Dispute Resolution on Blockchain:
An Opportunity to Increase Efficiency
of Business Dispute Resolution?

Shantanu PACHAHARA
Chandan MAHESHWARI

Abstract: With the advent of blockchain technology and smart contracts, the finance, business, and legal industries have witnessed a drastic shift in their modus operandi. A *smart contract* does not necessarily mean and include a legally binding contract as it is under the legal regime but is instead a computer software built on blockchain technology, which is competent to self-execute its functions, as well as self-enforce its results. *Smart contracts* with the help of complex algorithms have raised the efficiency of conducting business online. Consequently, disputes pertaining to smart contracts have also increased. The utilization of *smart contracts* in the legal industry has assisted businesses in maintaining the efficiency gained in the initial phase of the process and resolving their *smart contract* and/or other disputes expeditiously. The pivotal question that knocks on our door is whether a decision rendered by an autonomous computer program is binding on the parties, specifically an award rendered in a *smart contract* arbitration? This article explores rudimentary knowledge pertaining to blockchain and *smart contracts*, and analyses the validity of *smart contract* dispute resolution mechanisms and their role in enhancing business dispute resolution efficiency. Lastly, it sheds light on the legitimacy of *smart contract* arbitration under the international conventions which regulate international commercial arbitration.

Keywords: Dispute resolution, Blockchain, Smart contract arbitration, Efficiency, Legitimacy.

Shantanu PACHAHARA
Assistant Professor
Alliance University, Bangalore
E-mail: pachahara.law@gmail.com

Chandan MAHESHWARI
Ph.D. Research Scholar
National Law University, New Delhi
E-mail: chandanmaheshwari2601@gmail.com

**Booting-up the *Smart Contract* Software
— An Introduction**

Technological advancement brings about diverse alterations in our surroundings and the environment we work in. The blockchain platform is one of the technologies which possesses the capability to transform our lives and how we experience the Internet — from simple cloud storage to encrypted decentralized ledgers for data storage; from fiat currency to cryptocurrency; from in-person service bookings to autonomous online service bookings; and from traditional face-to-face arbitration to smart contract arbitration, all powered by blockchain technology. Blockchain is one of the most discussed and debated technologies of recent years. *Smart contracts* are software built on the blockchain platform which can execute multifarious service functions and obligations, including execution and enforcement of legal obligations in isolation of any external or third-party assistance. Consequently, the life cycle of *smart contracts* is entirely digital and autonomous, due to which users experience expedited and efficient resolution of their disputes.

With the integration of blockchain into the finance and services sectors, businesses have started providing online dispute resolution platforms relating to certain types of disputes, expediting dispute resolution and enhancing the efficiency of their businesses. Various companies have adopted different procedures and underlying codes to make this a reality. Therefore, the legal question that surfaces for inquiry is whether the decision or award of smart computer software is binding and enforceable through a national court?

This article sheds light on the elementary knowledge relating to blockchain technology and how smart contracts software embedded on the blockchain platform assists in enhanced efficiency in resolving business disputes. Secondly, the article analyses the legitimacy of smart contract arbitration in light of the New York Convention, United Nations Commission on International Trade Law Model Law on International Commercial Arbitration, and other international instruments relating to international commercial arbitration. Thirdly, it discusses the advantages and disadvantages of smart contract arbitration from a practical perspective, followed by a conclusion and outlook.

**An Outline of Novel Technologies
— Blockchain and *Smart Contracts***

The totality of implications brought about by any novel technological development is not estimable, and blockchain is no different. We can, however, interpret blockchain functioning and its uses in a piecemeal fashion. Keeping in mind the objectives of this article, we will briefly outline blockchain technology and *smart contracts*.

Blockchain
— A Block Ledger Technology

A blockchain stores data in parts at different places and then links it together. It is a distributed ledger that keeps information in blocks. Christidis and Devetsikiotis (2016) defined blockchain technology as "a decentralized digital database that consists of secure transactions that are copied and shared amongst the members of the network". It is important to note that there is no single blockchain technology but multiple different implementations working on the same fundamentals, storing data onto various links, and making a chain of these decentralized links to confirm the validity of data.

In general, blockchain technology is identified by the following characteristics (Kreis & Kaulartz, 2019; Michaelson & Jeskie, 2019; Hourani, 2020):

1. It is a method to collect information, i.e., a database.
2. The information is not stored centrally as it would have been in any traditional database but is decentralized on different computers at different places. Whenever any new information is fed into the database, a copy of the new data is stored in each of the existing blocks/computers, which means all information is saved several times.
3. The decentralized information is stored in interconnected blocks, thus blockchain. Each block contains some information of the preceding block, which is done using hashing. Each block contains a unique code from the previous block to validate transactions. Any change in a block would invalidate the unique code and break the link.
4. The method of validating data or transactions ensures the safety of the data fed into such blocks.

Blockchain technology enables anonymous users to establish an impregnable trust in each other in an efficacious, cost-effective, and distributed fashion. Blockchain technology has created a faith that cannot be breached and is absolute, extinguishing the need for intermediaries. However, blockchain technology by itself is just half a part of these machine-implemented self-executing contracts. The other half is the software code that manifests the codes on the blockchain, called *smart contracts*.

