Forum. Available at https://tclf.in/2024/03/18/from-social-contracts-to-smart-contracts-navigating-decentralization-blockchain-and-kleros-arbitration/ Last visited 17/1/2026

[82] Mohit A. & Gunjan C. (2025). Smart Contracts and Decentralized Justice: Dispute Resolution on the Blockchain. The Indian Journal for Research in Law and Management, Volume II (Issue 8). Retrieved from https://ijrlm.com/journal/smart-contracts-and-decentralized-justice-dispute-resolution-on-the-blockchain/. last visited 17/1/2026

[83] Supra note 57.

[84] Mohit A. & Gunjan C. (2025). Op. cit pg. 9.

[85] Calibrant (2025). "The 7 Most Powerful Smart Contract Platforms to Build and Scale in 2025". Calibrant pg. 4. Available at https://www.calibraint.com/blog/top-smart-contract-platforms-list-2025#:~:text=Key%20Criteria%20for%20Choosing%20a,Conclusion. Last visited 18/1/2026

[86] Liam W. (2024) "What Is Ethereum and How Does It Work?". Forbes. Pg. 1. Available at

one of the most widely adopted. [87] The Ethereum platform allows applications to run precisely as they are programmed, with no downtime, censorship, theft, or interference of a third party. Ethereum applications are powered by Ether, Ethereum's platform-specific cryptographic token. Ether can be utilized as a digital currency and reward the participant nodes for their tasks. [88] Ethereum was first proposed in 2013 by Vitalik Buterin, aiming to expand blockchain's potential beyond financial transactions. Alongside co-founders Gavin Wood, Charles Hoskinson, Anthony Di Iorio and Joseph Lubin, Ethereum launched in 2015 after a successful crowdfunding an initial coin offering campaign (ICO).[89]

One startup, Kleros, an ODR provider, [90] has created a dApp built on the Ethereum platform. Their platform is an ADR application that randomly chooses vetted jurors. They are selected based on the cryptocurrency they have staked and their qualifications in the dispute field. In this case, staking is the act of offering cryptocurrency as collateral for the opportunity to be chosen as a juror.[91] Within this platform, transactions are executed as long as enough funds or fuel exists (such fuel is called 'gas' on the Ethereum Blockchain), unless its owner or another party as defined in the contract terminates the smart contract by activating the self-destruct function (in order to terminate a smart contract, proper code must be embedded in the smart contract).[92]

The platform itself functions by utilizing a distributed ledger to record transactions and state changes in smart contracts. Developers write smart contracts using languages like Solidity, which are compiled to run on the EVM. Transactions and computations are validated by network participants (nodes) and secured through consensus mechanisms. Ether serves as the medium for compensating validators

and facilitating network operations. [93] Ethereum owners use wallets to store their ether keys. A wallet is a digital interface that lets you access your cryptocurrency. Your wallet has an address, which can be thought of as an email address in that it is where users send ether, much like they would an email. [94] While Kleros allows for decision appeal processes, other emerging ODR platforms will have different rules and fees. [95] On this platform, jurors are randomly picked and chosen out of a pool of individuals who have staked platform-specific tokens. [96] Kleros is an example of an on-chain resolution platform like Aragon Court. On-chain dispute resolution tokens. They are built directly into the blockchain infrastructure, allowing disputes to be resolved within the same ecosystem as the smart contract. [97] The selection process is designed to be ransom and anonymous, preventing collusion and ensuring impartiality. A stake is a measure of deterrence because a juror voting against the majority can lose his stake due to the process of staking. [98] The way Ethereum operates is through the storage of information in blocks. Each block contains encoded data from the block before it and new information creating an encoded chain of information that cannot be changed. Then, throughout the blockchain network, an identical copy of the blockchain is distributed. [99] Decentralized Arbitration Platforms such as Kleros, Jur and Aragon Court offer well-defined dispute resolution systems. They capitalize on the transparency and immutability of blockchain and provide impartial arbitration, frequently using the community and utilizing crypto-economic incentives. [100] 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,

https://www.forbes.com/sites/digital-assets/article/what-is-ethereum-how-does-it-work/. Last visited 18/1/2026

[87] Calibrant (2025). Op. cit. pg. 5.

[88] Yamashita, K., Y. et al., (2019) "Potential Risks of Hyper Ledger Fabric Smart Contracts," In Proceedings of the IEEE International Workshop on Blockchain Oriented Software Engineering (IWBOSE' 19), 2019, pp. 1–10.

[89] Liam W. (2024) Op. cit. pg. 2.

[90] Amy J. S. (n.d.) "Making Smart Contracts "Smarter" with Arbitration". Pg. 5. Available at https://go.adr.org/rs/294-SFS-516/images/Making%20Smart%20Contracts%20Smarter%20with%20Arbitration%20by%20Amy%20Schmitz.pdf. last visited 19/01/2026

[91] Rakesh S. (2024) Op. cit. pg. 3.

[92] BDO (2019) Op. cit. pg 3.

[93] Liam W. (2024) Op. cit. pg. 2.

[94] The innvestopedia team (2025) "Ethereum explained: Blockchain, Smart Contacts and the furture".

Investopedia. Pg. 3. Available at https://www.investopedia.com/terms/e/ethereum.asp. Last visited 19/1/2026.

[95] Ibid.

[96] Maahi Agarwal, (2024) "From Social Contracts to Smart Contracts: Navigating Decentralization, Blockchain, and Kleros Arbitration," The Contemporary Law Forum https://tclf.in/2024/03/18/from-social-contracts-to-smart-contracts-navigating-decentralization-blockchain-and-kleros-arbitration/. last visited 16/1/2026

[97] Adhip R. (2025) Op. cit pg.4.

[98] Maahi A. (2024) Op. cit. pg. 3.

[99] The Investopedia team (2025) Op. cit. pg. 2.

