

Smart Contracts and Smart Dispute Resolution

Just Hype or a Real Game Changer?

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Abstract

This article explains the functioning of smart contracts and technology underlying blockchain. This contribution aims to compare smart contracts with traditional contracts and discuss their situation under the present contract law. It further discusses possible issues that may arise out of the application of smart contracts, for instance, coding errors and programming defects. It studies the possible application of smart contracts to specific fields, such as e-commerce and consumer transactions and possible disputes arising out of this application. It divides the smart contracts into categories based on their form and discusses legal issues in regard to their application.

Against the common perception that smart contracts will replace the judicial enforcement of traditional contracts, it argues that smart contracts will not replace the system but are rather another form of contracts to be governed by it. In fact, the interplay of smart contracts and contractual law creates possible legal issues as to their validity, recognition and enforcement. It provides possible solutions as to the legal issues arising out of the application of smart contracts under present contract law. The study concludes that a robust and 'smart' dispute resolution mechanism is required for dealing with disputes arising out of the application of new technology. Online or blockchain arbitration and other online dispute resolution mechanisms are argued to be better suited to dealing with such disputes.

Keywords: smart contracts, blockchain, arbitration, dispute resolution, contract law, distributed ledger technology, internet of things, cyber law, technology, innovation.

1 Introduction

Innovation and technology are developing at such a rapid pace that law continually struggles to catch up with the new developments. In a similar fashion, the new technology called 'smart contracts' is challenging the way traditional contracts are constructed and performed. Smart contracts bring automation to the performance and execution of contracts. This automation of contracts is

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brought about by computer programmes that execute the terms of contract as defined in the computer code. This brings a shift in the traditional concept of manual performance of the contractual obligations by the parties to contract. The parties are no longer responsible for the performance under the new concept, where the machines ensure the performance by excluding human discretion from the process. The concept of smart contracts is built on the idea of private justice and self-help, which are also the reasons why parties to a contract use dispute resolution mechanisms such as arbitration and online dispute resolution.

A most practical example of a smart contract is the vending machine, which dispenses items automatically after a coin is inserted. It presents the simplest application of a smart contract in real life, where the machine will not dispense the item until the coin is inserted and once the coin is inserted, it is absolute that machine will dispense the chosen item and its execution cannot be stopped. Smart contracts also work on a similar basis and seek to create a contract that is auto-executable on fulfilment of certain conditions. The performance of a contract cannot be stopped or paused once those conditions have been met, and the contract will execute itself.

Although smart contracts have long been in use, their recent application includes the use of blockchain technology, which will be elaborated later in this article. Blockchain-based smart contracts are irreversible in nature and cannot be modified once launched into the blockchain network. Their performance is ensured by nodes, which are users who run the blockchain network. Both technologies work in harmony, as smart contracts execute the performance of the terms of a contract, while blockchain ensures that the code is not tampered with and the execution is verified by a large number of nodes on the blockchain network.

With the implementation of new technology, many practical problems could arise, and legal issues are bound to follow. The nature of legal issues, disputes and method of resolving such disputes will also see a shift along with the nature of contractual relations and execution of contracts brought by smart contracts. This article explains certain legal issues that could arise with this emerging technology and proposes some developments in the law in order to deal with it. First, it provides a background of smart contracts and their functioning together with blockchain technology. It then makes a brief comparison of smart contracts with traditional contracts and the former's interpretation under the present contract law. Furthermore, the article highlights issues concerning the validity of smart contracts and the legal issues that may arise out of their creation, performance and enforcement.

The article divides smart contracts into, first, those that are executed and verified through blockchain but that have a physical copy of contract substantiating the agreement of parties, which, in practice, do not lead to many problems as to their validity and enforcement. Secondly smart contracts *ex machina*, and those which are written entirely in the form of a codewould be the focus of the article as possible issues might arise as to their legal validity and enforceability. Furthermore, Section 3 outlines the potential issues and disputes that might arise with their use, which include, first, their validity and recognition

under the present contract law, and second, the coding and programming defects, and irreversible nature of smart contracts. The third type of issues are related to trust in the context of the potential application of smart contracts in e-commerce. Section 4 outlines the solutions to the problems outlined in Section 3. This article analyses the potential for blockchain-based arbitration to be the smart dispute resolution mechanism for blockchain-based smart contracts and concludes with a proposal that arbitration is a better dispute resolution mechanism for smart contract disputes than the national courts.

2 Background

2.1 Smart Contracts

A smart contract is defined as an agreement whose execution is automated.¹ Such automation is made possible using programmable applications or codes that give effect to the legal agreement between parties to a contract. A smart contract may include an asset in exchange for value or in exchange for an asset. Furthermore, in the case of blockchain-based smart contracts, the value of consideration could be represented by a digital token or cryptocurrency.² Simply stated, a smart contract is a code-based auto-enforcement of the legal agreement of parties to a contract, the terms of which cannot be modified once the code is launched into the blockchain network (in the case of blockchain-based smart contracts). The performance and enforcement of contractual conditions occur automatically without the need for human intervention once such a contract is programmed into a code.³

Nick Szabo, who introduced the concept of smart contracts in 1994, defined it thus:⁴

A smart contract is a set of promises, specified in digital form, including protocols within which the parties perform on these promises.

Such programs or codes might have control over digital or physical assets, which is made possible using the internet of things (IoT) technologies that are often used to control physical things. A practical example of such control can be, for instance, using a remote code to control access into a building by the owner or rental agency. The code can be remotely changed every time there is a new tenant and stays valid for a specific period, according to the booking arrangements. Simply, a smart contract enforces the agreement between the parties and ensures

- 1 Max Raskin, 'The Law and Legality of Smart Contracts' (2017) 1 *Georgetown Law Technology Review* 305, 309.
- 2 Philippa Ryan, 'Smart Contract Relations in e-Commerce: Legal Implications of Exchanges Conducted on the Blockchain' (2017) 7(10) *Technology Innovation Management Review* 10.
- 3 Coindesk, 'How Do Ethereum Smart Contracts Work', www.coindesk.com/information/ethereum-smart-contracts-work/ (accessed 24 January 2021).
- 4 Nick Szabo, 'Smart Contracts' (1994), www.fon.hum.uva.nl/rob/Courses/InformationInSpeech/CDROM/Literature/LOTwinterschool2006/szabo.best.vwh.net/idea.html (accessed 10 August 2018).

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its performance on each side. It seeks to exclude the voluntary enforcement of obligation by parties to a contract, which, in some cases, requires litigation or enforcement in the civil courts, involving a lengthy and costly process.

2.2 Blockchain Technology

The blockchain is a ledger technology that seeks to resolve any problems of trust between the users by providing a high level of security to transactions that take place over its network. It makes use of distributed ledger technology (DLT), which is a network of nodes that verify a transaction once a request is made for such a purpose. This node then creates a block that is added to a chain of blocks (blockchain) after being timestamped and verified by other nodes on the network. The chain is continuous, and a block once stored on the blockchain cannot be modified. If any individual node unilaterally tries to modify the data stored on a blockchain, the other nodes will not verify such a transaction, which will be rendered invalid. Therefore, blockchain is practically a ledger of data being stored and timestamped continuously after the transaction on the network. Any modifications or reverse transactions must be verified and stored on a blockchain again as a new block.⁵

The major advantage of blockchain technology is that it consists of a peer-to-peer network interconnecting everyone on it without the need for any central authority to manage the network, such as intermediaries.⁶ All nodes on the network are responsible to each other for verification and creation of new blocks, which is done by consensus protocols. Payments are made using the digital cryptocurrency such as bitcoin.⁷ A transfer of bitcoins from one account to the other is stored on the blockchain after being verified by nodes. The blockchain can be open to the public or can stay private. Furthermore, the public blockchains are stored with all the nodes on a distributed network. However, a single node cannot modify a blockchain without being verified by other nodes, which makes it unmodifiable.

2.3 Use of Smart Contracts Through a Blockchain

A blockchain seeks to create a trustless environment through smart contracting in which there is no need for intermediaries. Therefore, for example, the funds from a transferor will get transferred only once the underlying obligation is fulfilled. For instance, in a simple e-commerce transaction, the money will get transferred to the seller only once the item purchased has been delivered. This is different from paying in advance such as in the case of regular online purchases, which put the seller in a stronger position because it has already received the funds and is yet to deliver the items purchased. Owing to the possible issues that might arise in such situations, e-commerce giants and intermediaries such as e-

5 Bitcoin and Blockchain Lessons, www.youtube.com/watch?v=YG7l0XPtzD4 (accessed 24 January 2021).

6 Pierluigi Cuccuru, 'Beyond Bitcoin: An Early Overview on Smart Contracts' (2017) 25 *International Journal of Law and Information Technology* 179, 182.

7 Satoshi Nakamoto, 'Bitcoin: A Peer-to-Peer Electronic Cash System' (2008) 1, <https://bitcoin.org/bitcoin.pdf> (accessed 25 January 2021).

buy offer consumer protection to assure the buyer that the seller will fulfil its obligations, such as shipping of purchased items in this case.

However, it is not applicable in the case of smart contracts. The seller receives funds only once the buyer has received the items. Once that obligation is fulfilled, there is nothing that can stop the payment from going through, but if that obligation is not fulfilled, the payment does not go through and reverts to the buyer. Smart contracts make use of moderators to verify the facts of the transaction, i.e. whether the item has been delivered or not. Moderators are individuals or computers that feed data about the occurrence or non-occurrence of an event and are used to verify whether an event has taken place or not. The use of moderators can bring the human factor into the otherwise automated performance of a contract in case a transaction has to be manually verified. However, sensors and Global Positioning System (GPS) technologies can be used to fully automate this process, although usually in regular e-commerce transactions payment is made in advance and must be reclaimed from the intermediary in case of a default in obligation by the seller.

Smart contracts resemble the working of an escrow service albeit without the need for an intermediary. Here 'code' is the new escrow.⁸ For instance, Paypal is used worldwide as an escrow and dispute resolution service. It holds the funds for its users until a transaction goes through smoothly and provides for online dispute resolution (ODR) in case a dispute arises between the parties to a transaction. With smart contracts, code works as the escrow and holds the funds in confidence for the parties to a transaction. The code releases the funds being held by it when a party performs the obligations stipulated in the agreement.⁹

The use of smart contracts is expanding rapidly as many start-ups and open source projects are exploring its potential for future use. Ethereum is a blockchain-based platform built specifically for creating smart contracts. It seeks to provide a decentralized platform for the creation and execution of smart contracts. It has been developed to create a programming language that will enable the creation of sophisticated smart contracts.¹⁰ It has its own cryptocurrency, called Ether (ETH), to be used for payment in smart contracts. Counterparty¹¹ and Mastercoin¹² are also working on open source projects for developing programming languages to be used in the creation of smart contracts.