Smart Contracts
— Self-executing-enforcing computer software

Smart contracts are a more advanced application of blockchain technology, and they are the product of proliferation of cryptocurrencies and distributed ledger technologies (Koulu, 2016). A *smart contract* is a computer software that runs on a blockchain and can benefit from its unique characteristics. Often, when people hear the term *smart contract*, they think of an autonomous legal contract binding parties to a legal relationship. The term *smart contract* is a misnomer, as it does not always constitute a legal agreement. Instead, it is a computer program that validates the information and automatically

transfers digital assets from one party to another if certain preconditions, which were fed into its code, are met. A *smart contract* may be used to make bookings online for varied services such as flights, parcels, buses, trains, and others. If the *smart contract* receives any information validating a successful journey or delivery it will automatically transfer the money to the service provider. Suppose there is any impediment in successfully completing the service such as cancellation or delay. In that case, the *smart contract* will automatically take it into account and run the code to either refund the money to the customer's account or give the customer some other advantage, as per the contract and code. Looking from a legal perspective, *smart contracts* can perform certain legal obligations on part of the party, resulting from a legal agreement. That is to say; the software can automatically transfer the funds to the seller upon successful delivery of a shipment to the customer.

What is expected in all smart contract software is that the preconditions that result in the execution of the transaction are not verified by any third party but by the software itself (Kreis & Kaulartz, 2019). Such *smart contracts* eliminate the need for both virtual trustees and external verification and are thus cost-and-time-effective. Moreover, once the software has begun to run, neither party can interfere with its operation.

Smart contracts are coded by IT industry experts, and once coded, they execute all functions without requiring intervention. The nexus between the real-non-digital world and the blockchain is known as an 'oracle' — it is through the oracle interface that relevant information enters into the digital world (Kreis & Kaulartz, 2019). In reference to the above illustration, an oracle provides relevant information, such as real-time flight schedules, delivery receipts, and others, to the *smart contract* enabling it to show the customers real-time flight status and digital parcel tracking. Thus, a *smart contract* does not entail a legal contract, but in reference to this article, *smart contract* will include a smart legal contract, setting out and governing the parties' rights, duties, and obligations.

Smart Legal Contract Dispute Resolution
— Why to Choose?

Like any other traditional contractual relationship, a relationship arising out of a *smart contract* may be subject to disputes between the parties. The use of a *smart contract* will increase the efficiency of the transactions during the performance stage of the contract, but if, there arises any dispute concerning the performance of the *smart contract*, it may add complexity and delay in the completion of the contractual relationship. Irrespective of the case or the nature of the dispute, the parties would not want to lose the efficiency gained in the initial stage of the contract and would like to carry at least a part of it through effective dispute resolution means.

A myriad of disputes might arise in executing obligations under a *smart contract*. These disputes may or may not relate to or arise out of the concerned *smart contract*.

Fundamentally, the dispute resulting from the *smart contract* does not significantly differ from the traditional dispute. In general, a *smart contract* dispute may revolve around any complex issues relating to software or the blockchain, involving the questions pertaining to its functioning, alleged bugs in the software, or the underlying blockchain. For example, there may be impediments in the *smart contract*'s function, such as the oracle feeding incorrect information into the system. Moreover, the dispute may also relate to purely legal questions, such as the meaning and interpretation of specific legal terms which are not encoded into the *smart contract* code by the coder ('(un)foreseeable,' 'vis major,' '(un)reasonable').

Considering the dispute in isolation of its technical complexity, judges and arbitrators will adjudicate the dispute by traditional means of dispute resolution and render a binding decision. But if any perplexing technical questions need to be answered to render a decision, the assistance of an IT expert is unavoidable and imperative.

Nevertheless, as reflected above, one of the pivotal benefits of deploying *smart contracts* is that they raise the efficiency and reliability of the business transaction. If the parties resort to conventional means to resolve their dispute, the efficiency achieved during the transitional contractual performance will possibly be neutralized. The claim is initiated by filing a formal statement of claim or a notice of request for arbitration before the court or the arbitral institution. The adjudicating process takes several months to conclude, depending on the nature or size of the dispute involved. This substantial disruption of the initial efficient process may even result in a claimant's reluctance to pursue their claim in the first place. The loss of efficiency will manifest during the commencement of the dispute resolution process.

The Silicon Valley Arbitration & Mediation Center's (Silicon Valley Arbitration & Mediation Center [SVAMC], 2017) survey regarding dispute resolution in the technology sector shows that the participants perceived costs (64 percent), time taken in the resolution of disputes (57 percent), the inexperience of judges with the subject matter in question (46 percent) as the main problem with litigations. On the other hand, the expertise of the arbitrators (80 percent) and the time taken to resolve disputes (54 percent) were the main advantages of arbitration, with cost being number seven on the list. The parties who make use of a *smart contract* for their business transactions have an inherent interest in preserving at least a part of the transactional efficiency through a dispute resolution mechanism that employs a specialist neutral person. Arbitration is currently the most popular private method of dispute resolution for B2B disputes (The Queen Mary University of London, 2018). Moreover, as pointed out by Koulu (2018), blockchain technology, as with other types of digital technologies, is bound to have an impact over traditional methods of dispute resolution.

