BLOCKCHAIN AND FREEDOM TO CONDUCT A BUSINESS: BETWEEN MYTH AND REALITY

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Abstract: Recent advances in technology have demonstrated the enormous flexibility of Distributed Ledger Technology (DLT), whose potential goes well beyond the cryptocurrency trading. This article explores the potential impact that the utilization of a permissioned blockchain could have on listed companies and how this could be an appropriate instrument for a more effective implementation of the provisions of the Shareholder Rights Directive II. This technological infrastructure could attest the correct formation of will within the shareholders' meeting and contribute to the creation of a truly democratic space for the meeting and discussion among shareholders, thus allowing achievement of freedom to conduct a business. However, the most advanced use of blockchain technology has a disruptive effect and exposes us to the great danger of an "algocratic" drift. Therefore, this article analyses the main critical issues from both a technical and legal viewpoint of Decentralized Autonomous Organizations (DAOs).

Keywords: DLT, blockchain, DAO, e-democracy, algocracy, shareholders rights, shareholder engagement.

1. Introduction[2]

The blockchain phenomenon has in recent years aroused great media interest. Recent advances in technology have, in fact, clearly demonstrated the enormous flexibility of Distributed Ledger Technology (henceforth DLT), whose potential goes well beyond the simple registration of transactions and cryptocurrency trading. The interest and fascination aroused by this new technology and its only partially revealed potential could even lead the interpreter to believe that blockchain seems to be "the best of all possible worlds"[3]. Indeed, blockchains are often considered the solution to all the problems of the analogue world, due to their ability to ensure traceability and transparency and to allow secure transactions without the intermediation of third parties.

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[2] This article has been written within the TRUST Project (TRUST - digital TuRn in EUrope: Strengthening relational reliance through Technology) - www.trust-rise.eu.

[3] See Leibniz 1985: 228.

This research intends to analyse the potential and risks to companies and corporate law that may derive from the application of blockchain technology and its potential impact on the freedom to conduct a business. The analysis begins with an examination of the characteristics and functioning of this technology. Among other things, the fundamental distinction between permissioned and permissionless blockchains is explored.

This technical reconstruction leads to the cognizance of the fact that, leaving aside its great potentiality, blockchain cannot be considered a sort of panacea of the evils and dysfunctions of the analogue world: the most advanced use of this technology can have a disruptive effect and exposes us to the great danger of a "cyber-libertarian" drift, potentially capable of subverting the institutions and traditional categories of company law and compromising the freedom to conduct a business.

This article takes into account Decentralized Autonomous Organizations (henceforth DAOs). These are entirely virtual organizations with no central authority which, at least in theory, promise to revolutionize the very concept of a company, establishing an e-democracy among the members and forms of flat governance. DAOs are taking on the features of totally or partially autonomous entities which, by exploiting the potentialities of the synergistic use of the permissionless blockchain, smart contracts and AI, are capable of establishing their own rules, placing themselves in sharp antithesis both to the traditional concept of a company and to state company law.

The study continues by assessing whether the technological infrastructure is developed enough to set up new organisational structures capable of ensuring a more concrete implementation of the freedom to conduct a business. In addition, the possible uses of the permissioned blockchain are taken into account. More precisely the potential impact that the utilization of a permissioned blockchain 2.0 could have on listed companies is investigated.

Lastly, this research analyses whether the blockchain can be an appropriate instrument for a more effective implementation of the provisions of the Shareholder Rights Directive II. Indeed, this version of the blockchain, which makes it possible to overcome (at least partly) the problems deriving from the long chains of intermediaries, could permit the direct identification of shareholders, ensure a more rapid, safe transmission of company information and, by exploiting the potentialities of tokens and smart contracts, facilitate the exercise of shareholders' rights.

A technological infrastructure like this could prevent tampering with the votes cast and reduce the incidence of opportunistic behaviour. This, therefore, could attest to the correct formation of will within the shareholders' meeting and contribute to the creation of a democratic space for the meeting and discussion among shareholders, thus attenuating the crisis in the participation in company life and revitalizing the shareholders' meeting.

