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SMART CONTRACTS: ELEMENTS, PATHOLOGIES AND REMEDIES

*Andrea Stazi**

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In reviewing the characteristics of "smart contracts", above all their peculiarities of automatic execution and resistance to tampering, the paper aims to define the characteristics and peculiarities of their binding force, legal effectiveness and regulation.
Thus, the paper examines the elements, pathologies and contractual remedies for smart contracts, and the related main issues that emerge in comparative contract law.

I. "SMART CONTRACTS": CHARACTERISTICS, PECULIARITIES AND CHALLENGES

"Smart contracts"[1], built on distributed ledger technologies, first of all the Blockchain,[2] are characterised by the self-execution of the contractual clauses without the need for human intervention.
They generally exclude the possibility of interrupting such execution or modifying the content, although with some exceptions such as the options of multi-signature or self-destruct[3].

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1 Regarding the definition of smart contracts, see e.g.: A. Stazi *Smart Contracts and Comparative Law - A Western Perspective*, Berlin: Springer, 2021, p. 71 ff.; R. De Caria, *The Legal Meaning of Smart Contracts*, in *European Review of Private Law*, 2019, vol. 26, p. 731 ff.; R. Herian, *Legal Recognition of Blockchain Registries and Smart Contracts*, EU Blockchain Observatory and Forum, 2018, https://www.eublockchainforum.eu/knowledge, p. 16 f.; L.W. Cong, Z. He, *Blockchain Disruption and Smart Contracts*, NBER Working Papers 24399, 2018, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2985764, p. 11.

2 Which provides the ecosystem within which the idea of smart contracts proposed by Nick Szabo in the nineties of the last century can be realised, which at the time still seemed substantially utopian; see: N. Szabo, *Formalizing and Securing Relationships on Public Networks*, in *First Monday*, 1997, http://firstmonday.org/ojs/index.php/fm/article/view/548/469; N. Szabo, *Smart Contracts: Building Blocks for Digital Markets*, 1996, www.fon.hum.uva.nl/rob/Courses/InformationInSpeech/CDROM/Literature/LOTwinterschool2006/szabo.best.vwh.net/smart_contracts_2.html; N. Szabo, *Smart Contracts*, 1994, http://www.fon.hum.uva.nl/rob/Courses/InformationInSpeech/CDROM/Literature/LOTwinterschool2006/szabo.best.vwh.net/smart.contracts.html, who argued that the objectives of such contracts would be to fulfil contractual obligations such as payment terms, privileges, confidentiality and even enforcement, and to minimise both harmful and accidental exceptions and the need for trusted intermediaries.

3 Multi-signature, or "multisig", verification technology allows you to stop running a smart contract until several parties have signed the transaction with their private keys. These can include not only the parts of the smart contract, but also an external third party, a so-called referee. See: K.D. Werbach, N. Cornell, *Contracts Ex Machina*, in *Duke Law Journal*, 2017, vol. 67, p. 313 ff. (345). Furthermore, the code of most smart contracts contains a so-called kill switch. Solidity, the language used to write smart contracts on the Ethereum Blockchain, allows an operation called self-destruction, which removes the smart contract code from the Blockchain; see: H. Eenmaa-Dimitrieva, M.J. Schmidt-Kessen, *Creating markets in no-trust environments: The law and economics of smart contracts*, in *Computer Law & Security Review*, 2019, vol. 35, p. 69 ff. (84-5).

In a technical sense, smart contracts are computer protocols that execute themselves by applying the lines of the computer source code[4] for which they were programmed, stored on a distributed ledger[5].

A smart contract program is executed by a network of so-called miners, who, once consensus has been reached on the outcome of the execution, update the status of the contract on the Blockchain accordingly. In this way, users can send or receive money, data, *etc.*[6].

The fields of application of smart contracts, in fact, are numerous. They can be used, at least in theory, in all cases in which economic activities are correlated to the Internet and some events can be digitally verified[7].

In addition to the financial and insurance sectors where digital bargaining already plays a central role, the use of smart contracts is developing in sectors such as art and entertainment, agri-food, energy, *etc.*[8].

Devices and other material properties can be registered on a Blockchain and, using smart contracts, transformed into "smart properties", thus allowing the control of material properties on the network[9].

Although most of the data comes from the Blockchain or other databases connected to it, some smart contracts, for their execution, may have to acquire data from outside the Blockchain. This creates the need to make use of reliable external sources, so-called "oracles", which represent interfaces between contracts and the outside world[10].

If through smart contracts an economic function recognized by the legal system in which they are intended to carry out their effects is pursued, they allow the drafting and possible automation of the agreement between the parties - as a real contract in the legal sense - according to an "if / then" logic[11].

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[4] The source code, in computer science, is the text of an algorithm of a program written in a programming language by a programmer during programming. It therefore defines the flow of execution of the program itself. See: Wikipedia, "*Source code*". https://it.wikipedia.org/wiki/Codice_sorgente.

[5] P. De Filippi, A. Wright, *Blockchain and the Law: The Rule of Code*, Cambridge (Mass.): Harvard University Press, 2018, p. 33 ff.; V. Buterin, *Ethereum White Paper: A Next-Generation Smart Contract and Decentralized Application Platform*, 2013, https://github.com/ethereum/wiki/wiki/White-Paper, p. 1 ff.

[6] See: G.O.B. Jaccard, *Smart Contracts and the Role of Law*, in *Jusletter IT*, November 2017, available on: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3099885, p. 5 ff.; A. Juels, A. Kosba, E. Shi, *The Ring of Gyges: Investigating the Future of Criminal Smart Contract*, in E. Weippl (eds), *Proceedings of the 2016 ACM SIGSAC Conference on Computer and Communications Security*, New York: ACM, 2016, p. 283 ff.

[7] In this regard, see: D. Linardatos, *Smart Contracts – einige klarstellende Bemerkungen*, in *Kommunikation & Recht*, 2018, p. 9 ff.; G. Governatori et al., *On legal contracts, imperative and declarative smart contracts, and blockchain systems*, in *Artificial Intelligence and Law*, 2018, vol. 26, p. 377 ff.

[8] In this regard, see e.g.: A. Stazi, R. Jovine, *Food Traceability in Europe, the US and China: Comparative Law and Technological Regulation*, forthcoming in *BioLaw Journal*, 2022; A. Stazi, *Genetically modified organisms and sustainable development*, in *BioLaw Journal*, 2020, p. 127 ff. (149); Chamber of Digital Commerce – Smart Contracts Alliance, 2016, available on: http://digitalchamber.org/assets/smart-contracts-alliance-press-release-7_27_2016-final.pdf; R. Unsworth, *Smart Contract This! An Assessment of the Contractual Landscape and the Herculean Challenges it Currently Presents for "Self-executing" Contracts*, in M. Corrales, M. Fenwick, H. Haapio, 2019, p. 17 ff.