These general interests coalesce into and contribute towards the need for a smart contract dispute resolution mechanism. An automated mechanism is utilized to re-

solve any dispute arising out of *a smart contract*, which is also encoded into the smart contract's code.

Understanding the Technical Implementation of Smart Contract Dispute Resolution — The Autonomous Dispute Resolution Protocol

As mentioned above, a *smart contract* cannot be stopped, interfered with, or amended in its code once initiated to execute. Stopping, interfering, or amendment can only be done if such a move is contemplated beforehand. Interfering with the code goes against the concept of self-execution and non-interference of parties. And hence, the power to interfere with the *smart contract* must be (a) foreseen in principle, (b) embedded in its code, and (c) it should be granted to a reliable third party (Kreis & Kaulartz, 2019). Such a reliable and trusted third party will act as an oracle, permitting it to make determinations outside the *smart contract*'s ken. The oracle will insert relevant information into the *smart contract* and, if necessary, influence its execution to illuminate the third parties' determinations. There are as such no restrictions as to who or what the trusted third party could be from a technical viewpoint. But in light of the ethos and principles of using a *smart contract*, the oracle shall only be enabled to interfere with the *smart contract* in cases of necessity, such as if the party expresses dissatisfaction with the working of the software or the result produced.

The above-stated considerations reflect the cornerstone of the technical implementation of a smart contract dispute resolution system, which functions as follows (CodeLegit White Paper on Blockchain Arbitration, n.d.).

The parties trigger the *smart contract* that has embedded foreseen interference code. The *smart contract* self-executes. The software provides a grace period to the parties to raise an objection to the *smart contracts*' functioning and result. If the party raises an issue before the expiry of the grace period, it will pause the execution of the *smart contract*. The asset flow may or may not be reversed (single or multiple transactions), or it may have absolutely no effect on the *smart contract*. Raising the issue will trigger an autonomous dispute resolution protocol through the 'Dispute Resolution Library'. The *smart contract* can directly enforce the outcome or the specific relief granted of such dispute resolution process by implementing it by itself. This is one illustrative process that forms the smart contract dispute resolution process outline. Still, the forum and specific procedure for smart contract dispute resolution are practically unlimited and depend on the parties' interests and needs in each case (see Figure 1).

Smart Contract Dispute Resolution Mechanisms — Enhanced Efficiency in Business Disputes

Alternative dispute resolution (ADR) mechanisms based on contractual obligations allow the parties to tailor the applicable procedural rules as per their need; specifically,
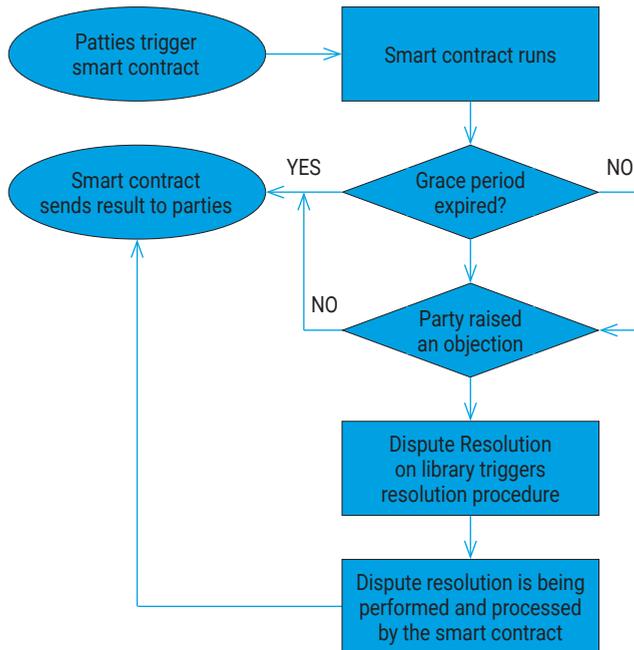
Figure 1: Function of a *smart contract*
Source: CodeLegit, n.d.

ADR methods including arbitration, mediation, conciliation, expert determination, and private adjudication allow for considerable flexibility and party autonomy (Born, 2014). Unlike an arbitral award, the decision in the rest of ADR methods, be it mediation, expert determination, or adjudication, is not enforceable as a decree on the parties. Still, there is no doubt that they allow the parties to settle their differences cost-effectively, specifically in cases where the difference relates to any question of fact, such as payment disputes, simple logistics disputes, and others. Differences involving simple questions and insignificant amounts of money require a more straightforward procedure. Kreis et al. (2019) found that, especially in the Information Technology (IT) sector, parties are more inclined towards fast resolution of their disputes in somewhat isolation of the actual legal implication.

Let's look at the different dispute resolution mechanisms adopted by leading online payment or trading corporations, such as PayPal, WazirX, or similar platforms. It is axiomatic that these corporations prefer expeditiousness to binding decisions for low-value claims. One example of such dispute resolution mechanism (WazirX, n.d.) is the robust dispute resolution of peer-to-peer (P2P) disputes arising between a seller and a buyer on WazirX. If the seller or buyer is of the opinion that there exists any discrepancy in the P2P cryptocurrency transaction, he can move such P2P transaction to dispute mode.