2. Blockchain: nature and technical profiles

Blockchain is a particular type of DLT. This is characterized by the fact that: a) the ledger is structured as a sequential chain of blocks, within which all the transactions carried out are recorded chronologically; b) additional functionalities and applications can be developed on the blockchain platform (such as smart contracts, which perform specific actions when predetermined conditions occur) (Lener & Furnari 2020: 36 ff.; Sarzana di Sant'Ippolito & Nicotra 2018: 17; Swan 2015: 9 ff.; Abriani & Schneider 2020: 1335)[4].

The blockchain could be defined as a digital register shared among all the nodes which crystallizes the records in a peer-to-peer network. An updated copy of the entire blockchain is stored on (and available to) all servers participating in the network (Giaccaglia 2019: 944; Brunelli & Gasparri 2022: 57; Ibáñez Jiménez 2021: 49-51), which, being constantly synchronized with each other, have direct access to the contents of the ledger and are able to personally verify it.

From a structural point of view, each ledger is internally divided into smaller datasets, the so-called "blocks", whose storage capacity is limited to a certain number of transactions and which are interconnected through cryptographic systems and the use of hash functions (Ahlberg & Soria Ruiz-Ogarrioz 2020: 11-12, 23-25; Al Shaikhli, Alahmad & Munthir 2013: 1-2; Garavaglia 2018: 98-99).

The data entered by a user in a blockchain infrastructure is propagated, as unconfirmed data, among all the participants of the network, to then be verified, collected in a block in formation and validated by a validator node (Brakeville & Perepa 2016). These then flow into a specific block, which will have to be approved by the validator nodes on the basis of the pre-established consensus mechanism.

Once the data introduced into the system fill a block, this will be closed and time-marked using a time-stamp, and it will pass to a subsequent block, which will be validated by the network nodes to be definitively connected to the previous and subsequent blocks, thus forming a "chain of blocks".

The connection between the first block (so-called "genesis block") and the following block is made by inserting a "pointer" in this, i.e. the hash of the entire previous block. The hash of the next block will thus contain the hash of the previous one, establishing a link between the blocks.

The hash represents the unique identifier of the block and is a sort of "fingerprint" (Sarzana di Sant'Ippolito & Nicotra 2018: 13). This inevitably means that, by altering the data contained in a block, there will be a change in the hash of that block and,

[4] The so-called blockchains 2.0 (or second-generation blockchains) integrate additional applications and functionalities into the blockchain infrastructure, for example, smart contracts or the possibility of tokenizing assets.

consequently, an incompatibility with the hashes of all subsequent blocks, leading to a breaking of the chain (Urban & Pineda 2018: 8, 16, 21 ff.). The data, therefore, once entered into the ledger, cannot be modified at a later time without the participants in the network noticing it.

The data are linked to the history of previous transactions[5] and, even in the event of an attack or malfunction of some nodes, it will be almost impossible to compromise the integrity of the shared database, since this will survive in its entirety in the collective memory of the blockchain and can always be restored in the nodes where an anomaly has occurred.

Two initial conclusions on this phenomenon can be drawn from the above considerations: a) it is correct to say that blockchain technology is revolutionary in terms of the results that have already been achieved with it or that we expect to be able to achieve in the near future. However, despite what some believe[6], blockchain is not a turning point from the point of view of the evolution of IT systems, since the technological solutions that it uses have already been developed for some time. Therefore, it does not represent a completely new technology, but rather an innovative and original use of existing technologies (Urban & Pineda 2018: 8). Asymmetric key cryptosystems[7], cryptographic hash and peer-to-peer networks have been developed since the late 1970s[8], while time stamping[9], systems to ensure anonymity within telematic networks and decentralised and distributed data storage date back to the 1990s; b) it is reasonable to believe that the use of a blockchain is a "cyber-safe choice to store and transmit data and information" (Lener & Furnari 2020: 33-38): it is highly unlikely (although not impossible) that the network is subject to cyber-attacks from outside or that its data are modified without its participants being aware of this alteration, since the network is widespread, being made up of a plurality of nodes, and, attacking a single node, by itself, does not involve the tampering of the chain[10].

