Transformative impact of blockchain technology and smart contracts on dispute resolution: legal challenges and other implications.

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Transformative Impact of Blockchain Technology and Smart Contracts on Dispute Resolution: Legal Challenges and Other Implications

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Abstract:

This paper comprehensively analyses the potential of blockchain technology and smart contracts to revolutionise dispute resolution. As dispute resolution methods evolve, blockchain and smart contracts, which offer efficiency, transparency, and fairness, are becoming more critical. That is especially the case in mediation and construction adjudication, which are less traditionally formal and tend to be carried through much more quickly than other forms of dispute resolution. The opportunity of blockchain comes from its ability to demonstrate a tamper-proof, clear record, reducing risks of misunderstanding and bias. This facilitates the transfer and verification of evidence both in the carrying out of projects and during dispute resolution processes. Smart–digital contracts with terms coded indirectly- allow for automated contract enforcement. They execute automatically upon meeting specific conditions. This automation brings a new efficiency level, cutting the time and costs of conventional dispute resolution. Nonetheless, integrating blockchain and smart contracts in dispute resolution faces several challenges. The current limited understanding and acceptance of these technologies in the legal sector is an imminent issue. Legislative changes are necessary to provide a solid legal framework for these technologies in legal processes and to address potential inconsistencies of approach. Such reform requires strong cooperation among lawmakers, technologists, and legal experts to ensure implementation that adheres to legal and ethical norms and ensures that the technologies can be applied with confidence by the stakeholders within the process. This collective effort is crucial for seamlessly integrating blockchain and smart contracts into legal frameworks.

1. Introduction

The rapid advancement of technological innovation, including blockchain and smart contract technologies in the post-COVID-19 era, has begun to significantly alter the landscape of legal infrastructure, processes, and dispute resolution mechanisms worldwide. Traditionally, dispute resolution methods such as litigation, mediation and arbitration suffer from delays, procedural inefficiencies, and lack of transparency. Many dispute resolution processes are information-driven. Both clients and solicitors will often rely on relevant factual/evidential or legal sources

to craft negotiating positions (in the case of many Alternative dispute resolution processes) and prepare their cases. The process of gathering and verifying the authenticity and validity of information can be complex and time-consuming. As these technologies grow in sophistication and adoption, they promise to transform traditional legal procedures, offering increased efficiency, transparency, and security. Legal systems globally have been slow in leveraging the positives of technological innovations to improve structures and practices.

This article explores the implications of blockchain and smart contracts for dispute resolution. It uses examples from mediation and construction adjudication to demonstrate how these technologies can be used to facilitate different aspects of dispute avoidance and resolution. The piece begins with an explanation of blockchain technology and smart contracts, briefly sets out the rationale, benefits, and challenges of their adoption, and provides some conceptual description of the scope of their application in dispute resolution. This section is followed by a detailed look at how these technologies can contribute in a practical way to the effective delivery of mediation and construction adjudication services. Then, the potential benefits and challenges posed by these technologies are examined. The piece ends by offering some suggestions regarding addressing these challenges.

2. Understanding Blockchain and Smart Contracts

Fundamentally, a blockchain is a digital filing system, a database which has the capacity to record, timestamp and retain information from transactions conducted with it.[1] In its basic form, it is an electronic ledger where data is recorded and distributed. It does not lend itself to editing; data, once stored, is immutable. To Arcari, blockchain refers to different types of "distributed information systems, which should more precisely be variously referred to as "distributed ledger technology" (DLT), shared ledger technology or "mutual distributed ledger" (MDL).[2]

The name "blockchain" is derived from the process by which data is received and stored on the DLT.[3] All information or transactions fed to the network are hashed (meaning converted into encrypted codes), categorised into blocks of data, and chained together with sophisticated mathematical formulas.[4] Bacon et al. note that the hash function creates a persistent, tamper-evident record of relevant transactions.[5] It generates "a string of digits of a fixed length that are

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[1] Jean Bacon, Johan David Michels, Christopher Millard, and Jatinder Singh, 'Blockchain Demystified: A Technical and Legal Introduction to Distributed and Centralised Ledgers' (2018) 25 (1) Richmond Journal of Law and Technology 1, 6.

[2] Jared Arcari, 'Decoding Smart Contracts: technology, Legitimacy and Legislative Uniformity' (2019) 24 Fordham Journal of Corporate & Financial Law 363.

[3] ibid, 366.

[4] ibid.