The disputed transactions are multi-checked through a fool-proof process providing absolute accuracy while reviewing the dispute. Then the dispute team can make a fair decision to finally settle the dispute in favor of either seller or buyer. The dispute resolution team relies on blockchain to validate the payments.

Another mechanism (PayPal, n.d.) is adopted by the PayPal Dispute Resolution Process. The process facilitates the settlement of disputes regarding any purchase or transaction done via PayPal. The buyer may initiate a dispute by opening a dispute in the PayPal Resolution Center by explaining the issue. The issue of such a dispute raised by the buyer may be regarding an item not received or an item significantly not as described. There are no processing fees for such issues, and the owner of the process or policy is PayPal. Once the dispute has been brought to the seller's attention, they are enabled to respond to the buyer's issue within a few days via e-mail. This opens a direct communication between the seller and the buyer and attempts to facilitate mutual settlement between them. If they fail to settle mutually, the issue can be escalated to the next stage where there is the direct involvement of PayPal and is called a 'claim". Therein, PayPal relooks into the claim and requests the seller to render proof of a document, delivery, or other documents. On this basis, PayPal renders a decision. It is non-binding expeditious dispute resolution of international low-value claims.

Moreover, another protocol identified as 'double-blind bidding' ("ICDR Manufacturer/Supplier Online Dispute Resolution Protocol" [MSODRP]) is also employed by various online service providers and dispute resolution organizations, including International Centre for Dispute Resolution (ICDR). Double-blind bidding is a confidential process of dispute resolution which allows the parties to offer and demand against each other without letting each other know what has been offered or demanded and evaluated by an unbiased third-party autonomous system. The system (MSODRP) evaluates the amount offered and demanded, and if the offer is greater or equal to the other party's demand, the system declares a settlement and considers the dispute resolved. ICDR Double Blind Bidding Manufacturer/Supplier Online Dispute Resolution Protocol (MSODRP) assists the manufacturer and the supplier parties to maintain the cordial relationship by resolving minor payments disputes within a short time frame of sixty days.

Keeping in mind the nature and magnitude of the dispute, various protocols could be employed to resolve business-to-business disputes expeditiously. As pointed out by Mcllwrath (2010), these uncomplicated protocols based on simple systems are indeed used in commercial disputes. Smart contract non-binding dispute resolution protocols are best suited for small-value and high-volume disputes. Besides an agreement to resolve disputes via these novel and expeditious smart protocols, parties should also explicitly provide a binding and final resolution, like arbitration.

**Smart Contract Dispute Resolution Mechanism Legitimacy
— Smart Contract Award Upheld or Quashed?**

The above illuminated technical implementation of dispute resolution via the Dispute Resolution Library initiates an independent dispute resolution process. Nevertheless, the question arises whether such implementation of smart contract dispute resolution is sufficient to bind the parties legally or are there any further requirements to uphold such a decision in a court of law. Where disputes arising out of a *smart contract* are directly referred to a court of law, such a question becomes irrelevant as the court follows its own procedure to adjudicate any matter made before it. But the question becomes significant regarding cases referred to any alternative dispute resolution mechanism, such as arbitration, conciliation, mediation, or adjudication.

Despite the numerous potential dispute resolution mechanisms which could be utilized by parties to resolve their dispute outside the court, the focus is drawn to the requirements of arbitration proceedings, specifically because arbitration is the only method that requires specific formal prerequisites under the national laws (inter alia, Romania Code of Civil Procedure, 1965; Indian Arbitration and Conciliation Act, 1996; U.K. Arbitration Act, 1996), and international conventions (New York Convention [NYC], 1958; United Nations Commissions on International Trade Law [UNCITRAL] Model Law,1985) and arbitration is the only alternative dispute resolution method with a protocol similar to that of judicial adjudication rendering a binding decision; nationally, internationally and off-blockchain. Currently, there are no uniform standard arbitration procedures for arbitrating disputes involving smart agreements (Hourani, 2019). They are just very new. The purpose of this section is to provide an outline of how various aspects of smart contract arbitration are implemented under the applicable law and assess whether arbitration can be considered having business sustainability to enable sufficient access to justice from a legal perspective.

**Smart Contract Arbitration Agreement
— Indispensable Requirement**

To conduct valid arbitration proceedings, specific prerequisites must exist to make the award passed binding, recognizable, and enforceable through the national courts. Article II(1) of the NYC provides for an indispensable requirement of an 'agreement in writing' concerning the subject matter of the dispute capable of settlement by arbitration (NYC). The peculiar feature of a smart contract arbitration is that the arbitration agreement regarding its form is entirely authenticated in computer language and not in spoken languages. This raises the question of whether an arbitration agreement digitally signed by the parties containing the agreement in a code language can be validated and recognized by the legal framework.