A practical example of a smart contract is the use of it by a bank to repossess a car or by a lender if the person renting the car does not pay instalments on time. The device, called starter interrupter, can be fitted into an engine that can block the car's ignition if the payment of an instalment is due. This is a perfect example of a smart contract functioning on a blockchain. Once the payment to

8 Kevin Werbach and Nicolas Cornell, 'Contracts Ex Machina' (2017) 67 *Duke Law Journal* 313, 337.

9 Paypal, www.paypal.com/uk/webapps/mpp/about (accessed 24 January 2021).

10 Vitalik Buterin, 'A Next Generation Smart Contract & Decentralised Application Platform' (2013), <https://ethereum.org/en/whitepaper/> (accessed 24 January 2021).

11 COUNTERPARTY, <http://counterparty.io/> (accessed 24 January 2021).

12 MASTERCoin, <https://blog.omni.foundation/2013/11/29/a-brief-history-of-mastercoin//> (accessed 24 February 2021).

the bank or the lender goes through, the code executes commands and lets the interrupter device ignite the car. Thus, it makes it easier for the bank to repossess the car in case of default.¹³ Another example is blocking the entry of a tenant into the building if the rent has not been paid on time, thereby allowing the owner to repossess the property, without actually having to be present, in case the tenant defaults on his or her obligations. It is always expected for both parties to an agreement to honour their terms of the contract and perform their part of the obligations. Furthermore, blockchain-based smart contracts have been tipped for use in providing real-time royalties to musicians,¹⁴ i.e. automatic pay per click or view. It has been further tipped for collection and processing of taxes in real time without the need for an intermediary to process it manually.¹⁵ This concerns the fintech application of blockchain and smart contracts.

However, with all the hype surrounding smart contracts, they are still under development and have limited use, being unable to address all kinds of contractual situations. In practical terms, it is just a form of code stored on a blockchain, triggered by transactions that read or write data on the blockchain database.¹⁶

2.4 Smart Contracts Compared with Traditional Contracts

Traditional legal contracts become enforceable at law only if they comply with certain preconditions such as the meeting of minds, offer and acceptance, consent, consideration and formal requirements such as the signatures of both parties or exchange in writing. For instance, some laws require that a contract be in writing and signed by both parties to transactions such as transfer of immovable property, for instance, a piece of land. This raises some concerns over the validity of smart contracts as being contracts themselves. However, smart contracts are also usually agreed between the parties after deliberations and negotiations over the terms of the agreement, and only in cases where a computer is programmed to enter into contracts with other computers or where the contract is written entirely in code do issues concerning their validity arise. This resembles traditional contracts and would sufficiently comply with the preconditions of a valid contract. It is only the performance aspect that is made smart and auto-executable.¹⁷

Smart contracts can be enforced even when the aforementioned conditions have not been complied with because they are self-enforcing and do not require

13 Max Raskin (n2), 330.

14 D.A. Wallach, 'Bitcoin for Rockstars: How Cryptocurrency Can Revolutionize the Music Industry' (MEDIUM, 10 December 2014), <https://medium.com/backchannel/bitcoin-for-rockstars-ca8366802f9> (accessed 12 July 2018).

15 Aaron Wright and Primavera De Filippi, 'Decentralized Blockchain Technology and the Rise of Lex Cryptographia' (2015) 12, <http://ssrn.com/abstract=2580664> (accessed 22 January 2021).

16 Gideon Greenspan, 'Why Many Smart Contract Use Cases Are Simply Impossible' (COINDESK, 17 April 2016), www.coindesk.com/three-smart-contract-misconceptions (accessed 23 January 2021).

17 Jean Bacon, Johan David Michels, Christopher Millard and Jatinder Singh, 'Blockchain Demystified' (2017) 31, Queen Mary School of Law Legal Studies Research Paper No. 268/2017, <https://ssrn.com/abstract=3091218> (accessed 22 January 2021).

enforceability through the legal process. However, it is the auto contract formation with the use of computer machines and contracts written entirely in code that raises some concerns over the consent and authority to enter into such contracts.¹⁸ The traditional contract law recognizes the principal and agent relationship, whereby the agents can validly enter into a contract on behalf of the principal; however, it applies to natural beings and not digital assets. Furthermore, contracts that are written entirely in code also raise issues with regard to their binding nature and meeting of minds and whether the parties understood what obligations they undertook in the form of code.

Traditional contracts are known for ambiguity and vagueness of wording that parties often use to bring some flexibility into the contract and its performance.¹⁹ It is not necessary that the parties to a contract want to perform terms and obligations absolutely. Circumstances could change after they entered into the contract, making it impossible for a party to perform its obligations in case of hardship or in case they want to set off the amount in one contract against a balance in some other contract between the same parties. Smart contracts, by their very nature, are quite rigid and less flexible once they are put into a code and will not take external circumstances into consideration, but will self-execute the terms of the code.

Smart contracts intend to create a non-trust relationship through use with blockchain technology; however, ambiguity and trust over long-term contracts are a cherished feature of traditional contracts. Smart contracts are more suited to one-time contracting parties or short-term relationships, but with long-term contracts, the contractual terms are intentionally kept vague to provide them with some flexibility so that they can be modified in the case of a change in circumstances.²⁰ Parties involved in trust relationships and entering into long-term contracts know that a change in circumstances is bound to arise and, therefore, terms of the contract are often kept adaptable. Long-term contracts may include a renegotiation clause that makes them possible to modify by mutual consent.²¹ Smart contracts, in contrast, are rigid and do not allow any kind of modification. Contractual disputes often arise over unexpected circumstances that were not intended or anticipated and that fundamentally alter the parties' expectations. At their current stage of development, it seems unlikely that parties would be able to address all contingencies in a self-contained, self-executing smart agreement.²²

18 Harry Surden, 'Computable Contracts' (2012) 46 UC Davies Law Review 629.

19 Jeremy Sklaroff, 'Smart Contracts and the Cost of Inflexibility' (2017) 166 University of Pennsylvania Law Review 263, 279.

20 Karen E.C. Levy, 'Book-Smart, Not Street-Smart: Blockchain-Based Smart Contracts and The Social Workings of Law' (2017), 3 Engaging Science, Technology, and Society 1, 7.

21 Jeremy Tan, 'Smart Contract and Law' (2017), Holborn Law and Olswang.

22 Erika Morphy, 'The Problems with Blockchain's Smart Contracts' (CMS WIRE, 9 April 2018), www.cmswire.com/information-management/the-problems-with-blockchains-smart-contracts/ (accessed 24 January 2021).

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2.5 Smart Contracts Under the Present Contract Law

The anticipation by many technical experts and start-ups working on smart contracts that a code can replace the contract law is baseless. One commentator puts this radical claim as follows:

Smart contracts don't need a legal system to exist: they may operate without any overarching legal framework. De facto, they represent a technological alternative to the whole legal system.²³

Another claims that:

Smart contracts replace judges with code... They are enforced by cryptographic algorithms. The rules of the game are determined before the contract executes, rather than at the foot of a judge's podium.²⁴

Smart contracts ensure the performance of a contract and bind the parties to their promises, but they cannot be used with all kinds of contracts. Furthermore, they usually make only the execution of a contract 'smart', while the rest of it remains in the traditional form. The code supplements the execution of contracts and working of the law, rather than replacing it completely.²⁵ Although contract law exists to make contracts enforceable at law and holds the parties to an agreement to their promises, it serves purposes beyond mere enforceability of a contract.

Disputes are likely to arise in contractual relationships, smart contracts being no exception, and contract law is required to resolve them. What changes is that the nature of disputes arising out of contracts will differ. If a contract is invalid or the performance of a contract has become impossible, the aggrieved party could apply to the court to rescind the contract before it is performed. However, with smart contracts, the contract would already have been executed and the aggrieved party applies to the court *ex post* for the remedy. The nature of the remedy also changes because interim measures cannot be granted to stop the execution of smart contracts, and the court must decide after the contract has already been executed.²⁶

Smart contracts are regulated by contract law, as are traditional contracts. They are not a replacement for contract law but rather new kinds of contracts

23 Alexander Savelyev, 'Contract Law 2.0: Smart Contracts as the Beginning of the End of Classic Contract Law', https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2885241 (accessed 24 January 2021).

24 Alyssa Hertig, 'Code of Law; How Bitcoin Could Decentralise the Courtroom' (3 July 2014), <https://www.vice.com/en/article/vvb79d/code-as-law-how-bitcoin-could-decentralize-the-courtroom> (accessed 24 February 2021).

25 Perkins Coie LLP, 'Legal Aspects of Smart Contract Applications', www.virtualcurrencyreport.com/wp-content/uploads/sites/13/2017/05/Perkins-Coie-LLP-Legal-Aspects-of-Smart-Contracts-Applications.pdf (accessed 24 January 2021).

26 Aaron Wright and Primavera De Filippi (n15), 26.

that will be governed by it.²⁷ There may be a reduction in disputes that are related to the execution of contracts, but they cannot be absolutely ruled out. Smart contracts and codes will never fully replace natural language law.²⁸ They can be categorized into weak and strong contracts according to the terms they contain. In case a smart contract contains prohibitive costs against revocation or modification of the terms of agreement of parties and the courts could do little to change these terms or their execution, it would be considered a strong contract.²⁹ By contrast, a contract is considered weak if it can be easily altered by the courts before or after its execution. The courts retain the power to grant a remedy in the form of damages to a party to a contract even after it has been auto-executed using the code. The court can always pass an interim order against an oracle to cease feeding data into the code if the oracle is a human being or a machine under human control.

The civil courts of any country have the ultimate power to maintain public order and regulate contracts according to the contract law unless a contract is subject to arbitration or other ADR mechanisms. Imagine a situation where a smart contract is formed for carrying out an illegal activity such as selling drugs or human trafficking, the courts and law enforcement authorities must intervene for the public good and stop such a menace. For instance, if a vending machine dispenses drugs or copyrighted materials³⁰ it is hard to imagine that the code is the law and that such a machine would be allowed to operate. This is where the contract becomes invalid for its purpose and law enforcement must intervene.

For further discussion of the application of present contract law, smart contracts can be divided into the following categories:³¹

- 1 Smart contracts that are written entirely in code.
- 2 Smart contracts created and executed by machines, with no human involvement (*Contracts ex machina*³²).
- 3 Smart contracts written in code but having a translated version of legal contract in natural language agreed between the parties.
- 4 Smart contracts that are written in code form while incorporating the natural language version of a legal contract by terms of reference (non-operational clauses within the code).
- 5 A legal contract in natural language with some part of it translated into code form, such as the performance.

