Key Legal Issues Surrounding Smart Contract Applications

Pablo Sanz Bayón*

* Assistant Professor in Commercial Law. School of Law, Comillas Pontifical University (Madrid, Spain). Tel: +34 91 542 28 00, Email: psbayon@comillas.edu.

Abstract

The aim of this work is to delve into some key legal issues surrounding Smart Contract applications. In the first and second parts, this paper defines the concept of Smart Contract and how it applies within the blockchain ecosystem. In the third part, this work exposes the functioning of this digital technology and the main advantage that it implies for solving the crucial issues of execution and breach of contracts. In the fourth section, this paper analyzes a set of problematic aspects that arise around Smart Contracts such as the scope and delimitation of them or the validity and certification of blockchain transactions. It also analyzes different issues related to the design of a legislative policy that addresses the design of a supranational and harmonized legal framework.

Keywords: Smart Contract, Blockchain, Distributed-Ledger Technology, Transactions, Self-executing Agreements, Enforcement, Legislative Policy

Manuscript received: Feb. 7, 2019; review completed: Mar. 14, 2019; accepted: Apr. 15, 2019

I. A Basic Concept of Smart Contract

The concept of Smart Contract (SC) was introduced at the end of the last century by the computer cryptographer Nick Szabo, who proposed it to automate the fulfillment of computerized promises.[1] Szabo defined SC as a set of promises and specified in digital form, including protocols within which the parties perform on the other promises.[2] The automation of the execution of contractual obligations is made possible through the translation of the terms of the contract into an executable program. This program allows the control over the physical or digital objects necessary to perform such execution. In this way, once the possibility of a dispute regarding the conditions has been closed (because they are codified and previously agreed upon by the parties), the key point is to wait for the conditions in the programming to be fulfilled or not in order to carry out the agreed obligations.

The functioning of the SC is given through conditional statements that have the form [if this (X), then (Y)]. This task can be entrusted to a software thanks to the possibility of putting in computer code some of the provisions of a contract (which may have been previously formalized in natural language).[3] The

---

1) Mr. Szabo was the first author to use the term "smart contracts" and is theorized to be the person behind the pseudonym of Satoshi Nakamoto, the creator of the cryptocurrency Bitcoin. For more information regarding these claims. See Nathaniel Popper, *Decoding the Enigma of Satoshi Nakamoto and the Birth of Bitcoin,* The New York Times (Apr. 26, 2019), https://www.nytimes.com/2015/05/17/business/decoding-the-enigma-of-satoshi-nakamoto-and-the-birth-of-bitcoin.html. For more information: SZABO, N. (1997), The Idea of Smart contract. Retrieved from https://web.archive.org/web/20060615044959/http:/szabo.best.vwh.net/smart_contracts_idea.html

2) Nick Szabo, Smart contracts, ¶ 1, (Apr. 26, 2019), Phonetic Sciences, University of Amsterdam http://www.fon.hum.uva.nl/rob/Courses/InformationInSpeech/CDROM/Literature/LOTwinterschool2006/szabo.best.vwh.net/smart.contracts.html.

3) One of the SC applications based on private blockchain is led by a consortium of major international banks called R3. R3 successfully used its proprietary Corda blockchain for the first time to trade bonds as part of a pilot project. This is another case where blockchain-based SC has the potential to cut costs and speed up processes by automating manual tasks. Corda blockchain allows members to use the transaction platform whilst receiving exclusive access to the data and combining this system with SC in order to trade derivatives, as Barclays demonstrated in April 2016. The vision is for the SC to be capable of automatically transferring the value of a derivative to the account of the transaction´s beneficiary from the account of its counterparty. As Deloitte states in its report, the current legal framework still requires the counterparty owing the payment to authorize automated transfers, but technically it is already possible today to fully automate the process without leaving any possibility for intervention by the parties. The same process is possible for energy networks to be controlled through SC, since

importance of SC is of such magnitude that the Nobel Prize Laureate in Economics 2016, Oliver Hart, for his contribution to the Theory of Contracts, announced his interest in participating in some projects that are developing innovations in this field.[4]

II. Blockchain as a Suitable Technology for Smart Contracts

The blockchain technology constitutes a very useful computational platform for programming and registering this type of operations whoseself-execution depends on verifying the conditions previously established between the parties.All this is achieved without the intervention of any of the parties or of an intermediary or central authority. In this sense, any agreement between individuals or companies can include clauses whose execution is automated thanks to the use of blockchain technology.[5]

Blockchain is more well-known as the means to the end that it serves, since it is the technology that enables the functioning of Bitcoin (which is the most well-known cryptocurrency).[6] This technology is a type of Distributed Ledger Technology (DLT),[7] which has been characterized as "a distributed, shared, and

---

they would signal to the system when to initiate what transactions based ojn predefined rules. See Felix Hasse, Axel von Perfall, Thomas Hillebrand, Erwin Smole, Lena Lay, and Maximilian Charlet, *Blockchain - an opportunity for energy producers and consumers?*, PwC global power & utilities, available at *https://www.pwc.com/gx/en/industries/assets/pwc-blockchain* -opportunity-for-energy-producers-and-consumers.pdf.

4) Michael del Castillo, *Nobel Prize Winner Joins Blockchain Startup to Fix Smart Contracts*, Forbes (Aug. 1, 2018), https://www.forbes.com/consent/?toURL=https://www.forbes.com/sites /michaeldelcastillo/2018/08/01/nobel-prize-winner-joins-blockchain-startup-to-fix-smart-contracts/#2faf421e7cc7.

5) Tessa Hoser, Blockchain basics, commercial impacts and governance challenges, 68 Governance Directions, 608-12 (2016).

6) Bitcoin is a cryptocurrency created in 2009 that serves the function of money without requiring the control of a central authority, since it depends on cryptography through a consensus network. This cryptocurrency works via a peer to peer network that enables the use of this digital money. For more information, see Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System, available at https://bitcoin.org/bitcoin.pdf; see also Reuben Grinberg, Bitcoin: An Innovative Alternative Digital Currency, 4 Hastings Sci. & Tech. L.J. (2011), available at https://ssrn.com/abstract=1817857.

7) See A Report by the UK Government Chief Scientific Adviser, Distributed Ledger Technology: beyond block chain, Government Office for Science (2016), available at https://www.gov.uk/government

encrypted database that serves as an irreversible and incorruptible repository of information."[8] Blockchain operates as a digital platform that validates and stores the history and timeline of transactions of all users throughout the network. By creating a new "block" in the chain, the platform contains all the information created from the transactions, and timestamps them in order to preserve all the information unaltered. Its operating is close to a double-entry bookkeeping system, in the sense that once the transaction has been carried out, the blockchain registers and sends it to all the users in the network. The blocks are chronologically saved and also connected to a database that will enable a secure and trustworthy way of ensuring the origin and owner of the digital file or asset that has been transferred.[9] The transactions are verified by high-advanced cryptographic system, and once validated, they are stored in different blocks that are also later verified by the whole network of members (each through its node), and thus chained to one another, which is synchronized among the other nodes via Peer-to-Peer (P2P) protocol.[10]

The main difference, and its main advantage over the more traditional systems of bookkeeping is that this digital accounting system is completely decentralized. This ensures that the possibility of tampering with the records is close to null. If some altering were to be done to a certain block or piece of information, the author would have to change all records of the whole blockchain network. This means to alter all the records which were sent to the network members, one by one, and in the shortest time as possible.[11]

In practice, this technological advantage allows for transactions to occur and be approved without requiring the services of a middle-man or intermediary, since the whole network will ensure the instant legitimacy of the transaction deployed in the Peer-to-Peer platform.[12] For this reason, the main virtue of this

---

/uploads/system/uploads/attachment_data/file/492972/gs-16-1-distributed-ledger-technology.pdf.