Article II(2) of the NYC elucidates the term 'in writing' as an arbitration clause in a contract or a whole agreement signed by the parties or that which form part of letters or telegrams exchanged between the parties (NYC). The scope of Article II(2) is limited to conventional modes of communication and agreement but The United Nations Commissions on International Trade Law (UNCITRAL) in its thirty-ninth session passed a recommendation extending its application to electronic communications in international contracts ("Recommendation regarding the interpretation of Article II, paragraph 2, and Article VII, paragraph 1, of the Convention on the Recognition and Enforcement of Foreign Arbitral Awards", 2006). It can be said safely that a broad interpretation can be given to the term 'in writing' under the NYC (Wolff, 2018). By applying these provisions to an arbitration agreement that is in the form of code, it can be said that NYC recognizes such agreements to be in writing. Article VII(3) of UNCITRAL Model Law on International Commercial Arbitration provides that an agreement is in writing if it is recorded in any form and concluded orally, by conduct, or by other means. (UNCITRAL). Article VII(4) states that an arbitration agreement is in writing if it is an electronic communication and accessible for subsequent reference. (UNCITRAL). Thus, the words 'other means' and 'electronic communication' under Article VII of UNCITRAL confirm the term agreement's broad scope in writing, enabling it to include a smart contract arbitration agreement encrypted in code.

There are, however, restrictions under the NYC concerning the recognition of an arbitration agreement in code as satisfying the 'in writing' prerequisite. Articles XI(c), V(1)(a), and IV(1)(b) of NYC direct the national courts back to the pertinent national law. These provisions culminate into a situation where if the national law in issue does not recognize a comprehensive understanding of the term 'in writing' prerequisite of the NYC, then the smart contract arbitration agreement in form of a code might not be acknowledged under the convention in that jurisdiction. The remedy for such an impediment is to include the arbitration agreement in a *smart contract*'s code — the arbitration agreement can be fed in the code in the English language comprehensible to the parties along with the agreement in computer language. This can be done by inserting comments in the *smart contract* code, generally indicated by a hash before each comment line. In such a scenario, the agreement is present in a comprehensible and permanent form for evidentiary purpose before the court. Moreover, it reflects the meeting of the mind of the parties to resort to smart contract arbitration.

For countries that are signatories to the NYC but have not adopted the UNCITRAL Model Law and have instead adopted other international conventions which provide for a more favourable approach towards recognition and enforcement of the award, such an international convention would supersede the applicability of the NYC, as per Article 7(1) of NYC. For illustrative purposes, the United Nations Convention on the Use of Electronic Communication in International Contracts, New York, 2005 favors

a broader interpretation of the term 'in writing'. It can facilitate the national court of such countries to recognize an award based on an agreement in code passed in a smart contract arbitration.

Reference by National Court to Arbitration
— Autonomous Initiation Validity

A *smart contract* can automatically trigger arbitration proceedings by executing the arbitration agreement encoded within its code upon fulfilment of certain pre-inserted stipulations (CodeLegit, n.d.). This autonomous initiation of arbitration proceedings eliminates the need for an arbitration administer to initiate the arbitration proceedings. Article II(3) of NYC stipulates that a national court shall refer the parties to arbitration if there exists an arbitration agreement between the parties on the point of the issue raised before the national court, except if the court finds the agreement to be null and void, inoperative, and unperformable. There is no inconsistency between Article II(3) and the autonomous initiation of the arbitration proceeding as Article II(3) speaks of a situation prior to initiation of arbitration proceedings. However, if the agreement contained in the form of code is null and void ab initio and the *smart contract* executes the coded agreement, it would breach Article II(3) unless a programmer intervenes and terminates the autonomous arbitration process. From a legal perspective, there is not much difference between the automated enforcement of the arbitration agreement and the traditional commencement of arbitration proceeding as there is a meeting of minds in both, so this would not necessarily be a problem from a legal perspective.

Prerequisite of Due Process in Arbitration
— Validity of The Digital Arbitral Proceeding

Depending on the coding style, the design of the smart contract arbitration may vary; the coder may encrypt an utterly autonomous process of conducting the arbitral proceedings. In such situations, keeping in mind the *curial law*, an issue may arise regarding the opportunity of being heard in arbitral proceedings. As the proceeding was conducted entirely autonomously, the parties were not given the opportunity to present their arguments in the arbitral proceedings. The UNCITRAL Model Law under Article 18 stipulates that the parties shall be treated equally and shall be given a full chance to present their case before the tribunal. Conducting completely autonomous and digital proceedings without allowing any parties to present their arguments can substantially breach the principles of natural justice.

Attention is drawn to a recent case wherein the Amsterdam Court of Appeal refused to enforce three arbitral awards pertaining to the trading of bitcoins passed in the United States. The Court pronounced that the arbitral proceedings (conducted on email) did not provide the opportunity of being heard to the parties and defend their claim. Hence,

they were in breach of Article 1075Rv of the Code of Civil Procedure of the Netherlands and were thus against the public policy of the Netherlands.

The organization facilitating smart contract arbitration shall encode such a design that ensures and entails a procedure that provides both the parties equal opportunity to present their case and advance arguments to defend their case. One way is to conduct a documents-based arbitration. A smart contract arbitration initiated autonomously and supplemented with all relevant documents and pleadings through the oracle could be vital. It doesn't seem easy, but a right cocktail of computer and human interface would taste just right, facilitating due process, the right to a fair trial, and access to justice.