[100] "When Online Dispute Resolution Meets Blockchain: The Birth of Decentralized Justice," Stanford Journal of Blockchain Law & Policy https://stanford-jblp.pubpub.org/pub/birth-of-decentralized-justice/release/1. Last visited 17/1/2026

etc., as prerequisites to admitting such issues within the conflict settlement clause of a smart contract. [101] Other blockchains like Fabric, Corda, and EOS support smart contracts due to their success on Ethereum. [102]

2.3.1.2. Hyperledger Fabric

Hyperledger Fabric is an open, enterprise-grade, distributed ledger platform. It has advanced privacy controls, so you share only the data you want among the permissioned, or known, network participants.[103] Fabric is a modular and extensible open-source system for deploying and operating permissioned blockchains and one of the Hyperledger projects hosted by the Linux Foundation.[104] The platform uses container technology to store smart contracts known as "chain code," which make up the system's application logic. The key to implementing smart contracts for this platform is to use the "chain code" interface. Its smart contracts are written in Go and Java languages. [105] Fabric is also the first blockchain system that runs distributed applications written in standard, general-purpose programming languages, without systemic dependency on a native cryptocurrency. This stands in sharp contrast to existing blockchain platforms that require "smart contracts" to be written in domain-specific languages or rely on a cryptocurrency. [106] Smart contracts document the business processes you want to automate with self-executing terms between the parties written into lines of code. The code and the agreements contained therein exist across the distributed, decentralized blockchain network. Transactions are trackable and irreversible, creating trust between organizations and enabling businesses to make more informed decisions more quickly, saving time and reducing costs and risks. [107] Fabric is used in more than 400 prototypes, proofs-of-concept, and production distributed-ledger systems across different industries and use cases. These use cases include but are not limited to areas such as dispute resolution, contract management, identity management, and settlement through digital currency. [108]

Hyperledger Fabric is an enterprise-level permissioned blockchain network. It is made up of various unique organizations or members that interact with each other to serve a specific purpose. It uses a consensus algorithm to achieve agreement among the participants in a network on the contents of the shared ledger.[109] This unique approach to concensus facilllitate scalable performance while maintaining privacy.[110] The consensus algorithm in Hyperledger Fabric is pluggable, which means that it can be replaced with a different algorithm as needed.[111] This pluggable design supports the implementations of different components, and accommodates the complexity and intricacies that exist across the economic ecosystem.[112] Conclusively, Hyperledger Fabric is a platform for distributed ledger solutions, underpinned by a modular architecture delivering high degrees of confidentiality, resiliency, flexibility and scalability. It delivers a uniquely elastic and extensible architecture, distinguishing it from alternative blockchain solutions. [113]

3. Abbreviations and Acronyms

These abbreviations and acronyms are demonstrative of the major concepts that are revisited constantly within this paper. They include abbreviations like OArb, ODR, ADR, and SCA. They shall be analysed in the subsequent paragraphs.

3.1. OArb

OArb or Online arbitration, also known as e-arbitration, virtual hearings or electronic arbitration, can

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[101] Ansh A. Himanshu K. "The Symphony of Smart Contracts & Blockchain Arbitration: Automating Justice in Decentralized Systems" Indian Journal of Integrated Research in Law Volume V Issue III | ISSN: 2583-0538. Available at https://ijirl.com/wp-content/uploads/2025/05/the-symphony-of-smart-contracts-blockchain-arbitration-automating-justice-in-decentralized-systems.pdf Last visited 19/1/2026.

[102] Chakraborty R. et al., (2023), Op. cit, pg 56

[103] IBM (2026) "What is Hyperledger Fabric?". IBM. Pg. 1. Available at https://www.ibm.com/think/topics/hyperledger. Last visited 19/1/2026.

[104] Elli A. et al., (2018). Hyperledger Fabric: A Distributed Operating System for Permissioned Blockchains. In EuroSys '18: Thirteenth EuroSys Conference 2018, April 23–26, 2018, Porto, Portugal. ACM, New York, NY, USA, 15 pages. Available at https://doi.org/10.1145/3190508.3190538. Last visited 19/1/2026.

[105] Kalra, S. et al., (2018) "Zeus: Analyzing Safety of Smart Contracts," In Proceedings of the Network and Distributed Systems Security Symposium (NDSS '18), 2018, pp. 1–15.

[106] Elli A.et al., (2018). Op. cit. pg 1.

[107] IBM (2026). Op ci. Pg 3.

[108] Elli A. et al., (2018). Op. cit. pg 2.

[109] Geeksforgeeks (2025). Op. cit. pg.1.

[110] Hyperledger Fabric (2026) "Hyperledger Fabric". Hyperledger Fabric. Pg.1. Available at https://www.lfdecentralizedtrust.org/projects/fabric/. Last visited 19/1/2026.

[111] Geeksforgeeks (2025) "Hyperledger Fabric in Blockchain". Geeksforgeeks. Pg. 1. Available at https://www.geeksforgeeks.org/computer-networks/hyperledger-fabric-in-blockchain/. Last visited 19/1/2026.

[112] Hyperledger (2020) "hyperledger-fabricdocs Documentation". Readthedocs. Pg 2. Available at https://app.readthedocs.org/projects/hyperledger-fabric/downloads/pdf/release-1.1/ . Last visited 19/1/2026.

[113] Hyperledger (2020) Op. cit. pg. 2.

be defined as an arbitration in which all aspects of the proceedings are conducted online. Online arbitrations can have hearings through the use of video conferencing, but most online arbitrations simply require parties to upload their evidential documents, respond to questions from the arbitrator, and they will receive a decision from the arbitrator.[114] If arbitration is conducted online, the parties have to discuss through email about the choice of law, enter into an arbitration agreement digitally, and determine the geographical location. Online arbitration is, in effect, an electronic version of offline arbitration, including the components of traditional (offline) arbitration, beginning with an 'online arbitration agreement' and ending with an 'online arbitral award.'[115]

3.2. ODR

Online dispute resolution is a branch of dispute resolution which uses technology to facilitate the resolution of disputes between parties. Online dispute resolution primarily involves negotiation, mediation or arbitration or a combination of all three. [116] In other words, Online Dispute Resolution (ODR) is a dispute resolution process conducted with the assistance of communications and information technology, particularly the internet. It is a synergy between ICT and ADR. It also uses a range of communication methods, including email, instant messaging, online chat, threaded discussion, and video conferencing. [117] The emergence of online disputes required urgent attention, and as such, academics and non-profit organisations pressed for the use of ODR to resolve most of these disputes. They began experimenting with the efficacy of ODR in resolving online disputes. Being a contemporary issue in the ADR community, [118] ODR has attracted many authors. Most of these authors have further

described ODR using other names. Some of the names used are: [119] Internet Dispute Resolution (iDR), Electronic Dispute Resolution (eDR), Electronic ADR (eADR), Online ADR (oADR). The above names have been used interchangeably by various authors. However, ODR has emerged as the most used term in recent years.