27 Eliza Mik, 'Smart Contracts: Terminology, Technical Limitations and Real World Complexity' (2017) 15 <https://ssrn.com/abstract=3038406> (accessed 24 January 2021).

28 John Stark, 'How Close Are Smart Contracts to Impacting Real-World Law' (COINDESK 2016), <https://www.coindesk.com/blockchain-smarts-contracts-real-world-law/> (accessed 24 January 2021).

29 Max Raskin (n1), 310.

30 *Ibid.*, 322.

31 Norton Rose Fulbright, International Arbitration Report Issue 9 (October 2017), www.nortonrosefulbright.com/knowledge/publications/157162/arbitrating-smart-contract-disputes (accessed 24 January 2021).

32 Kevin Werbach and Nicolas Cornell (n8), 360.

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The following section will further discuss the traditional contractual concepts and doctrines in the context of smart contracts under the following heads:

2.6 Formation of Contract: Are Smart Contracts Really Contracts?

'Smart contract' as a term can be quite misleading because it is just a form of contract that is auto-executing through the use of computer codes. This raises the question whether it is a legal contract. In its usual form, a smart contract is a contract that is verified by the blockchain network and substantiated in the form of a physical copy.³³ The terms of an agreement are translated into code equivalent or expressed in the machine language in such a way that it leads to the performance of the underlying contract. Even in the case of a contract written entirely in code, the terms and their effects are explained to the counterparties in the language they understand. A contract cannot come into existence unless the parties reach an agreement over its terms and often include an offer and acceptance of that offer by a counterparty.³⁴

Therefore, there do not seem to be many problems over the offer and acceptance aspect in the valid formation of a smart contract. Rather, the problem arises with some common misinterpretations of law, fact or certainty of terms, i.e. whether the code actually represents the parties' intentions.³⁵ It could be argued that the intention to create legally binding and enforceable contracts can be missing in smart contracts because they are meant to be self-executing and self-enforcing.³⁶ Parties do not intend to enforce them in courts.

Various legal and practical problems can arise in contracts *ex machina* as there is no human involvement and contracts are created using programmed code language. The contracts *ex machina* are the possible future application of smart contracts, and many fintech start-ups are considering their potential application. The problems in this scenario can arise concerning the 'consent' of parties forming the contract, as the law recognizes a contract to be valid only if it is entered into by parties with voluntary consent. The machine is not a human and contracts formed by machines are out of the scope of contract law at present. Furthermore, when machines enter into a contract on behalf of a minor consumer (who is below the legal age for contracting), the validity of the contract comes into question because it does not emerge from valid consent.

Another precondition in the formation of a valid contract is a consideration. It distinguishes a contract from a gift. A contract is valid when it ensures mutual obligations between the parties each of whom performs his or her part of the obligations in exchange for a consideration. Therefore, it is a two-way undertaking of obligations to be performed by both parties; i.e. one party undertakes to pay the other for the performance of an act or obligation under the contract. Smart contracts in this context are unilateral in nature; for instance, A

33 'Smart Contracts: The Blockchain Technology That Will Replace Lawyers', <https://blockgeeks.com/guides/smart-contracts/> (accessed 20 January 2021).

34 Jean Bacon, Johan David Michels, Christopher Millard and Jatinder Singh (n17), 31.

35 RESTATEMENT (SECOND) OF CONTRACTS §§ 20(1) & ill. 2, 152 (1981).

36 Kevin Werbach and Nicolas Cornell (n8), 332.

will pay B a certain amount in case B performs a certain contingent act. Although the transfer of funds is executed by the code, however, the performance of the act is outside its control, constituting an off-the-chain event. The smart contract will execute only if B performs its part of the contract. Therefore, a smart contract represents only half of the performance, i.e. the payment. It cannot enforce the transaction or specific performance of the contract by B, and B has the option to either perform its obligations or simply refuse to do so. If B chooses to perform its part of the obligation, the smart contract code will transfer the funds to B. On the other hand, if B does not perform its part of the obligation, the funds will be transferred back to A. This does not represent bilateral undertaking of obligations by the parties to a traditional contract, whereby a specific performance of the contract is possible through civil litigation if one of the parties fails or refuses to perform its part of the obligations.

2.7 Performance, Modification and Breach of Smart Contracts

Smart contracts ensure the performance of terms that are put into the code; however, the parties to an agreement mostly have some terms and obligations that cannot be expressed into the code.³⁷ For example, the ‘reasonableness and hardship’ clauses or other communications are not recognized in computer language. The code language is rigid and ensures the performance of defined terms at all costs. Therefore, some part of the contract may remain unperformed, and the code will not fully capture all the obligations between the parties.³⁸ Further, there can be problems with performance when the real-world assets are involved in the transaction. For instance, the starter interrupter discussed previously might malfunction and fail to start the car, rendering the contract unperformed.

The smart contract code running on a blockchain is unmodifiable and irreversible. It is a feature that ensures absolute execution of the terms of a contract once put on the chain, which may prove costly in some situations because code is prone to bugs, and an error may prove costly. Any transaction resulting from running the faulty code will be recorded in the blockchain, which is tamper proof. The mistakes in the chain could be ratified by future transactions between the parties, but the faulty transaction cannot be modified. This means there is no scope for withholding performance and renegotiating terms even if parties wish to do so should it become impossible or impractical to perform the contract owing to changed circumstances.³⁹ This is where legal contracts are better, and they may provide an opportunity for the parties to correct the mistakes.

For instance, a user accidentally triggered a flaw in smart contract service called Parity and destroyed \$ 300m worth of cryptocurrency forever. He accidentally took control of hundreds of accounts and mistakenly transferred the

37 Stewart Macaulay, ‘Non-Contractual Relations in Business: A Preliminary Study’ (1963) 28 *American Sociological Review* 55.

38 Jean Bacon, Johan David Michels, Christopher Millard and Jatinder Singh (n17), 33.

39 Max Raskin (n1), 328.

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funds into inaccessible accounts while trying to return them.⁴⁰ This kind of transaction is irreversible unless a centralized platform is being used. The controlling entity can undo the transaction in a centralized blockchain platform. However, it is almost impossible to undo a transaction on a decentralized platform because all the nodes will never agree to undo the same. Although the hard fork can be initiated, however, it does not lead to total reversibility of the transaction. For instance, 60% of the nodes may agree to the fork and create a separate new blockchain, but the remaining 40% may continue with the same unchanged transactional record.

3 Problems and Legal Issues Related to Smart Contracts

The preceding sections discussed smart contracts that are the auto-execution of legal contracts translated into code form. Not many problems seem to arise in the case of smart contracts verified by blockchain and substantiated by physical copy. However, most disputes tend to arise in smart contracts written entirely in code or machine-to-machine contracts (contracts *ex machina*). In contracts *ex machina*, the computers or machines are programmed in such a way that they enter into a contract on meeting certain conditions and terms. For instance, in the case of a corporate entity selling shares, the buying entity may program its computer in such a way that it executes the purchase of the shares when they reach a certain value at which the buyer desires them. It can automatically buy the shares once a certain value is reached and transfer payment to the address of the entity offering to sell it.⁴¹

Many issues can potentially arise out of such transactions. The contract law might not recognize it as a valid contract because it does not fit well with the formal requirements in regard to offer and acceptance, consent, signature, the identity of parties, meeting of minds, certainty of terms and evidence of the contract.⁴² Other problems that may arise in blockchain-based smart contracts pertain to jurisdiction and governing law because of the distributed nature of nodes that ensure the performance of a contract. The place of performance of the contract is a major consideration in ascertaining the governing law and jurisdiction of the disputes arising out of the contract. However, in view of the wider distribution of nodes ensuring the performance of smart contracts, it may become difficult to ascertain exactly where the contract was performed. Further, the code or the contract formed by the machines may have different consequences from those that the parties initially expected or intended them to be, leading to further problems with amending such contracts later as they are irreversible and unmodifiable. The next part will discuss the various disputes that could arise with the application of smart contracts:

40 Alex Hern, '\$ 300m in Cryptocurrency' Accidentally Lost Forever Due to Bug' (THE GUARDIAN, 8 November 2017), www.theguardian.com/technology/2017/nov/08/cryptocurrency-300m-dollars-stolen-bug-ether?CMP=share_btn_tw (accessed 15 January 2021).

41 Pierluigi Cuccuru (n6), 194.

42 Jeremy Tan (n21), 12.

3.1 *Legal Issues Arising Under the Contract Law*

3.1.1 *Issues Related to the Validity and Enforceability of Smart Contracts*

The contracts formed entirely in code or through interaction between the machines raise questions concerning their validity in the context of existing contract laws around the world. Almost all law jurisdictions require the contract to be certain about terms; under English law,⁴³ for instance, contracts must be sufficiently certain in terms of both inherent clarity and completeness in order to bind the parties, while under American common law⁴⁴ a contract is rendered unenforceable if the contracts are indefinite or vague with regard to their essential terms. Furthermore, it must be entered by a person having the legal capacity⁴⁵ (e.g. legal age to contract), be it a natural or legal person such as a corporation or company.⁴⁶ Contracts formed through communications between machines do not fulfil the criteria and may be challenged in the courts as being legally invalid. Indeed, all such contracts *ex machina* will not give rise to many disputes as to their validity or performance because they are auto-executing. Furthermore, parties use smart contracts to ensure both sides perform their part of their obligations, implying that they have a strong intent to honour the contract.

However, a party to the contract may conceivably fail to honour it after its creation or after some change in circumstances forces them to change their stance. Challenging contracts *ex machina* or those that are written entirely in code would be an easy option, therefore, because, first, it does not provide any evidence of contract as a separate legal document as it is just created by the computers or in the code form. Second, there is no proof of consent and meeting of minds as the parties might fail to understand the implications of the terms they agree to in the code form. There might be uncertainty as to the terms of the contract because they are in form of computer code.⁴⁷ Therefore, the party to a contract may contend that the contract does not exist at all.

3.1.2 *Identity of Parties*

The missing proof of signature and separate existence of contract creates problems with regard to the identity of the parties to the contract. The contract laws require that parties to the contract must be sufficiently identified before they can file a claim of damage concerning the contract. The anonymous and peer-to-peer nature of transactions through blockchain technology makes it even more difficult to establish the identity of the parties involved. A person can easily use a pseudonymous identity to defraud the other person. Therefore, contracting

43 *G Scammell & Nephew Ltd v. HC & JG Ouston* [1941] AC 251.

44 *Rosenthal v. National Produce Co* 573 A.2d 365 (DC App. 1990).

45 See RESTATEMENT (SECOND) OF CONTRACTS § 12(1) (1981) ("Capacity to contract may be partial and its existence in respect of a particular transaction may depend upon the nature of the transaction or upon other circumstances").