Smart Contract Arbitration Award
— Form, Recognition, and Enforcement of Smart Award

One peculiar characteristic of a smart contract arbitration decision is that it is authenticated or verified in code and communicated to the parties through the smart contract software (CodeLegit). Authentication of the decision through a code raises the issue of whether the arbitrator(s) can include their reasoning and signature in code and whether such reason and signature would stand the test of the applicable national law. Companies offering smart contract arbitration services often employ real humans to act as jurors or arbitrators to give straightforward 'yes' or 'no' or 'not applicable' answers (Keleros, n. d.). Moreover, specific organizations adopt a system that provides an arbitral award in writing and communicates the written award to the parties through a post, if such is the necessary legal requirement for enforcement of the award under the applicable law (CodeLegit).

The analysis of whether a smart contract award would be recognized and enforced by the national courts under the NYC is imperative. The NYC mandates neither any specific form of arbitral award nor any manner in which the arbitral award shall be communicated to the parties. Under Article I of NYC, there is no mention of what the form, or content, or mode of communication of the award shall be. Article III of the NYC states that each contracting country shall recognize an arbitral award as final and binding subject to the country's national law where such award is relied upon. And a conjoint reading of Article I along with Article VII(1) of NYC (preferential rule on the recognition and enforcement as stated above), it can be safely deduced that an award in the form of a code and communicated over the *smart contract* to the parties can be recognized and enforced under NYC. This safety can be breached by an argument that the coded award could be refused recognition and enforcement under Article V(1)(e) of the NYC, which stipulates that if the national law of the enforcing state does not recognize an award in coded form or communication over the smart contract software, then such coded awards would not be recognized and enforced under the Convention.

Moving onto the enforcement or execution stage of smart contact arbitration. The enforcement of a smart contract arbitration award is digitally executed without the interference of a court. It eliminates the requirement of the national court to enforce or execute the coded award. This again raises an issue pertaining to the legitimacy of such autonomously executed coded awards. Moreover, the automated enforcement of the arbitral award may be in conflict with national laws regarding the recognition of the award under NYC (Ortolani, 2019). Article III of the NYC states that each contracting country shall recognize an arbitral award as final and binding subject to the country's national law where such award is relied upon. Article III refers to the laws of the national jurisdiction for recognition and enforcement of an award. So, whether an autonomously executed coded award would stand before the national court depends on the national law in question.

Advantages and Disadvantages of Blockchain Arbitration
— Not Exactly a Losing Battle but an Uphill Battle

This part accentuates the arguments for and against the use of blockchain arbitration in business-to-business (B2B) disputes and its efficiency in resolving business disputes. It illuminates a pragmatic assessment of the need for smart contract arbitrations and its practical limitations as a forum for resolving B2B disputes. The tenets of international commercial arbitration are expeditiousness, cost-efficiency, and fair resolution of commercial disputes, but in recent times, there has been a disruption in the international arbitration community regarding these tenets, specifically cost-and-time-efficiency. International arbitration is taking the role of litigation (Trakman & Montgomery, 2017). One of the many benefits of smart contract arbitration is that it offers efficiency in terms of time and cost (Soares, 2018).

Technology is impacting arbitration as the main contribution is increased efficiency and the reduction of costs (Vanniewenhuyse, 2018). The enhanced efficiency of smart contract arbitration needs to be understood from three outlooks. First, the procedure is entirely digital and is entirely conducted online on a blockchain platform. This eliminates the cost of travel and securing a venue for the proceedings. Second, there is greater accessibility to information and documents. The smart contract arbitration, which is embedded on a blockchain, can easily make accessible all information and documents to the parties remotely. The smart contract software stores all the documents and verifies their authenticity through the blockchain network verification and encryption procedure (Barnett & Treleaven, 2018). Third, smart contract arbitration eliminates human intervention and autonomously functions on the decentralized structure of the blockchain. It implies that there is no need for outside assistance to enforce the arbitration agreement and the award in smart contract arbitrations. The decentralized structure of the blockchain ensures that the platform is transparent and there is real-time visibility and streamlining of the process, reducing the in-person administrative

processing time. It results in enhanced efficiency in the procedure while eliminating the human error involved.

Traditional arbitration at times becomes the victim of a breach of confidentiality and security when the systems used to store case documentation are compromised due to hacking attacks. In Libnanco v. Republic of Turkey (ICSID ARB/06/8), the defendant admitted to obtaining information illegally by hacking the claimant's correspondence. The decentralized and encrypted blockchain technology architecture makes the system more resilient to hacking in comparison to the cloud storage used in traditional arbitration proceedings (Mohsin et al., 2019). Better security is the result of better work done on the blockchain network (Mik, 2017). It is almost impossible to breach blockchain from a single point of entry as the data is stored on the ledgers of all the members of the network with interlocking encryption verified at each step. Thus, the security of the smart contract system is provided by encryption and timestamping each transaction block on the system. Consequently, the smart arbitration procedure benefits from higher security levels than cloud storage, especially in private permissioned networks.

Garth and Capellati's definition of access to justice places paramount importance on the element of cost and time in rendering justice (Garth & Capelleti, 1978). In this regard, smart contract arbitration provides for efficient and secure resolution of disputes enhancing the parties' access to justice, specifically suited for low-value B2B disputes.