8) See Hossein Kakavand, Nicolette Kost De Sevres, and Bart Chilton, The Blockchain Revolution: An Analysis of Regulation and Technology Related to Distributed Ledger Technologies, (2017), available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2849251.

9) See Matthew Spoke, How Blockchain Tech Will Change Auditing for Good (2015), coindesk, available at https://www.coindesk.com/blockchains-and-the-future-of-audit/.

10) See Kakavand, Sevres, and Chilton, supra note 8.

11) See Douglas W. Arner, Janos Nathan Barberis, and Ross P. Buckley, The Evolution of Fintech: A New Post-Crisis Paradigm?, Univ. H.K. Fac. L. Res. Paper No. 2015/047 (2015), UNSW L. Res. Paper No.2016-62 (2016), available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2676553.

12) See Special Report: Slings and Arrows, Blockchain - The Next Big Thing, The Economist (2015),

new digital technology is its unlimited applications.[13] In fact, blockchain can be applied in all technological dimensions, but it can also be used in order to solve and fulfil operational, legal, and regulatory issues, by covering all aspects of market and corporate concerns, which could include: public registrars and filings (commercial and property ones, management of securities or intellectual property rights), notarization and public faith, and even invoice tracking.[14]

III. Operation of Smart Contracts on Blockchain Platforms

As indicated above, a SC is an automatable and enforceable agreement. Although some parts may require human input and control, it can be automated by computer. It is enforceable either by legal enforcement of rights and obligations or via tamper-proof execution of computer code.[15] Its main utility in the network consists of serving as a condition to execute orders that allow the

---

available at https://www.economist.com/news/special-report/21650295-or-it-next-big-thing.

13) For more information, see James Ray, Decentralized apps (dapps), Ethereum / wiki (2018), available at https://github.com/ethereum/wiki/wiki/Decentralized-apps-(dapps).

14) According to Maria Pedernal, *Legal framework and international comparison of regulatory technologies (Regtech) and its implications for the financial sector*, Universidad Pontificia Comillas (2018): "A great example of the interest that corporations have regarding this technology is the photograph-company Kodak, which caused a major fuzz in the markets once they announced that they were entering into a partnership agreement with WENN Digital to establish the management of photographers' image rights on the blockchain, along with the launching of a "photo-centric cryptocurrency." The result was prompt: their shares' value increased in a 200%, despite the fact that they had filed for bankruptcy in 2012 and their revenues were declining since they returned to the printing business in 2013." For more information, see Cory Johnson and Olga Kharif, Kodak CEO Plans to Seize Blockchain Moment and Win Over Skeptics, Bloomberg (2018), available at https://www.bloomberg.com/news/articles/2018-01-12/kodak-ceo-plans-to-seize-blockchain-moment-and-win-over-skeptics.

15) The use of the expression "tamper-proof" reflects the definition's indebtedness to the aforementioned blockchain technologies, which are fundamentally a way of creating tamper-proof electronic record of transactions − i.e. a record which neither the parties nor any third party can modify. What the definition is getting at here is that the enforceability of a SC may not necessarily lie in the fact that the output (i.e. its performance) can be enforced by a court, but, as an alternative sense of "enforceable", that it may be affected by an autonomous technological process which, once initiated, cannot be interfered with. See CLIFFORD CHANCE (2017), *Are smart contracts contracts?* Retrieved from http://globalmandatoolkit.cliffordchance.com/downloads/Smart_Contracts.pdf.

administration of digital assets (tokens), and therefore, of the data encrypted in the blocks of the chain.

From a computer perspective, each SC involves the processing of a set of automated orders. The SC is executed when an external agent to the chain (but connected to it) intervenes by stating a fact or verifying the fulfillment of a condition.[16] Once the agent (usually a machine or an application called "oracle") issues the command, the SC triggers a programmed digital event.[17] The execution of the provisions of a SC allows the virtual operators of the blockchain platform (or even of other interconnected blockchains) to display the consequences of the scheduled event online. Normally, such event will consist of a payment, the conclusion of a transaction, the transfer of digital assets, or any other predetermined event. Therefore, the automatic operation of SC in a blockchain platform is intended to produce facts with legal relevance.

Consequently, it is necessary to clarify that SC is a useful program to exchange digital assets when certain conditions are met or the external scheduled events occur. Thanks to this way of operating, SC can be very useful to automate markets, products, services, and even new systems of business organizations (Decentralized Autonomous Organizations or DAO).[18] This automation of SC requires support and legal recognition in order to provide not only full effects among the parties but also *erga omnes*, insofar as the material consequences that they deploy on the network are the object of legal recognition regarding registered data with full evidentiary effects.[19]

---

16) See Vitalik Buterin, A Next Generation Smart contract and Decentralized Application Platform, Ethereum White Paper (2018), available at http://blockchainlab.com/pdf/Ethereum_white_paper-a_next_generation_smart_contract_and_decentralized_application_platform-vitalik-buterin.pdf.

17) See Angela Walch, The Path of the Blockchain Lexicon (and the Law), 36 Rev. Banking & Fin. L. 713 (2017), available at https://www.academia.edu/32573448/The_Path_of_the_Blockchain_Lexicon_and_the_Law.

18) See Andrew Hinkes, The Law of the DAO, coindesk, (2016), available at https://www.coindesk.com/the-law-of-the-dao/ and Reuben Bramanathan, Blockchains, Smart contracts and the Law. Unravelling the legal issues surrounding the DAO, The Coinbase Blog (2016), available at https://blog.coinbase.com/blockchains-smart-contracts-and-the-law -709c5b4a9895.

19) For example, in the Ethereum platform, SC is executed to achieve any goals pursued with the data incorporated into the token (transfer properties or credits or the creation of cryptocurrencies). Software developers are designing decentralized applications, strengthening the ecosystem and demand for Ether (Ethereum's gas or currency). See Financial Services Regulatory Authority, Supplementary Guidance - Regulation of Initial Coin Offerings and Virtual Currencies under the Financial Services and Market Regulations, Abu Dhabi Global Market (2017), available at https://www.adgm.com/media/192772/20171009-fsra-guidance-for-icos-and-virtual-currencies.pdf.

A. The Main Problem of Contracts

Blockchain has gained considerable strength in relation to the actual implementation of SC. This is because the technology of SC aims to solve the biggest inconvenience that economic agents have encountered throughout history: total, partial, or late non-compliance with the contractual obligations between the parties. When, for example, two parties agree to carry out any exchange, it is natural that the expectation of both is directed to both the one and the other complying with the agreement. However, over time, the interests or intentions of each of the parties may vary. If the fulfillment of a contract depends on the will of the parties, it may happen that one of them changes his or her mind and refrains from fulfilling it or does so incompletely or defectively. If this situation were to occur, the legitimate expectations of its counterpart would be frustrated. The traditional solution would be to go to court or to arbitration to demand compliance with the terms of the contract or the termination of the contract with compensation for damages. All this uncertainty about the execution of the contract implies time and costs for the plaintiff.[20]

B. The Blockchain Solution to the Main Problem of Contracts

Thanks to the SC and blockchain technology, the risk of lack of execution of contracts can be reduced and solved very efficiently. This is achieved through an automated mechanism that assurances a quick and cheap execution of the contract when certain agreed conditions are met. This mechanism is completed through the programming of algorithms. The algorithm itself searches the data it needs and then checks whether the condition has been met or not according to an