46 Kevin Werbach and Nicolas Cornell (n8), 360.

47 Mark Giancaspro, 'Is a 'Smart Contract' Really a Smart Idea? Insights from a Legal Perspective' (2017) 33 Computer Law & Security Review 825, 831.

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under mistaken identity does not meet the requirement as to capacity and consent.⁴⁸

3.1.3 *Governing Law and Jurisdictional Issues*

The old concepts still apply to the developing technologies but with a little twist in their application. Smart contracts running through blockchain technology will create issues with regard to the governing law of the contract and personal jurisdiction. However, the considerations for establishing the personal jurisdiction are, first, the location of parties, second, location of the servers and the nodes that verified the transaction and, third, the place where the contract was breached or cause of action giving rise to the claim occurred. Furthermore, the considerations for establishing the applicable law of the contract in those disputes are First, the place where the contract was formed, secondly, where it was performed or a substantial part of it was performed and, third, the applicable law to the parties to contract are some of the considerations that may be used in determining the applicable law in such disputes. However, the pseudonymous nature of transactions and wider distribution of nodes on the blockchain network spreading out through different countries makes it hard to determine which court will exercise jurisdiction over the blockchain disputes.

3.1.4 *Enforceability Issues*

As discussed before, smart contracts do not fulfil the preconditions of a valid contract under the contract law as it requires a meeting of minds and undertaking of mutual obligations.⁴⁹ Smart contracts, by their very nature, are agreed within a code with certain conditions to be performed through 'if-then' conditions. These conditions are unilateral in nature, differing considerably from legal contracts that contain bilateral obligations. In legal contracts, both parties undertake some obligations to be performed as part of the contract that makes it a bilateral agreement. However, smart contracts make use of unilateral obligations such as 'if X then Y', which are often referred to as 'if-then' conditions.⁵⁰ For instance, A promises to pay B a certain amount of money (which will be transferred automatically by the code) if B delivers a certain item to C. In this case, if the conditions governing the delivery of the item are met, such as submitting the acknowledgment receipt into the computer program or delivery being reported by C or using the GPS technology or sensors to track the delivery, the payment will automatically go through.

However, just half of the contract is represented by the code, i.e. the payment system. The other half is not included in the code and depends on B's performance of his obligation to deliver the item to C. If this contract is formed through the code, it is not a valid contract because the payment is contingent on B performing his part of the obligation. If he delivers the item to C, the payment

48 *Ibid.*, 829.

49 See RESTATEMENT (SECOND) OF CONTRACTS § 12. As with meeting of the minds, this is an objective test.

50 Pierluigi Cuccuru (n6), 185.

will go through. If he does not deliver it to C, the money stays in A's accounts. However, the issue here is about the enforcement of obligations. In a conditional contract, B has no duty to deliver the item to C, and he may simply refuse to do so. The payment will not go through to B, but, at the same time, A cannot compel the performance of this arrangement through courts because they do not have a legally enforceable contract. Therefore, A cannot compel the specific performance of B's obligations through the process of the court. This is the kind of issue that may arise with smart contracts *ex machina* or contracts written in code form.

At present, the law does not recognize smart contracts *ex machina* or the contracts that are written entirely in code form. It is therefore advisable to have a legal contract signed by the parties stating their respective obligations or at least include some statements detailing the agreement within the smart contract code itself. It must state the intentions of parties to the agreement and the purpose for which the contract has been formed. In this case, it will make it much easier for a judge or an arbitrator to interpret the contract from the code once the issue comes up for its enforcement.⁵¹

3.1.5 Confidentiality Issues

Smart contracts on the blockchain are executed by all the nodes on the network, and hence the contractual details are available to everyone. Therefore, it is not suitable for contracts of a confidential nature to be executed through blockchain because it may contain a matter subject to non-disclosure or trade secrets. The contractual parties may not wish such information to be disclosed to the public.⁵²

3.2 Coding Errors, Programming Defects and Issues Related to Irreversibility

3.2.1 Coding Errors and Programming Defects

The computer codes are never perfect and are always prone to bugs. Who is liable for the loss caused by a coding error in a smart contract? For contracts written entirely in code form, it is not easy to establish the identity of parties. Furthermore, in the contracts *ex machina*, the blame for entering into a faulty contract can always be laid on the machines, and human counterparts can try to escape the liability by calling it a coding error. Software engineers are not truly accustomed to law and legal terms and can hence make errors while translating the contract into code. Coders are not trained to write the perfect code, and they always try to find and fix the bugs. However, it is impossible to modify the code of the smart contract once it is launched into the blockchain. Are the programmers liable for writing faulty codes and for smart contracts not performing as they were originally intended to? Well, a party to a contract trying to avoid liability may argue that they are.

51 Max Raskin (n1), 328.

52 Jean Bacon, Johan David Michels, Christopher Millard and Jatinder Singh (n17), 34.

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Dan Mayer⁵³ has cited research showing that the ratio of bugs per code lines average 15-50 at the industry level; 0.5 per 1,000 in Microsoft and almost 0 in 500,000 lines of code at NASA.⁵⁴ However, the errors in code lines decrease with big companies because they spend a substantial amount of money on their development. The cost of forming smart contracts, however, will rise further if parties decide to hire developers to reduce errors and bugs from the code. The usual error rate with Ethereum smart contracts, as reported by Ethercasts, is 100 per 1,000 code lines or maybe higher.⁵⁵ This means considerable investment in code development or, otherwise, the constant risk of code vulnerability being exploited by someone.

The translation is often a difficult task and renders results different from what are expressed in the original language. For instance, it is thought that even in the case of translating one natural language into another, much of its expression and intent is lost. It can never be translated perfectly into the other language with all the emotions and intent. The same is the case with code language, as there will always be some intent that will get lost while translating a natural language version of a legal contract to a coded smart contract.

Therefore, the contracts originally formed in natural language and executed through the code may lead to some issues with their translation. The terms and obligations of the parties to a legal contract are translated into a code by a programmer, which is not an easy task. The parties may have intended one result, while the code may lead to another. Translation of the legal terms that are quite wider in meaning and sometimes too vague cannot be easily translated into the code. The programmers will not understand the common intentional or unintentional mistakes often made by the lawyers in legal contracts. A lawyer can well understand the language used by another lawyer, but a developer will have a hard time understanding it.

The legal language is significantly wider in scope and sometimes tries to include all the possibilities of future events through the legal terms that are sometimes vague and hard to understand by a person from a non-legal background. The developers and the computer language often fail to understand such a wider scope of the legal language. The programming language is quite simple and only understands '0' or '1', or, if '1' then '0', to put it the other way. It only understands logic and simple 'if-then' conditions. The natural language is much wider in scope and contains a wealth of real-world technicalities, all of which cannot be expressed in the coding language. Therefore, it is common for the developers to fail to understand the technicalities of the legal language, and a code might end up being created that does not exactly represent the actual intentions of the parties to a legal contract. The translation of such legal

53 Dan Mayer, 'Ratio of Bugs Per Line of Code' (11 November 2012), www.mayerdan.com/ruby/2012/11/11/bugs-per-line-of-code-ratio (accessed 23 January 2021).

54 Peter Vessenes, 'Ethereum Contracts are Going to be Candy for Hackers' (18 May 2016), <https://vessenes.com/ethereum-contracts-are-going-to-be-candy-for-hackers/> (accessed 18 January 2021).

55 State of the Daps, <http://dapps.ethercasts.com/> (accessed 12 January 2021).

contracts into code versions will often lead to discrepancies between the actual intent of the parties and the result that the code entails.⁵⁶

The coding language is very simple and logical. It fails to understand the intentional flexibility provided by vague legal terms. For example, if you ask a computer code what is 1 and 1, it will always say 2. However, with the natural language, you may often get responses such as 1 and 1 could be either 2 or 11. These are the kinds of instances you come across only in natural language versions but not in computer language codes. Therefore, the coders will never be able to perfectly translate the natural version of a contract to the smart contract code, and some discrepancies can arise between what was originally intended by the parties and what is performed by the codes. Are the developers responsible for coding liable for that?

Smart contracts can also be used to create a DAO (decentralized autonomous organization) and manage its assets, structure and functioning of such an autonomous virtual organization. It is a kind of virtual organization created through computer code and executed on the blockchain.

As defined by Stephan Tual (co-founder of Slock.it, an Ethereum company)

A DAO, or Decentralized Autonomous Organization, is a digital company with its by-laws set immutably within the Blockchain: its governance is transparent, its finances can be audited by anyone, it suffers zero downtime and corruption is impossible.⁵⁷

It is intended to operate as a for-profit entity. It can offer ICO (initial coin offerings) to the investors and hold the assets digitally by selling DAO tokens to investors.⁵⁸ The DAO project was famously created by slock.it, and all the funds of 'The DAO' were held in Ethereum blockchain address, and the token holders were given the right to vote on contract proposals, new projects to be undertaken, distributing the DAO's anticipated earnings and other important issues of the organization.

Almost \$ 150 million was raised by selling 'The DAO's' tokens. The funds raised from such sales were stored in the Ethereum blockchain address associated with the DAO. Before any project could be commenced or any investment made from those earnings, a hacker exploited a flaw in the DAO's code and transferred to himself almost one-third of the funds.⁵⁹ The code, in this case, performed as it was programmed, and it was not a hack. Rather, the person identified a vulnerability in the code and exploited it to reroute funds to himself.

The smart contract may execute as it was expected to, but someone can still exploit the defect in vulnerable code to redirect the funds to some other accounts under its control. There is no breach of contract in this case, and no law is

56 Eliza Mik (n27), 16.

57 See https://www.huffpost.com/entry/an-indepth-interview-with_7_b_13415318 (accessed 25 February 2021).

58 Law 360, 'What to Expect When Litigating Smart Contract Disputes', www.law360.com/articles/1028009/what-to-expect-when-litigating-smart-contract-disputes (accessed 14 January 2021).

59 *Ibid.*

violated, yet someone else makes illegal gains. The contract performs differently from what was expected by the parties, although it performs exactly the way it was programmed. Prosecuting the person exploiting a hack in the code would be another issue because he did not break any law and it is not a breach of contract. This happened in the DAO attack.⁶⁰

Further, the investors of the DAO went on to nullify the transaction totally by employing a hard fork. Most of the nodes on the Ethereum blockchain agreed to employ the hard fork after the DAO attack and to reverse the transactions, yet not all the nodes agreed to it. Thereby, a new blockchain, named Ethereum (ETH), was created, and the old users kept the same old blockchain operating under the name Ethereum Classic (ETC).⁶¹ However, it is again an issue to the non-trust environment that blockchain technology seeks to create if the transactions can be undone in any manner whatsoever.