[5] Jean Bacon, Johan David Michels, Christopher Millard, and Jatinder Singh, 'Blockchain Demystified: A Technical and Legal Introduction to Distributed and Centralised Ledgers' (2018) 25 (1) Richmond Journal of Law and Technology 1, 6.

unique" to each block of data called the hash value.[6] Using a process called hash pointers, hash values of a previous block are combined with the data in a new block to generate the new block's hash value.[7] This process is replicated across many blocks, forming an immutable chain of blocks. Hence, the term blockchain. The processes ensure the integrity of the data saved, as any tampering with the original hash value will produce a different result. Consequently, the hash value rather than the content of each block is made visible to external observers.[8]

To save any information on a blockchain, the party or parties submitting it must be authenticated. The 'public key' infrastructure allows an individual to generate a key pair consisting of a public and a private key to sign a data item.[9] Encrypted data using the public key can only be decrypted using the private key pair.[10] As a database or ledger, blockchains may be centralised or decentralised. The latter means that the data is stored across a peer-to-peer network in a distributed manner. This is what is often referred to as DLT. This process secures the data by making it difficult for a single entity to control or alter, thereby ensuring transparency.

Although various forms of blockchain technology were in existence prior to 2008, it is generally accepted that the popularity of the technology surged with the introduction of the cryptocurrency called Bitcoins by one Satoshi Nakamoto in 2008.[11] The cryptocurrency platform allows debit and credit transactions to be encoded and stored as blocks on the network. This data is encrypted. Hash pointers known as Secure Hash Algorithm 256 (SHA-256) are then used to string the "blocks" together securely, ensuring tamper-evident data structure.[12] Beyond cryptocurrencies, blockchain technology has also been deployed to address data storage and management challenges in the financial markets, insurance, contract management, property transfers and healthcare.[13] The two key selling points of blockchain technology are its ability to ensure data integrity and identity authentication.[14]

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[6] ibid, 9.
[7] ibid.
[8] For more on a basic description of blockchains, *see* Theodoros Dounas & Davide Lombardi, 'Blockchain Technologies in Construction' in *Blockchain for Construction* (Theodoros Dounas & Davide Lombardi eds) (Springer, 2022), 3. *See* also Jean Bacon, Johan David Michels, Christopher Millard, and Jatinder Singh, 'Blockchain Demystified: A Technical and Legal Introduction to Distributed and Centralised Ledgers' (2018) 25 (1) Richmond Journal of Law and Technology 1, 6.
[9] ibid, 13
[10] ibid.
[11] James A Cox and Mark W Rasmussen (eds), *Blockchain for Business Lawyers* (American Bar Association, 2019).
[12] Jean Bacon, Johan David Michels, Christopher Millard, and Jatinder Singh, 'Blockchain Demystified: A Technical and Legal Introduction to Distributed and Centralised Ledgers' (2018) 25 (1) Richmond Journal of Law and Technology 1, 13.
[13] Nathan Fulmer, 'Exploring the Legal Issues of Blockchain Applications' (2019) 52 (1) Akron Law Review 161, 172.
[14] Pierluigi Cuccuru, 'Beyond Bitcoin: An Early Overview on Smart Contracts' (2017) 25 *International Journal of Law and Information Technology* 179. *See* also Nathan Fulmer, 'Exploring the Legal Issues of Blockchain Applications' (2019) 52 (1) Akron Law Review 161, 164.

As a data management solution, blockchain technology has changed how data is managed. However, the introduction of smart contracts has unlocked previously impossible vistas of technological innovation. Beckham and Sendra[15] note that smart contracts now constitute a significant part of the blockchain ecosystem.[16] The transformative potential of blockchain technology is often attributed to the introduction of smart contracts and their inherent self-executing capabilities (i.e., the ability to execute actions autonomously). Smart contracts have been variously defined as computer programs with or without any legal implications.[17] Some view smart contracts as computer codes which execute simple or complex commands.[18] These programmes or codes execute specified actions according to pre-defined rules.[19] They are "computer programs which run automatically, in whole or in part, without the need for human intervention" or "computer code that, upon the occurrence of a specified condition or conditions, is capable of running automatically according to pre-specified functions".[20] In this sense, smart contracts are defined principally by reference to the process by which certain commands or instructions are operationalised rather than the effect of the process. In this sense, it may be argued that not all actions undertaken by smart contracts have contractual implications. Consequently, defining such computer programmes or codes based on their physical description and functionality is appropriate.

On the other hand, when smart contracts are used to define legal rights and obligations and terms of their performance, they are considered a 'type' of contract: smart legal contracts.[21] Nick Szabo, the cryptographic expert credited with popularising the term 'smart contracts' defined them as "a set of promises, specified in digital form, including protocols within which the parties perform on these promises".[22] Undoubtedly, this pioneer had in mind that smart contracts will have legal connotations. Indeed, the oft-used example of common smart contract, the automated vending machine, illustrates both definitions. On the one hand, there is

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[15] Jonathan A Beckham and Maria Sendra, 'Smart Contracts Lead the Way to Blockchain Implementation' (Thomson Reuters, 26 September 2018).

[16] ibid.

[17] David Christie and Joseph Mante, 'Smart Contracts and Payment in the UK Construction: The Legal Framework' in Theodoros Dounas and Davide Lombardi (eds), *Blockchain for Construction* (Springer 2022) 167–184.

[18] Theodoros Dounas and Davide Lombardi, 'Blockchain Technologies in Construction' in Theodoros Dounas and Davide Lombardi (eds), *Blockchain for Construction* (Springer 2022) 3.