---

20) The introduction of blockchain-based SC in a shared-ledger platform drives substantial efficiency, fraud prevention and cost take out. In the chemicals and petroleum industry, for instance, due to the vast and intricate geographies in which the companies operate, each participant in a supply chain must maintain their records, updated with their transactions and systems, which must be reconciled among other participants in the network. As a result, all participants in the supply chain incur costs and delays associated with this reconciliation. These issues are further complicated when third-party validation or intermediaries have to be brought to resolve disputes. As IBM states, much more than a technology to automate business transactions, blockchain create a new model for trust by establishing transactional relationship between businesses via SC, certifications and digital compliance. IBM Cross Business Unit White Paper, *Blockchain can help transform supply chain networks in the chemicals and petroleum industry* (2018), available at https://www.ibm.com/downloads/cas/B4OYMO5Q.

oracle (which is a source of external information, for example, a webpage with information on asset prices).[21] If the condition has been met, the transaction is executed by the SC (for example, a purchase order, payments, etc.).[22]

In this sense, blockchain helps solve potential difficulties in the execution of contracts. This is achieved thanks to the generation and maintenance of the information through an encrypted and decentralized registry that is supervised by each member of the network (*nodes*).[23] Consequently, since there is no central depositor of the information with which the SC is going to operate, it would be necessary to hack or crack the entire network in order to modify the terms of the contract or take possession of the digital assets that it can dispose of. This hypothesis is practically impossible.

This advantageous feature of blockchain provides a very high level of security and transparency that is consistent with the objectives of operations carried out with SC. For this reason, it said that the great advantage of SC is that they are very difficult to be altered or revoked, once they have been operated and even more so when the automatic execution of the contracts has taken plac e.[24] The irreversibility and immutability of blockchain guarantee the fulfillment and effectiveness of the legal obligations. Thus, the nature of SC fits very well with the Blockchain ecosystem. Once programmed by the parties, the execution of the SC does not need any intermediary to carry them out. This means that many commercial exchanges are potentially more efficient by reducing the transaction costs associated with both the default of the counterparty and those derived from going to court to claim compensation.[25]

---

21) See Alexander Preukschat, Blockchain: la revolución industrial de internet, (Gestión 2000, 2017).

22) Thanks to a blockchain platform operating SC some practices in certain sectors could be improved such as work order which are manually created and processed, inefficient notification across parties, lack of compliance checks, discrepancies in services performed and included on the invoice resulting in errors and unauthorized spend. *See* Accenture, *A Digital Future for Oil and Gas: Blockchain – Understanding New Technologies* (Sep. 12, 2017), available at https://s3.amazonaws.com/bizzabo.users.files/27UDMvJRJ6w3WSvUq8j1_BC%201%20-%20Rich%20Meszaros%20-%20Accenture.pdf.

23) For more information, please see S. Asharaf and S. Adarsh, Decentralized Computing Using Blockchain Technologies and Smart contracts: Emerging Research and Opportunities, (Information Science Reference, 2017).

24) See Max Raskin, The law and legality of smart contracts, 1 Geo. Tech. L. R. 305 (2017).

25) Blockchain-based SC have the potential of simplifying processes that can lead to enhanced efficiency and cost reductions, offering transactional verification instantly across the network, without relying on a central authority. This advantage has the potential of reducing operating

IV. Legal Categorization of Smart Contracts and Some Problematic Aspects

A. Premises for a Legal Categorization of Smart Contracts

Both legal traditions, Common Law and Civil Law, give the parties to a contract ample scope to reach agreements and negotiate the terms of a contract. Since the SC is based exclusively on the algorithmic configuration of a condition or a set of conditions, it is obvious that the contractual freedom will be subject to the limits of the conditions in accordance with the legal system under which it is celebrated. For instance, this is the case of the existing prohibitions for certain contracts because of their purpose (illicit activities or contrary to public order) or restrictions on what can or cannot be agreed, as it happens with consumers or labor contracts. Criminal law, consumer law, or labor law, in this sense, would operate as certain limits to contractual conditions. Therefore, a SC should respect them, to be considered valid and legally enforceable. Nothing prevents a contract from being subject to conditions. There are relatively simple contractual conditions to formulate in programming language and that the SC itself can verify. This verification can occur in two ways: using reliable sources within the blockchain environment itself (or outside through an external oracle) or through the contribution of a certain document of assessed content. For instance, this last method would be the proper one to execute an escrow contract.[26]

---

cost, managing data and improving the speed of transaction processing. Regarding oil and gas industry, Deloitte states that supply chains will be a good place to start in assessing practical value. SC in blockchain for this sector and markets can enhance supply chain efficiency, better secure real-time data generated during delivery, by creating a chain of order requests connecting engineers, analysts and laboratories. In this sense, through blockchain platforms oil and gas companies could forge new agreements with producers, suppliers, financial experts, record-keeping departments and third-party vendors, potentially leading to reduced cost, streamlined management and a clearer understanding of the assignments and expectations of each player on the field. See Mark Koeppen, David Shrier, and Morgan Bazilian, *Is blockchain´s future in oil and gas transformative or transient?,* Deloitte (2017), available at https://www2.deloitte.com/content/dam/Deloitte/de/Documents/energy-resources/gx-blockchain-report-future-in-oil-and-gas.pdf.

26) SC can be an extraordinary instrument to improve value chain efficiency in the oil and gas sector. As Deloitte has explained, many years of volatility in commodity prices, growth stagnancy and limited expansion have put exploration and production companies in a tough spot. Because of this situation, they have been forced to drastically reduce drilling times and

B. Problematic Aspects that Arise with Smart Contracts

The previous legal categorization opens several important discussions.

1. On the Scope and Delimitation of Smart Contracts

In first place, it is necessary to examine the question of whether the SC can really be considered a true legal contract or rather it simply consists of a clause of a pre-existing contract. This would lead us to raise the question of whether a SC is really a contract or only a translation of a part of a legal contract previously written in natural language but that can be translated into an algorithmic code and subsequently deploy on a blockchain platform, so that there it acquires its self-executing function *de facto*. In this sense, it seems more reasonable to assume the existence of a dual dimension: on the one hand, the contract written in natural language, and on the other hand, the computer program that executes a certain clause of said contract. For this reason, the SC should not be understood as a separate contract but as a conditional clause translated into computer terms (code) to display the effects sought by the parties in the contract in an automated way.[27]

---

search for other means of reducing costs and expense to maintain acceptable margins. Tracking issues among contractors, subcontractors and suppliers, change orders, receipts and other trade-related documentation and data on inventory could be achieved by following specific codified rules. In these sense, as Deloitte states in one of its sector reports, drafting agreements that afford new tracking and bookkeeping should create a more seamless supply chain and simplify contractual obligations at each point along the way (simply put, knowing who gets paid what, why and where; who is owed money; and who along the chain is performing as explicitly mandated by the agreement). See Koeppen, Shrier, and Bazilian, *supra* note 25.

27) In highly complex markets, SC can help to stablish an agreed criterion, removing the ambiguity of terms and reducing the requirements for lawyers to draft and interpret. In this sense, when the criteria of the contract are fulfilled, ownership or payment would be automatically transferred. Thanks to a blockchain platform, the parties would maintain a record of all versions and amendments to the contract. It then would automatically complete once the criteria of the most up to date version are satisfied. Criteria could include payment or even government approval for the transaction. This may save time and costs for interpreting legal terms and tracking records, and government authorities could potentially access relevant parts of contracts to audit or pre-approve the taxation treatment. See Geoffrey Cann, and Emily Catmur, *Blockchain: overview of the potential applications for the oil and gas market and the related taxation implications (2017),* Deloitte, available at https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Energy-and-Resources/gx-oil-gas-blockchain-article.pdf.