3.3. ADR

Alternative dispute resolution is a compendium of services and strategies, including mediation service facilitating dispute resolution between parties that might otherwise lead to litigation. [120] Kaufmann-Kohler and Schultz argue that the alternative dispute resolution (ADR)process emerged in the United States in the 1970s due to deficiencies in litigation. [121] It is fair to state that ODR emanated from traditional Alternative Dispute Resolution (ADR). For this reason, many authors have seen ODR simply as using the internet to provide ADR. According to Arun, ODR involves the use of information technology to facilitate the application of traditional alternative dispute resolution mechanisms in cyberspace. [122] Thus, alternative dispute resolution (ADR) was developed to address the gaps in dispute resolution that litigation uncovered.

3.4. SCA

SCA refers to Smart contract arbitration. SCA platforms like Kleros and Jur have emerged within this context, offering innovative solutions for settling disputes arising from smart contracts and off-chain transactions. [123] Smart contracts are not always legal contracts; they are often mechanisms of execution attached to traditional text agreements. For arbitration, this duality means identifying applicable law, seat of arbitration, and competent tribunal, while ensuring arbitrators can examine on-chain logs and enforce

[114] Ihab A. (2019) "Online Arbitration in Theory and in Practice: A Comparative Study in Common Law and Civil Law Countries". Kluwer Arbitration Blog. Available at Online Arbitration in Theory and in Practice: A Comparative Study in Common Law and Civil Law Countries | Kluwer Arbitration Blog. Last visited 29/01/2026.

[115] Ibid

[116] Ruslijanto, P. A. (2018) "Transforming Landscapes: How ODR reshaping the prospect of dispute settlement in a connected world," Indonesian Journal of International Law: Vol. 16: No. 1, Article 4.DOI: 10.17304/ijil.vol16.1.744 Available at: https://scholarhub.ui.ac.id/ijil/vol16/iss1/4

[117] Rainey, S. S., & Tyler, M. C. (2007). "From eBay to eternity: Advances in online dispute resolution." Internet and Higher Education, 5(3), 197-181.

[118] Cited by Nwandem O. L. "Online Dispute Resolution: Scope and Matters Arising". LL.M Candidate. University of Ibadan.

[119] Petrauskas F. and Kybartiene E., op.cit. p. 926

[120] Law, K. M. (2013). "Best technology practices of conflict resolution specialists: A case study of online

dispute resolution at united states universities" (Order No. 3613218). Available from ProQuest Dissertations & Theses Global. (1511455396). Retrieved from https://www.proquest.com/dissertations-theses/best-technology-practices-conflict-resolution/docview/1511455396/se-2

[121] Bakhramova, M. (2022). "Peculiarities of Online and Electronic Dispute Resolution in the Republic of Uzbekistan. Spanish Journal of Innovation and Integrity," 05, 462-467. Available https://www.academia.edu/78444157/Peculiarities_of_Online_and_Electronic_Dispute_Resolution_in_the_Republic_of_Uzbekistan

[122] Arun R. 2007. "The Legal Challenges Facing Online Dispute Resolution: An Overview". Available at http://www.galexia.com/public/research/articles/research_articles-art42.html. Last visited 30/06/25

[123] Bahadır K. (2024). "Smart Contract Arbitration: Anonymity or Transparency". Faculty of Law Blogs. Available at Smart Contract Arbitration: Anonymity or Transparency | Oxford Law Blogs. Last visited 16/11/2025.

awards technically.[124] The above-mentioned platforms leverage blockchain's inherent characteristics, such as anonymity, immutability and decentralization.[125] It is notable that while transparency is seen as essential for maintaining the integrity of the arbitration process, contrastingly, SCA platforms often emphasize anonymity to align with the decentralized nature of blockchain.[126]

4. Smart Contracts and Online Arbitration

As earlier mentioned, a smart contract can be defined as a set of promises, specified in digital form, including protocols within which the parties perform on these promises. [127] It is equally defined as a digital agreement that is both human and machine-readable according to the Accord Project. This innovative contract format integrates natural language with computable components, ensuring comprehensibility for signatories, lawyers, and contracting parties, while also allowing for interpretation and execution by computers. [128] In other words, they are self-executing digital agreements written in code, programmed to respond to specific conditions (for example, a missed delivery deadline or failed payment). When a condition is met or not met the smart contract can automatically initiate arbitration or withhold payment until a dispute is resolved. This automated enforcement mechanism enhances predictability and reduces the likelihood of procedural gamesmanship. [129]

These contracts differ from traditional contracts in that they are not written in traditional languages such as English or German but are expressed entirely in code. Secondly, Smart Contracts will self-execute upon the occurrence of the contingency mentioned in the code and on receiving the trigger, such as the click of a button. [130] They equally differ from common e-contracts in that they are essentially computer code. [131] There are

two levels of dispute resolution in the context of smart contracts. The first level is dispute resolution through a dispute avoidance mechanism based on the automatic execution of smart contracts (smart contract dispute resolution in a broad sense), the second level to be discussed here is the use of forum selection clauses in a smart contract for an online arbitration procedure in the event of a dispute arising from the deployment of the smart contract (smart contract dispute resolution in a strict sense).[132]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.[133] 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 transitioning to online systems) to a distributed ledger and incorporate it with additional applications or smart agreements.[134] Ideally, a well-designed online arbitration system for smart contract disputes would provide resolutions outside of the legal and political confines of the courts. Online arbitration built into the blockchain would provide resolutions outside the gaze of any one national policy or court. [135]

4.1. Disputes arising from the use of Smart Contracts

As blockchain technology and smart contracts evolve, a distinct category of disputes is emerging, necessitating appropriate resolution methods, raising the question of whether these disputes should be addressed by state courts or through alternative methods, particularly online arbitration. [136] A significant development is "blockchain arbitration," where

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[124] Begaim K. (2025). Pg. 2.