[19] Jean Bacon, Johan David Michels, Christopher Millard, and Jatinder Singh, 'Blockchain Demystified: A Technical and Legal Introduction to Distributed and Centralised Ledgers' (2018) 25 (1) Richmond Journal of Law and Technology 1, 13.

[20] Law Commission, *Smart Legal Contracts: Advice to Government* (November 2021) vii, 1 <https://www.lawcom.gov.uk/project/smart-contracts/> accessed 22 April 2024.

[21] *See Law Commission, Smart Legal Contracts: Advice to Government (November 2021) vii, 1 <https://www.lawcom.gov.uk/project/smart-contracts/> accessed 22 April 2024, and* also Charles Ho Wang Mak and Joseph Mante, 'Blockchain and Smart Contracts: A Game Changer in Mediation?' (2023) Asian Journal on Mediation 49.

[22] Nick Szabo, 'Smart Contracts: Formalizing and Securing Relationships on Public Networks' (1997) 2(9) First Monday <https://firstmonday.org/ojs/index.php/fm/article/download/548/469> accessed 22 April 2024. Elsewhere, Szabo defined smart contracts as ' a computerised transaction protocol that executes the terms of a contract'. *See* Nick Szabo, 'Smart Contracts' <https://www.fon.hum.uva.nl/rob/Courses/InformationInSpeech/CDROM/Literature/LOTwinterschool2006/szabo.best.vwh.net/smart.contracts.html> accessed 22 April 2024. The author cited the vending machine as the quintessential example of the basic form of smart contract in operation.

the technology which enables some item to be dispensed on certain prompts. On the other, there is also the reality that transactions at the vending machine have legal implications.

Consequently, the English Law Commission defines a smart legal contract as 'a legally binding contract in which some or all of the contractual terms are defined in and/or performed automatically by a computer program'.[23] Conceptualised this way, smart legal contracts should be regarded as another form of a contract, like standard form, internet-based contracts, etc., albeit with their own peculiarities. They must comply with the legal requirements of a valid contract. They must also be subject to contract principles on terms and conditions, vitiating factors, breach, remedies enforcement, etc. There may be difficulties around interpretation of terms and other areas of the existing law in England.

Smart contracts promise to reduce human involvement in transactions (including dispute resolution) by transforming the static ledger of blockchain into a dynamic system capable of executing the logic of contractual agreements.[24] In the specific context of dispute resolution, there are prospects for dispute avoidance/reduction following contract automation, immutability of records, transparency, and automation of enforcement processes. Conceptually, the role of technology in dispute resolution could focus on process automation generally or complete automation of the dispute resolution process. As smart contracts become much "smarter" with more use of large language models and other artificial intelligence software, executing complex judicial and quasi-judicial tasks will become routine.

Despite the numerous potential benefits, it is essential to consider the challenges and obstacles that may arise when integrating blockchain technology and smart contracts into mediation processes. Technological innovation has the potential to bring about transformational change, but it has its challenges. Smart contracts are currently facing a significant challenge due to their legal ambiguity.[25] In many jurisdictions, it is necessary to establish clear legal frameworks that define the legal status of smart contracts. This lack of clarity can create significant problems when using them in mediation. For instance, if there is a dispute during the execution of a smart contract, it is unclear how a court would handle it without established legal precedents. The English Law Commission has differentiated between "smart contracts" and "smart legal contracts" to address this issue.[26] The latter will be treated as legal contracts without doubt and must meet the basic requirements of a valid contract under English law. In other words, parties who use blockchain and smart contract technology to resolve disputes should be aware that the process has legal implications. When the legal status of smart contracts is uncertain in certain

[23] ibid, 1, para 1.2.

[24] Pierluigi Cuccuru, 'Beyond Bitcoin: An Early Overview on Smart Contracts' (2017) 25 *International Journal of Law and Information Technology* 179. See also Charles Ho Wang Mak and Joseph Mante, 'Blockchain and Smart Contracts: A Game Changer in Mediation?' (2023) Asian Journal on Mediation 49.

[25] Shafaq Naheed Khan, Faiza Loukil, Chirine Ghedira-Guegan, Elhadj Benkhelifa, and Anoud Bani-Hani, 'Blockchain Smart Contracts: Applications, Challenges, and Future Trends' (2021) 14 Peer-to-Peer Networking and Applications 2901, 2901-2902.

[26] For a detailed exploration of the terminologies of "smart contracts" and "smart legal contracts", *see* Joseph Mante and Charles Ho Wang Mak, 'Smart Contracts versus Smart Legal Contracts: Shifting Terminology' (RGU Law Blog, 2 October 2023) <https://rgulaw.blog/2023/10/02/smart-contracts-versus-smart-legal-contracts-shifting-terminology/> accessed 20 April 2024.

jurisdictions, concerns about the enforceability of these agreements are raised. This lack of clarity can discourage parties from using smart contracts in mediation due to the potential legal complexities that may arise.