In other words, blockchain removes the risk of the "single point of potential failure" (European Securities and Markets Authority 2016: 12; Werbach 2018: 500; Priteshkumar, Krutarth & Parth 2020: 897-898) typical of any centralized system. If the external attack is successful, thus compromising a single node, the others will remain operational and the shared database will remain perfectly intact in their collective memory. In order to alter the records, it would be necessary to simultaneously hack all copies of the database held by each participant in the network.

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[5] See CLUSIT 2019: 10.

[6] Usually people believe that blockchains were created in 2008, when an unidentified person – known as Satoshi Nakamoto – published a paper entitled "Bitcoin: A Peer-to-Peer Electronic Cash System". See Nakamoto 2008.

[7] See Mienert 2022: 14.

[8] See Diffie & Hellman 1976: 644 ff.

[9] See Haber & Stornetta 1991: 99 ff.

[10] See Recital J) of European Parliament resolution of 3 October 2018 on distributed ledger technologies and blockchains: building trust with disintermediation (2017/2772(RSP)).

3. Permissionless blockchain vs. permissioned blockchain

However, it must be noted that not all blockchains are the same and that an excessive generalization does not allow us to understand the sometimes substantial differences that exist between the various types of blockchains. For the purposes of this discussion, it is, therefore, appropriate to focus attention on the distinction between permissionless blockchain and permissioned blockchain and analyse the main differences between the two models as regards: the possibility for individuals to participate in the network; the ways in which the internal governance is structured; the consensus mechanisms; the powers granted to the participants; the different trust regimes that are established between the nodes[11].

Permissionless blockchains take the form of a totally decentralized and disintermediated system, in which all participants – from the point of view of powers – are equal. Permissioned blockchains determine a centralized system, in which the participants see their powers and the possibility of accessing the ledger subject to the will of a control entity or body, which establishes the rules of access and use of the platform itself.

Permissionless blockchains are characterized by the total absence of any central authority in its traditional sense, or – rather – by the replacement of this with the different (and distributed) authority of the entire community that makes up the network (Wright & De Filippi 2015: 4). Consequently, there is no form of barrier to entry and no censorship. Each participant in the network: a) assumes the quality of node; b) is able to view the history of all the registrations without any restrictions[12]; c) takes care of the validation of transactions carried out by others and, in turn, inserts his transactions. Therefore, there is no need to request authorizations or permits from a central authority or an intermediary delegated by this.

In the permissioned variant, on the other hand, participation in the network is subject to the consent and authorization of the central entity. On the basis of a set of defined rules, this provides for the identification and selection of the subjects who will assume the role of validator nodes, in addition to the simple users. All subjects who take part in the network are always identifiable. In permissionless blockchains users and validators – who do not know each other, since their personal identity has been pseudonymised – are difficult to identify: the transactions, although viewable by all, are not directly attributable to any natural person, but only to a particular address or a public key (Rampone 2018: 462-468).

Furthermore, in the permissioned blockchain, on the basis of a set of defined rules the central entity is able to limit the reading and writing powers of the nodes according to its specific needs and operating rules. In this variant, therefore, the existence and

[11] See Osservatorio Blockchain & Distributed Ledger 2021: 17.
[12] See Bitfury Group & Garzik 2015: 10-11.

extent of the powers to carry out operations, to introduce content within the blockchain infrastructure and to use it, are left to the will of the entity that created it.

In other words, permissionless blockchains make it possible to eliminate the middleman and establish trustless transactions, relying on the users' trust in the network or, rather, in the cryptographic consensus algorithms and in the application of the rules of the specific blockchain protocol (Garavaglia 2018: 114-115) that regulate the mechanism of validation and data storage.

In contrast, the permissioned blockchain involves the "restoration" of a trusted third party, but this does not seem to be limiting as regards its potential applications. Indeed, while retaining all the advantages of the public variant in terms of cost reduction, greater efficiency and traceability of information, it ensures the non-integral replacement of the human factor in the governance of the blockchain system and appears to be more controllable by the public authorities[13].