Shedding light on the practical limitations of smart contract arbitration, there arise several questions such as whether such coded software is considered to be legally binding and equivalent to a standard contract. This question remains unclear due to the lack of uniform international regulations. Moreover, there is another issue regarding the interpretation of such smart contracts, for example, which of the two should prevail if there exists any inconsistency between the written code and the wordings of the contract (Maxwell & Vannieuwenhuyse, 2018). In addition to this, the chances of detecting any vitiating circumstances are rare, leading to mistakes in the execution of the proceedings due to the automated execution with no way to stop the execution. It is pointed out that shifting towards electronic-based communication without human intervention can cause a multitude of misinterpretations in the execution of the smart contract (Wahab & Katsh, 2018). Moreover, an autonomous arbitration proceeding with an artificial intelligence arbitrator may lack the human touch of empathy, emotions, and morals, even though they are not considered as fundamentals of the process but holds importance from a humanity perspective (Vanniewenhuyse, 2018). These arguments are against smart contract arbitration and reflect the limited flexibility of smart contract arbitration protocols.

Apart from lack of flexibility, smart contract arbitration is also prone to security breaches as it is not entirely failsafe from a security perspective; for example, the private key which is used to access the data and sign the transaction can be stolen to access data

illegally. Moreover, there also exists other data privacy issues (such as, what happens to the data stored on the blockchain?), which further negates the argument of increased efficiency of the smart contract arbitration.

Despite the efficiency of smart contract arbitration in private permissioned blockchain networks, it has been asserted that it would not be pragmatic to implement smart contract systems on a large scale or public domains because of the problems with system responsiveness, meaning thereby that it would perform functions very slowly (Giancaspro, 2017).

Smart contract arbitration provides several pragmatic solutions to some of the issues that hinder the efficiency of traditional in-person arbitration. These solutions facilitate enhanced access to justice in B2B disputes, specifically in blockchain-based disputes relating to supply chain, documentation, logistics, and online bookings. While on the other hand, detractors raise several questions regarding the immutable security and impeccable execution of the procedure that creates technical and legal barriers. In other words, from a practical perspective, the adoption of smart contract arbitration enhances access to justice but can also hinder it at times, making it an uphill battle.

Conclusion

No promise can be an end in itself; a promise must be executed for a successful performance of the contract. Blockchain ledgers are presumed to have immutable trustworthiness and security, incorporated in smart contracts. These smart contract ledgers are destined to be utilized across varied fields — dispute resolution/arbitration is just one of them.

First contracts were digitalized, and now, in the next stage, the contracts are automated — capable of self-execution and enforcement — all possible because of blockchain technology. Smart contract software possesses the capability to increase the efficiency of business transactions significantly, but disputes nonetheless still arise, which must also be settled through a smart dispute resolution system to preserve the efficiency gained in the initial stage of the transactions. The efficiency of business lies in a speedy dispute resolution mechanism which can be substantially obtained by resorting to smart contract dispute redressal mechanism or smart contract arbitration. The year 2020, due to the pandemic COVID-19, largely contributed to the acceleration of blockchain dispute resolution.

Looking from the international legal framework perspective, smart contract arbitration is a legitimate mechanism of binding dispute resolution subject to the fulfillment of the mandatory pre-requisites of arbitration. NYC is relatively favorable towards significant aspects of smart contract arbitration despite being faced with several limitations. The major drawback is at the national level, where NYC is side-lined, and the national legislation occupies the field.

Smart contract dispute redressal mechanism is without any iota of doubt a legitimate but a non-binding alternative dispute redressal mechanism. Notwithstanding the limitations, a smart contract presents the highest efficiency level, especially when used to resolve high volume-less value disputes such as peer-to-peer transactions disputes on financial servers, logistics disputes, flight booking, hotel bookings, etc. Such a simple but intelligent dispute resolution mechanism based on blockchain technology can highly enhance the efficiency of a business. Smart contracts provide the customer with a seamless redressal of his dispute making him a happy and returning customer.

What needs to be developed and designed is a better smart contract arbitration protocol that fulfills all essentials of arbitration and guarantees better access to justice for the parties. Moreover, the legislatures of arbitration-favoring states shall keep turning their wheels to include smart contract arbitration within the ambit of the national arbitration legislation. Such a trusted protocol can only be developed when the leading minds of the legal and information technology sectors work together in such an endeavor.

References
1. Born, G. B. (2014). *International Commercial Arbitration*. Wolters Kluwer.
2. Barnett, J., & Treleaven, P. (2018). Algorithmic dispute resolution—The automation of professional dispute resolution using AI and Blockchain technologies. *The Computer Journal*, *61*(3), 399–408. DOI: https://doi.org/10.1093/comjnl/bxx103
3. Christidis, K., & Devetsikiotis, M. (2016). Blockchains and smart contracts for the Internet of Things. *IEEE Access*, *4*, 2292–2303.
4. CodeLegit. (n.d.). *White Paper on Blockchain Arbitration*. Retrieved from https://docs.google.com/document/d/1mDKjaNpKtAkjxxYElAjWrBgXnQGHbkzH/edit?usp=sharing&ouid=115935577927484233781&rtpof=true&sd=true/.
5. Garth, B. G., & Cappelletti, M. (1978). Access to justice: The newest wave in the worldwide movement to make rights effective. *Articles by Maurer Faculty*, 181–292.
6. Giancaspro, M. (2017). Is a 'smart contract' really a smart idea? Insights from a legal perspective. *Computer Law & Security Review*, *33*, 825–835.
7. Hourani S. (2019). *The legal reality of the recognition and enforcement of cross-border Blockchain-based arbitral awards: Beyond futuristic idealism?.* Off the Chain. Retrieved from https://eprints.mdx.ac.uk/29090/.
8. Hourani S. (2020). *The resolution of b2b disputes in blockchain based arbitration: A solution for improving the parties' right of access to justice in the digital age?* In L. V. P., de Oliveira and S. Hourani (Eds.), Access to justice in arbitration: Concept, context and practice (pp. 251–272). Kluwer Law International
9. International Centre for Dispute Resolution. (n.d.). ICDR Manufacturer/Supplier Online Dispute Resolution Program frequently asked questions. *Services*. Retrieved from https://icdr.org/msodr.
10. Koulu, R. (2018). *Law, technology and dispute resolution: The privatisation of coercion.* Routledge.