2. On the Effective Functioning of Smart Contracts

Commercial contracting normally contains conditions that are unfit for use as a trigger for the implementation of SC. One of the probable causes is that the condition is not susceptible to representation and execution through computer code, or because the verification of its compliance requires an interpretative task. In these cases, a legally binding and enforceable agreement will need a set of mixed solutions that combine natural language and computer language. In this field, lawyers will have much to contribute to computer scientists, but also computer scientists to lawyers.

Therefore, in a SC, legal restrictions regarding the type of admissible conditions must be respected, so it would not be possible to subject a contractual obligation to a condition that is impossible or prohibited by Law. Nor should it be admissible that the fulfillment of the condition depended only on the will of the party that assumes the obligation. This aspect is fundamental because a contract should avoid clauses that could be self-executed by SC that use external oracles that are under the control of the party that must perform the obligation.[28]

3. On the international elements in the Smart Contracts

The plurality of international elements in a global and digital context will open a horizon of interesting questions on the determination of the governing law and jurisdiction to SC and protection of certain groups (consumers, creditors, employees, etc.). These issues will have to be resolved by the rules and principles of International Private Law with the assistance of a highly specialized regulatory harmonization in this matter. Likewise, the proposal of optimal systems for resolving conflicts in blockchain will have to play a highly relevant role.

In particular, the question of the limits of the conditions in the contract raises

28) In this regard, the Beagle system is very interesting because it facilitates at the inter-company level the revision of contracts in general, and also SC, in record time, through artificial intelligence mechanisms that read the contracts, indicating the points that must be reviewed and suggesting an optimal alternative wording. The problem lies in the substitution of the lawyer as a trusted third party, whose function can be performed by alternative mechanisms, such as the creation of a SC linked to an oracle (a notary, for example) that performs the external control function. See Selva Ozelli, Smart contracts are Taking Over Functions of Lawyers, Cointelegraph (2018), available at https://cointelegraph.com/news/smart-contracts-are-taking -over- functions-of-lawyers-expert-blog.

the question about the determination of the applicable law and jurisdiction when the SC is used in a context that derives from a contractual situation with multiple international elements: the parties to the contract may have different nationalities and places of residence; the location of the computer servers of the blockchain platform and of the legal entity that manage it; and the last and perhaps most decisive point, the place where the condition has to be met. International standards which contain to determine the governing law and jurisdiction usually give priority to what the parties agree on the law to which they attach the contract. But not always a clause on the governing law and jurisdiction to the contract will avoid the application of imperative rules from other jurisdictions.[29]

4. On the Formalities of Contractual Clauses Recognized as Smart Contracts

In general, freedom of form is allowed in all legal systems. Only under certain cases, the Law requires a concrete formality for some specific contracts (for example, public deed). There seems to be no discussion in recognizing that contracts on electronic support comply with the written form. In the case of SC, the doubt is found when the computer code does not have a clause drawn up in natural language. If only the SC code were the only proof of the contract, there would be no difficulty either, unless the SC had as its object a clear null condition. However, it should be avoided that a SC lacked support in a previous contract of greater scope and whose contents are the cause of the algorithmic programming of the conditions through a blockchain platform. What seems more sensible is that the SC can be readable in natural language to facilitate its comprehensibility by the parties and make solutions easier to find. In addition, a written contract in natural language that incorporates SC clauses would guarantee that the parties know and consent that a part of the contract can be self-executed through a blockchain platform.[30]

---

29) In addition, as this report refers, most contracts in this market contain audit clauses giving the parties the right to audit each other to make sure that all parties are complying with the contract. Introducing a blockchain ledger to record joint venture transactions and using SC to define, negotiate, and execute the contractual conditions will provide all involved parties, including the tax authorities, with transparency and consensus on what has occurred. See Cann and Catmur, *supra* note 27.

30) In this regard, the proposal of Hazard and Haapio is very suggestive, in the sense of

This legal problem will come up against another unsuspected implications regarding SC like those based on blockchain platforms which operate in IoT (Internet of Things) and M2M (Machine to Machine) environments, that is, automated transactions without the intervention of natural or legal persons. The question here is whether contracts of this type could be accepted without the intervention of natural or legal persons. Obviously, it seems clear that at least in an initial moment the intervention of a person or their legal representative (who shall be a person) will be essential and never avoidable. But once the contract is put into operation, it is possible to conceive contractual relationships in which the intervention of human beings is no longer necessary. Only the interconnection of machines (robots and artificial intelligence programs with machine learning applications) will be enough for self-executing SC. Ultimately, the conflict resolution in these operations will go in the direction of clearly identifying the person under whose control or sphere of supervision the machine or the software acts. Contracts of this type will therefore have to be governed by a legal and contractual framework in which the responsibility of the natural or legal persons under whose control the machines that are involved in SC environments are defined very well.[31]

---

understanding SC as a kind of legal coding that reduces the inherent incompleteness of contracts. From this conception, SC use and extend the wisdom of legal and other experts, iteratively learn from experience and work for people and machines, by means of applications written to improve coordination among SC and arbitration services relating to them. As the authors state in their article, the combination of code, codification of prose, visual presentation and big data promises a revolution in how contracts are made, drafted, managed, and presented. See James Hazard and Helena Haapio, *Wise Contracts: Smart Contracts that Work for People and Machines*, (Erich Schweighofer et al. (Eds.), 2017).

31) In fact, the current IoT ecosystem in oil and gas organizations currently relies on centralized, brokered communication models. This model is in use for decades, connecting generic computing devices and supporting small IoT networks. But it will not be able to respond to the growing needs of the IoT ecosystems of tomorrow. As INFOSYS confirms in a report, with a blockchain solution, a distributed digital ledger stores the transactions among the various nodes of the network. Only those nodes that are identified and authenticated by secure cryptographic methods will be allowed to add or make changes to the ledger. After this, the other nodes on the network must confirm this transaction for the change to be accepted. It eliminates the need for a central authority. See Infosys Limited, *Oil and gas industry - blockchain, the disruptive force of the 21st century*, External Document (2018), available at https://www.infosys.com/industries/oil-and-gas/features-opinions/Documents/blockchain-disruptive-force.pdf.

5. On the Validity and Certification of Blockchain Transactions

Much has been theorized about the possibility of being rid of public registrars and notaries since the implementation of SC would render them unessential. It is important to firstly make a distinction among the different types of legal systems, since they shape the role of these institutions: for example, in Common Law system, the notary plays a less strict role than the one expected in the Civil Law system. Under the Common Law system, a notary only verifies the existence of a fact, whereas in the Civil or Continental system, the notary has a wider range of functions, such as verifying the legitimacy and identity of the parties, certifying their proof of legal status and capacity to act, ensuring that the contracts are valid and binding, and one of the most important aspects of the Civil system, granting a public deed, which enables that contract or document public enforceability against a third party.