From what has been said so far, it clearly emerges that the two different types of blockchains outline antithetical network governance models: while permissioned blockchains configure an authoritarian and totally centralized system, the permissionless variant implies a "democratic" and decentralized one.

Permissioned blockchains, therefore, outline a rigid governance structure – in which the "freedoms" of the participants are limited by compliance with stringent internal rules – decidedly far from the flexible model of public blockchains, in which each user can assume the privilege and the burden of being an active part of the whole system (Sarzana di Sant'Ippolito & Nicotra 2018: 23). Furthermore, the permissioned variant ensures a quick and relatively simple customization of the validation procedures: if this is the will of the entity that establishes the blockchain, it could also guarantee that the subject in charge of the validation process of the new data is invested with certain qualities. In this way, the validator could carry out a substantial control of the data.

Adopting a private blockchain, therefore, could solve two of the main problems of distributed consensus cryptographic mechanisms: a) the total irrelevance of the

[13] In this sense, Italian notaries have shown their interest for the permissioned blockchain while keeping their distance from the permissionless blockchain. Indeed, blockchain technology could be used as a tool for the transfer processes in the real rights of real estates and, at the same time, could ensure a link with the legal system. For example, in 2017 the Italian National Council of Notaries launched Notarchain, a project on a permissioned blockchain, based on "a closed structure where the validation is reserved to a restricted core group of knots particularly qualified". Through this digital platform it will be possible to transfer, record and archive goods and rights, with a significant reduction in costs and times. Notarchain will also provide a high level of safety: a) all information and transactions can be handled directly by notaries and not by anonymous subjects; b) the data cannot be modified arbitrarily by all nodes; c) notaries can check the identity of all users; d) the content of the register can be singled out and shared by notaries only; e) notaries can examine and certify the will of the parties and their capacity to act. See Damiani 2020: 229 ff.

subjective qualities of the validator node, whose specific skills are not considered at all in the public variant; and b) the prejudice that the formal and automated control of the algorithms is a "neutral" procedure and free from the errors and temptations of the human operator.

In permissionless blockchains, validator nodes are not necessarily equipped with specific IT or legal skills to carry out the processes of data validation and verification. Validators will impose themselves on the basis of computational power (in the case of Proof of Work) or will be randomly selected by an algorithm based on the coin-age (in the case of Proof of Stake)[14].

The most common validation procedures in permissionless blockchains do not imply an analytical control of data, but rather quick checks of their IT compliance. Legally incorrect or illegal contents could thus enter the blockchain due to the consistency and correctness of their IT appearance[15].

The permissioned variant, on the contrary, could offer greater guarantees on this point. The central entity could attribute the qualification of validator node only to subjects who are endowed with specific skills or who already hold a certain public role.

Furthermore, the validation process could be filled with legal content by the same entity that established the blockchain, which could require compliance with specific legal rules and institutes of the off-chain world. Therefore, permissioned blockchain can also potentially fit more easily into existing legal and regulatory frameworks and institutional arrangements. It also ensures greater control of network users (Bitfury Group & Garzik 2015: 4-5). In fact, their reading and writing powers could be limited and they could be prevented from altering the correct functioning of the blockchain from within.

A final aspect that must be taken into account concerns the incompatibility of the permissionless blockchain with the principles expressed by Regulation (EU) 2016/679 (henceforth GDPR) (Giordano 2019: 99-102) in all those cases in which personal data are recorded or processed in the chain[16]. Due to its technical characteristics, the public variant prevents the rectification[17] and erasure[18] of personal data[19].

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[14] Proof of Work and Proof of Stake are the most common consensus mechanisms, but they are not the only ones employed in the world of blockchains. For a description of their technical functioning and for an analysis of the other cryptographic consensus mechanisms see: Kwon 2014: 1 ff.; Yang et al. 2019: 118541 ff.; Marchionni 2018: 6 ff.

[15] The main "Achilles heel" of permissionless blockchains concerns their inability to ensure the truthfulness and correctness of the data recorded in them: if at the time of entry into the ledger a datum turns out to be qualitatively incorrect, the chain will only ensure its archiving, integrity and non-alterability. See Brunelli & Gasparri 2022: 64.