[9] Relationships and credentials can also be encoded in the Blockchain regarding certain cryptographically activated resources, such as key blocks or smartphones, to ensure that only certain subjects or nodes have access to the functionality of the property. In this regard, see again: De Filippi, Wright, 2015, cit., p. 14 ff.

[10] A case of smart contracts activated by external inputs is, for example, that of the insurance policies proposed by AXA and Etherisc, insurance companies that offer policies that compensate travellers who experience flight delays or cancellations. Flight information is acquired automatically and in real time by an oracle company indicated in the contract and the compensation is paid automatically.

[11] See eg: A.M. Gambino, A. Stazi, *Contract Automation from Telematic Agreements to Smart Contracts*, in *Italian Law Journal*, 2021, vol. 7, p. 97 ff.; F. Idelberger et al., *Evaluation of Logic-Based Smart Contracts for Blockchain Systems*, in JJ. Alferes et al (eds) *Rule Technologies. Research, Tools, and Applications*, 10th International Symposium RuleML, Stony Brook, NY, USA, July 2016, Cham: Springer, p. 167 ff.

Smart contracts can implement a previous contractual agreement in the legal sense, the clauses of which are formalised in the source code[12].
Otherwise smart contracts can establish new coded relationships that are both defined and automatically applied by the computer code, but are not linked to any underlying contractual right or obligation[13].
From the legal point of view, regardless of the technical necessity, there may be a need to draw up a smart contract in writing in order to make its clauses legally binding and applicable at the judicial level, that is to give rise to a so-called smart legal contract[14].
Smart contracts operate autonomously, in a transparent, anti-tampering and tendentially immutable way[15]. Actually, as mentioned, a smart contract is not always immutable. The Blockchain could be "forked" by the majority of users. Moreover, the computer code of smart contracts can contain several functions that allow for a certain range of flexibility[16].
These characteristics grant the contracting parties several significant advantages over traditional contracts. The parties can rely on contractual promises that are stored in the smart contract, that is the transaction protocol automatically executed without recourse to judicial intervention, and do not have to trust the counterparty.
This allows them to take calculated risks, even in areas where the parties are not directly opposed to each other, but which are often characterised by anonymity and application risks, as is usually the case in electronic commerce and international contracts.[17].
Consumers/users, in particular, could benefit from these advantages in a relevant way, since they usually face difficulties and costs for which they neglect to assert their rights in court[18].
Furthermore, smart contracts involve the possibility of reducing transaction costs, performing some functions currently performed by intermediaries such as Amazon, eBay, PayPal, *etc.*[19]. Smart contracts, in fact, allow the parties to incorporate the commercial practice in their agreement, bypassing the need for explicit but redundant negotiation[20].

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12 The creation of smart contract models, in practice, could lead to a reduction in the role of lawyers in the moment of contract formation, especially with respect to those that can be easily modelled; on this point; see: M. Corrales, M. Fenwick, H. Haapio (eds), *Legal Tech, Smart Contracts and Blockchain. Perspectives in Law, Business and Innovation*, Berlin: Springer, 2019.

13 In this regard, see among others: Chamber of Digital Commerce - Smart Contracts Alliance, *Smart Contracts: Is the Law Ready?*, September 2018, available on: https://digitalchamber.org/smart-contracts-whitepaper, p. 10 ff.

14 See: P. De Filippi, A. Wright, *Decentralized Blockchain Technology and the Rise of Lex Cryptographia*, 2015, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2580664, p. 11, who found that, while at the beginning smart contracts were mainly developed to automatically execute derivatives, options, futures and swaps, later they began to be used to enable the sale of goods on the network between unrelated persons without the need for a centralised organisation. The authors cite in this sense the example of OpenBazaar, an open source service aimed at creating a decentralised global market in which people can buy and sell products directly, without intermediation costs or centralised control (see: https://openbazaar.org).

15 In this regard, see: De Filippi, Wright, 2018, cit., p. 72; Linardatos, 2018, cit., p. 2.

16 Like the multi-signature or self-destruct assumptions mentioned above, but also functions like "call" (which accepts an arbitrary number of arguments of any type), "enums" (a way to create a user-defined type), "self-destruct", and also variable functions that allow the smart contract to process inputs external; in this regard, see: Juels, Marino, 2016, cit., p. 151 ff.

17 See: P. Ryan, *Smart Contract Relations in e-Commerce: Legal Implications of Exchanges Conducted on the Blockchain*, in *Technology Innovation Management Review*, 2017, vol. 7, p. 14 ff..

18 In this regard, see: O. Borgogno, *Usefulness and Dangers of Smart Contracts in Consumer and Commercial Transactions*, in L.A. DiMatteo, M. Cannarsa, C. Poncibò, *The Cambridge Handbook of Smart Contracts, Blockchain Technology and Digital Platforms*, Cambridge: Cambridge University Press, 2019, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3350128, p. 8 ff.

19 Borgogno, 2019, cit, p. 13 ff.; M. Sokolov, *Smart Legal Contract as a Future of Contracts Enforcement*, 2018, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3208292, p. 11; E. Mik, *Smart contracts: terminology, technical limitations and real world complexity*, in *Law, Innovation and Technology*, 2017, vol. 9, p. 272 ff. (277).

20 On this point, see: J.M. Sklaroff, *Smart Contracts and the Cost of Inflexibility*, in *University of Pennsylvania Law Review*, 2017, vol. 166, p. 263 ff. (282 ff.).

Automatic application or compensation has the potential to reduce the amount of disputes, increasing certainty and reducing performance monitoring costs[21]. In general, therefore, smart contracts give rise to a further reduction of human intervention in the negotiation and formalisation of the contract[22].
Compared to traditional contracts, again, smart contracts increase the speed with which it is possible to execute contractual relationships. Given that they are not dependent on paper and related procedural steps and can be performed in real time, they simultaneously enable cost savings and faster execution than paper contracts[23].
Finally, smart contracts offer an alternative to a key aspect of contractual drafting: the intrinsic ambiguity of natural language[24], with the relative flexibility in terms of contractual performance[25].
The ambiguity and editorial shortcomings can also be used by the parties who intend to free themselves from contractual conditions that they no longer want to honour[26]. Compared to this phenomenon, smart contracts provide a different binding option by incorporating legal provisions into the computer code[27].
On the other hand, smart contracts also present a number of new issues and challenges for trade law and practice.
A first question that can arise is that of the identification of the other contracting party, when the Blockchain allows anonymous, or rather pseudonymous transactions[28], such as when transactions are registered by referring to an IP address or a cryptocurrency wallet[29].
The codification of the clauses in computer language may give rise to a limitation of the possible contents of the smart contracts, linked to the possibilities of automation of the contractual prose according to the if/then logic[30].
Connected to this is the risk that the parties or the legal operators misunderstand the code, drawn up by IT technicians[31], or the code incorrectly reports the provisions of the contractual agreement between the parties, or again it operates differently from what was planned, with the related issue of attributing liability.
In practice, the connection between the text in computer code and a contractual text drawn up in natural language is increasingly common. The texts may have the same content, so-