3. Integration of blockchain and smart contracts technology in mediation

Using blockchain technology and smart contracts in mediation is a new and innovative way to resolve disputes. Blockchain's decentralised ledger technology offers a transparent and tamper-proof record of transactions, while smart contracts provide automation and contractual certainty. Together, they minimise disagreements, enable faster resolution, and enhance the efficiency and effectiveness of the mediation process.[27]

There are different styles of mediation, most predominantly facilitative and evaluative.[28] Facilitative mediation is the most common approach, allowing parties to control the outcome while the mediator guides the process. Evaluative mediation is useful when the parties have an uneven power dynamic. The mediator is more active in guiding the process and provides an objective assessment to promote a fair resolution. Blockchain technology can provide a secure and transparent means of recording and tracking all mediation proceedings. All communications, settlements, and agreements can be timestamped and stored on the blockchain, ensuring secure record-keeping and effective management of the mediation process.

Blockchain technology has the potential to streamline the mediation process through automation of tasks such as data collection, document creation, and contract execution. For instance, during mediator selection, the blockchain can maintain a decentralised database of certified mediators, including information about their qualifications, experiences and past performances. It can be used to select mediators with expertise on a particular subject. Parties can sign on for the automatic selection of a mediator with certain characteristics. This will promote transparency and make it easier for the parties to select a mediator that meets their needs.

Additionally, integrating smart contracts at the agreement-signing stage of the mediation process can reduce the time for the process, improve trust, and reduce the risk of bias, error, and fraud. The different rights, obligations, and series of activities can be coded with the terms and conditions of the mediation agreed upon. Each activity can be triggered by agreed verified steps. In evaluative mediation, smart contracts can significantly enhance fairness and transparency. The mediator's evaluations or recommendations could be embedded within a smart contract, establishing an unchangeable record of their agreement made after the mediation. This level of transparency confirms that the mediator displays no undue bias or

[27] For a more comprehensive and detailed analysis of the use of blockchain and smart contracts in mediation that is illustrated in this paper, *see* Charles Ho Wang Mak and Joseph Mante, 'Blockchain and Smart Contracts: A Game Changer in Mediation?' (2023) Asian Journal on Mediation 49.

[28] For a detailed comparison between evaluative and facilitative mediation and their applications, *see* James J Alfini, 'Evaluative versus Facilitative Mediation: A Discussion' (1996) 24 Florida State University Law Review 919; and Andrew Boon, Peter Urwin, and Valeriya Karuk, 'What Difference Does it Make? Facilitative Judicial Mediation of Discrimination Cases in Employment Tribunals' (2011) 40 (1) Industrial Law Journal 45.

preference towards either party. Cost savings are also a tangible advantage of smart contracts, as they remove intermediaries and automate processes, making dispute resolution more accessible and cost-effective for small enterprises and individuals with limited financial resources.[29] It is possible to trace the fulfilment of a contract even after it has been completed due to the blockchain's immutability and durability.[30]

Smart contracts can act as an escrow during mediation, holding disputed funds securely until both parties agree. The contract then automatically releases the funds according to the agreed terms, enhancing the enforcement of the outcome of the process. By leveraging the unique features of smart contracts, evaluative mediation can be transformed into a more secure and transparent process, promoting fairness and equity in resolving disputes. Blockchain technology can also securely store digital evidence for mediation. It ensures easy access to uncorrupted data, enhances evidence credibility and accuracy, and promotes fairness and equity. The accessibility of smart contracts will be further improved, allowing parties to resolve disputes remotely and making it convenient for individuals unable to visit a physical site, especially in different countries or regions.

3.1. Future directions: Multi-step blockchain-based dispute resolution

An ideal blockchain system can be adjusted to fit a multiple-step resolution process. Parties that use blockchain and smart contracts in mediation do not have to worry about the next steps if the mediation fails and the dispute needs to escalate to arbitration. The same or similar system, such as the online multi-step dispute resolution process based on blockchain proposed by Rabinovich-Einy and Katsch, will make it easy to switch from mediation to online arbitration.[31] Kleros and similar platforms can facilitate a smooth transition from mediation to arbitration using smart contracts. They can automate the enforcement of rulings and incentivise fair voting by distributing tokens to jurors.[32] Streamlined conflict resolution platforms promote openness, efficiency, and justice, aligning with dispute resolution values.[33]

3.2.Mediation-related challenges of blockchain-based smart contract

One of the significant challenges that blockchain-based smart contracts pose to mediation is the difficulty of encouraging all parties involved in mediation to adopt blockchain and smart contracts technology. Some parties might be hesitant to use this new technology and prefer to rely on traditional mediation methods that they are more familiar with. Their reluctance to use blockchain technology may be due to a need for understanding or concerns about its security