Furthermore, investors whose funds were stolen as a result of the DAO attack might want to sue the organization to recover their investments. Can they, however, sue the DAO? It does not hold a separate legal personality and is just a creation of the internet and runs through smart contracts with no separate legal existence. This will create another issue for investors once they find out that the smart contract they entered into by investing in the DAO is not legally valid and they have no legal remedy.⁶² However, it is left to the courts to interpret the nature of smart contracts and identify the transactions that took place on the blockchain network, which are not hard to find as a piece of evidence because they are stored on the distributed ledger permanently. Furthermore, to bring some certainty the DAO might consider including the arbitration or jurisdiction clause in the code for any claim arising out of transactions made with the DAO.

Furthermore, following developments in artificial intelligence, the machines can also themselves act by developing new instructions in response to the information they acquire,⁶³ as, for example, the voice assistant software booking an appointment with the hairdresser for a specific time and date. However, if the hairdresser has stipulated a penalty charge of £20 in case the appointment is cancelled and the assistant accepts it without notifying the user, who is liable to pay the penalty, the user or the software developer?

3.2.2 *Irreversibility of Smart Contracts and Subsequent Changes in Law or Regulation*

The very nature of smart contracts is to freeze the terms of contract and performance, leaving them unmodifiable at a later stage. It will self-execute and perform the contract as it was coded. However, what happens if there is a change in law or regulation that makes the performance of smart contracts illegal after

60 Jean Bacon, Johan David Michels, Christopher Millard and Jatinder Singh (n17), 35.

61 Ameer Rosic, 'What is Ethereum Classic? Ethereum vs Ethereum Classic', <https://blockgeeks.com/guides/what-is-ethereum-classic/> (accessed 19 January 2021).

62 Dirk Zetzsche, Ross P. Buckley and Douglas W. Arner, 'The Distributed Liability of Distributed Ledgers: Legal Risks of Blockchain' (2017) Law Working Paper Series Number 2017-007.

63 Lauren Henry Scholz, 'Algorithmic Contracts' (2017) 20 Stanford Technology Law Review 128, 164.

the code has been set into the blockchain. It becomes impossible to stop its performance because the code is irreversible and unmodifiable once set in motion and put onto the blockchain.⁶⁴ How do the parties stop their performance? Would they face liability for breach of law committed because of the performance of such a contract?

Furthermore, parties may want to terminate the contract on grounds of misrepresentation, fraud or mistake at the time of its formation. However, since a smart contract is unmodifiable and irreversible once put on the blockchain, how do the parties react and stop the performance of a smart contract in such a case? It is further difficult for the court to intervene and grant an interim injunction in such a case because of the irreversible nature of smart contracts. There is nothing that the parties or courts can do to stop a contract's performance, regardless of whether it is illegal or suffers from some invalidity on grounds of misrepresentation, fraud or mistake.⁶⁵ The only remedy left for the parties desiring to terminate the contract is to sue for damages after the contract has been executed. Damages are not the best remedies when it comes to contracts, because the loss has already been caused and can sometimes never be cured by awarding damages.⁶⁶ However, smart contracts leave no scope for intervention in the performance, and even if granted by the court, the interim measures would have no effect whatsoever.

3.3 *E-commerce, Consumer Disputes and Trust Issues*

Most disputes arising out of the use of the internet are related to e-commerce and online trading and constitute a large proportion of the transactions that take place through the internet every day, involving considerable fund transfers. The security of such transactions has been a major problem in the last decade.⁶⁷ The potential use of smart contracts through blockchain technology will commonly involve e-commerce and online trade activities. Smart contracts are being used to facilitate the sale of goods between unrelated persons on the internet without the use of an intermediary, whereas in common practice the use of an intermediary requires trust and reputation, which the intermediary tries to gain through advertising and previous experience.

The use of smart contracts through blockchain creates a perfect environment for online markets and peer-to-peer trading without the use of an intermediary. The traditional concept of e-commerce evolved with commercial corporations, such as e-commerce giants Amazon and eBay, selling items and commodities

64 Riikka Koulu, 'Blockchains and Online Dispute Resolution: Smart Contracts as an Alternative to Enforcement' (2016) 13(1) SCRIPTed 40, 65.

65 Cheng Lim, T.J. Saw and Calum Sargeant, 'Smart Contracts: Bridging the Gap Between Expectation and Reality' (OXFORD UNIVERSITY BUSINESS LAW BLOG, 11 July 2016), www.law.ox.ac.uk/business-law-blog/blog/2016/07/smart-contracts-bridging-gap-between-expectation-and-reality (accessed 16 January 2021).

66 Aaron Wright and Primavera De Filippi (n15), 26.

67 Marjory Blumenthal and David D Clark, 'Rethinking the Design of the Internet: The End-To-End Arguments Vs. The Brave New World' (2001) 1 ACM Transactions on Internet Technology 70, 80.

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online. However, using these websites to buy items online requires the use of these trusted intermediaries and, further, the use of bank cards for making payments to them. This involves a trust issue, i.e. a consumer must trust the intermediaries before making the purchase. They must trust them not to defraud the consumer of his or her funds and also trust the seller to perform its part of the agreement, for instance, delivering the exact item that was put up for sale on the website. Furthermore, they must trust the bank to revert the transaction in case the consumer is defrauded in such online purchase.

In this case, it could turn out that the seller might not perform its part or that the wrong item is delivered that does not match the description displayed on the website at the time of purchase. In an extreme case, nothing may be delivered at all. This is when the intermediary comes in, to right the wrong done to the consumer. For instance, eBay has its own dispute resolution centre where the consumer can file the complaint regarding purchase at the online portal. The representative from the dispute resolution centre then seeks explanations from both sides and decides on the basis of facts and evidence provided to them. The online services such as eBay, Uber and TripAdvisor try to create a relationship of trust and a reputation through exchanges with the users.⁶⁸ It is done by way of reviews and rating of experience of a certain intermediary. But all this requires trust and the intervention of intermediaries.

Smart contracts through blockchain technology seek to mitigate trust issues to create peer-to-peer transactions and exclude the use of intermediaries. Peer-to-peer means connection is end to end, and the users transact or interact with each other directly without the use of any third party. A practical example of this is the file sharing service called torrents, which makes the sharing of files possible between users directly without the use of an intermediary, i.e. Google Cloud or OneDrive. In another instance, Bitcoin is a crypto/digital currency based on the blockchain technology platform that makes such peer-to-peer transfers possible without the use of any intermediary such as a bank.

The idea behind blockchain technology and smart contracts is to create a trustless environment supported by a decentralized network.⁶⁹ Therefore, the performance of the contract in the aforementioned e-commerce scenario is no longer dependent on the seller or the intermediary in case of default by the seller. A perfect example of such a decentralized market is OpenBazaar, which is an open-source decentralized platform allowing its users to list the items for sale through its software. It stores the data and listings through a distributed file system and makes use of cryptocurrencies for payments. It uses Ricardian contracts to store the contractual agreements between the users, which can also be smart contracts according to the user's choice.

Furthermore, the parties may enter into a smart contract to ensure the performance of the obligations they undertake. It will make the transactions trustless because the payment does not go through till the seller delivers what he offered and because the buyer cannot stop the performance after the item has

68 Eliza Mik (n27), 8.

69 *Ibid.*, 7.

been delivered. It binds both the parties to their mutual obligations. Often, the attitude and will of parties change once they have entered into the contract. Smart contracts ensure the performance and take the will of parties out of the equation.⁷⁰ They seek to reduce non-compliance issues and brings certainty into the relations formed digitally. The performance of a smart contract becomes independent of the will of parties once launched into a blockchain, and the network ensures its performance.

However, online e-commerce and trade are being operated by intermediaries such as eBay, Amazon and Uber, which are registered entities and usually have a presence, such as registered offices, in almost any area of the world they operate in, making it easier for legislatures to frame regulations for consumer protection. It further empowers the consumers in such cases, who can often turn to local courts to help resolve consumer disputes. Furthermore, such entities have all the required details of the sellers operating with them and can be requested to act against the defaulting sellers, which they often do to preserve their reputation online and bring good feedback to the company. The dispute resolution platform hosted by eBay is an example of how they try to resolve the consumer disputes without requiring any recourse to the court by a consumer.

With blockchain-based smart contracts seeking to exclude the need for intermediaries, it is to be seen how the disputes will be resolved without the presence of intermediaries. Disputes relating to the performance of the contract would be significantly reduced because of the use of smart contracts. However, most of the disputes that arise relating to e-commerce are not performance related. Usually, the presence of an intermediary provides confidence to buyers owing to its reputation, and local presence ensures they can seek their redress in local courts. Furthermore, the dispute resolution mechanisms of such intermediaries provide efficient redress in most of the disputes. However, in peer-to-peer transactions such as blockchain-based smart contracts, there is no intermediary to mediate or arbitrate the dispute between the parties, and the consumers would have to approach courts when a dispute arises. It will lead to an increase in litigation, which is often difficult owing to the cross-border nature of transactions taking place on the internet. The parties are often situated in different countries with different laws applicable to them.

The seller might be established in some other country, complying with different consumer regulations applicable to it. With local laws protecting the consumer and providing local jurisdiction in consumer disputes cases, it is difficult to imagine how the buyer could effectively litigate against a seller present in a foreign country. It is quite difficult to enforce any order of the court against a seller based in some other territory. The costs of pursuing the case in foreign territory will often exceed the amount in the transaction by a wide margin. The amount involved in regular individual e-commerce transactions is often not high, and that is why local and efficient redress of consumer disputes is provided by means of jurisdiction in the territory where the buyer resides. It also leads to

70 Pierluigi Cuccuru (n6), 186.

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jurisdictional and governing law issues that arise often in internet-related transactions and disputes.