[21] See: Werbach, Cornell, 2017, cit., p. 318 and 352 ff.
[22] A. Savelyev, *Contract law 2.0: 'Smart' contracts as the beginning of the end of classic contract law*, in *Information & Communications Technology Law*, 2017, vol. 26, p. 116 ff. (120 ff.).
[23] In this regard, see: De Filippi, Wright, 2015, cit., p. 25.
[24] See, among others: M. Raskin, *The Law and Legality of Smart Contracts*, in *Georgetown Law Technology Review*, 2017, vol. 1, p. 305 ff. (324); E.A. Farnsworth, *"Dmeaning" in the Law of Contracts*, in *Yale Law Journal*, 1967, vol. 76, p. 939 ff.
[25] In this regard, see: M.P. Gergen, *The Use of Open Terms in Contract*, in *Columbia Law Review*, 1992, vol. 92, p. 997 ff. (1006); G.K. Hadfield, *Judicial Competence and the Interpretation of Incomplete Contracts*, in *Journal of Legal Studies*, 1984, vol. 23, p. 159 ff.
[26] See: S.J. Burnham et al., *Transactional Skills Training: Contract Drafting-Beyond the Basics*, in *Transactions: The Tennessee Journal of Business Law*, 2009, p. 253 ff.
[27] Thus: De Filippi, Wright, 2015, cit., p. 25.
[28] By pseudonymity we mean the possibility that, although a person is not identifiable with his real name, such identification can still take place through the acquisition of further information about him, such as a pseudonym, an IP address, a current account, *etc.*; on the subject, see: Article 29 Data Protection Working Party, *Opinion 05/2014 on Anonymisation Techniques*, WP 216, April 2014, https://ec.europa.eu/justice/article-29/documentation/opinion-recommendation/index_en.htm, p. 20 ff.
[29] On this point, see: European Bank for Reconstruction and Development, Clifford Chance, *Smart Contracts: Legal Framework and Proposed Guidelines for Lawmakers*, October 2018, https://www.ebrd.com, p. 22 ff.
[30] Cardozo Blockchain Project, *Research Report #2: "Smart Contracts" & Legal Enforceability*, October 2018, https://cardozo.yu.edu/sites/default/files/Smart%20Contracts%20Report%20%232_0.pdf, p. 365 ff.
[31] Regarding these profiles, see: M. Giancaspro, *Is a 'Smart Contract' Really a Smart Idea?*, in *Computer Law & Security Review*, 2017,vol. 33, p. 830 ff.; MIK, 2017, cit., p. 281 ff.

called split contracting, or they can be respectively the specification and/or execution of the other, so-called hybrid agreement[32].
In a system governed by self-imposed smart contracts and other technical agreements, there would be less need for judicial intervention, since the computer code through which the rules were defined is the same tool through which they are applied[33].
Although the implementation of basic contractual guarantees and consumer protection regulations in smart contracts is theoretically possible, in fact it can prove to be complex, given the formalised and deterministic nature of the computer code[34].
The possible acquisition of external data requires the guarantee that the oracle is reliable and actually a third party, and that there is no interference or security threats during the acquisition of data from the same[35].
Another problematic issue concerns the need to intervene on a smart contract in the event that an injunction issued by the judicial authority must be executed.
In general, given the impossibility of interrupting the execution of a smart contract - excluding the exceptions mentioned above - the realisation of this result may take place in the hypothesis of using a private Blockchain which provides mechanisms for blocking the execution under the responsibility of certain nodes.

II. Formation of contract

In smart contracts, offer, acceptance and consent are manifested by signing the transaction in a cryptographic way. In this regard, the main question lies in the fact that the computer code represents an obscure language for most human beings[36].
Different considerations must be made depending on whether the smart contract on the Blockchain is the only existing contract, as the parties have never reached an oral agreement or entered into a written document, or there is an oral or written agreement next to or that includes the smart contract.
In the first hypothesis, the computer code represents the only proof of a legal relationship between the parties, and it is not clear whether the contract and/or its clauses have been well understood by them. However, based on the principle of freedom of form, the contract can still be considered valid[37].
In this case, the entire process of offering, accepting and existence of consent takes place only on the Blockchain. In case of uncertainty on the content, the rules that require to interpret the will of the parties must be applied, and in the event of non-compliance, declare the nullity of the contract or clauses without consent[38].
When there is an oral or paper version alongside or that includes the smart contract, the first can be considered hierarchically higher than that expressed in the computer code,

32 On this point, see: European Bank for Reconstruction and Development, Clifford Chance, 2018, cit., p. 17 ff.; De Filippi, Wright, 2018, cit., p. 76 ff.; J.G. Allen, *Wrapped and Stacked: 'Smart Contracts' and the Interaction of Natural and Formal Languages*, in *European Review of Contract Law*, 2018, vol. 14, p. 307 ff.
33 From the merger of law and code it follows, therefore, that the only way to violate the law is to effectively break the code.
34 T. Cutts, *Smart Contracts and Consumers*, LSE Legal Studies Working Paper No. 1/2019, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3354272; De Filippi, Wright, 2015, cit., p. 26.
35 See again: Sokolov, 2018, cit., p. 10; Mik, 2017, cit., p. 292 ff.
36 On this point, see: Giancaspro, 2017, cit., p. 830 ff.
37 See, for example: Swiss Federal Council, Rapport du Conseil fédéral sur les monnaies virtuelles en réponse aux postulats Schwaab (13.3687) et Weibel (13.4070) du 25 juin 2014, p. 11; Singapore High Court, Chwee Kin Keong and Others v Digilandmail.com Pte Ltd [2005] 2 LRC 28I.
38 See: G.O.B. Jaccard, 2017, cit., P. 22 s .; M. Eggen, *Chain of Contracts*, in *Aktuelle juristische Praxis - Pratique juridique Actuelle*, 2017, p. 3 ff. (8).

similarly to what is considered for the interpretation of the *click-wrap* agreements in relation to the main contract[39].