[125] Bahadır K. (2024). Pg. 1

[126] ibid Pg. 2.

[127] Harriet J. F. & Adam S. (2017) "Arbitrating Smart Contract disputes". Norton Role Fulbright website. pg.3. Available at Arbitrating Smart Contract disputes | Global law firm | Norton Rose Fulbright. Last visited 30/06/25

[128] Atoyebi O. M. (2024) Supra. pg.3.

[129] SchreiderADR (2025) "Blockchain and Smart Contracts in Arbitration – A New Era of Enforceability and Efficiency". SchreiderADR website. pg.1. Available at https://www.schreiberadr.com/blockchain-and-smart-contracts-in-arbitration-a-new-era-of-enforceability-and-efficiency. Last visited 30/06/26

[130] Ashita A. & Joy R. (2025). "Interaction Between Blockchain Technology and Arbitration". Arbitration Chambers website. pg.2.Available at Interaction Between Blockchain Technology And Arbitration – ADR Arbitration Chambers. Last visited 30/06/25.

[131] David Z. (2018). "What to Expect When Litigating Smart Contract Disputes", Lᴀw360. Available at

https://www.law360.com/articles/1028009/what-to-expect-when-litigating-smart-contract-disputes. Last visited 19/1/2026.

[132] Janssen, A.U.; Vennmanns, T.J. (2021), "Smart Dispute Resolution in the Digital Age. The Potential of Smart Contracts and Online Dispute Resolution for Dispute Prevention and Resolution in Consumer Law Cases" International Journal on Consumer Law and Practice, 9, 1, (2021), pp. 52-73

[133] Christoph S. (2024). Decentralized Dispute Resolution: Using Blockchain Technology and Smart Contracts in
Arbitration, 24 Pepp. Disp. Resol. L.J. 65.

[134] Clifford C. (2022). "Arbitration for Cryptoasset and Smart Contract Disputes". Available at https://www.cliffordchance.com/content/dam/cliffordchance/briefings/2022/01/arbitration-for-cryptoasset-and-smart-contract-disputes.pdf. Last visited 19/1/2026.

[135] Amy J. S. (n.d.) Op. cit. pg. 5.

[136] Atoyebi O. M. (2024). "Blockchain and Dispute Resolution: The Role of Arbitration and Innovative

blockchain technology is integrated into the ODR process. This gives rise to two distinct approaches: "on-chain" and "off-chain" arbitration. Off-chain arbitration looks like the traditional arbitration proceedings and does not provide for the automatic enforcement of the award, while On-chain arbitration, on the other hand, utilizes technological solutions to ensure that the equivalent of a traditional arbitral award is automatically enforced by the smart contract. Off-chain arbitration is more akin to traditional arbitration proceedings as it does not provide for automatic enforcement of the award. On the other hand, On-chain arbitration essentially involves the use of technological solutions whereby the equivalent of a traditional arbitral award is automatically enforced by the smart contract. [137]Although Smart Contracts provide huge potential benefits in terms of reducing transaction costs and increasing security, disputes can and will arise. In fact, the intersection of contract law and code creates new areas of potential dispute. [138] Common issues in smart contracts include re-entry attacks, syntax errors and frontrunning, which are significant causes for disputes.

4.1.1. Reentrancy attacks

A reentrancy attack is a type of vulnerability exploit where an attacker leverages an unsynchronized state during an external contract call. In simpler terms, the attacker can repeatedly carry out actions that are supposed to be executed only once.[139] In platforms like Ethereum, the most common pattern is a withdrawal function that transfers tokens to a user before decrementing their recorded balance. That order of operations lets a malicious contract re-enter the withdrawal function multiple times, each time tricking the contract into sending more funds than intended.[140]

This weakness has led to significant losses of funds in blockchains, resulting in smart contract disputes.

4.1.2. Syntax Errors

A syntax error is an error in the syntax of a sequence of characters that is intended to be written in a particular programming language. These errors occur when the code does not conform to the rules and grammar of the language. Syntax errors are detected at compile-time in compiled languages, and during program execution in interpreted languages.[141] As opposed to other bugs that slip in after your code runs, syntax mistakes don't even allow your program to start with them present. Every programming language has a structure, and a syntax error occurs each time your code breaks that structure.[142] Syntax errors can hinder the functioning of smart contracts, preventing them from operating as intended and increasing security risks.[143]

4.1.3. Frontrunning

This attack occurs when a bad actor can see and act on transactions before they are confirmed on the blockchain by assuming their timing and order.[144] In the context of smart contracts, front running occurs when an attacker anticipates and exploits the execution of a transaction before it is included in a block. This can result in the attacker profiting at the expense of the original transaction sender.[145] Attackers launch front-running attacks by inserting additional transactions before upcoming victim transactions to manipulate victim transaction executions and make profits. It is the vulnerabilities in smart contracts, which are blockchain programs invoked by transactions, that enable the front-running attack opportunities.[146]

Resolution Methods." Omaplex website. pg.2. Available at Blockchain and Dispute Resolution: The Role of Arbitration and Innovative Resolution Methods. - Omaplex Law Firm. Last visited 30/06/2025

137 Gide L. N. (2023). "Blockchain, Smart Contracts and Alternative Dispute Resolution". Gide. Pg 1. Available at Blockchain, Smart Contracts and Alternative Dispute Resolution Gide. Last visited 16/11/25

138 Global (2017) "Arbitrating Smart Contract disputes". Norton Rose Fulbright. Available at https://www.nortonrosefulbright.com/en/knowledge/publications/ea958758/arbitrating-smart-contract-disputes#section3. Last visited 28/01/25.