With the use of blockchain-based smart contracts, transactions through online platforms would not entail many disputes as they would not require much trust and parties will perform their parts. However, problems arise when some offline (off-chain) event is involved, for instance, in the present scenario, when an item is to be delivered to the buyer before payment can be released by the code. As a common practice for online transactions, the escrow services are used as an intermediary, who pay the seller in case delivery goes through or may revert the money in case the transaction is disputed by the buyer. There can be a risk to the seller where the party receiving the item does not consent to release the funds from escrow and disputes the transaction. However, the risk is quite low because funds will be held in escrow until a dispute related to delivery is resolved. In another scenario the items may get delivered to the wrong person or might get lost, in which case there is nothing that escrow service or the buyer could do, and sellers remain unpaid after parting with the item. It is hard to imagine whether banks, intermediary or the code could do anything in this scenario. This is high risk and might warrant the use of an insurance policy.⁷¹

Furthermore, spending large amounts in an online transaction would require more trust between the parties to a transaction. This brings us back to the issue of trust, which is quite necessary for contractual relations. It is easy to talk about a trustless environment⁷² with blockchain technology and smart contracts, but quite hard to imagine it practically. Contracts, by their very nature, are social constructs and often demand trust between the parties to have a continued relationship.⁷³ Therefore, contracting can never be totally trustless. The trust and reputation of the parties or businesses is the most important consideration before anyone enters into a transaction with them. Nobody likes to deal with someone with a low reputation in the market. The reputation and trust built through repeated transactions is something that everyone values before deciding to enter into a relationship with another party. Ratings and trust built through feedback mechanisms lead to voluntary compliance and reduce the need for litigation and even ODR.⁷⁴

The one-time and short-term nature of a smart contract transaction is not very conducive to the trust that sophisticated and long-term contractual relations require. Business entities would also need to have the same 'trust' in smart contracts before they put their funds on stake. However, the larger the amount involved, the more reluctant the parties would be to use new technology for that purpose. Furthermore, the anonymous and non-trust nature of blockchain-based smart contracts may provide an opportunity to parties with a low reputation in

71 Philippa Ryan (n2), 14.

72 Jean Bacon, Johan David Michels, Christopher Millard and Jatinder Singh (n17), 11.

73 Karen E. C. Levy (n20), 10.

74 Pietro Ortolani, 'Self-Enforcing Online Dispute Resolution: Lessons from Bitcoin' (2016) 36(3) *Oxford Journal of Legal Studies* 595, 605.

the market to enter into contracts, leading to an increase, rather than a reduction, in disputes.

4 Potential Solutions to the Outlined Problems

This section provides potential solutions to the problems outlined in the previous section. For this purpose, this section has been divided into three subsections, as follows:

4.1 Solutions to Legal Issues

The following subsections provide potential solutions to the foregoing legal problems arising out of the application of smart contracts under the present contract law.

4.1.1 The Validity of Smart Contracts

The contract law throughout different jurisdictions recognizes contracts as valid only if they comply with certain preconditions. The preconditions are usually common among various jurisdictions and include offer and acceptance, a meeting of minds, certainty of terms, agreement in writing and proof of signature. Therefore, it is mandatory for a contract to comply with such preconditions in order to be enforceable through the courts.

Typically, smart contracts, which are entirely written in the code, might lead to some problems with regard to their validity and enforceability under the contract law because the parties to a contract generally do not understand the code, which is often written by the developer or a programmer. Therefore, a translated natural language version of the smart contract written entirely in code should be created as a legal contract separately and signed by the parties to form the proof of agreement and certainty of terms. Furthermore, a natural language version of a legal contract can be entered into alongside the smart contract code as non-operational text.⁷⁵ This can deal with the issues concerning the validity and enforceability of smart contracts under the contract law. It will provide the party going to litigation or arbitration with an important ground for the intention of the parties to create a valid contract.

Similarly, smart contracts *ex machina* (created by the machines) also pose issues with regard to their validity under the contract law. The law relating to contracts in both common law and civil jurisdictions recognize only contracts between human or legal persons (such as companies or corporations). It does not recognize contracts between machines as valid contracts. Therefore, in order to be valid and enforceable at law contracts *ex machina* require a separate legal contract in natural language legal terms to be agreed between the parties. For instance, it could be stated within the separate contract that all the contracts created, or obligations undertaken by the communication or altercation between

75 Linklaters, 'Whitepaper: Smart Contracts and Distributed Ledger – A Legal Perspective' (2017) 11, www.isda.org/a/6EKDE/smart-contracts-and-distributed-ledger-a-legal-perspective.pdf (accessed 5 January 2021).

such computers or machines, would be valid under the authority of a person who owns such computers or machines.

Furthermore, the relationship between a computer or machine and its owner can be regarded as that of one between principal and agent. The machines could be considered as artificial agents of its principal for creating valid contracts.⁷⁶ Although the machines can be interpreted as artificial agents of their principal (owner), the contract law at present does not recognize computers or machines as agents but only human or legal persons as valid agents to enter into contracts on behalf of their principal. It is only suggested for the courts or arbitral tribunals interpreting the contract law to consider them as the artificial agents of their owners and the contracts created between such machines to be valid contracts entered into between their principals. This interpretation can deal with issues concerning the validity of smart contracts until a regulation or amendment is made to contract law to deal with the case of smart contracts. The e-commerce regulations such as the United Nations Convention on the Use of Electronic Communications in International Contracts⁷⁷ or the Uniform Electronic Transactions Act⁷⁸ have already recognized the possibility of automating transactions or expressing contractual intention through computer processes.

The consideration of machines as artificial agents of their owner is based on the logic that machines are programmed, by the owner or by the developer on their behalf, for creating and enforcing smart contracts. It amounts to the constructive intent on the part of the owner that it authorizes its machine to create contracts on its behalf. Furthermore, machines do not act on their own but always require human input to initiate an action. It can be assumed that they acted only in the way their owner wanted them to. Therefore, the acts of machines can be imputed constructively to their owners. The owner (principal) cannot escape liability when something goes wrong as a result of a coding error by pleading that the machine malfunctioned or the code misperformed. The owner should be fully responsible for the acts of such machines or the code based on the principle and agent relationship as the principal can be sued for the acts and omissions of its agents, i.e. the code or machine in the present case.

The machines can be programmed to include the arbitration clause in their contractual creations, which can set terms for arbitrating any disputes that arise out of the application of smart contracts. It will be easier to resolve those disputes through online arbitration with an expert who understands the working of those machines and the contracts they create. Therefore, the parties would not have to go through the lengthy and sophisticated process of litigation where the courts might lack the technical expertise on the working of smart contracts and the technology underlying it. It is not uncommon for courts to appoint experts to weigh in with opinions in such cases. Therefore, an expert should arbitrate the dispute, which is quite a flexible process compared with court litigation.

76 Eliza Mik (n27), 15.

77 See: Convention on the Use of Electronic Communications in International Contracting, 23 November 2005, U.N. Doc. A/60/21, Art. 12.

78 See UETA comment 1 to Section 14.

It can be argued that both situations, i.e. smart contracts *ex machina* and contracts written entirely in code, are valid contracts between the parties unless they suffer from some illegality in their purpose. For instance, the smart contract for drug trafficking or selling copyrighted materials would be void for their purpose. However, smart contracts that do not suffer from any illegality in their purpose are perfectly valid contracts. Just like verbal or oral contracts, they are not enforceable at law, but they are not void.⁷⁹ Enforceability and validity are two different concepts under the contract law. Only a valid contract will indeed be enforceable at law. However, a contract may be valid but still not enforceable at law, just as in the case of oral contracts. They are valid contracts until the parties to the agreement honour their obligations. The only problem that arises with oral contracts is related to their enforcement, in that the court will not enforce oral or verbal agreements if they are not in some way evidenced in writing.

Therefore, it is argued that speculation about the invalidity of smart contracts is wrong, because they are perfectly valid contracts. The only problem that arises with them relates to their enforceability. The preceding measures suggested, namely to have a separate natural language legal contract evident in writing and signed by the parties, seeks to deal with the problem of enforceability of smart contracts. It makes them enforceable under law, and parties will be able to make claims with regard to the contracts before the national courts or arbitral tribunals. Furthermore, including an arbitration clause within the smart contract code or the separate legal agreement would subject any disputes concerning such smart contracts to the arbitrator, who can provide a binding decision on such dispute. It is sufficient to include an arbitration clause within the smart contract code; however, it would be better if the terms of the agreement and the arbitration clause are included in a separate legal contract in natural language. This represents the express intent of the parties to make a contract enforceable at law.

Another requirement for a contract to be valid is the intent of parties to enter into an agreement, to create mutual obligations and define the terms of a contract with certainty. All the requirements are usually present in smart contracts, for instance, when one party creates the contract and the other makes a transaction to the contract from its bank account. It is enough intention to create mutual obligations and perform their part of the agreement.⁸⁰

Furthermore, under the present contract law smart contracts can be treated as valid and binding because, first, they are in writing or exchanged (electronically) in writing. Second, the precondition as to signature of parties could be fulfilled by an e-signature, which is recognized by the laws of most jurisdictions as a valid signature of a user. Furthermore, smart contracts running on blockchain technology require the use of private and public keys that would satisfy the requirement that the contract is signed.⁸¹ It is assumed that the owner holds a private key to the address associated with a user account and is never

79 Jean Bacon, Johan David Michels, Christopher Millard and Jatinder Singh (n17), 31.

80 Riikka Koulu (n64), 65.

81 See Law 360 (n58).

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expected to share it with anyone else. If the key has been used it can safely be assumed to be used by the owner and hence the contract can be deemed validly signed. As a practical example, a corporate email address is assumed to be used by the owner of the account, i.e. the employee of a certain corporation, and can therefore bind the corporation to an agreement with a response through its corporate email address.

4.1.2 Issues Related to the Identity of Parties

Unlike traditional contracts where the identity of the parties is required for the enforcement of contracts, it is no longer required under smart contracts' non-trust environment, where obligations are automated that seek to exclude the state and court involvement in contract execution. However, disputes will arise out of the use of smart contracts, and it is advisable to have a separate legal contract stating the terms of the agreement. It will help to identify the parties to the contract for the purpose of litigation or arbitration. Furthermore, an arbitration clause included within the smart contract will provide it with a robust dispute resolution mechanism that can help in identifying the other party to the agreement against whom a claim may be brought. Otherwise, in the case of pseudonymous execution of a smart contract, a party might find it difficult to find someone to sue. The arbitrator possessing expertise in coding and functioning of blockchain technology should be in a better position to trace the identity of a party against whom a claim is being brought.

4.1.3 Governing Law and Jurisdictional Issues

The parties, nodes, place of performance of contract and place where the contract was formed will often be scattered over different jurisdictions with different applicable laws governing such issues. Furthermore, it will lead to different courts and states claiming jurisdiction over such issues, making it hard to resolve the dispute efficiently at one place.

Therefore, it is advisable to include arbitration and choice of law clause as part of the agreement, which enables the parties to agree to the governing law of the contract, the procedural and substantive law to be applicable to the arbitral proceedings. It will provide the arbitrator with enough guidance as to the intention of the parties and the way they want their dispute to be resolved.

4.1.4 Issues Relating to Confidentiality

The blockchain-based smart contracts are, by their nature, not meant for storing confidential information, because the code of the smart contract is executed by all the nodes on the network and anyone on the network can access it. It creates an issue with regard to the confidentiality of sensitive information and trade secrets that often form part of contracts. For instance, the smart contract may include certain information or intellectual property (IP) rights licence, which might be attached to the contract, and it is programmed in such a way that the file

containing such information or licence would be released once the other party transfers certain consideration.⁸² It is then launched into the blockchain.