[16] See Article 4 of the GDPR.

[17] See Article 16 of the GDPR.

[18] See Article 17 of the GDPR.

[19] See Commision Nationale Informatique & Libertés 2018: 10; Finck 2019: 7 ff.

Even if there is a fork[20], personal data would still remain stored in the ledger, thus inexorably entering into conflict with the rights to erasure and rectification sanctioned by the GDPR. The widespread and distributed nature of public blockchains prevents the identification of the data controller or processor (Berberich & Steiner 2016: 424 ff.; Giordano 2019: 103-104) and hinders – or makes extremely difficult – the correct exercise of the right of access by the data subject[21].

The incompatibility with the GDPR, however, could be mitigated or even disappear if a private blockchain is adopted. The permissioned variant, in fact, would make it possible to identify a person responsible in the event of a chain malfunction (Giaccaglia 2019: 951) and to distinguish within it the figures of the data controller, the data processor and the data subject, as defined by the GDPR.

4. DAOs: disruptive revolution or new freedom paradigm?

4.1. Main features of a new organizational model

The potential of blockchain manifests its revolutionary scope with reference to the phenomenon of DAOs[22] which constitute the last frontier in the application of blockchain technology. The automatisms deriving from the use of smart contracts written into a blockchain platform promise to encourage the diffusion of new organizational models for the exercise of a business activity, alternatives to traditional "analogue companies" (Piselli 2019: 377; Fenwick, Kaal & Vermeulen 2019: 75 ff.).

These are entirely virtual organizations[23] without legal personhood (Werbach 2018: 493-494; García Mandaloniz 2020a: 7 ff.), characterized by a horizontal structure

[20] Forks arise when the blockchain splits into two competing chains. In some cases, the division of the main chain can fix itself spontaneously, while in others the new chain has an IT code that is incompatible with that of the previous chain. In this case, the new chain operates on the basis of new rules. It is usually possible to distinguish: a) soft fork, which "is backward-compatible, meaning that the blocks mined by nodes using upgraded software are considered valid by nodes that have not upgraded their software, but the reverse does not hold true: blocks mined by non-upgraded nodes are not valid to upgraded nodes"; b) hard fork, conversely, occurs when the new IT code is not compatible with the previous one. This implies that "the software upgrade has introduced a new rule which is not considered valid until a node upgrades. In this case, if members of the community of nodes do not agree with the new rules, they can choose not to upgrade to the new consensus and instead continue trading on the original (pre-fork) blockchain using the old software". See Krause, Natarajan & Gradstein 2017: 19; Kaal 2021: 11-12.

[21] See Article 15 of the GDPR.

[22] Sometimes also known as Decentralized Autonomous Corporation (DAC). It must be noted that there is no univocal and generally recognized terminological classification that makes it possible to clearly distinguish the various systems that integrate smart contracts into a blockchain infrastructure. The terms "DAO", "DAC", "DA" (Decentralized Agent), although presupposing the same basic technology and performing the same functions, thus end up differentiating themselves on the basis of the reference context. See: Johnston et al. 2014; Buterin 2014; Kaal 2020: 6-7; Wright 2021: 156-158.

[23] See Mondoh et al. 2022: 1 ff.; Chohan 2022: 6.

and open to entry (and to exit) of members of a community who have common speculative interests.

By analysing their functioning, it is possible to distinguish between "algorithmic DAOs" and "participatory DAOs" (Wright 2021: 156-158). Algorithmic DAOs constitute completely autonomous "digital organisations", since smart contracts are programmed directly by an AI algorithm (García Mandaloniz 2020b: 312 ff.) and recognize only members' economic rights or other benefits.

The participatory DAOs, which can also be used for lucrative activities, are essentially DOs ("Decentralized Organizations"), since, despite automatisms in the executive phase, in the planning and decision-making phases, they are never entirely automated, but still require human intervention.

Apart from definitional difficulties, there are doubts about the possibility and convenience of juridically framing them in existing corporate models[24]. The DAOs have set up a first concrete attempt to automate the administrative body (Abriani & Schneider 2020: 1363; Abriani 2022b: 747) and have configured a radically new (Antonacchio 2022: 3755; Mienert 2022: 4) organizational model – in some ways also antithetical – compared to what is traditionally understood by a company.