[29] Guenther Dobrauz-Saldapenna and Mark A. Schrackmann, 'Economics of Smart Contracts: Efficiency and Legal Challenges' in Eva Kaili and Dimitrios Psarrakis (eds), *Disintermediation Economics* (Palgrave Macmillan, Cham 2021) 33-45. For the critics against smart contracts, *see* Jeremy M Sklaroff, 'Smart Contracts and the Cost of Inflexibility' (2017) 166 (1) University of Pennsylvania Law Review 263.
[30] ibid.
[31] Orna Rabinovich-Einy and Ethan Katsh, 'Blockchain and the Inevitability of Disputes: The Role for Online Dispute Resolution' (2019) 2 Journal of Dispute Resolution 1, 61.
[32] ibid.
[33] ibid; Luis Bergolla, Karen Seif, and Can Eken, 'Kleros: A Socio-legal Case Study of Decentralized Justice & Blockchain Arbitration' (2022) 37 (1) Ohio State Journal on Dispute Resolution 56.

risks. Therefore, it is essential to ensure that all parties involved in the mediation process accept and embrace the technology.

The code used in smart contracts is complex, and mistakes can result in major problems.[34] Furthermore, not all users may possess the digital literacy required to use smart contracts effectively. It has been observed that the implementation of blockchain technology in education is progressing at a sluggish pace.[35] The implication is that many students currently graduating from universities and tertiary institutions know very little or nothing at all about, blockchain and smart contracts, technologies increasingly being adopted in many industries. This is a challenge that will impact services including mediation.

While the parties involved in mediation and the mediator can agree on the terms and procedures of the process, they might need more digital literacy to convert it into the necessary computer programming language. As a result, they may need to rely on technical experts who are knowledgeable in coding rather than law. This can lead to a situation where certain aspects of the parties' agreement may be translated literally and idiomatically. These technical challenges can be a significant obstacle to the widespread adoption of smart contracts in mediation. This is what we call the "translation problem." Also, as the volume of transactions and complexity of smart contracts increase, so does the demand for computational resources required to process them.[36] This can result in higher costs and slower transaction times, which may need to be more satisfactory in mediation scenarios where swift resolution is often critical.[37]

In mediation, exchanging sensitive information poses a significant challenge to maintaining data privacy. Implementing blockchain technology and smart contracts raises concerns regarding protecting confidential information and compliance with regulatory laws such as the General Data Protection Regulation (GDPR) in the European Union.[38] To build trust in the technology and ensure its successful adoption in mediation, it is crucial to address these privacy concerns and comply with relevant regulations to maintain confidentiality.

3.3.Possible Solutions

Regarding smart contracts, laws or regulations need to define their legal status precisely. This might include extensive legal frameworks that acknowledge and enforce these digital agreements. The efforts of the English Law Commission in this area represent an initial step. English law has posited that existing legislation could be modified to accommodate such

[34] Shafaq Naheed Khan, Faiza Loukil, Chirine Ghedira-Guegan, Elhadj Benkhelifa, and Anoud Bani-Hani, 'Blockchain Smart Contracts: Applications, Challenges, and Future Trends' (2021) 14 Peer-to-Peer Networking and Applications 2901, 2915.
[35] Jae Park, 'Promises and Challenges of Blockchain in Education' (2021) 8 Smart Learning Environment 33, 33.
[36] Zhenyu Zhou, Haijun Liao, Bo Gu, Shahid Mumtaz, and Jonathan Rodriguez, 'Resource Sharing and Task Offloading in IoT Fog Computing: A Contract-Learning Approach' (2020) 4 (3) IEEE Transactions on Emerging Topics in Computational Intelligence 227.
[37] Pratima Sharma, Rajni Jindal, and Malaya Dutta Borah, 'A Review of Smart Contract-Based Platforms, Applications, and Challenges' (2023) 26 Cluster Computing 395, 414.
[38] Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation).

technological advances. Moreover, there is a belief that the common law will gradually evolve to establish norms in this emerging field. This adaptation is evident in electronic transactions through emails and websites. While jurisdictions that adhere to the common law might see merit in this method, those that subscribe to the civil law tradition favour a definitive codification of rules concerning this topic. Additionally, legislation can offer directions on the usage and interpretation of smart contracts, providing the necessary certainty for parties to adopt this technology.

Concerning the reluctance to embrace new technology, educating individuals about the technology can mitigate related anxieties.[39] This education might include details on the advantages and hazards associated with the technology, its operational mechanisms, and the safeguards established to protect security. For instance, clarifying the principles of decentralisation and encryption and the security measures that safeguard blockchain networks from fraud could form a component of this educational effort. Additionally, it is vital to underscore blockchain technology's and smart contracts' proven success in delivering secure and effective solutions across different sectors.

Digital illiteracy in blockchain technology poses a considerable obstacle to entry, necessitating resources and expertise that many may need more. Facilitating the development of these capabilities and infrastructure through resources and support could mitigate this issue. This support could encompass training programs, guides, and services enabling parties to develop and deploy smart contracts. Governments and educational bodies can contribute significantly by providing blockchain technology, smart contract courses, and workshops. Similarly, this mirrors the historical expansion of internet literacy following the internet's introduction.