This might create issues concerning the confidentiality of such information, which can be accessed by all the nodes executing the smart contract. The party transferring such information must ensure that no unauthorized access is granted to the file. However, the problem with regard to its access and confidentiality could be solved by using end-to-end encryption of the file containing the confidential or sensitive information. Encryption provides users with a private and public key for access to the file. A private key is meant to be used by the recipient of the file, and matching the private key with a public key ensures the integrity of a file containing the information. Therefore, encryption ensures that the file is accessed only by the intended recipient and provides security to confidential information disseminated in public blockchain after encrypting data.

Furthermore, using arbitration as a dispute resolution mechanism ensures that the evidence about proprietary software or hardware does not go to the public courts when a dispute arises. The source code and other commercially sensitive information exchanged between the parties may be highly valued by parties, and they are often unwilling to bring it before public courts. Such information is often required as evidence, while resolving any dispute and arbitration can limit such disclosure if the parties agree to the inclusion of a confidential arbitration clause within the contract.

4.2 Solutions to Programming Defects, Coding Errors and Irreversibility Issues

4.2.1 Programming Defects and Coding Errors

As already discussed, programming and coding errors are bound to arise during the development and use of a smart contract. These defects can arise in both scenarios, where the contract is created entirely in code and in case the terms of a legal agreement are translated into code language to give effect to the contract. Either the lawyers must learn the programming language or the programmers must learn the basic principles of contract law, both of which possibilities are a distant reality. However, the legal contracts could be drafted keeping in mind their future translation into code and might state the obligations to be executed in code form.

Furthermore, to deal with such issues it is advisable that a programming language be developed that is compatible with smart contracts and easy to understand for experts from a legal background. It will provide them with an opportunity to learn about the technicalities and functioning of smart contracts. ‘Legal engineering’⁸³ or ‘legal programming’ are terms that have emerged for creating a programming language compatible with law and technology, to be used by the lawyers. The skills required of lawyers would also change. Furthermore, it

82 Pierluigi Cuccuru (n6), 186.

83 Kevin Werbach, ‘Trust, But Verify: Why the Blockchain Needs the Law’ (2017) 50, <https://ssrn.com/abstract=2844409> (accessed 5 January 2021).

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will enable the lawyers to draft the smart contracts that exactly resemble the terms of an agreement between the parties to the contract. It seeks to exclude the possibility of misunderstandings or mistakes made by programmers while creating or translating the legal contracts to smart contracts.

Until such legal friendly programming language is developed, it is advisable to have a co-operative effort between the coders and the lawyers to ensure that the coding language being translated from a natural language version of a smart contract or directly being drafted in the form of code represents the rights and obligations of the parties as agreed by them. Therefore, the presence and cooperative understanding between a lawyer and a coder will help reduce such discrepancies. It assumes importance in the smart contract scenario because the code once launched into the blockchain is irreversible and cannot be modified later. Therefore, it is important to analyse the possible commercial outcomes of a smart contract.

4.2.2 *Irreversibility of Smart Contracts*

The smart contracts are, by their nature, irreversible; they cannot be modified once launched into the blockchain. One way to bring some flexibility within smart contracts is to use a multi-sig contract with a blockchain arbitrator who can make changes if required.⁸⁴ Furthermore, as proposed by Parikshit Joshi, Lead, IoT, and Data Science principal with Simform Solutions, the use of modular programming in smart contracts can enable the modification of smart contracts. Usually, the entire data on the blockchain will be lost in the effort to modify or upgrade a smart contract. Using modular programming enables smart contracts to contain modular.sol files that can be upgraded without losing the entire data from a blockchain.⁸⁵ Companies are further exploring the development of an editable blockchain where a certain small number of authorized parties can change blocks stored in the past.⁸⁶

4.3 *Smart Dispute Resolution for Smart Contract Disputes*

4.3.1 *Arbitrating Smart Contract Disputes*

As the internet bypasses all territorial borders, disputes over smart contracts and blockchain technology are often international in nature. Therefore, resolving such disputes calls for a dispute resolution mechanism that is also truly smart and international in nature. Globally, a large number of cross-border disputes are resolved through arbitration because of its convenience, efficiency and international acceptance. For instance, most disputes related to the shipping business are resolved through maritime arbitration. It is preferred by the parties to a contract because the shipping trade is international in nature and neither of

84 Pietro Ortolani (n74), 621.

85 Erika Morphy (n22).

86 Accenture, 'Editing the Uneditable Blockchain: Why Distributed Ledger Technology Must Adapt to an Imperfect World' (2017), <https://newsroom.accenture.com/content/1101/files/CrossFSBC.pdf> (accessed 20 January 2021).

the parties prefers going through national courts processes in different countries in case a dispute arises in regard to the agreements. Furthermore, arbitration serves as a method of private justice and self-help.⁸⁷ Cross-border disputes will arise with the use of this technology and most of them relate to jurisdiction and governing law issues. Therefore, it is argued that national courts are not a preferred means of dispute redressal in resolving disputes related to the internet, specifically blockchain-based smart contracts.

Arbitration is a method of resolving disputes between parties to a contract and for disputes arising out of the same contract, or all contracts related to a business relationship, as agreed between the parties. In arbitration, the matter is finally decided by a third person or a person appointed by an institution, as agreed by the parties in an arbitration clause. This method of resolving disputes can be achieved by the parties by including an arbitration clause in their contract and submitting any disputes arising out of the contract to binding arbitration. The parties can agree on a person to be appointed as an arbitrator or can provide for institutional arbitration where the arbitrator is nominated by the appointing authority or institution, as chosen by the parties. The seat and venue of arbitration can be further agreed in the arbitration clause to save the parties from litigation procedures that can be unduly long in view of the distant location of the foreign courts and parties residing in different countries.

Another consideration for preference to arbitration in such cases is the expertise provided by the arbitrators working in this field. Mostly, the national or local courts do not possess the kind of technical knowledge required to deal with matters in the area of the internet and technology.⁸⁸ Sometimes arbitrators are not even from the legal or judicial field, and usually they belong to the technical field with extensive knowledge and experience dealing with technical matters. The specific knowledge about the technicalities and the experience those experts have gathered through their work experience is the reason for appointing them to arbitrate such disputes. Furthermore, the recognition and enforcement that is accorded to arbitral awards worldwide on the basis of the New York Convention, 1958, makes arbitration perfectly suited for resolving international disputes.

It can be argued that if the parties to maritime and international commercial contracts prefer arbitration and ADR (alternative dispute resolution) mechanisms to resolve disputes because of the international nature of transactions they enter into, the transactions over the internet certainly bypass every border, and millions of transactions take place over the internet every minute. Furthermore, the increase in e-commerce has expanded the volume of contracts being created online every day. Therefore, arbitration and ADR mechanisms are the perfect fit for internet and smart contract-related disputes.

87 J. Goldenfein and A. Leiter, 'Legal Engineering on the Blockchain: Smart Contracts as Legal Conduct' (2018) 29 *Law and Critique* 141, 147.

88 Lee Bacon and Nigel Brook (Clyde and Co), 'Arbitrating Blockchain Disputes: Will Smart-Contracts Require Smart Dispute Resolution?' <https://www.mondaq.com/uk/insurance-laws-and-products/510218/arbitrating-blockchain-disputes-will-smart-contracts-require-smart-dispute-resolution> (accessed 25 February 2021).

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Arbitration is preferred over national courts' litigation procedure because it provides a flexible mechanism for dispute resolution. The parties or the arbitrators (with the consent of parties) are free to agree on the procedure to be adopted in an arbitration proceeding. The parties can also agree on the governing law of their contract. The arbitrators are not bound by the national laws or procedures while deciding a dispute and can apply the customary rules established through trade and usage known as *lex mercatoria*.⁸⁹ Using arbitration and *lex mercatoria* would provide a huge advantage in the internet and smart contracts-related disputes because, first, the law has not been developed enough to accommodate smart contracts and will often lag behind technology. With the new inventions in technology, it would always be preferred that someone from the technical field with sufficient knowledge and experience dealing with technicalities decide on the matter. Second, most of the problems would arise in relation to governing law and the jurisdictional issues that can be dealt with by resorting to arbitration as parties can agree and specify the governing law and procedure within the arbitration clause. Third, arbitrators have the power to decide on their own appointment and the validity of the arbitration clause. They can also decide on the validity of the underlying contract, which can be gathered from the intent of parties to a smart contract.⁹⁰

Furthermore, an arbitrator possessing technical expertise would be better suited to understanding the code language and would be able to interpret the intentions of parties to a smart contract. After going through the code or legal terms of the contract, the arbitrator can decide whether the intentions of parties are enough to create a valid contract and uphold it as valid. This is where arbitration provides a huge advantage over litigation in national courts. It provides more flexible interpretations of the contract, whereas the national courts follow rigid contract law and rules that do not provide the required recognition to the validity of smart contracts.

Lex mercatoria in the case of energy arbitrations is known as *lex petroli*, because it is a separate field consisting of different kinds of customs and usages applicable to energy-related transactions. Similarly, the customs and usages applicable to the internet and blockchain-based smart contracts disputes constitute *lex electronica* or *lex cryptographia*.⁹¹ It should consist of people having expertise in internet jurisdiction and smart contracts-related disputes. They must possess sufficient knowledge about the working of computer programmes and code language, which will enable them to decide on any disputes arising out of their application. *Lex electronica* or *lex cryptographia* will constitute separate sets of rules and governing laws applicable to the internet and technological disputes, which develop over time with the use of such technology and, further, through the decisions rendered over time on such disputes by the experts working in the area of law and technology.

89 Julia Hörnle, *Cross-border internet dispute resolution* (Cambridge University Press 2009) 63.

90 Aaron Wright and Primavera De Filippi (n15), 44.

91 *Ibid.*, 48.

Arbitration, as a dispute resolution mechanism, is known for its flexibility and adaptability to emerging disputes. It is therefore more likely to evolve as a preferred dispute resolution mechanism for smart contracts disputes, which in turn will further drive innovation in present arbitration law, arbitral bodies and procedures to suit the needs of new disputes. New principles concerning the validity, enforcement, liability and various other issues arising out of the application of smart contracts must evolve with this separate branch of rules and regulations for arbitration of technological disputes. The arbitral institutions are likely to develop a specialist pool of arbitrators with relevant experience related to technology and blockchain. As a result, an arbitral tribunal possesses technical knowledge with specially tailored procedures for dealing with disputes arising out of using such new technology.