Thus, DAOs outline a new corporate model (Werbach & Cornell 2017: 337; Navarro Lérida 2018: 2-3), destined to operate in Automatic Markets and create a new kind of economic order (Werbach 2018: 492-494; Swan 2015: 22-23, 26). The idea behind the DAOs is to conceive the governance of the digital company of the future as a community-driven governance[25].

Having abandoned the traditional separation between the functions of the corporate bodies, the DAOs simply transfer all the powers of the administrative and control bodies to the investors and promise to establish horizontal governance (the so-called "flat governance")[26], eliminating – through the use of technological support – all risks of censorship, fraud or third-party interference (De Filippi & Wright 2018: 101).

Structurally, they are based on a predetermined set of rules included in the IT protocol and operate through the use of the permissionless blockchain technology associated with the smart contracts[27], whose codes are programmed to automate the management function.

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[24] See Zetzsche, Buckley & Arner 2018: 1400-1401; Gitti 2020: 33-34; Metjahic 2018: 1533 ff.; Menéndez Arias, Rodríguez García & Alcaide Soler 2018: 505 ff.
[25] See Fenwick, McCahery & Vermeulen 2019: 187-189; Fenwick & Vermeulen 2018: 19 ff.
[26] See Fenwick, Kaal & Vermeulen 2019: 76-82, 116-120; Fenwick, McCahery & Vermeulen 2019: 187 ff.
[27] See Swan 2015: 24-25; Buterin 2014; Rigazio 2021: 378; Chohan 2022: 5.

The main advantages of DAOs, therefore, are – at least in the intentions of the developers – the reduction of costs, the greater transparency of decisions and the drastic reduction of corruption (Sicignano 2021: 1271 ff.) and opaque behaviours.

4.2. Towards a new e-democracy?

All participants are thus ideally placed on the same level, since together they are called to decide on investment proposals, having the same information at their disposal, due to the transparency of transactions ensured by the blockchain infrastructure.

The DAOs promise, then, to solve the problem of distrust which – according to the developers – unites the participants in traditional corporate forms. A distrust that originates: a) from the fact that company law rules are often not correctly observed nor correctly interpreted; b) from frequent episodes of mismanagement by the administrative body, which often take the form of real frauds; c) from the irrelevance of small investors, who cannot participate actively and significantly in corporate decisions.

Conversely, members of a DAO would be able to maintain direct real-time control of the funds conferred (Fenwick, Kaal & Vermeulen 2019: 118) and would be reassured of the correct application of the rules by the simple fact that, in this, human arbitrariness would be replaced by the infallible and mechanical efficiency of machines[28]. Indeed, the entire DAO project is based on a libertarian ideal, which has as its ultimate goals to create a new form of governance based on automation and to achieve an e-democracy[29], thus freeing the business and investment activities from any form of "tyranny" and "oppression".

More precisely, the fortune of the DAOs can be ascribed to the willingness of investors, on the one hand, to escape from state control that is considered excessively pervasive (Möslein 2020: 243) and, on the other, to eliminate the dynamics of power and control which, within traditional companies, compromise the autonomy and free will of small investors[30].

Furthermore, the peer-to-peer network should establish cooperation between equals, eliminating the inequalities among investors (Werbach 2018: 491). In this sense, the horizontal and distributed management of DAOs should counter the onset of opaque and opportunistic behaviour (Davidson, De Filippi & Potts 2018: 639 ff.) and ensure real and active participation of investors (Abriani & Schneider 2020: 1363), endowed with pervasive powers of direct and real-time control over all investment decisions.

Hence, at least in theory, DAOs should reduce the direct and indirect costs of business activity, broadening the organization's objectives far beyond the mere maximization of

[28] See Jentzsch 2016a: 1.
[29] See Jentzsch 2016b.
[30] See Vermeulen 2018; Fenwick & Vermeulen 2018: 9-10; Chohan 2022: 5, 8.

profit (World Economic Forum 2022: 6) and, most importantly, remove any obstacle to the realization of freedom to conduct a business.