Some authors believe that coexistence with an off-chain contract should become a good practice whenever the contract is of some relevance[40]. In this way, then, the parties can actually verify that consent has been given on the specific content of the contract[41]. On the other hand, this practice - especially for simpler transactions - could risk reducing the advantages of using smart contracts in terms of speed and saving of transaction costs.

The initial phase of a contractual agreement relating to a smart contract can be similar to that of traditional contracts, with the contracting parties that agree on a series of contractual terms, or closer to standard contracts in the case of a smart contract unilaterally prepared by one of the parties[42].

The publication of the contract on the chosen Blockchain platform appears configurable as an offer, and the acceptance of the other party by means of its own cryptographic key will configure an acceptance[43].

Similarly to what happens in the context of electronic bargaining *tout court*, depending on the circumstances, the publication of the message by the proposing party on the Blockchain can be considered similar to an advertisement and therefore a mere invitation to offer[44], or instead the terms of the transaction may configure a real contractual offer[45].

Furthermore, the publication may, depending on the preferences of the offeror and the permissioned or permissionless characteristics of the Blockchain, constitute an offer to a specific recipient or an offer to the public[46].

Acceptance can take place either through the execution of a specific service, or through authorization to transfer a consideration or digital asset by entering a cryptographic key[47].

The offer and the contractual acceptance, therefore, can be considered expressed, in the light of the regulations in force at transnational level, by «data messages» stored in a Blockchain. These are defined in the UNCITRAL Model Electronic Commerce Act as

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[39] In this sense, see: Giancaspro, 2017, cit., p. 834; B. Winiger, in L. Thévenoz, F. Werro (edited by), *Commentaire Romand, Code des obligations I*, Munich: Helbing Lichtenhahn, 2021, *Art. 18 n. 1 ff.*

[40] In fact, the automatic compilation of a smart contract in human-readable language is quite easy.

[41] See J. Hazard, H. Haapio, *Wise Contracts: Smart Contracts that Work for People and Machines*, in E. Schweighofer et al. (edited by), *Trends und Communities der Rechtsinformatik / Trends and Communities of Legal Informatics*, *Tagungsband des 20. Internationalen Rechtsinformatik Symposions IRIS 2017*, Österreichische Computer, Vienna, 2017, p. 2 ff.

[42] See: Raskin, 2017, cit.,, p. 305 ff. (322).

[43] In this sense, see: M. Durovic, A. Janssen, *The Formation of Blockchain-based Smart Contracts in the Light of Contract Law*, European Review of Private Law, 2019, p. 762.

[44] See: United Nations Convention on the Use of Electronic Communications in International Contracts. New York, November 23, 2005, art. 11. In doctrine, see among others: M. Kaulartz, J. Heckmann, *Smart Contracts - Anwendung der Blockchain-Technologie*, in *Computer und Recht*, 2016, p 621.

[45] See: Durovic, Janssen, 2019, cit., p. 762. For a broader overview on formation of contracts in electronic bargaining, see among others: Y. Goh, *Contractual Consent in the Age of Machine Learning*, in G. Chan Kok Yew, M. Yip (eds.), *AI, Data and Private Law. Translating Theory into Practice*, London: Bloomsbury, 2021, p. 199 ff.; Stazi, 2021, cit., p. 29 ff.

[46] In the Italian legal system, pursuant to art. 1336 of the Italian Civil Code. For a comparative framework, with particular regard to the *common law* English, US and Australian, see: J. Madir, *Smart Contract: (How) Do They Fit Under Existing Legal Frameworks?*, 2018, available on: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3301463, p. 7 ff.; Chamber of Digital Commerce - Smart Contracts Alliance, 2018, cit., p. 15 ff.; R3, Norton Rose Fullbright, *Can smart contracts be legally binding contracts?*, November 2016, available on: https://www.nortonrosefulbright.com/en-it/knowledge/publications/a90a5588/can-smart-contracts-be-legally-binding-contracts, p. 27 ff. For an analysis of the issues posed by smart contracts in the Chinese system, see: J. Wang, C. Lei, *legalWill Innovative Technology Result in Innovative Legal Frameworks? Smart Contracts in China*, in *European Review of Private Law*, 2019, p. 921 ff.

[47] See: G.O.B. Jaccard, 2017, cit., p. 22; JJ Szczerbowski, *Place of Smart Contracts in Civil Law. A Few Comments on Form and Interpretation*, Proceedings of the 12th Annual International Scientific Conference "New Trends 2017", Private College of Economic Studies Znojmo, in 2018, p. 336, available on: https://ssrn.com/abstract=3095933; see also: Carlill v. Carbolic Smoke Ball Co Ltd (1892) 1 QB 256, 262.

information generated, sent, received or stored by electronic, optical or "similar" means. This definition appears applicable to both traditional communication techniques and digital communications, including smart contracts[48].
The Convention on the use of electronic communications in international contracts, then, with regard to the formation of a contract, provides the principle of functional equivalence, under which the execution of a contract by an automated system cannot be denied for the only reason that no natural person intervened in each of the actions carried out[49].
The subscription requirement can be difficult to fulfil for smart contracts since the signature could only be a code entered into the software by one of the contracting parties. Moreover, the purpose of a signature is to ensure that the signatory party actually intended to contract[50], therefore a fully electronic environment without any human intervention can make it difficult to establish an intent[51].
On the other hand, smart contracts meet the originality and integrity requirements of the data messages provided for in the Model Law on electronic commerce[52], given the characteristics of tamper resistance and unchangeable tendency of the Blockchain[53].
The Model Law on Electronic Transferable Records, which allows the use of these registers[54] for transferable instruments, provided that the electronic register meets the purposes and functions of the transferable instrument[55], requires the guarantee of the singularity of the document and the use of a reliable method for identifying and checking the record[56].
Distributed ledger technologies such as Blockchain appear capable of replacing the registry administrator with an algorithm that guarantees that the tokens registered in it are subject to the exclusive control of the holders of the relative private keys[57].
The Electronic Records Model Law also requires a reliable method to be used to identify the person in order to meet the signature requirement[58].
A signer can use a pseudonym, but the distributed registry system must have the ability to link it to a real name to meet the signer identification requirement, since some reports or actions require mandatory links to real names[59].