Furthermore, online arbitration and ODR mechanisms must be preferred over traditional arbitration in the case of technological and smart contracts-related disputes because they conduct the process of dispute resolution using internet and communication technologies (ICT). ODR is sometimes known as the fourth party to the dispute resolution process as it makes the process very efficient and quicker. The perfect working example of the ODR mechanism is the Austrian Ombudsman, who acts as a mediator between the disputing parties and issues a binding decision after receiving the pleadings and supporting evidential material from the parties to a contract. The disputes it deals with are consumer disputes related to online purchases.⁹²

Furthermore, Ebay's dispute resolution centre is one of the largest ODR platforms resolving millions of disputes every year. Cybersettle, Weclaim and Smartsettle are also some of the ODR platforms seeking to successfully resolve internet and smart contract disputes easily online.⁹³ The use of artificial intelligence, ICT and blockchain technology in ODR drives further innovation in making dispute resolution quicker and cheaper.⁹⁴ It also makes justice accessible to persons who cannot afford to go through the court process.⁹⁵

4.3.2 *Blockchain Arbitration and Crowdsourcing ODR as a Smart Dispute Resolution Mechanism for Smart Contract Disputes*

Crowdsourcing is a process whereby a task is performed by a large number of people (on a network) rather than a limited group. Crowdsourcing can be used for working on a task cost-effectively and quickly. The best example of crowdsourcing is Wikipedia, where many editors work around the world to feed information into

92 Julia Hörnle (n89), 76.

93 Jeremy Barnett and Philip Treleaven, 'Algorithmic Dispute Resolution—The Automation of Professional Dispute Resolution Using AI and Blockchain Technologies' (2018) 61(3) *The Computer Journal* 399, 405.

94 *Ibid.*, 402.

95 Jay Cassano, 'What are Smart Contracts? Cryptocurrency's Killer App' (FAST COMPANY, 17 September 2014), www.fastcompany.com/3035723/smart-contracts-could-be-cryptocurrencys-killer-app (accessed 8 January 2021).

its platform, making it one of the best encyclopaedia projects ever.⁹⁶ The nature of blockchain technology resembles that of crowdsourcing as it is a network of nodes constituting a decentralized blockchain. Although it is different in case of centralized platforms, however, regardless of centralized or decentralized nature, the nodes and users can be scattered over a large network. The idea of blockchain arbitration also evolves from the crowdsourcing of the arbitration process.⁹⁷ Traditional arbitration is not a cheap process for resolving disputes, and, therefore, decentralized arbitration seeks to solve issues related to the high cost of arbitration.

Decentralized online arbitration is a process by which arbitrators are selected through the internet at random, and they can decide on the dispute referred to them. They are provided with the power to enforce the remedy by recording their decision on the blockchain. This process resembles crowdsourcing, where people come together to solve a single issue,⁹⁸ such as Kleros, which is an online jury and dispute resolution platform.⁹⁹ However, in the present scenario, choosing online or blockchain arbitration and ODR as a dispute resolution mechanism provides the parties with the flexibility to choose their own procedures and remedies in case of a dispute. It can help overcome the pseudonymous and irreversible nature of smart contracts.¹⁰⁰

Parties to a contract can agree to refer disputes below a certain threshold to be decided by a central blockchain administrator, whose decision would be final and enforceable through remedial transactions being recorded on the blockchain.¹⁰¹ This can be achieved through an arbitration clause to refer the disputes to arbitration by including it in the smart contract. The arbitration clause can contain aspects related to the procedure, appointment and remedies that can be granted by an arbitrator. The arbitrator gets the power to execute the arbitration clause and pronounce a final and binding decision on the dispute. This power to execute the decision through blockchain can be provided using the multi-sig transactions,¹⁰² which work like escrow service. The funds are kept frozen in a third party account and three private keys are generated that can be used to execute the contract. The execution is conditional on the use of 2 out of 3 keys, each of which is held by each party and the third key by the arbitrator. Therefore, the arbitrator may decide in favour of one party, resulting in two keys being used to enforce the contract, which can be, for instance, to effectuate the

96 D.V. Dimov, 'Crowdsourced Online Dispute Resolution' (2017) Meijers-reeks (Leiden University, 27 June 2017), <http://hdl.handle.net/1887/50156> (accessed 9 January 2021).

97 Financial Times, <https://ftalphaville.ft.com/2016/04/29/2160502/decentralised-courts-and-blockchains/> (accessed 18 July 2018).

98 Jaap Van Den Herik and Daniel Dimov, 'Towards Crowdsourced Online Dispute Resolution' (2012) 7 International Journal of Law and Information Technology 99.

99 Gerry Riskin, 'Crowdsourcing Dispute Resolution on the Blockchain' (LAW FIRM TECHNOLOGY, 10 May 2018), www.gerryriskin.com/crowdsourcing-dispute-resolution-on-the-blockchain/ (accessed 23 January 2021).

100 Norton Rose Fulbright (n31).

101 *Ibid.*

102 Vitalik Buterin, 'Multisig: The Future of Bitcoin', (BITCOIN MAGAZINE, 13 March 2014), <https://bitcoinmagazine.com/11108/multisig-future-bitcoin/> (accessed 8 January 2021).

transfer of assets or funds on the blockchain.¹⁰³ It prevents the execution of action till multiple parties agree to the transaction. Blockchain arbitration further provides a solution to the problem of enforcing ODR decisions.¹⁰⁴ It can deal with voluntary non-compliance issues and seeks to auto-enforce ODR decisions by launching them into the blockchain, once the agreement has been reached and keys are used to effectuate a transaction.¹⁰⁵

Traditional methods should not be used for resolving non-traditional disputes. Therefore, newly evolving disputes require new methods for their redress. Technologies move forward so quickly that they live and die, sometimes without even legislation being brought in to deal with them. The combination of both smart contracts and blockchain arbitration has the potential to revolutionize the dispute resolution process and take its quality and enforceability to a new level.¹⁰⁶ Arbitration is considered best for business-related disputes; however, it is not as quick and cost-effective as per the requirements of an average transaction through blockchain and smart contracts. Therefore, arbitration via blockchain (decentralized arbitration) seeks to resolve two problems with traditional arbitration of smart contract disputes, i.e. the high cost of the arbitration process and the irreversible nature of smart contracts. An arbitrator can terminate the contract and make changes to a blockchain. It can further be used in case the smart contract remains inactive for too long and the funds are frozen in an account without access. An arbitrator can decide to release the funds when the performance of a smart contract becomes impossible.

One practical example of how blockchain arbitration works is the new start-up called Confideal. It is a smart contract start-up providing its users with an Ethereum-based platform for creating self-executable smart contracts that are backed by a dispute arbitration service staffed by lawyers.¹⁰⁷ Although the process is lawyer free and they intend to operate as escrow and dispute resolution service based on blockchain, a user can avail of the services of listed lawyers to handle formal arbitration or mediation proceedings.

Although the blockchain-based decentralized arbitration is the best fit for resolving smart contract and blockchain-related disputes, it does raise issues with regard to due process, rule of law and protection of weaker parties in resolving such disputes. The private ODR mechanisms do not follow the same level of due process as that followed by the national courts.¹⁰⁸ Regardless, most individual e-commerce disputes are of low value, and the parties seek to resolve them without

103 Pietro Ortolani (n74), 621.

104 Riikka Koulu (n64), 47.

105 *Ibid.*, 48.

106 Confideal, 'Why is Blockchain-based Arbitration the Only Future for Dispute Resolution?' (5 October 2017) <https://medium.com/@confideal/why-is-blockchain-based-arbitration-the-only-future-for-dispute-resolution-93e34d99ec83> (accessed 20 January 2021).

107 Artificial Lawyer, 'Smart Contract Platform, Confideal, to Offer Dispute Arbitration Service' (23 October 2017), www.artificiallawyer.com/2017/10/23/smart-contract-platform-confideal-to-offer-dispute-arbitration-service/ (accessed 11 January 2021).

108 Derric Yeoh, 'Is Online Dispute Resolution the Future of Alternative Dispute Resolution?', <http://arbitrationblog.kluwerarbitration.com/2018/03/29/online-dispute-resolution-future-alternative-dispute-resolution/> (accessed 17 January 2021).

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all the hassle of going through court litigation. This does not mean that blockchain arbitrators ignore the due process, as they are still expected to maintain high standards. The parties can, however, bring a matter before the national or consumer courts if there is a violation of basic laws and principles.¹⁰⁹

Furthermore, the use of ODR and ADR mechanisms do not entail binding precedents. Therefore, the use of these dispute resolution mechanisms do not interfere with rule of law but rather nourishes it because parties to a contract are free to choose the dispute resolution mechanisms they want in order to resolve their disputes. The decisions rendered by arbitrators or opinions of mediators only have *inter partes* effect, which means they only bind the parties to the dispute and not the general public at large. It is therefore argued that issues of rule of law do not arise with the use of ODR or ADR mechanisms.

5 Conclusion

Smart contracts are truly revolutionary in the way they can automate the performance of contracts. They can prove to be real game changers by shaping the way online transactions are conducted. The goal of this article was to analyse smart contracts from the perspective of law, in view of their wide adoption and the fact that many fintech start-ups are researching their potential application for automating transactions, eventually leading to replacing human discretion from the contractual performance. There are many problems with their adoption under the present law, and the legislatures and courts should act quickly to accommodate smart contracts within the traditional jurisprudence, if not by new regulations.

Smart contracts challenge the traditional concept of legal contracts by creating a trustless environment. However, one should bear in mind that legal contracts are social constructs and serve a broader social purpose rather than merely enforcing contractual obligations. Parties to a contract often use them as a vehicle of trust and long-term relationships that cannot fit into the smart contracts as they are meant to be trustless. It is further argued that contracts can never be fully trustless; they would not have existed if that were the case. Therefore, even the use of smart contracts for future transactions would require similar trust in their application. Various kinds of problems emerge with the application of new technology, and errors are most likely to occur when computers or machines are involved. They always work on test and fix mechanisms that cannot be applied to real-world transactions before these technologies are tested as fail-proof. A single error could prove costly and may ruin years of a trusted relationship between the parties, as evidenced by the DAO attack.

This article has aimed to demonstrate that there is no problem with accommodating smart contracts within the present law. The smart contracts are not a replacement for contract law but rather a new kind of contracts to be

109 Riikka Koulu (n64), 67.

governed by it. Furthermore, arbitration as a flexible and dynamic mechanism of dispute resolution can deal with new challenges as to the validity, enforcement and disputes arising out of smart contracts and their possible applications. Arbitration can devise soft laws and its own procedures to deal with emerging disputes. The potential of blockchain arbitration cannot be undermined, it being a truly smart dispute resolution mechanism that makes it a perfect fit for internet and smart contract-related disputes. It would be premature to make a projection about the success of smart contracts and blockchain-based arbitration at this stage; however, considering that start-ups like Confideal are already offering ICOs, much can be said for their potential.