Considering the current circumstances, the application of blockchain-based SC could operate as a notary in the Common Law system. It means that it could demonstrate that a certain situation has happened, but it could not grant the same legal certainty as a notary or public registry in the Civil system. This is mainly because SC only are enforceable and operate among the parties of the contract, but not against third parties, which is the main reason why parties of a contract would wish to convert a contract into a public deed.[32]

C. The Path towards the Design of a Harmonized Supranational Legislative Policy for Smart Contracts: Main Challenges

The possibilities offered by SC would be underutilized if their ability to self-execute transactions could not be effective for a broad set of individuals and organizations. That is why this decentralized contracting system requires a harmonized environment among the largest number of countries, so that the full potential of its applications can be realized globally. For a SC to provide true legal certainty it is essential that they comply with some basic requirements to

---

32) See Pedernal, *supra* note 14. For more information on the influence of blockchain on Civil law notaries, please see Javier Wenceslao Ibañez Jiménez, *Blockchain, ¿el Nuevo notario?*, everis an NTT DATA Company (2016), available at https://repositorio.comillas.edu/xmlui/bitstream/handle/11531/14564/Blockchain_el_nuevo_notario.pdf?sequence=1.

constitute enough proof of consent on the content of the agreement. This requires that the different parties involved in a SC have the reasonable certainty that there is irrefutable evidence before the courts of a transaction at a specific date between those specific parties and with that precise content.[33]

1. Technological Neutrality of Regulators on Infrastructure for Smart Contracts

SC requires an advanced computer and telecommunication systems to be able to activate and execute the transactions with legal effects for the parties. However, SC does not necessarily require a blockchain platform for their normal operation although as mentioned before, blockchain offers very significant advantages for the execution of this type of transactions.

From the perspective of the principles of the Law of Internet, it should be preliminarily considered that under the principle of technological neutrality, regulators should not assume or demand the use of blockchain platforms. The support or infrastructure of SC should be left to market forces. Therefore, any computerized mass data storage mechanism could be set up, from a private contractual point of view, as a technical element that facilitates automated systems for the exchange and execution of commercial operations. In this sense, the decentralized and cryptographic nature of blockchain favors the security and distribution of information between the parties to a contract. This makes it very promising to use it as a platform or permanent infrastructure for storing data.[34]

Following the United Nations criteria (Articles 5, 8, 9 and 11 of the UNCITRAL Model Law of Electronic Commerce of 1996), the creation of contractual rights and obligations in virtual spaces is possible, provided that the electronic infrastructure allows to document the provisions in a way equivalent to other supports.[35] In this sense, the blockchain system is suitable to perform

33) See Javier Wenceslao Ibañez Jiménez, Blockchain: primeras cuestiones en el ordenamiento español, (Editorial Dyckinson, S.L., 2018).

34) Blockchain could improve and transform the entire value chain in many sectors. For instance, in the oilfield lifecycle management, facilities and equipment can be monitored with operating history recorded on the ledger. Events such as scheduled servicing, repairs and accidents can be updated throughout use via SC. In addition, regulatory reporting and oversite is simplified by providing access to the blockchain tracking. *See* Accenture, *A Digital Future for Oil and Gas: Blockchain – Understanding New Technologies (Sep. 12, 2017), available at supra* note 22.

35) For more information, see Koji Takahashi, Implications of the Blockchain Technology for the UNCITRAL Works, (UNCITRAL, 2017).

this function, provided that the system of constitution of rights and obligations is comparable and unequivocally recognizable. In this way, the contractual offer and acceptance, or the conclusion of the contract can be expressed in the form of messages or metadata stored in a blockchain platform.

In accordance with the principles of these international standards, the execution of a contract cannot be denied due to the mere fact that natural persons do not intervene in the operation directly or without legal representation. Now, the valid creation of contractual rights and obligations in blockchain requires the fulfillment of all the legal requirements that must be satisfied when the contract is written on paper. So, only when the blockchain platform effectively performs this function, in accordance with the principle of technological neutrality, there is a functional and legal equivalence among the blockchain platform, other technologies, and traditional paper documents.[36]

2. Legal Elements that Must be Fulfilled by a Blockchain-Based Smart Contracts in Accordance with United Nations Criteria to Get Functional Equivalence with Other Electronic Systems

UNCITRAL has already prepared provisions relevant to the legally enable use of SC. In particular, Article 12 of the United Nations Convention on the Use of Electronic Communications in International Contracts of 2005 provides the use of automated message systems for contract formation,[37] and Article 6 of the UNCITRAL Model Law on Electronic Transferable Records recognizes the possibility of inserting in an electronic transferable record information, including metadata, additional to that contained in a transferable document or

36) See Ibañez, *supra* note 33.

37) The UN Convention on the Use of Electronic Communications applies to the use of electronic communications used in the formation or performance of a contract between parties whose places of business are in different places. According to this Convention, a SC would be considered to be legally valid as these forms electronically through computer code. Moreover, Article 12 disposes that contracts formed as a result of automated messages are legally valid and enforceable under the Convention. Nevertheless, there is no legal provision that offers further indication on liability in an automated contract and from whom remedies would have to be given. See Dr Sara Hourani, *Cross-Border Smart Contracts: Boosting International Digital Trade through Trust and Adequate Remedies*, (UNCITRAL, 2017), available at http://www.uncitral.org/pdf/english/congress/Papers_for_Programme/11-HOURANI-Cross-Border_Smart_Contracts.pdf.

instrument. However, awareness of those provisions seems limited. Moreover, emerging business practices may suggest the formulation of additional provisions or legal guidance.[38]

In the first place, in accordance with Articles 6 and 7 of the UNCITRAL Model Law of Electronic Commerce, it is necessary the writing and the signature of those who promote the creation of contractual rights and obligations, so that there is a principle of confidence that the information is complete with respect to the encrypted data. In the case of blockchain platforms, this requirement is fulfilled because the time stamp and the data encryption in the blocks are resistant to external attacks (hacking/cracking). This is due not only to the conditions of incorporation, generation, and registration of hashes that unite the blocks of the chain, but also because of the technical inviolability of the consensus protocols. This feature guarantees the irreversibility of the registered information.

The second element consists of complying with the requirement of support for the rights and obligations created, in which the description of its content is found. In this sense, a blockchain platform that fulfills the function of supporting SC should comply with the conditions established in Articles 1, 2, 10 and 11 of the UNCITRAL Model Law on Transferable Electronic Records (2017).[39] A transferable electronic record allows the holder to enforce the contract before the courts. Likewise, the existence of the transferable record facilitates the valid transmission of the rights created and incorporated therein, in an analogous way to the transfer of ownership of the rights incorporated in letters of credit. Blockchain encourages the creation of contractual rights and obligations in a secure way to the extent that the *cyberdocuments* are identified

38) Those issues were discussed at the UNCITRAL Congress "Modernizing International Trade Law to Support Innovation and Sustainable Development", held on 4−6 July 2017 in Vienna, to celebrate UNCITRAL fiftieth anniversary. Among the various works presented, it is worth mentioning Scott Farrell, Heidi Machin, and Roslyn Hinchliffe, *Lost and found in smart contract translation-considerations in transitioning to automation in legal architecture,* (UNCITRAL, 2017), available at *http://www.uncitral.org/pdf/english/congress/Papers_for_Programme*/14FARRELL_and_MACHIN_and_HINCHLIFFE-Smart_Contracts.pdf.