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48 UNCITRAL Model Law of Electronic Commerce with Guide to Enactment, 1996, arts. 2 (a) and 11 and par. 31.
49 United Nations Convention on the Use of Electronic Communications in International Contracts. New York, cit., Arts. 8 and 12. On the topic, see: V. Ooi, *Contracts Formed by Software: An Approach from the Law of Mistake*, SMU Center for AI & Data Governance Research Paper No. 2019/02, available on: https: //papers.ssrn. com / G3 / papers.cfm? abstract_id = 3322308.
50 See UNCITRAL Model Law of Electronic Commerce with Guide to Enactment, cit., Par. 56.
51 Thus: A. Mukherjee, *Smart Contracts - Another Feather in UNCITRAL's Cap*, in *Cornell International Law Journal Online*, February 2018, available on: http://cornellilj.org/smart-contracts-another-feather-in-uncitrals- Postal Code.
52 See again: UNCITRAL Model Law of Electronic Commerce with Guide to Enactment, cit., Arts. 8-10.
53 In this sense, see: Mukherjee, 2018, cit.
54 A transferable register is a document that authorises the holder to claim fulfilment of the obligation indicated in the document and to transfer the right to execute. See: UNCITRAL, Model Law on Electronic Transferable Records, 2017, art. 2.
55 Thus: UNCITRAL, Model Law on Electronic Transferable Records, cit., Art. 1 (1).
56 UNCITRAL, Model Law on Electronic Transferable Records, cit., Arts. 10-11 and parr. 189-190 of the Explanatory Note. Since it embodies the right to claim the execution of one obligation by another, it is essential to prevent multiple complaints about the same obligation.
57 See: K. Takahashi, *Blockchain Technology and Electronic Bills of Lading*, in *Journal of International Maritime Law*, 2016, vol. 22, p. 202 ff. (209).
58 See: UNCITRAL, Model Law on Electronic Transferable Records, cit., Art. 9.
59 UNCITRAL Model Law on Electronic Signatures with Guide to Enactment, 2001, par. 29. For example, you need to be able to link pseudonyms to real names when you appeal against a promissory note. The explanatory notes also suggest that to link pseudonyms to a real name, it is possible to rely on factual elements outside the distributed registry system.

III. MISTAKE

According to the law of mistake under English, Australian and Singapore law, while where when only one party to the contract is under a mistake the contract is not void, the contract can be void where at the time of signing the agreement one of the parties is mistaken as to a term of the contract, the party would not have entered the contract but for this mistake, and the mistake is known or reasonably ought to be known to the other party[60].

In the United States, as well, a contract can generally be voided at the discretion of the misled party if the other party was aware of it - as in the case of identity theft - and the execution of the contract would be unreasonable[61].

In civil law, in the Italian and French legal systems, for example, a mistake can void an agreement in which it influences the very essence of the same[62].

A particularly interesting case of application of the doctrine of mistake to smart contracts was the Singapore Court of Appeal's decision in Quoine v B2C2[63].

B2C2 had entered into a membership contract with Quoine under which B2C2 could make trades of cryptocurrencies with other counterparties on Quoine's automated cryptocurrency trading platform. However, the platform executed the B2C2 trades of Ethereum in exchange for Bitcoin at an exchange rate approximately 250 times the then current market rate, in favour of B2C2, whose account was automatically credited with the proceeds of the trades.

When Quoine later reviewed the trades, it considered that they were the result of an error and reversed them, notwithstanding that the membership contract provided that trades were "irreversible". B2C2 brought an action against Quoine, claiming that in reversing the trades Quoine's actions were a breach of the contract and Quoine was in breach of trust[64].

Both the Singapore International Commercial Court and the Singapore Court of Appeal decided in B2C2's favour. In reversing the trades, Quoine had breached its contract with B2C2, and Quoine had failed to establish a mistake that would make the contracts for trades void[65]. Thus, Quoine was also held in breach of trust and liable for damages[66].

As for the subject and the time regarding which to assess whether the non-mistaken party had the requisite actual knowledge of the mistake[67], the Court of Appeal held that - given that it is the programmer who sets the parameters which the algorithm is bound by - her

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[60] See: Cundy v Lindsay (1878) 3 App Cas 459; Hartog v Colin & Shields (1939) 3 All ER 566; Shogun Finance Ltd v Hudson (2003) UKHL 62; Chwee Kin Keong v Digilandmall.com Pte Ltd [2005] 1 SLR(R) 502. This is the case known as "unilateral mistake". Regarding its application to automated contracts, in a critical perspective, see eg: K.F.K. Low, E. Mik, *Lost in Transmission: Unilateral Mistakes in Automated Contracts*, in *Law Quarterly Review*, 2020, vol. 136, p. 563 ff.

[61] In this sense, see: Restatement (Second) of Contracts (1981) art 153; Gethsemane Lutheran Church v Zacho 258 Minn 438 (1960); Maryland Casualty Co v Krasnek 174 So 2d 541 (1965).

[62] See: art. 1130 ff. of the French *Code Civil*; art. 1429 ff. of the Italian Civil Code.

[63] Quoine Pte Ltd v B2C2 Ltd [2020] 2 SLR 20, on appeal from the Singapore International Commercial Court (SICC) ([2019] 4 SLR 17.

[64] See: Low, Mik, 2020, cit., p. 563 ff.; R. Kulms, *Blockchain: Private Law Matters*, in *Singapore Journal of Legal Studies*, 2020, p. 63 ff. (74 ff.); Norton Rose Fulbright, Singapore court's cryptocurrency decision: Implications for cryptocurrency trading, smart contracts and AI, available at: https://www.nortonrosefulbright.com/nl-nl/knowledge/publications/6a118f69/singapore-courts-cryptocurrency-decision-implications-for-trading-smart-contracts-and-ai.

[65] The mistake was in the way in which Quoine's platform had operated. This "might conceivably be seen as a mistake as to the premise on which the buy orders were placed, but it can in no way be said to be a mistake as to the terms on which the contracts could or would be formed"; see Quoine [2020], 114.

[66] Furthermore, the Court confirmed the requirement of actual knowledge to invoke unilateral mistake. In line with the analysis above, then, the means by which the subjective knowledge of the non-mistaken party is ascertained may include considerations of the matter from an objective perspective. In this regard, see: Goh, 2021, cit. p. 221.

[67] Time which is in general that of contract formation.

or his state of knowledge is the one to assess, from the time of programming to when the relevant contract is formed[68].

IV. Form and interpretation

Contractual freedom allows contracting parties to draw up the contract in any form and language they wish, including the computer code[69]. Similarly to what happened in the past with the progressive adaptation of contract law to the new communication methods and technologies, a similar adaptation to smart contracts seems underway, in some systems through *ad hoc* regulatory interventions[70].

As in the case of the vending machine in which a contract is formed when the coins are inserted into the machine, the fact that the subsequent execution process occurs without human intervention does not preclude the formation and existence of a legally binding contract[71].

Regarding the question of the intelligibility of the contractual content[72], except for the hypothesis in which both parties participate in the drafting and/or understand the terms written in the computer code, problems arise if at least one of the contracting parties does not understand the computer code but concludes the smart contract[73].