Addressing concerns about data privacy necessitates adopting strong data protection strategies and adhering to pertinent legal and regulatory standards. This may include employing sophisticated encryption methods to safeguard data maintained on the blockchain and implementing controls to guarantee that only authorised individuals have access to and can alter this data. Furthermore, it is essential to comply with data protection regulations, such as the GDPR in the European Union.

Concerning the scalability of technology as blockchain and smart contract usage increases, the technology must be capable of handling a growing number of transactions without the associated costs. This may include enhancing the efficiency of blockchain networks, for example, by adopting more efficient consensus algorithms. Additionally, developing off-chain solutions that process transactions away from the primary blockchain could reduce network load. Initially, a smaller, centralised network managed by trusted experts might serve as a testing ground for those interested in exploring blockchain and smart contract technologies. As the advantages become apparent, it will be simpler for these users to transition to a

[39] For further information regarding the blockchain technology in education, *see* Prity Rani, Rohit Kumar Sachan, and Sonal Kukreja, 'A Systematic Study on Blockchain Technology in Education: Initiatives, Products, Applications, Benefits, Challenges and Research Direction' (2024) 106 Computing 405.

decentralised system. Ongoing research and development are vital to ensure the technology can accommodate the increasing demand.

4. Construction Adjudication

As noted under the section which introduced the technology, the use of blockchain and smart contracts offers key enhancements in dispute resolution with the ability to create transparency and authenticity to information provided, supported by automation of functions and certainty of contract. These benefits are available in consensual dispute resolution (such as mediation). They are also in the adversarial arena. Construction adjudication is a case in point.

Construction Adjudication is a specialist form of dispute resolution used in several jurisdictions internationally, particularly in the UK, Australia and Malaysia. It may be statutory or contractual. The form of construction adjudication discussed in this paper relates to a mechanism which is imposed on construction projects by legislation. Notwithstanding this, the parties also have flexibility regarding the contractual requirements. Construction adjudication is linked but sufficiently distinct from dispute adjudication boards, which are commonly used on major infrastructure projects globally. This balance of legally mandated requirements within an agreed process provides a platform upon which the particular features of construction adjudication which make it a suitable framework for technological innovation.

4.1.Introduction to Construction Adjudication

The policy basis of adjudication is vital to understanding its operation and role within the legal systems in which it operates. The idea that "cash flow is the very lifeblood of the enterprise" has been understood in UK construction for a long time[40]. However, in the early 1990s the UK construction industry was particularly beset with problems of cash flow, giving rise to insolvencies and other issues. The industry was adversarial, and disputes took so long to formally resolve that parties would run out of money pending resolution.

The UK construction industry and politicians established a working group under the chairmanship of Sir Michael Latham to identify ways to improve this situation.[41] That process identified a range of proposals. The most enduring of those in legal terms is a double-sided mechanism to enhance cash flow within the UK construction industry. On one hand are provisions to streamline the payment process.[42] On the other, a fast-track form of dispute resolution is construction adjudication.[43] These are complementary ways to get cash flow in the UK construction industry. This double-sided mechanism[44] is found in the relevant provisions of the Housing Grants Construction and Regeneration Act 1996 (as amended).

[40] *Gilbert-Ash (Northern) Ltd v Modern Engineering (Bristol) Ltd* (1973) 71 L.G.R. 162 per Lord Denning 167.
[41] Sir Michael Latham *Constructing the Team: Final Report* (HMSO 1994).
[42] Housing Grants, Construction and Regeneration Act 1996 (as amended), ss.109 -113.
[43] ibid, s. 108.
[44] Amended by the Local Democracy Economic Development and Construction Act 2009, ss. 138-145.

This model has been "conspicuously successful"[45] and has been adopted internationally.[46] The original system in the UK and its international variants share a standard conceptual model, with the latter adopting aspects and details from the original UK approach.[47] The key element of these systems is the focus on cash flow. It is this need which provides the immediate opportunity for the development of blockchain and smart contracts.

4.1.1. The Payment process

The payment process imposed by the Act underpins the "cash flow system". That payment regime relies on the key aim of making sure that people are paid what they expect to be paid and are given notice if that is not the case. This happens through a series of notices and gateways that ensure certainty and transparency. Disputes arising from the payment process are promptly identified and resolved swiftly through construction adjudication.[48]

4.1.2. Adjudication

Adjudication is a fast-track process. It takes about 28 days to complete in the UK. In other jurisdictions, such as Malaysia, it takes longer: around 55 days. That is fast in terms of forms of dispute resolution (28 months would be reasonably common in the Scottish courts, for example) – even compared with mediation, which is close to a one-stop shop for dispute resolution.

The basic procedure is broadly comparable to arbitration in many ways (albeit less formal)[49] but puts some onus on the adjudicator to govern the process: they have a somewhat inquisitorial power.[50] There are constraints on this within the bounds of natural justice.[51] The natural justice requirements, which were not in the original legislation have been imposed through the process of judicial interpretation to ensure fairness in the process. Essentially, these requirements ensure that (i) the parties have the opportunity to answer each other's arguments and (ii) the adjudicator is not biased, nor do they appear to be biased.[52]

The speed of the process gives rise to concerns about the quality of decision-making and the idea that adjudication can be "rough justice". This is a concern that the courts have leaned into.