139 Hacken (2025) "Reentrancy Attack: Risks, Impact, And Prevention In Smart Contracts". Hacken. Available at Reentrancy Attack: Risks, Impact, And Prevention In Smart Contracts - Hacken. Last visited 28/01/2025

140 Cube (2025), "Wat is Re-entrancy Attack?" Cube. Pg. 1. Available at What is Re-entrancy Attack? Smart Contract Risk Explained | Cube Exchange. Last visited 28/01/2025

141 Geeksforgeeks (2024) "What is a Syntax Error and How to Solve it?". Geeks for geeks. Available at What is

a Syntax Error and How to Solve it? - GeeksforGeeks. Last visited 28/01/2025

142 Live Proxies Editorial Team (2025) "What Is a Syntax Error? How to Solve It, Types & Examples". Live Proxies. Available at What Is a Syntax Error? How to Solve It, Types & Examples | Live Proxies. Last visited 28/01/2025

143 Crypto A. C. (2025) "Common Issues in Smart Contracts: An Examination of Audit Practices and Vulnerabilities". Crypto Asset Compliance. Available at Common Issues In Smart Contracts: An Examination Of Audit Practices And Vulnerabilities. Last visited 28/01/2025

144 Crypto A. C. Op. cit. pg 5

145 Rajithkumar C. (2024). "Mitigate Front running attacks in smart contracts?" Medium. Available at Mitigate Front running attacks in smart contracts? | by Ranjithkumar C | The Capital | Medium. Last visited 28/01/2025

146 Zhang et al., (2025) "Combatting Fromt-Runnin in Smart Contract: Attack Minig, Benchmark Construction and Vulnerabilty Detector Evaluation ». IEEE. Vol 49 Issue 6. Available at Combatting Front-Running in Smart Contracts: Attack Mining, Benchmark Construction and

4.2. Legally binding Nature of Smart Contracts as a necessity for Arbitration.

In most jurisdictions, a contract would only be valid if it is entered into by a person with legal capacity to do so. The fact that pseudonymous parties can enter into smart contracts would make it impossible to validate whether they have the capacity to perform the obligations under such contracts or not. Some civil law jurisdictions lay down some legal requirements (that is, writing and signing requirements) for the formation of a legally binding contract. [147] Furthermore, for an agreement to be legally binding, several elements must be present. These include an offer, acceptance, and consideration the exchange of something of value. Parties must also have the legal capacity to contract, meaning they are of sound mind and legal age. Finally, the contract's purpose must be legal and not against public policy. [148] A discussion regarding the enforceability of smart contracts must start with the fundamental distinction between an agreement and a "contract." States generally recognize that although two parties can enter into a variety of "agreements," a contract means that the agreement is legally binding and enforceable in a court of law. [149]

As smart contracts operate via distributed nodes, it might be difficult to determine the applicable law and the concerned jurisdiction, especially since most smart contract disputes will take the form of cross-border disputes, which will usually introduce conflict of laws issues that are extremely challenging to deal with. [150] These contracts can align with the traditional elements of a legally binding agreement. Offer and acceptance can be demonstrated through the code, where one party initiates the contract and another interacts with it, signalling agreement. Consideration is often the transfer of cryptocurrency or other digital assets handled by the contract. Challenges arise concerning legal capacity and purpose. Determining the legal identity and capacity of parties interacting pseudonymously on a blockchain can be complex.[151] Another challenge may be the difficulty in amending smart contracts, as they are rigid and require extensive coding to accommodate changes,

unlike traditional contracts.[152] Nevertheless, these key features must be present; that agreement has objectively been reached between the parties as to sufficiently certain terms; the parties objectively intended to be legally bound by their agreement; and unless the contract is made by deed, that each party to it has given something of benefit (i.e. consideration) to one another, in order to make the contract enforceable.[153] Once an initial contract has been established, the terms of the contract need to be identifiable. [154] Contract disputes between parties remain under the jurisdiction of the countries or areas the parties fall subject to, so disputes must be handled according to local, national, or international laws. Decentralized dispute resolution technology and techniques are still being created, but are not necessarily legally recognized or available globally. [155] One milestone case, which recognized blockchain arbitration in the courts, concerned a rental agreement containing a hybrid arbitration Agreement: the arbiter prepared a procedural order and submitted it to Kleros, and his decision was included in the final award. The Mexican courts supported the enforcement of an arbitral award that involved a ruling made by Kleros. [156]

4.3. Enhanced Collaboration with Blockchain Technology for dispute resolution.

In recent years, blockchain technology and smart contracts have begun to reshape how parties enter, monitor, and enforce arbitration agreements.[157] Smart contracts, digital contracts that are programmed to automatically carry out the terms of an agreement between two or more parties when certain conditions are met, are kept on a blockchain, a decentralized digital ledger that keeps a permanent and tamper-proof record of transactions.[158] Blockchain might not just create economic and legal challenges through the tensions of code and incompleteness of contracting but might also incentivize and facilitate new dispute resolution institutional possibilities. For instance, there is the potential to create new private decentralized dispute resolution mechanisms. [159]

Vulnerability Detector Evaluation | IEEE Journals & Magazine | IEEE Xplore. Last visited 28/01/2025

[147] Shehata, I. M. N. (2018). Pg. 11

[148] Legal Clarity Team. (2025). "Are Smart Contracts Legally Binding?". Legal clarity. Pg 1. Available at Are Smart Contracts Legally Binding? - LegalClarity. Last visited 18/11/2025.

[149] Skadden (2025), Op. cit. pg 4

[150] Shehata, I. M. N. (2018). Pg. 12

[151] Legal Clarity Team. (2025). Pg.2. Op. cit.

[152] Destiny A. (2024), "Smart Contracts: The Future of Contract Law and Its Legal Implications". Aigbe Law. Pg.1. Available at Smart Contracts: The Future of Contract Law and Its Legal Implications — The Law Offices of Destiny Aigbe PLLC. Last visited 18/11/2025.