39) While UNCITRAL texts aim to accommodate new technologies, such as the use of blockchain and smart contracts, the practical implementations remain to be seen. This is even more pertinent considering that the most recent Model Law on Electronic Transferable Records (2017) makes references to "distributed ledgers" and does not make explicit reference to "blockchain" and "smart contracts", due to its technology neutral principle. See UNCITRAL Model Law on Electronic Transferable Records, at ¶ 124.

in the blocks unambiguously, by allowing exclusive control of the community of nodes. This allows compliance with the conditions of legal security referred to in the aforementioned Model Law but also in accordance with the Rotterdam Rules. Both regulatory bodies establish the functional equivalence between electronic mechanisms (cyber-registration) and the possession of other kind of commercial document in paper.[40]

In the case of blockchain, a system of algorithms ensures that there is a single version of the digital files or *tokens* created. Consequently, there will be no possibility of exercising the rights incorporated in the chain of blocks from different versions that may appear in the computers or servers of the nodes. Likewise, blockchain makes it possible to ensure that nobody will modify the existing single version of the digital files and the rights incorporated to them. Neither in blockchain it is possible to alter the origin, ownership and authorship of the digital asset or *token*. In any case, no objective of this kind can be achieved if at least the main world jurisdictions do not reach a minimum level of consensus on the rules applicable to blockchain platforms, and are provided with an international framework of common solutions to solve the potential conflicts that may arise outside the platform (*offchain*).[41]

In a global economy, blockchain platforms were built and shared by individuals and organizations in many countries that should be governed by common rules, otherwise it could generate a problem of legal uncertainty for its users that would offset the efficiencies that this digital technology brings to the economy and markets. This circumstance will play an increasingly relevant role for UNCITRAL, as it has already happened in other legal areas, such as arbitration, maritime trade, or international sale of goods.[42] In this sense, it is urgent for the development of blockchain and its applications such as SC, to resolve several aspects that are currently problematic at the international level.[43] This work

---

40) See Ibañez, *supra* note 33.

41) The only difference between electronic transferable document and "token" is that the first is a set of data and the second another set of data but this time associated with a computer code (computer program), which may lead to the agreements being self-executing, dispensing with the further will of the parties. That is, the transfer of ownership is automatic; through the execution of that program when the requirements agreed upon by the parties are met.

42) See Takahashi, supra note 35.

43) One of the major issues that regulators will have to solve in the short-term is the definition of the legal nature as well as the taxonomy of tokens, as digital assets that can incorporate legal rights and obligations. Using a distributed ledger with a SC system, digital tokens could be used to represent the asset being transacted. Those tokens could be issued by a trusted authority for

should be done in coordination with other relevant organizations, namely the International Institute for the Unification of Private Law (UNIDROIT), the Hague Conference on Private International Law, and other entities.[44]

3. Towards an International Coordination of Digital Identity Services

It seems clear that it is necessary to establish a common international regime on the systems of accreditation of the identity of the individuals participating in blockchain and SC. An international digital identity system should also collect some essential attributes such as age and ability to be part of a contract.[45]

Although the use of asymmetric cryptography systems provides security and reinforces the authenticity of the transaction, it will be necessary to examine whether some identity systems on public blockchain platforms may or may not be admitted by the courts in case of litigation. For this reason, it seems foreseeable that the blockchain systems that end up being imposed in the market and in the market dealings are those that are private and permissioned, that is, those in which a legal entity manages and oversees the access of the users and therefore guarantees the identity of them, in contrast with the inherent risks and lack of transparency of public blockchain platforms.[46]

4. The Accreditation of the Integrity of the Transaction Records

Another key point for an international legislative policy should be focused on

---

the needs of the companies or participating parties. For instance, if oil and gas companies used a blockchain ledger to buy and sell barrels of oil, transactions could include digital tokens. These tokens would represent the underlying asset and would remain digitally attached throughout its supply chain journey. For further information, see Cann and Catmur, *supra* note 27.

44) In that respect, it should be noted that the International Organization for Standardization has set up the Technical Committee ISO/TC 307, on "Blockchain and distributed ledger technologies," see https://www.iso.org/committee/6266604.html.

45) See Djuri Baars, Towards Self-Sovereign Identity using Blockchain Technology, (University of Twente, 2016), available at https://essay.utwente.nl/71274/1/Baars_MA_BMS.pdf.

46) See Accord Project, The Smart Legal Contract Identity and Trust Framework Standard, (Open Identity Exchange White Paper, 2018), available at http://www.openidentityexchange.org/bitgov/wp-content/uploads/2018/05/Accord-Project-ID-The-Smart-Legal-Contracts-Identity-and-Trust-Framework-Standard-FINAL1.pdf.

the common regulation of the accreditation of the integrity of the transaction records. The objective would be to ensure that the content of the records where the transaction has been collected and the exchange of money or goods through SC has not been altered after its creation. As mentioned before, blockchain platforms are attributed the ability to assurance and prevent the subsequent manipulation of transactions.

In a global environment such as the current one, it is necessary to standardize the regulation and supervision of certification service providers or trust service providers that accredit electronic identities and transactions (with different levels of probative force). These international legal uncertainties will be less in private blockchain platforms than in the public ones. The organization in charge of the private blockchain platform could maintain a greater degree of control over the identity of the users by means of the authentication mechanisms provided by the platform. If the platform operates at an international level, the organization of this type of blockchain ecosystem will require a broad consensus or membership contracts. It can also happen that the entity in charge of the platform assumes the roles of a certification provider or a trust service provider, thereby strengthening the probative effectiveness of the records of transactions carried out by the parties via SC.[47]

---

47) These issues will have great legal significance when the operations within the blockchain system are delegated to an autonomous organization, as a part of the commercial or institutional activity of a corporation. In this respect, it can be said that Corporations can also be transformed by the emergence of blockchain and the digital automation of some processes. In this sense, the appearance of SC in blockchain platforms that can operate as automatic organizations opens up a novel field where some corporate transactions and the management of information and decisions can be automated under certain conditions previously established by the network partners or token holders. In this context, the Decentralized Autonomous Organization (DAO) is a complex type of Decentralized Application (Dapp) and it can be understood as a new organization than can be similar to a digital entity. Its legal form and legal personality are still much discussed. DAO are included in the development stage called Blockchain 3.0, the stage where the SC concept can create autonomous units that rely on their own laws and operate with a high degree of autonomy. DAO can be created by members as a self-governing body operating on democratic principles that is not influenced by outside forces. It is important to note that the DAO´s are embedded in the blockchain and is built on SC which works under the majority rule which means that only a majority of DAO token holders can decide by vote to adapt the code, and thus the DAO itself. So, the utility of this kind on entity is that they rely on contractors who participate on its behalf in the physical world. These contractors are connected with one another and carry proposals which are submitted by DAO token holders, who can then profit from the sale or use of the products created. DAO token

5. Coordination of Self-Executing Systems for Smart Contracts

To evaluate the ability to legally demand compliance with the SC, it is advisable to take its self-execution with caution beyond simple payment transactions or electronic sale orders subject to easily verified conditions. It must be borne in mind that certain provisions or benefits of SC may not be fulfilled or executed with the simple interaction of the computer code within blockchain because they affect assets that are foreign to it, or because compliance depends on expert interpretations.

This situation could complicate the worldwide application of rules of an international legal framework for blockchain. The solution to this problem will not be quick or easy. Obviously, the first goal of the legislative policy on this phenomenon should start with the simplest transactions, that is, the most basic SC. Once these transactions are under harmonized regulation, common solutions at a higher level of complexity could be explored. For example, a situation of greater complexity is found when applying a SC requires a hybrid compliance, that is, instructions within the blockchain platform but also others that occur outside of it. For these latter applications, it may be necessary to resort to institutions or external mechanisms to make possible the fulfillment of everything provided in the SC.