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[45] *Bresco Electrical Services v Michael J Lonsdale* (2019) UKSC 36, para. 10.
[46] *See* e.g. the various Building and Construction Industry Security of Payment Acts introduced in the states of Australia between 1999 and 2009; the Construction Contracts Act 2002 (as amended by Construction Contracts Amendment Act 2015) in New Zealand; Singapore's Building and Construction Industry Security of Payment Act (Cap 30B) of 2004; the Security of Payment Act 2012, in Malaysia and Construction Contracts Act 2013 in Ireland.
[47] James Pickavance, *A practical guide to construction adjudication* (Wiley 2015).
[48] David Christie and Joseph Mante, 'Smart Contracts and Payment in the UK Construction: The Legal Framework' in Theodoros Dounas and Davide Lombardi (eds), *Blockchain for Construction* (Springer 2022) 167–184.
[49] *See* Deko Scotland Limited v. Edinburgh Royal Joint Venture and Others [2003] SLT 727 at para. 9, and *Bresco Electrical Services v Michael J Lonsdale* (2019) UKSC 36, para. 10.
[50] Housing Grants, Construction and Regneration Act 1996 (as amended) s. 1087 (2) (f).
[51] *Carillion Construction v Devonport Royal Dockyard* [2005] EWCA Civ 1358.
[52] Sir Peter Coulson, *Coulson on Construction Adjudication* (4th edn, OUP 2018), Chapter 12.

They acknowledge that the process may lead to "rough justice" and, to some extent, endorse that as an acceptable trade-off in the name of ensuring cash flow.

As a result, the courts will support an adjudicator who makes the wrong decision – if they do so "in the right way" (meaning, by following the appropriate procedures).[53] The key is that there is a fast decision which facilitates the overall policy of achieving cash flow. If the parties want greater purity of decision-making, they can utilise the traditional forms of dispute resolution—such as litigation or arbitration even after the interim process of adjudication. The evidence in the UK is that parties to construction disputes prefer imperfect justice to slow justice. So, even if the decision-making might be questioned in some cases, the actual process meets the needs of the parties.

4.2.Role of smart contracts and blockchain in Adjudication

The primacy of the need to ensure cash flow and the fact that this subordinates other considerations around the efficacy of the process provides an opportunity for blockchain and smart contracts. In other dispute resolution forums, the courts may see the novelty and uncertainty around blockchain as an imperfection of the process in some way, which casts doubt on the integrity of any decision-making. Adjudication gets more leeway.

Part of these benefits relate to the speed of the process: the less time taken on challenges; the more time can be spent on quality decision-making. The key features are as follows:

4.2.1. Authenticity and lack of bias of the adjudicator.

The first step in the credibility of a dispute resolution process is the credibility of the decision maker. As noted, this is ingrained in the UK legislation, which provides that the adjudicator must be "impartial".[54] While bias does not seem to be a particularly prevalent issue in UK Adjudication, the use of the blockchain smart contract can help – in the same way as with mediation - by building up databases of information on adjudicators which can be transparent and verified. Smart contracts may, in time, be able to select and record information in such a way that even underlying confidentiality can be preserved while issues can be flagged. For instance, the fact that an adjudicator may have been involved with one of the parties to a dispute in the past could be identified in a system without the specific details of that needing to be shared.

4.2.2. Improving the underlying payment process

At present, the two "sides" of the payment security legislation are conceptually distinct. The payment part is contractual and within the parties' relationship, the adjudication part is a dispute resolution process outside of it. The smart contract mechanism could help speed up the payment process and automate some of the initial steps in invoking adjudication. This might help to integrate the processes more. For example, this could help if there was an automated "Notice of Adjudication" which was served if the paying party notified the other that it was not

[53] *Bouygues UK Ltd v. Dahl-Jensen UK Ltd* [2000] BLR 49.
[54] Housing Grants, Construction and Regeneration Act 1996 (as amended), s.108 (2) (e).

paying the sum in full. At the same time, there may be scope to abuse this if a smart contract can provide some sort of automated "blocking" notice.

4.2.3. Transmission of evidence in the process itself.

Smart contracts can speed up the already quick adjudication process further by automating certain processes and recording information using the same sort of underlying processes as exist in mediation. This would particularly be in the more direct linking of breaches of the payment process with adjudication. Blockchain technology's ability to provide transparency is also valuable here. This will help the parties to develop further confidence that they have been "heard": they can transmit the information they want and engagement with it can be tracked. This may further reduce the likelihood that a party will seek to challenge the decision.

4.2.4. Collation and recording of evidence.

The speed of communication is a necessity for successful adjudication. The blockchain and its ability to transmit significant volumes of information and create transparency and authenticity is an obvious candidate to improve that further.