[153] Kate A. (2020). "The legal status of "smart contracts": a guide to the conclusions of the LawTech Delivery

Panel". Farrer&Co. pg 3. Available at What are smart contracts and are they legally binding?. Last visited 18/11/2025.

[154] HS Blog, (2023). Op. cit. pg. 6.

[155] Rakesh S. (2024) Op. cit. pg. 5.

[156] Mohit A. & Gunjan C. (2025). Op. cit pg. 9.

[157] Schreiber (2025), "Blockchain and Smart Contracts in Arbitration – A New Era of Enforceability and Efficiency". SchreiberADR. Pg.3. Available at Schreiber ADR | Arbitrators and Mediators. Last visited 21/07/2025.

[158] Our Legal World (2025). "Artificial Intelligence as an Arbitrator". Our Legal World. Available at artificial intelligence as an arbitrator. Pg.1. Last visited 19/07/2025.

[159] Darcy W. E. Allen, Aaron M. Lane, Marta Poblet (n.d.) "The Governance of Blockchain Dispute

In the context of arbitration, blockchain can be used to create a decentralized arbitration platform, where parties can submit evidence, track the progress of the case, and access the final award.[160] It provides a neutral technological framework that supports international arbitration enforcement more transparently.[161] This can reduce the risk of fraud and tampering and improve the enforceability of arbitration awards.[162] In the strict sense of smart dispute resolution, there is the use of forum selection clauses in a smart contract for an ODR procedure in the event of a dispute arising through the use of a smart contract itself.[163] An ODR forum selection clause in a smart contract could have the following content: 'Any dispute, controversy, difference or claim arising out of or relating to the contract, performance, breach or termination thereof will be settled by the name of the ODR system/provider'.[164]

Blockchains can equally verify contract terms, ensure procedural integrity, and streamline enforcement across jurisdictions. For example, an arbitration clause embedded in a blockchain-based agreement is not only timestamped and tamper-proof but can also be connected to a smart contract that triggers dispute resolution procedures automatically upon a breach. [165] Blockchain-based arbitration involves using blockchain technology to facilitate the arbitration process by recording arbitration agreements, managing evidence, tracking the progress of the case, and even enforcing awards. By leveraging the decentralized nature of blockchain, arbitration can be conducted more transparently and securely, reducing the risk of fraud and tampering. [166] It goes without saying that the implications of this tech for ADR professionals are that it renders the resolution process more efficient and secure.

4.3.1. Strengths Of Blockchains in International Arbitration

Implementation of dispute resolution systems based on blockchain presents various valuable advantages that have afforded these benefits and their wider applicability. One of the main benefits lies in efficiency: the longer time and considerable cost to resolve disputes is saved by automated smart contracts and digitally generated workflow, and such systems are especially appealing to high-volume, low-value or cross-border transactions.[167] Open, accessible systems and decentralized selection of jurors or arbitrators, possibly incentivized by crypto economics of these systems, can lead to impartiality and minimized possibility of collusion or systemic bias; the openness and accessibility of these platforms has the additional property of democratising participation, since anyone in the world can participate in dispute resolution without the traditional impediments of geography, price, or institutional gatekeepers.[168] What's more, a public blockchain is a blockchain that anyone in the world can read, anyone in the world can send transactions to and expect to see them included if they are valid, and anyone in the world can participate in the consensus process – the process for determining what blocks get added to the chain and what the current state is.[169]

More recently, private developers, leveraging this power, have begun to create ODR platforms that seek to use blockchain technology to decentralise the delivery of dispute resolution to disputing parties in any location through a worldwide network of self-selecting juror-arbitrators, all of whom interact through decentralised apps ('dApps') built on top of the blockchain.[170] Smart contract applications or decentralized apps may be developed and tested more easily on public blockchains. Startups can use public smart contracts to raise capital. Big businesses are primarily interested in using permissioned smart contracts to incorporate their business models and enforce business rules. [171]

The development of d-apps on the blockchain differs from regular app development. D-app developers must have a deep understanding of blockchain operations. Otherwise, smart contract creators' intentions are frequently at odds with smart contract implementation. Furthermore, because blockchain technologies advance swiftly, design faults in blockchain platforms or smart contract languages may emerge. D-

Resolution" Harvard Negotiation Law Review Vol. 25:75. Available at https://journals.law.harvard.edu/hnlr/wp-content/uploads/sites/91/75-allen-et-al.pdf. Last visited 19/01/26.

[160] Prakash G. & Joshi N. (2024) "The Impact of Technology on ADR processes, including online dispute resolution, AI-assisted mediation, and blockchain-based Arbitration". E-Justice India. Pg.4. Available at The Impact of Technology on ADR processes, including online dispute resolution, AI-assisted mediation, and blockchain-based Arbitration - E-Justice India. Last visited 19/07/25.

[161] Schreiber, (2025) Op. cit. pg.2.

[162] Prakash G. & Joshi N. (2024) Op. cit. pg.1.

[163] Janssen, A.U.; Vennmanns, T.J. (2021), Op. cit, pg. 69.

[164] ibid

[165] Schreiber, (2025) Op. cit. pg.2.

[166] Prakash G. & Joshi N. (2024) Op. cit. pg.1.

[167] Mohit A. & Gunjan C. (2025). Op. cit pg. 11.

[168] ibid

[169] James M. (2019), "The current landscape of blockchain-based, crowdsourced arbitration". Macquarie law Journal Vol 19. Pg.6. Available at Blockchain-Based-Crowdsourced-Arbitration.pdf. Last visited 21/07/2025.

[170] ibid pg.1.