DAOs are also one of the clearest manifestations of the "Code is Law" principle, theorized by Lessig[31]. They are, consequently, completely impervious to the positive discipline of company law[32]: their functioning and their internal[33] and external[34] relationships are regulated exclusively on the basis of the rules incorporated in the IT protocol of the system and depend solely on how smart contracts have been programmed. DAOs constitute a new digital and supra-national corporate model, able to free itself from the tax impositions of individual states and overcome the fragmentation of jurisdictions (Swan 2015: 24-25).

National rules thus become completely irrelevant, since the discipline of the individual organizations must be identified exclusively within the system's programming code. The DAOs constitute decentralised systems that are completely independent of the States. Their members are geographically distant from each other and they can cooperate from all over the world. They act in the way determined in permissionless blockchain's protocols. In doing so, they observe a set of spontaneously elaborated IT rules which are very far from the formalism of positive law. This challenges the very concept of State sovereignty[35] and territoriality (Baktygul 2023: 7) and often makes it impossible to determine the applicable law under the private international law principles.

From the point of view of the structure, DAOs are characterized by an extreme organizational simplicity (Piselli 2019: 377-379): the participants pay a certain amount of cryptocurrency to the organization's wallet, i.e. to the address of the DAO's smart contract (the so-called "treasury's account") and receive in return a certain number of tokens (Gitti 2020: 14-16; Fenwick, McCahery & Vermeulen 2019: 189), i.e. tools for participating in the organization's activities (Abriani & Schneider 2020: 1335).

The token subscription attributes the status of a member of the DAO (Wright 2021: 156; Rohr & Wright 2019: 479) and confers, basically in proportion to the paid-up capital (Jentzsch 2016a: 2), a series of economic and administrative rights, which the members will be able to exercise within the same IT platform (Antonacchio 2022: 3755; Nielsen 2019: 1108-1109; Wright 2021: 158).

Therefore, once the tokens have been paid, all token holders, in a regime of direct and participatory democracy (World Economic Forum 2022: 4), acquire the right to

[31] See Lessig 1999: 3 ff.; Lessig 2006: 3; Lessig 2000.
[32] See Thompson 2016.
[33] Between participants and between participants and the organization.
[34] Between the organization and third parties.
[35] See Baktygul 2023: 7. The Author notes that "it is clear that the domestic/national law is no longer applicable to the blockchain, it simply cannot enforce itself over the technology. It may be ironical to point out that for decades the international law was balancing between the law enforcement and the sovereign will, and now, this is no longer existing question, as the blockchain nullifies the concern of the state will".

express their opinion and to directly discuss the various proposals in special messaging platforms – usually outside the blockchain infrastructure[36] – as well as the right to vote and to submit investment proposals (Gitti 2020: 33-34) which will be selected and voted by the majority of the other token holders.

If the quorum is reached, the approved proposals are then translated into computer code to become the object of a specific smart contract, which executes when the pre-established conditions occur. The DAO will transfer part of the resources to a separate fund, linked to this specific smart contract, which, self-executing, will use these resources to carry out the approved operation.

4.3. Some legal issues of DAOs

However, DAOs outline legal issues, which place the phenomenon in open antithesis to the fundamental principles of "analogue" company law (Fenwick, McCahery & Vermeulen 2019: 172 ff.) and expose to great dangers both the members of the organization and third parties who come – directly or indirectly – in contact with the DAOs.

The main legal problems derive from the fact that the computer codes are not subjected to any form of control by public authorities with adequate legal or IT skills[37]. In the event of discrepancies between IT rules and the informative slogans contained in white papers[38], the latters will be destined to remain a dead letter.

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[36] See Picciau 2021: 114 ff.; Abriani & Schneider 2020: 1363-1364.