In this case, the party itself could try to affirm later the existence of an error and request the cancellation of the contract. In doctrine, on the one hand, there are those who believe that in contracts drawn up by one of the parties it is reasonable to attribute to the same the burden of proof of understanding of the computer code by the other[74].

On the other hand, this option has so far been rejected, for example in Italian law by art. 1429 of the Civil Code or in German law as Inhaltsirrtum pursuant to § 119 (1) BGB, believing that the risk of the conclusion of a contract without knowing the underlying code lies with the parties, based on the principle of self-responsibility and of entrustment[75].

The rules governing contract law on both sides of the Atlantic refer to the form of the contract, sometimes providing for legal requirements relating to the need for a specific form *ad substantiam* or to ensure particular guarantees.

The smart contracts recorded on the digital support of the Blockchain platform, as such, do not allow policyholders to make declarations in writing, but possibly in documentary form where there are two elements: i) the drafting of the declaration as a document; ii) the identifiability of the author of the declaration.

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[68] See again: Quoine [2020], 89-99; Y. Goh, 2021, cit., p. 222.

[69] See, *ex multis*: M. Giuliano, *The Blockchain and smart contracts in the innovation of third millennium*, in *The law of information and information technology*, 2018, p. 989 ff. (1030 ff.); Szczerbowski, 2018, cit., P. 335; M. Jünemann, A. Kast, *Rechtsfragen beim Einsatz der Blockchain*, in *Kreditwesen*, 2017, p. 533; Kaulartz, Heckmann, 2016, cit., p. 622; M. Kaulartz, *Herausforderungen bei der Gestaltung von Smart Contracts,* in *Zeitschrift zum Innovations- und Technikrecht*, 2016, p. 201 ff. (204).

[70] For a reconstruction of the various interventions adopted so far in the different legal systems, see: Stazi, 2021, cit.., p. 91 ff.; R3, 2016, cit., p. 22 ff.

[71] In this sense, see: Durovic, Janssen, 2019, cit., p. 764 f., Which recall what has been established in this regard in Thornton v. Shoe Lane Parking (1978) 2 QB 163 (Lord Denning MR), and R (Software Solutions Partners Ltd) v. HM Customs & Excise (2007) EWHC 971, par. 67.

[72] From which, moreover, as is known, contracts drawn up in natural language are not exempt; cf .: Madir, 2018, cit., p. 10-11, which also notes that, for example, in the German legal system the validity and binding nature of a contract is not affected by the lack of understanding of the German language (see: Bundesarbeitsgericht, 5 AZR 252/12 (B), 19 March 2014); International Swaps and Derivatives Association, Linklaters, *Whitepaper on Smart Contracts and Distributed Ledger - A Legal Perspective*, August 2017, available on: https://www.isda.org/2017/08/03/smart-contracts-and-distributed-ledger-a-legal-perspective, p. 17.

[73] See: Durovic, Janssen, 2019, cit., p. 764-5.

[74] Thus: Szczerbowski, 2018, cit., p. 336 f.

[75] In this regard, see: Jünemann, Kast, 2017, cit., p. 533; Kaulartz, Heckmann, 2016, cit., p. 622; A.M. Gambino, *L'accordo telematico*, Milan: Giuffré, 1997, p. 83 ff. In common law, for an approach aimed at reconciling the doctrine of mistake and responsibility, see: Ooi, 2019, cit.

The first requirement appears satisfied by the smart contracts since the declarations are recorded in a distributed register, which constitutes an informative support that allows the reading of the content.
Regarding the identification requirement, the declarations registered on Blockchain are labelled by the addresses of the accounts, a series of numbers and letters that does not indicate a specific person, but allows their identification[76].
In practice, there is a tendency to adopt the so-called split contracting or hybrid agreement approach, with the contextual drafting of a natural language contract together with a copy in computer code, or with the inclusion in the contractual text of some codified and self-executable parts[77].
The drafting of the contract generally takes place through a web interface, that is a module which contains, on the one hand, the text in natural language, on the other, the parameters that can be computed in computer code, relating to any information to be collected from sources external, any conditions to which execution or modification is subject, and to the automatic execution mechanism[78].
As regards the interpretation of the smart contract, where reference is made to it having regard exclusively to its codified part, it can be considered inflexible and interpretable in one way only: on the basis of the computer code, precisely[79]. In this sense, smart contracts could be considered inflexible and unable to adapt to changing circumstances or the preferences of the parties[80].
Specific problems of certainty of terms and interpretation may derive from the algorithmic application of clauses that refer to regulatory standards such as "good faith", "correctness", "reasonableness", *etc.*, or that contain a variation mechanism, a common feature in many commercial agreements.
These notions do not perfectly fit the "binary" approach of the computer code. It is not clear, at least so far, how it is possible to code a smart contract to apply these terms in the specific case[81].
Except for the hypothesis of recourse to an external oracle, the need to insert similar clauses would therefore seem at the moment to make inappropriate the use of smart contracts, which as mentioned are more suitable for the regulation of simple relationships[82].
In a smart contract, the terms are translated into a computer code that is usually incomprehensible to the lawyer or the average judge. The reference to the terms in a

[76] In this sense, see: Szczerbowski, 2018, cit., p. 336.
[77] In this regard, see in particular: V. Pasquino, *Smart contracts: characteristics, advantages and problems*, in *Dir. e proc.*, 2017, p. 245; D. Di Maio, G. Rinaldi, *Blockchain and the legal revolution of smart contracts*, in *Banking Law*, July 2016, available on: http://www.dirittobancario.it/news/contratti/blockchain-e-la-rivolution- legal-of-smart-contracts; De Filippi, Wright, 2018, cit., p. 76-78; MADIR, 2018, cit., p. 12; Dutch Blockchain Coalition, *Smart contracts as a specific application of blockchain technology*, December 2017, available on: https://www.dutchdigitaldelta.nl/uploads/pdf/Smart-Contracts-ENG-report.pdf, p. 23.
[78] Often referred to in technical jargon as a *smart contract*, but which from a legal point of view in reality properly constitutes only the part relating to the automatic execution.
[79] In this regard, see: De Filippi, Wright, 2018, cit., p. 82.
[80] These characteristics, which can also be considered an advantage as instruments of guarantee of execution, could also be altered through provisions that allow modification of some parts of the contract, for example through information from the oracles or interventions of the parties; cf .: De Filippi, Wright, 2018, cit., p. 75 ff.
[81] In this regard, see: M. Cannarsa, *Interpretation of Contracts and Smart Contracts: Smart Interpretation or Interpretation of Smart Contracts?*, in *European Review of Private Law*
2018, vol. 26, p. 780; Giancaspro, 2017, cit., p. 830-1; S. Farrell et al., *How to Use Humans to Make "Smart Contracts" Truly Smart*, July 2016, available on: http://www.kwm.com/en/au/knowledge/insights/smart-contracts-open-source-model-dna- digital-analoguehuman-20160630, which detect how trying to program similar clauses so that they can be performed computationally is currently science fiction (without the use of a huge amount of code or computing power).
[82] In this regard, see: V. Zeno-Zencovich, *Legal Epistemology in the Age of Big Data*, in G. Peruginelli, S. Faro (edited by), *Knowledge of the Law in the Big Data Age*, Amsterdam: IOS Press, 2019, p. 3 ff. (7 f.).