4.3.The particular opportunity with construction adjudication

The construction industry is known to be somewhat conservative in its adoption of new technologies. As with mediation, there may need to be efforts to educate stakeholders in this area. There are, however, three reasons why construction adjudication provides a particular opportunity for the use of blockchain and smart contracts in dispute resolution. The first of these is that the adoption of adjudication already reflects a technological success story. The second and third points are linked. They specifically relate to the legal and geographic nature of the safeguards for construction adjudication.

These are explained as follows:

4.3.1. Technological adoption success

In terms of technology, it is important to note that the conception of statutory construction adjudication arrived before technology really impacted dispute resolution. However, the development and passing of the 1996 Act coincided with the more mainstream use of the internet and, in particular, email.

This was a rising form of technology at that time, and this new form of dispute resolution, which relied on the fast transfer of information, arrived at the point when there was a new form of speedy communication. A new rapid form of dispute resolution met with a new rapid form of communication. That was somewhat serendipitous. However, the coincidence must have had some impact on the rapid development and acceptance of adjudication. It might be, however, that there was a downside to this. As originally conceived, adjudication was to be a rough and ready mechanism. One can imagine how "snail mail" and even fax transmission would have limited the amount of information which could be communicated within 28 days. The adjudicator might have had more power, in practice, to simply get on. It would be difficult

for the parties to intervene frequently or at length. However, with email, the practical cap on information transmission is effectively lifted. Given the success of adjudication, this is seen as a beneficial side effect, but the "lawyering up" formality of adjudication is sometimes questioned.

There are lessons in this for the adoption of new technologies more generally. The first step is to understand the legal processes involved.

4.3.1.1. Legal Security

The processes in adjudication are imposed by case law and legislation in the UK. These act as a constraint but also an opportunity. There are clear rules and procedures to follow and clear lines of appeal.

As a result, the legal framework provides a high degree of certainty and quality assurance for parties in dispute. When innovating in other ways, that underlying certainty is important. If appropriately deployed, these can provide a sound platform for the use of technology. The email example is instructive. There are concerns about the security and authenticity of email communication. And yet, email was adopted and used in adjudication, and there is no call today for a return to the traditional mechanism, which might be perceived to be more secure or less risky.

4.3.1.2. Geographic security

Construction adjudication provides another firm touch point upon which parties can build confidence in the technology since – at its heart – it concerns a construction contract. Therefore, unlike some other forms of dispute resolution, there will always be some form of physical asset (the thing being constructed) with which the dispute is linked in some way. Anonymity and intangibility are, therefore, less of an issue in these disputes than they might be in something which relates to the provision of a service (albeit they may still be issues). Even a sale of goods transaction has a greater risk in this respect as the geographic location – and the relevant legal jurisdiction – may be less certain.

4.4.Conclusion on the opportunity

These are firm foundations on which innovation can be built. The adjudication process balances this legal framework with scope for the parties to have flexibility in what they agree between them, otherwise. The courts are less likely to intervene if it can be shown that the imperative of cash flow, within the framework of natural justice, is being met.

4.5.Challenges in the use of blockchain and smart contracts

Therefore, Blockchain and Smart contracts provide a significant opportunity, particularly around information exchange and transparency. That does, however, bring with it a challenge. The more evidence there is in dispute, the more parties might seek to rely on aspects of it to challenge adjudication decisions. A concern is that this provides more information for parties to crawl through to find grounds to challenge the decision – the blockchain will become a

"quarry for litigation over legal niceties".[55] More information is not always better. Material can be taken out of context after the event and used to challenge the decision.

The other issue is the "oracle" one.[56] Adjudicators – complying with the statutory process - themselves must act as oracles in terms of allowing information "into" the smart contracts involved. There is, therefore, scope for human error. There may be scope to further improve the process by using smart contract-based forms of dispute resolution. At present, however, the "real life" and blockchain versions must co-exist. The constraints and opportunities provided by smart contracts and noted above however provide a framework for this as a way of defining the interaction between the parties, the adjudicator and the relevant blockchain.

So far, the UK judiciary have supported the process and the adjudicator. They would however need to be comfortable with the technology and how that was being deployed so that they understand how it works and what it is, so that they have confidence in the process with the blockchain as they do without it.

5. Conclusion

In conclusion, blockchain technology and smart contact will significantly advance dispute resolution mechanisms. Such technologies will enhance the efficiency, transparency, and security of dispute resolution mechanisms. The integration of these technologies in mediation and construction adjudication promises a more streamlined, equitable, and expedient process. Hence, the dependence on traditional, often cumbersome legal frameworks will be reduced. However, the application of such innovative technologies is challenging. Legal ambiguities surrounding smart contracts require clear regulatory frameworks to ensure their validity and enforceability. Furthermore, the complexity of technologies and the requirements for digital literacy among users present further obstacles. Different measures need to be taken to address these challenges. As this field continues to evolve, it offers a promising horizon for transforming legal processes and enhancing the efficacy of dispute resolution across various sectors.

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