In view of this circumstance, it is essential to look for cross-border solutions, on a global scale, in order to solve the doubts that may arise in these technological environments when the provisions of a SC is not met. Therefore, in addition to seeing whether the requirements for claiming the existence and validity of the contract or its self-executing clause are met, an evolution of the international legal framework will be necessary from a greater maturity and extension in the use and adoption of SC.[48]

---

holders have the right to collectively decide on proposals in proportion to the number of tokens they hold and participate in the profits based on their share of funds held in the DAO if the proposals executed are successful. New standards of corporate governance will have to be formulated to interconnect the digital technological world to business organizations, so that the potential derived from the self-execution of functions is realized within a framework of legal security and protection of rights. See Hasse, Perfall, Hillebrand, Smole, Lay, and Charlet, *supra* note 3.

48) International regulation and guides will necessarily have to adjust to the pace of developers and programmers of decentralized applications. Blockchain-based SC have the potential to be integrated into wider innovation strategies and existing systems, by improving commercial and technical

6. Other Legal Challenges of Smart Contracts

Everything said so far does not cover the full set of key issues posed by SC based on blockchain platforms. For instance, if SC is used for transactions of products or services regulated by the securities markets, they will also need to guarantee compliance with the specific regulatory requirements of formalization and supervision by the authorities.[49] The same policy should be adopted when the market is dominated by speculative forces, as happened with cryptocurrencies.[50] Tax law and anti-money-laundering (AML) also stand as key legal areas, especially in relation to transactions carried out on public blockchain platforms, where the parties could operate with anonymity and opacity. This problem is minor when it comes to transactions on private

---

capabilities. In the coming years, we will see a lot of pilot projects built, for instance, on the Ethereum platforms using Solidity Scripting language (https://solidity.readthedocs.io/en/v0.5.6/#). Any regulatory development in the future will require a great computer engineering knowledge of the details and effects of the programming of SC.

49) See European Securities Market Authority, The Distributed Ledger Technology Applied to Securities Markets, Report (2017), available at https://www.esma.europa.eu/system/files_force/library/dlt_report_-_esma50-1121423017-285.pdf.

50) The legal rules for SC may take years to be written but, at least in the US, regulators consider cryptocurrencies to be commodities, as we knew when in 2015, the Commodity Futures Trading Commission brought what was believed to be the first enforcement action against a Bitcoin-based market when it took action against Derivabit, "a risk management platform (...) that connects buyers and sellers of standardized Bitcoin options and futures contracts". Derivabit was a Bitcoin-based market that sold futures contracts – contracts with Bitcoins as the asset underlying the options, where users could place put and call bids executed at the speed of their computer processor. The same happened to Bitfinex, an "online platform for exchanging and trading cryptocurrencies," in 2016. Bitfinex was an online version of a currency exchange that dealt in e-currency (executing contracts bid on by buyers and sellers and executed at the speed of silicon). In this case, the CFTC found that Bitfinex was "engaged in illegal, off-exchange commodity transactions and failed to register as a futures commission merchant," violating the Commodity Exchange Act. As some legal firms have said (https://talkingtech.cliffordchance.com/en/fintech/smart-contracts--not-quite-the-wild-west-of-fintech.html) that means innovators need to be smart with their SC and follow the Commodity Exchange Act if their business model involves the exchange of contracts, options, derivatives, or other products that look and feel like something within the regulators' traditional portfolio. See also Press Release, South Korea Financial Services Commission, Financial Measures to Curb Speculation in Cryptocurrency Trading (Jan. 23, 2018), available at https://www.iosco.org/library/ico-statements/Korea%20-%20FSC%20-%2020180123%20-%20Financial%20Measures%20to%20Curb%20Speculation%20in%20Cryptocurrency%20Trading.pdf.

blockchain platforms, where by its nature, there is a legal entity that oversees the control of the access and identity of the users and members.

In addition to what has been said, as the global programming market of SC and blockchain platforms grow, new issues will arise that the Law will have to solve. One of them will be Data Protection. It will be also necessary to resolve the possible difficulty of identifying the person in charge of processing the personal and sensitive data that is included in the SC, as well as to solve the potential risks of inadvertently making international data transfers through nodes of the blockchain platform without complying with the legal requirements.

V. Final Remarks

The concept of SC has become popular in recent years, together with the impulse that blockchain technology has taken. Due to the novelty that blockchain still represents, it is not possible to offer a definitive or conclusive opinion about the many of its revolutionary innovations for the commercial transactions. For this reason, it will be necessary that the blockchain phenomenon reaches a greater maturity and consolidates its use and applications so that the SC can be deployed on blockchain and operate massively in the market. Only in this way, it will be possible to identify good practices and that regulators and courts reach the level of understanding necessary for a legislative policy that is truly adapted to the real legal problems that this phenomenon currently presents.

Only as the regulators, courts and users of these applications accumulate practical experience can we have a reasonable degree of legal certainty regarding their use and how to resolve the various legal issues such as those that this work has analyzed here. Meanwhile, the use of SC for commercial practices moves in legal uncertainty. In any case, it does seem highly advisable that both in the design and configuration of blockchain platforms and in the programming of applications, such as SC, professionals from the legal sector participate in order to ensure the validity and legal effectiveness of transactions.

The regulation of SC should focus on effectively incentivizing a set of good practices for operators related to this type of software (users and investors, managers of blockchain platforms, etc.). A guide of good practices that is first formulated as “soft law” (for example, *comply or explain rule*) and later be

implemented as "hard law" would be a suitable procedure to encourage non-opportunistic behavior and reward at a reputational level those that generate confidence in the blockchain platforms and with the applications of SC. To generate positive incentives that result in collective welfare, regulators should allow operators, when programming a SC, to design clauses that can be parameterized in the contracts that take place between the parties for execution on a blockchain platform. This situation would allow for a balance between the principles of contractual freedom and legal certainty. In this sense, regulators should allow SC to be created in accordance with the best practices of free software development, so as not to harm the development of this industry, so that the control, review and audit systems are self-regulated and accessible by the community of blockchain users.

This moment is crucial to theorize and identify potential problems in the relationship of this digital technology with the current legal framework. This work has precisely intended to be a brief contribution to this goal, which is essential to make way for future and broader reflections.

References

ACCORD PROJECT (2018), The Smart Legal Contract Identity and Trust Framework Standard. Retrieved from http://www.openidentityexchange.org/bitgov/wp-content/uploads/2018/05/Accord-Project-ID-The-Smart-Legal-Contracts-Identity-and-Trust-Framework-Standard-FINAL1.pdf.

ACCENTURE (2017), *Blockchain-understanding new technologies. A digital future for oil and gas.*

AHARAF, S./ADARAH, S. (2017), Decentralized Computing Using Blockchain Technologies and Smart contracts: Emerging Research and Opportunities, IGI Global, Hershey, Pennsylvania (USA).

ARNER, D. W./BARBERIS, J. N./BUCKLEY, R. P. (2015), The Evolution of Fintech: A New Post-Crisis Paradigm?, University of Hong Kong Faculty of Law Research Paper No. 2015/047. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2676553.

BAARS, D. (2016), Towards Self-Sovereign Identity using Blockchain Technology, University of Twente. Retrieved from https://essay.utwente.nl/71274/1/Baars_MA_BMS.pdf .

BRAMANATHAN, R. (2016), Blockchains, Smart contracts and the Law. Unravelling the legal issues surrounding the DAO. Retrieved from https://blog.coinbase.com/blockchains-smart-contracts-and-the-law-709c5b4a9895.

CLIFFORD CHANCE (2017), Are smart contracts contracts? Retrieved from https://talkingtech.cliffordchance.com/content/micro-cctech/en/tech/are-smart-contractscontracts/_jcr_content/text/parsysthumb/download/file.res/Are%20smart%20contracts%20contracts.pdf.