readable linguistic form in external materials[83], even where as in common law would be prohibited by the so-called parol evidence rule, according to which extrinsic evidence is inadmissible to change a written contract[84], is allowed if the terms of the smart contract are completely ambiguous and incomprehensible without reference to these extrinsic materials[85].
It is also possible that the parties or the judge make use of external experts such as qualified programmers to interpret the code of the smart contract. In any case, whenever a text in natural language is available, the interpretation process should reconcile the terms encoded in the smart contract with those of the natural language text[86].

V. VARIATIONS AND FULFILMENT

Smart contracts are self-executable, resistant to tampering and tend to be unchangeable. By virtue of these characteristics, smart contracts present the risk of programming errors and/or incorrect representation of the will of the parties which may not be reversible, or which require significant efforts to this end, as well as, given the possibility of spontaneous alteration of the computer code, the risk of complex disputes over liability for technical error[87].
The ancillary elements of the contract such as conditions or terms, vice versa, can be included originally in the smart contract. Some questions arise regarding specific profiles, such as the retroactive effectiveness of the fulfilment of the condition[88], which could contrast with the aforementioned characteristics of smart contracts.
In practice, in the case of a suspensive condition, the contract can only be entered in the Blockchain when the condition is fulfilled, while for the resolutive condition a subsequent restitutive bargain must be accompanied by an *ex nunc* dissolution of the previous contract[89].
The term relating to a future and certain event, then, can also be provided in smart contracts through a specific provision in the code that links the relative legal effect upon its expiry[90].

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83 As original terms of reference, negotiation notes, email, *etc.*
84 See, in US law: Restatement (Second) of Contracts (1981) art 213; Uniform Commercial Code (UCC) art 2-202; in English and Australian jurisprudence: Goss v Nugent (1833) 110 ER 713; Mercantile Bank of Sydney v Taylor (1891) 12 LR (NSW) 252. In *civil law*, cf. also for example art. 1359 of the Civil Code, although other provisions affect the way in which the evidence can be used towards the parties involved in the relationship.
85 See in this regard: Reardon Smith Line Ltd v Yngvar Hansen-Tangen and Sanko SS & Co Ltd (1976) 1 WLR 989; Codelfa Construction Pty Ltd v State Railway Authority of New South Wales (1982) 149 CLR 337.
86 See: Giancaspro, 2017, cit., p. 833. In this case the contractual agreement should be found in this original text.
87 In this sense, see: Giancaspro, 2017, cit., p. 830 f., which reports examples of the significant economic repercussions that occurred on the Ethereum platform; L. Luu et al., *Making Smart Contracts Smarter*, in Association for Computing Machinery, *CCS '16. Proceedings of the 2016 ACM SIGSAC Conference on Computer and Communications Security*, ACM, New York, 2016, p 254 ff.
88 Fruit of the will of the parties or imposed by law (so-called *condicio iuris*). In the Italian legal system, for example, the retroactivity mechanism on the one hand may not exist due to the will of the parties or due to the nature of the relationship, on the other hand it is without prejudice to the acts of ordinary administration carried out *medium-time* by the entitled person and the executed in contracts with continuous or periodic execution (see articles 1360-1361 of the Italian Civil Code). In the French legal system, cf. the articles 1304-6 and 1304-7 of the Civil Code, which following the 2016 reform eliminated the retroactivity for the suspension condition and not for the resolutive one, except for leaving both parties the right to predict or eliminate it respectively, and in any case maintaining the risk for the debtor and the effectiveness of the conservative and administrative documents.
89 Normally, pending the condition, the purchases made by third parties are not affected *medium tempore*, but a smart contract that is executed pending the suspensive condition of a previous contract determines a discontinuity in the transcriptions, blocking the possibility of executing the other contract.
90 For the purpose of verifying the fulfilment of both the condition and the deadline, it may be useful to acquire objective data from the outside through the oracles. Regarding the relevance of oracles in order to mitigate the rigidity of smart contracts, introduce conditions or terms, *etc.*, but also on any risks in terms of

The rigidity of smart contracts can constitute a significant limit for any interventions by public authorities, to guarantee compliance with legislation or regulation, or judicial interventions *ex post* in application, for example, of withdrawal or nullity[91].
However, as mentioned, some technical solutions can help prevent similar situations. The first is the destruction of the smart contract through the so-called self-destruction function, even if this remedy could be excessive compared to the problems encountered.
Other functions have been developed, such as cd. *callcode*, *enum* or other, which can modify the content of the computer code. The use of these functions by the courts could help address the legal issues that arise during or as a consequence of the execution of the contract[92].
If the smart contracts appear particularly useful because they are able to guarantee that the contract will actually be executed, then the creditor's right to the performance is not absolute, and each legal system recognizes that the execution of the contract can be prevented by several external factors[93].
In smart contracts, some contingencies can be easily foreseeable and programmable in the computer code, where they are part of the smart contract environment, such as in the case of insufficient balance of the cryptocurrency.
Other causes may be more difficult to assess, and possibly require the use of an oracle, such as in the case of ascertainment of the failure of a parcel to be delivered by the courier, which thus acts as an oracle.
Still other causes may be more complex to predict, code and verify, such as strikes, technical failures, *etc.* While it is theoretically possible to include long lists of possible contingencies, the determination is further complicated as there may be different relevant causes depending on the type of contract and different ways in which they can be verified[94].
A solution may be that of the presumption that the failure is attributable and the possibility of coding a limited set of foreseeable causes of significant contingency. Any remaining and unforeseen causes would therefore remain the responsibility of the debtor, in accordance with the provisions of most legal systems[95].
Regarding the most complex or relevant contracts, in-depth analysis may be necessary regarding the possible existence of facts that make the imputation of the cause of impediment or justification of the failure to fulfil the obligation configurable or not[96].