[171] Chakraborty R. et al., (2023), Op. cit, pg 63

app developers are constantly presented with new platform characteristics.[172] Also, blockchain platforms, due to the presence of scalability, can process a high number of disputes concurrently, which provides an efficient solution to the digital market and decentralized application.[173] Central to these platforms being able to provide the kind of dispute resolution promised is the existence of blockchain technology, which in turn allows for the creation of smart contracts, and finally the ability for programmers to develop the dApps that work on top of and in conjunction with the blockchain.[174]

4.3.2. Blockchain Technology for Secure Arbitration Agreements and Awards

Blockchain technology may also revolutionize online arbitration by offering transparent and tamper-proof record-keeping. This can foster trust among disputing parties, as all interactions and decisions will be securely logged and verifiable. [175] The key feature of blockchains is their immutability, which safeguards data integrity, which has always been a key concern when it comes to online dispute resolution. It also operates through a consensus mechanism, which allows participants in the network to agree on the validity of transactions, thus eliminating the need for a central authority, enhancing trust among users. As a result, online arbitration and blockchain technology can create more streamlined and efficient dispute resolution mechanisms. [176]

Therefore, a decision that should theoretically be made independently by an arbitrator is not ultimately independent anymore due to the assistance of computer software and programs. The use of computer software is likely to affect the final decision of the human arbitrator due to its influence on their decision-making process. If AI is somewhat involved in the drafting of an arbitral decision, parties might ask how much the arbitrator relied on it when writing their decision. [177] AI services and machine learning is expected to contribute to it greatly, helping in analysis of evidence, pattern detection, and even initial decision-making, which makes the process more efficient and reduces difference of human error and bias. [178]

4.4. Limitation of Smart Contracts and Blockchain Arbitration

Implementation of smart contract dispute resolution systems based on blockchain presents certain limitations.Firstly, the challenge to widespread smart contract adoption may therefore have less to do with the limits of the law than with potential clashes between how smart contract code operates and how parties transact business.[179] A key challenge in the widespread adoption of smart contracts is that parties will need to rely on a trusted, technical expert to either capture the parties' agreement in code or confirm that code written by a third party is accurate.[180] Among the key problems, we should point out that there are no existing legal frameworks that would suit the specific nature of blockchain transactions, blockchains currently work on various jurisdictions at the same time, which leads to the uncertainty as to which legal system should be applicable in the case of dispute.[181]

Another big challenge is the enforceability of arbitral awards that are based on blockchain as the direct awards granted by blockchain arbitration platforms may not be within the normal application of enforcement, casting the legality of the awards into question, and it will be hard to obtain recognition and enforcement of the awards in a national court.[182]Code-only smart contracts used for business-to-consumer transactions could pose an additional set of issues that will need to be addressed.[183] They are fixed once coded, and therefore their flaws or bugs are permanent, and technical experts may be needed to resolve the controversies regarding their implementation. This particularly affects emerging markets where government are yet to develop strategies concerning their digital assets, decentralized autonomous organizations (DAOs), and smart contracts which results in flawed or improperly structured regulations. [184]

We earlier saw that smart contracts have to rely on off-chain resources. This presents two issues. First, smart contracts do not have the ability to pull data from off-chain resources; rather, that information needs to be "pushed" to the smart contract. Second, if the data at issue is in constant f lux, and since the code is replicated across multiple nodes across the network, different nodes

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[172] Mohanta, B. K. et al., "An Overview of Smart Contract and use Cases in Blockchain Technology," 9th ICCCNT IISC, Bengaluru Bengaluru, India, July 10–12, 2018.

[173] Mohit A. & Gunjan C. (2025). Op. cit pg. 11.

[174] James M. (2019) Op. cit. pg.83.

[175] ES Editorial Staff. (2024) Supra. pg.1.

[176] Editorial. (2025) Op. cit. pg.3.

[177] Kristi B. (2024) "Arbitration in the era of e-commerce: A comprehensive overview" World Journal of Advanced Research and Reviews, 2024, 23(03), 089–103. Pg.95. Available at https://doi.org/10.30574/wjarr.2024.23.3.2628. Last visited 20/5/25

[178] Mohit A. & Gunjan C. (2025). Op. cit pg. 13.

[179] Skadden, A. (2025), Op. cit. pg 5

[180] ibid

[181] Mohit A. & Gunjan C. (2025). Op. cit pg. 9.

[182] ibid.

[183] Skadden, A. (2025), Op. cit. pg 6

[184] Ashish D. V (2025) "Legal Challenges in Web 3.0: Navigating Smart Contracts, DAOs and Blockchain Disputes," SCC Online Blog. Available at https://www.scconline.com/blog/post/2025/03/15/legal challenges-in-web-3-0-navigating-smart-contracts-daos-and-blockchain-disputes/. Last visited 17/1/26

may be receiving different information, even just a few seconds apart.[185] This would resort in the need for oracles which adds another party with whom the parties would need to contract to effectuate a smart contract, thus somewhat diluting the decentralised benefits of smart contracts. It also introduces a potential "point of failure."[186] The primary task of such oracle use is to capture, verify real-world occurrences and feed the smart contract with that data in a secure and trusted manner. For example, an oracle might experience a system flaw and be unable to push out the necessary information, provide erroneous data or simply go out of business.[187] Another core challenge that arises while designing off-chain execution protocols is to handle the possibility of parties that stop responding, either maliciously or accidentally, which violates the liveness property of blockchains, resulting in the risk of unresponsive parties.[188] Rigidity of smart contracts poses another challenge. Currently, there is no straightforward method to amend a smart contract, which creates certain challenges for contracting parties.

Data protection and privacy also create a great legal challenge. Smart contract security flaws could result in a high number of financial losses. Since their security is based on the immutability that implies that they cannot be fixed in the case of coding errors or vulnerabilities. [189] Moreover, this immutability weakens confidentiality in the sense that all transactions and past records of disputes will be made permanently and publicly visible. Such openness may threaten the anonymity of people involved in addition to revealing sensitive data, in case the identities of parties are revealed by their cryptographic addresses. [190] The DAO breach in Ethereum, for example, resulted in a hard fork of the blockchain to remove the malicious transactions. Hence, the security threat in smart contracts is more challenging than in regular contracts.