DELOITTE (2017), *Blockchain: overview of the potential applications for the oil and gas market and the related taxation implications.* Retrieved from: https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Energy-and-Resources/gx-oil-gas-blockchain-article.pdf.

DELOITTE (2017), *Is blockchain´s future in oil and gas transformative or transient?* Retrieved from: https://www2.deloitte.com/content/dam/Deloitte/de/Documents/energy-resources/gx-blockchain-report-future-in-oil-and-gas.pdf.

EUROPEAN SECURITIES MARKET AUTOTHORITY (2017), The Distributed Ledger Technology Applied to Securities Markets (Report). Retrieved from https://www.esma.europa.eu/system/files_force/library/dlt_report_-_esma50-1121423017-285.pdf.

FARRELL, S./MACHIN, H./HINCHLIFFE, R. (2017), *Lost and found in smart contract translation-considerations in transitioning to automation in legal architecture.* Retrieved from: http://www.uncitral.org/pdf/english/congress/Papers_for_Programme/14FARRELL_and_MACHIN_and_HINCHLIFFE-Smart_Contracts.pdf.

FINANCIAL SERVICES REGULATORY AUTHORITY (2017), Supplementary Guidance. Regulation of Initial Coin Offerings and Virtual Currencies under the Financial Services and Market Regulations. Retrieved from: https://www.adgm.com/media/192772/20171009-fsra-guidance-for-icos-and-virtual-currencies.pdf.

GEORGE, V.M. (2018), A Next Generation Smart contract and Decentralized Application Platform (White Paper). Retrieved from: http://blockchainlab.com/pdf/Ethereum_white_papera_next_generation_smart_contract_and_decentralized_application_platform-vitalik-buterin.pdf.

GRINBERG, R. (2011), Bitcoin: An Innovative Alternative Digital Currency. Hastings Science & Technology Law Journal, Vol. 4. Available at SSRN: https://ssrn.com/abstract=1817857.

HAZARD, J/HAAPIO, H. (2017), *Wise Contracts: Smart Contracts that Work for People and Machines*, Erich Schweighofer et al. (Eds.), Trends and Communities of Legal Informatics. Proceedings of the 20th International Legal Informatics Symposium IRIS 2017, pp. 425–432.

HINKES, D. (2016), The Law of the DAO. Retrieved from https://www.coindesk.com/the-law-of -the-dao/.

HOSSER, T. (2016), Blockchain basics, commercial impacts and governance challenges. Governance Directions, Vol. 68, Nº 10, pp. 608-612. Retrieved from https://library.charteredaccountantsanz.com/cgi-bin/koha/opac detail.pl?biblionumber=86285.

HOURANI, S. (2017), *Cross-Border Smart Contracts: Boosting International Digital Trade through Trust and Adequate Remedies*. Retrieved from: http://www.uncitral.org/pdf/english/congress/Papers_for_Programme/11-HOURANI-Cross Border_Smart_Contracts.pdf.

IBAÑEZ, J. W. (2016), Blockchain, ¿el Nuevo notario?. Universidad Pontificia Comillas https://repositorio.comillas.edu/xmlui/bitstream/handle/11531/14564/Blockchain_el_nuevo_notario.pdf?sequence=1.

IBAÑEZ, J. W. (2018), Blockchain: primeras cuestiones en el ordenamiento español, Dyckinson, Madrid.

IBM CROSS BUSINESS UNIT (2018), *Blockchain can help transform supply*

chain networks in the chemicals and petroleum industry. Retrieved from: https:// www.ibm.com/downloads/cas/B4OYMO5Q.

INFOSYS (2017), *Oil and gas industry. blockchain, the disruptive force of the 21st century*. Retrieved from: https://www.infosys.com/industries/oil-and-gas/features-opinions/Documents/blockchain-disruptive-force.pdf.

JOHNSON, C./KHARIF, O. (2018), Kodak CEO Plans to Seize Blockchain Moment and Win Over Skeptics. Retrieved from Bloomberg Technology: https://www.bloomberg.com/news/articles/2018-01-12/kodak-ceo-plans-to-seize-blockchain-moment-and-win-over-skeptics.

KAKAVAND, H./KOST DE SEVRES, N./CHILTON, B. (2016), The Blockchain Revolution: An Analysis of Regulation and Technology Related to Distributed Ledger Technologies. Retrieved from: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2849251.

NAKAMOTO, S. (2008), Bitcoin: A Peer-to-Peer Electronic Cash System, obtained from https://bitcoin.org/bitcoin.pdf.

OZELLI, S. (2018), Smart contracts are Taking Over Functions of Lawyers. Expert Blog. Retrieved from: https://cointelegraph.com/news/smart-contracts-are-taking-over-functions-of-lawyers-expert-blog.

POPPER, N. (2015), Decoding the Enigma of Satoshi Nakamoto and the Birth of Bitcoin. The New York Times. https://www.nytimes.com/2015/05/17/business/decoding-the-enigma-of-satoshi-nakamoto-and-the-birth-of-bitcoin.html.

PREUKSCHAT, A. (2017), Blockchain: la revolución industrial de internet, Gestión 2000, Barcelona (Spain).

PWC (2016), *Blockchain-An opportunity for energy producers and consumers?* Retrieved from: https://www.pwc.com/gx/en/industries/assets/pwc-blockchain-opportunity-for-energy-producers-and-consumers.pdf.

RASKIN, M. (2017), The law and legality of smart contracts, Georgetown Technology Law Review, Nº 305.

RAY, J. (2018), Decentralized apps (dapps). Retrieved from: https://github.com/ethereum/wiki/wiki/Decentralized-apps-(dapps).

SOUTH KOREA FINANCIAL SERVICES COMMISSION (2018), Financial Measures to Curb Speculation in Cryptocurrency Trading. Retrieved from http://www.fsc.go.kr/eng/new_press/releases.jsp?menu=01&bbsid=BBS0048&selYear=&sch1=&sword=&nxPage=1.

SPOKE, M. (2015), How Blockchain Tech Will Change Auditing for Good. Retrieved from Coindesk: https://www.coindesk.com/blockchains-and-the-future-of-audit/.

SWISS FEDERAL COUNCIL (2018), Blockchain/ICO working group established. Retrieved from the Portal of the Swiss government: https://www.admin.ch /gov/en/start/documentation/media-releases.msg-id-69539.html.

SZABO, N. (1994), Smart contracts. Retrieved from: http://www.fon.hum.uva.nl/rob/Courses /InformationInSpeech/CDROM/Literature/LOTwinterschool2006/szabo.best.vwh.net/smart.contracts.html.

SZABO, N. (1997), The Idea of Smart contract. Retrieved from: https://web.archive.org /web/20060615044959/http:/szabo.best.vwh.net/smart_contracts_idea.html.

TAKAHASHI, K. (2017), Implications of the Blockchain Technology for the UNCITRAL Works. Research Paper, Doshiba University Law School (Japan).

THE ECONOMIST (2015), Special report: Blockchain -The Next Big Thing. Retrieved from The Economist: https://www.economist.com/news/special-report /21650295-or-it-next-big-thing.

UK GOVERNMENT CHIEF SCIENTIFIC ADVISER (2016). Distributed Ledger Technology: beyond block chain. Report, UK Government Office for Science. Retrieved from: https://www.gov.uk/government/uploads/system/uploads /attachment_data/file/492972/gs-16-1-distributed-ledger-technology.pdf.

WALCH, A. (2017), The Path of the Blockchain Lexicon (and the Law). Review of Banking and Financial Law, Nº 36. Retrieved from https://www. academia.edu/32573448/The_Path_of_the_Blockchain_Lexicon_and_the_Law.