VI. WITHDRAWAL AND TERMINATION

Regarding the withdrawal attributed by law or contractual clause to one of the contracting parties, which in contracts with continuous or periodic execution can be exercised even after the start of execution[97], and of the cancellation, which differs from the first as refusal

trust and security, see: Mik, 2017, cit., p. 292-3; Wang, Lei, 2019, cit., p. 937-8; P. Ortolani, *Self-Enforcing Online Dispute Resolution: Lessons from Bitcoin*, in *Oxford Journal of Legal Studies*, 2016, vol. 36, p. 595 ff.

91 See: Pasquino, 2017, cit., p. 247; Giancaspro, 2017, cit., p. 831, which shows the example of the injunction with the relative complexity of interrupting the execution of the smart contract.

92 See: A. Juels, B. Marino, *Setting Standards for Altering and Undoing Smart Contracts*, in JJ Alferes et al. (edited by), *Rule Technologies. Research, Tools, and Applications - Proceedings of the 10th International Symposium RuleML 2016*, Springer, Cham, 2016, p. 151 ff. (158).

93 Thus: E. Tjong Tjin Tai, *Force Majeure and Excuses in Smart Contracts*, in *European Review of Private Law*, 2018, p. 787 ff., Tilburg Private Law Working Paper Series No. 10/2018, available on: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3183637, p. 5.

94 In this regard, see: Tjong Tjin Tai, 2018, cit., p. 12; Z. Xiaojing, *Development of Smart Contracts based on Blockchain and their Restrictions through the lens of Law*, in *Legality Vision*, 2018, p. 3-4.

95 See again: Tjong Tjin Tai, 2018, cit., p. 13, which highlights that the debtor will generally be in the best position to identify the possible risks and causes of default in advance and take precautionary measures or take out insurance against them.

96 See: G. Castellani, *Smart Contracts and civil law profiles*, in Comparazione e Diritto Civile, 2019, p. 8; Tjong Tjin Tai, 2018, cit., p. 14.

97 With regard to services that have not yet been performed or are in progress (see Article 1373 of the Italian Civil Code).

to renewal an automatic duration contract[98], in both cases an *ex ante* programming of these hypotheses and the related conditions at the time of the conclusion of the smart contract may be considered configurable, possibly against a deposit or promise of a consideration in cryptocurrency[99].
The withdrawal could be codified subordinating the execution of the smart contract to the moment in which its failure to exercise will be verified[100], while the cancellation could be similarly programmed so that, if it has not occurred within the deadline for the renewal, the latter will take place automatically[101].
In the event of non-fulfillment, the program may provide that if the obligee has not performed his service within a certain date, the contract will automatically be terminated[102]. However, as a result of the default, the party may not have an interest in activating the resolution and, if it has not yet fulfilled, want to activate an exception of default[103] or accept a late fulfilment[104]. In smart contract, this could take place where it is envisaged in the contract form that the creditor of the service will be able to choose which remedy to use[105].

98 See, among others: R. Sacco, G. De Nova, *The contract*, Turin: Giuffrè, 2010, p. 1715 ff.; E. Tuccari, *Contingencies and remedies in duration contracts*, Padua: Cedam, 2018, p. 217 ff.; M. Ambrosoli, *Withdrawal*, in *Digest of private disciplines*, Update IX, 2014, p. 527 ff.; P. Fava, *The contract*, Milan: Giuffré, 2012, p. 153 ff.; M. Granieri, *Time and the contract. Historical-comparative itinerary on duration contracts*, Milan: Giuffré, 2007, p. 291 ff.; G. De Nova, (edited by), *Withdrawal and termination in contracts*, Milan: Giuffré, 1994; G. Gabrielli, *Contractual bond and unilateral withdrawal*, Milan: Giuffré, 1985.

99 Who will then be automatically transferred to the counterparty at the time of the conclusion of the smart contract or the exercise of the agreed faculty. On the configurability of these hypotheses in *smart contracts*, see: L. Piatti, *From the Civil Code to the binary code: blockchain and smart contracts*, in *Cyberspace and law*, 2016, p. 325 ff. (339-40); Sokolov, 2018, cit., p. 31-2, Which highlights the relevance of the contextual programming of automatic compensation mechanisms.

100 Traditionally it is believed that the right of withdrawal is exercised by means of a declaration and not of a behaviour that indicates the will not to fulfil; v .: Sacco, De Nova, 2010, cit., p. 1721 ff .; Gabrielli, 1985, cit. p. 121 ff. On the other hand, in the context of automatic execution, the inclusion of a specific automatic mechanism, possibly following the occurrence of a certain condition, for the expression of the withdrawal declaration could also be considered configurable.

101 Conversely, if the condition occurs, the program will result in the termination of the contract with the related legal consequences.

102 With relative retroactive elimination of the effects of the contract, total or partial in the cases of contracts with continuous or periodic or plurilateral execution, and without prejudice to the rights purchased by third parties (see articles 1458-1459 of the Italian Civil Code). This elimination, however, in *smart contracts will* present the difficulty already noted *above* for termination. The plaintiff may also be entitled to propose further actions for the repetition of the undue and / or for compensation for the damage. Both the French legal system, pursuant to articles 1224-1230 Code civil, both the German one, in §§ 325-327 and 346-256, like the English one, release the case from the necessary judicial ruling. In doctrine, see among others: Sacco, De Nova, 2010, cit., p. 1583 ff. and 1637 ff., which among other things believe, contrary to the majority of interpreters, that in the Italian legal system the out-of-court declaration of resolution binds the declarant in application of the principle of custody.

103 In the Italian legal system *pursuant to* art. 1460 of the Civil Code, in French law see Articles. 1219-1220 Civil Code and Court of Appeal of Paris, 28 January 2015, RG n. 10/15692.

104 In this regard, see: G. Sicchiero, *The resolution for failure to fulfill obligations. Articles 1453-1459*, in the *Civil Code. Commentary*, founded by P. Schlesinger, directed by FD Busnelli, Milan: Giuffré, 2007; A. Luminoso, M. Costanza, U. Carnevali, *Resolution for failure to fulfill obligations*, vol. 1.1 (articles 1453-1454), in *Commentary of the Civil Code* Scialoja-Branca, Zanichelli, Bologna-Rome, 1990; L. Nanni, M. Costanza, U. Carnevali, *Resolution for failure to fulfill obligations*, vol. 1.2 (articles 1455-1459), ibid., 2007.

105 According to some scholars, a possible solution to various issues mentioned above could lie in the use of the Blockchain permissioned platforms, which restrict access to identified users and pre-select nodes that authorise the operations. So public/judicial interventions would have concrete targets (see: P. Cuccuru, *Blockchain and contractual automation. Reflections on smart contracts*, in La Nuova Giurisprudenza Civile Commentata, 2017, p. 116-7). Others point out that in such platforms the key advantages of decentralisation and autonomous execution would be missing (see: Pasquino, 2017, cit., p. 247).