4.5. Results
The findings of this work have been examined below.
4.5.1. Typology and Functionality of Smart Contracts
The analysis identified and classified smart contracts into several distinct types, each with unique operational and legal implications. These include off-chain contracts, smart legal contracts, decentralized autonomous organizations (DAOs), and application logic contracts. DAOs represent a paradigm shift in organizational governance, operating through collective decision-making encoded in blockchain protocols. Application logic contracts facilitate interactions between devices and software, underpinning decentralized applications (Dapps) and the Internet of Things (IoT).

4.5.2. Dispute Resolution Mechanisms in Blockchain Environments
The study revealed two primary models for resolving disputes arising from smart contracts: on-chain and off-chain arbitration. On-chain arbitration leverages blockchain's automation to enforce arbitral awards directly through smart contracts, while off-chain arbitration mirrors traditional processes but may lack automatic enforcement. Decentralized platforms such as Kleros and Aragon Court have emerged, utilizing crowdsourced juror pools and crypto-economic incentives to deliver transparent, impartial, and efficient dispute resolution. These platforms demonstrate the potential for blockchain to democratize access to justice and reduce the risk of collusion or systemic bias.
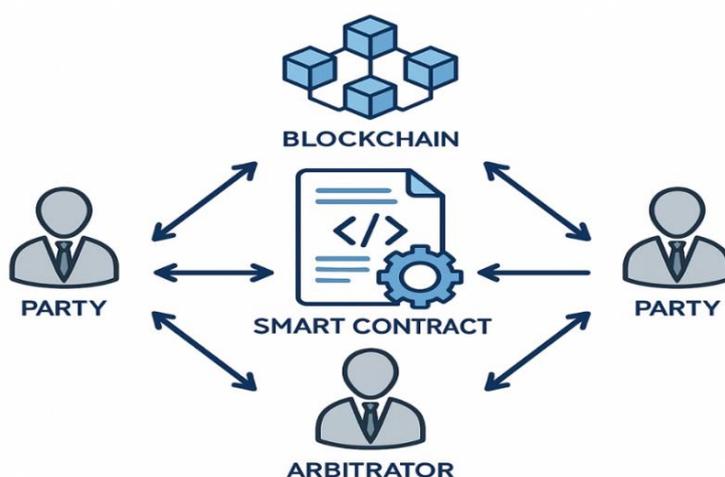

Figure 1: Architecture for Blockchain Arbitration

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[185] Skadden, A. (2025), Op. cit. pg 7
[186] Skadden, A. (2025), Op. cit. pg 7
[187] ibid
[188] Frassetto, J. et al., (2023), Op. cit. pg. 1

[189] Mohit A. & Gunjan C. (2025). "Smart Contracts and Decentralized Justice: Dispute Resolution on the Blockchain". 10.13140/RG.2.2.23683.82725.
[190] Ibid pg. 9.

4.6. Recommendations

Multiple solutions have been proposed to address these shortcomings of blockchains over the years, one of the most promising is the so-called off-chain execution systems. To address limitations that challenge liveness, the first approach is to require collateral, depending on the number of participants, i.e., parties have to block large amounts of money, which is used to disincentivize malicious behavior and to compensate parties in case of premature termination. [191]

4.6.1. Adoption of new technologies:

Empirical data from the international arbitration community hints towards improving arbitral efficiency through the adoption of new technologies like cloud storage, e-disclosure, video conferencing, and the use of online platforms and technologies.[192] The ICC Commission on Arbitration and ADR's updated Report on Information Technology in International Arbitration (2022) reveals that 93 per cent of interviewees believe that IT has revolutionised arbitrations by streamlining processes and reducing the burgeoning costs of arbitral processes.[193]

4.6.2. Exploit Artificial Intelligence:

Introduce the use of AI and machine learning to help in the analysis of evidence, recognize patterns, and make tough decisions to increase efficiency and limit biasness in dispute resolutions. [194]

4.6.3. Promote Interoperability:

Foster interoperability so that dispute resolution protocols can be seamlessly compatible with the diverse block franchises and digital ecosystems expanding the reach and scalability of those systems. [195]The second approach to store contract state on the blockchain to enable other parties to resume execution. [196]Clearly specifying the governing law and jurisdiction for dispute resolution in the contract by parties to a smart contract can help avoid potential conflicts and uncertainties arising from the decentralized nature of blockchain technology. [197]

4.7 CONCLUSION

This paper has illuminated the evolving interface between blockchain technology, smart contracts, and online arbitration. The integration of these digital innovations offers unprecedented efficiency, transparency, and accessibility in dispute resolution. However, significant legal and technical challenges persist, including jurisdictional ambiguity, enforceability issues, and security vulnerabilities. The emergence of decentralized platforms like Kleros demonstrates the potential for democratized and impartial arbitration. Yet, the rigidity of code-only contracts and privacy concerns highlight the need for robust safeguards. The findings underscore the importance of clear legal standards and technical interoperability. Adoption of artificial intelligence and off-chain execution systems can further enhance adaptability. Collaboration among legal, technical, and regulatory stakeholders is essential for progress. By embracing innovation while upholding fundamental rights, the future of arbitration can be both resilient and equitable. Ultimately, this work calls for proactive reforms to ensure digital dispute resolution meets the demands of a rapidly changing world.

[191] Frassetto, J. et al., (2023), Op. cit pg 1
[192] International Chamber of Commerce (2017). "Information Technology in International Arbitration- Report of the ICC Commission on Arbitration and ADR". ICC. Pg. 3. Available at Information Technology in International Arbitration- Report of the ICC Commission on Arbitration and ADR - ICC - International Chamber of Commerce. Last visited 15/11/2025.

[193] Payel C.et al. (2023). "Technology and artificial intelligence: Reengineering arbitration in the new world". IBA. Pg 2. Available at Technology and artificial intelligence: Reengineering arbitration in the new world | International Bar Association. Last visited 15/11/2025.
[194] Mohit A. & Gunjan C. (2025). Op. cit pg. 16.
[195] ibid
[196] Frassetto, J. et al., (2023), Op. cit pg 1
[197] Adhip R. (2025), Op. cit. pg 6.