11. Koulu, R. (2016). Blockchains and online dispute resolution: Smart contracts as an alternative to enforcement. *Scripted*, *13*(1), 41–69.

12. Kaulartz, M., & Kreis, F. (2019). Smart contracts and dispute resolution – A chance to raise efficiency? *ASA Bulletin*, *2*, 336–357.

13. Keleros. (n.d.). Court. Retrieved from https://kleros.gitbook.io/docs/products/court/.

14. Michaelson P. L., & Jeskie S. A. (2019). Arbitrating disputes involving blockchains, smart contracts, and smart legal contracts. *Dispute Resolution Journal, 74*(4), 89–134.

15. Maxwell, W., & Vannieuwenhuyse, G. (2018). Robots replacing arbitrators: Smart contract arbitration. *International Chamber of Commerce (ICC) Dispute Bulletin*, 24–33.

16. Mik, E. (2017). Smart contracts: Terminology, technical limitations and real-world complexity. *Law, Innovation and Technology*, *9*(2), 269–300.

17. Mohsin, A. H., Zaidan, A. A., Zaidan, B. B., Albahri, O. S., Albahri, A. S., Alsalem, M. A., & Mohammed, K. I. (2019). Blockchain authentication of network applications: Taxonomy, classification, capabilities, open challenges, motivations, recommendations and future directions. *Computer Standards & Interfaces*, *64*, 41–60.

18. Mcllwrath M. (2010). Anti-Arbitration: Coming soon to a commercial dispute near you? Inexpensive on-line mediation and arbitration. *Kluwer Arbitration Blog*. Retrieved from http://arbitrationblog.kluwerarbitration.com/2010/10/31/anti-arbitration-coming-soon-to-a-commercial-dispute-near-you-inexpensive-on-line-mediation-and-arbitration/.

19. Libnanco v. Republic of Turkey. ICSID ARB/06/8. Retrieved from http://icsidfiles.worldbank.org/icsid/icsidblobs/onlineawards/C77/DC4632_en.pdf/.

20. Ortolani, P. (2019). *The impact of blockchain technologies and smart contracts: Arbitration and court litigation at the crossroads*. Uniform Law Review, *24*(2), 430–448.

21. PayPal. (n.d.). Disputes, claims, chargebacks, and bank reversals. *Business Resource Center*. Retrieved from https://www.paypal.com/us/brc/article/customer-disputes-claims-chargebacks-bank-reversals.

22. Queen Mary University of London. (2018). *2018 International arbitration survey: The evolution of international arbitration*. Queen Mary University of London.

23. United Nations Commission on International Trade Law. (2006). Recommendation regarding the interpretation of article II, paragraph 2, and article VII, paragraph 1, of the Convention on the Recognition and Enforcement of Foreign Arbitral Awards, done in New York, 10 June 1958. Retrieved from https://uncitral.un.org/en/texts/arbitration/explanatorytexts/recommendations/foreign_arbitral_awards/.

24. Soares, F. U. (2018). New technologies and arbitration. *Indian Journal of Arbitration Law*, *7*(1), 84–103.

25. Trakman, L., & Montgomery, H. (2017). The 'judicialization' of international commercial arbitration: Pitfall or virtue? *Leiden Journal of International Law, 30*(2), 405–434. DOI:10.1017/S0922156517000024.

26. United Nations Commission on International Trade Law. (1985). *Model Law on International Commercial Arbitration*. UNCITRAL.

27. Vanniewenhuyse. (2018) Arbitration and new technologies: Mutual benefits. Journal of International Arbitration, *35*(1), 119–129.

28. Wahab, M., & Katsh, E. (2018). Revolutionizing technologies and the use of technology in international arbitration: Innovation, legitimacy, prospects and challenges. In M. Piers & C. Aschauer (Eds.), *Arbitration in the Digital Age: The Brave New World of Arbitration* (pp. 27–55). Cambridge: Cambridge University Press.

29. WazirX. (n.d.). WazirX P2P - How it Works? *Support*. Retrieved from https://support. wazirx.com/hc/en-us/articles/360007205514-WazirX-P2P-How-it-Works-.

30. Wolff, R. (2018). E-arbitration agreements and e-awards: Arbitration agreements concluded in an electronic environment and digital arbitral awards. In M. Piers & C. Aschauer (Eds.), *Arbitration in the digital age: the brave new world of arbitration* (pp. 151–181). Cambridge: Cambridge University Press.