[37] There can also be an internal legal team which might revise the code and make sure that it complies with certain ethical or legal standards. This is undoubtedly true for permissioned blockchains, in which a central entity can constantly monitor the creation and the development of IT protocols. This could also make the permissionless blockchain infrastructure compliant with national legislations. However, it should not be ignored that: a) programming experts and computer scientists who originally defined the technical-IT design of a permissionless blockchain may partially or completely lose their influence over further functioning and development of the project. Thus, it can happen that the token holders directly and profoundly modify the basic governance structure of the DAO, creating in this way new rules, which may also be non-compliant with national laws. Also the Coalition of Automated Legal Applications argues that "blockchain Developers, like most open source developers […] do not have control over the ways in which their code, once written, is used or modified, nor can they usually impose a particular code change onto the users of the software once released"; b) often core developers are anonymous in order to avoid responsibilities; c) "usually, a DAO has no seat, no board, no central point of government and no place of operation relating to the territory of one state" (The European Union Blockchain Observatory and Forum 2019: 29). This causes great legal problems and, even if developers comply with the law of one state, they may violate the law of other states; d) it has been correctly observed that often decentralized communities of permissionless blockchains have no wish "to register, in any state, as a business entity and to comply with the chosen legal system" (The European Union Blockchain Observatory and Forum 2019: 30). See Kaal 2021: 4 ff.; Bellavitis et al. 2023: 9; Coalition of Automated Legal Applications 2021: 40.

[38] The white paper is a document which is released in order to provide potential investors with a basic set of information on the project and rights embedded in the tokens (Annunziata 2019: 9). However, it frequently happens that this document does not contain any information that is really useful for investors. This often

As already mentioned, DAOs have their own assets, separate from those of their members. However, the perfect capital freedom does not derive in this case from an express legislative provision, but rather from the programming rules of the system and cryptographic mechanisms.

The liability regime limited to the contribution made is *de facto*[39], since it is impossible for the creditors of the DAO to attack personal assets of the members due to the latters' anonymity (Kaal & Calcaterra 2018: 134-135, 141; García Mandaloniz 2020a: 6 ff.). Members appear as simple addresses. This situation exposes DAO's creditors to serious financial prejudice.

Furthermore, the DAOs determine the total removal of the administrative and control bodies. The absence of the administrative body deprives these digital organizations of highly qualified subjects to carry out the usual management operations and of the body itself which is physiologically identified as responsible for assessing the convenience of using digital tools, their regulation within the corporate structure as well as their supervision and maintenance.

From this, it follows that within the DAOs there is no person in charge of: implementing those essential analyses of the risks associated with the use of digital tools; weighing the cost/benefit ratio; assuming liability for a use not suited to the corporate purpose and to the size and the nature of the organization.

The peculiar combination of DLT with smart contracts and the anonymity that characterizes permissionless blockchains make it very difficult – if not completely impossible – to identify the members of the community (Rampone 2018: 460) and prevent the identification of a person liable for the hypotheses of mismanagement, for illegal operations and for activities to the detriment of users or third parties.

Except for the cases – albeit rather rare – in which the activity of the DAOs is attributable to a legal person (for example to a traditional company registered in a national register), their evanescent nature, the absence of physical headquarters and directors (Bechini 2022: 507) make it particularly difficult to determine the national law applicable to DAOs[40] and the operations of locating the registered offices (Fenwick, Kaal & Vermeulen 2019: 118). The absence of a defined legal framework and the need to involve the entire community to change the rules of the IT protocol raise further problems.

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contains only emphatic sentences, which are devoid of any practical use: indeed, these sentences describe neither the governance rules of the DAO nor its technical characteristics. Therefore, I share the observation according to which white papers, although they give an overview of the planned project, "typically do not provide the same standard and detail of information as in securities prospectuses, regarding structure, comparability and informational significance and are often even confusing" (OICV-IOSCO 2020: 10). For these reasons, it can be concluded that the DAO white paper may not be the right tool to provide all the information useful for the token holders (Casarrubea 2022: 227).

[39] See Menéndez Arias, Rodríguez García & Alcaide Soler 2018: 528 ff.

[40] See Mienert 2022: 82 ff., 96 ff.; Spindler 2019: 144 ff.; García Mandaloniz 2020b: 196-197; García Mandaloniz 2020a: 8 ff.

In the event of programming defects, error situations or hacking attempts and in the absence of rules protecting the rights of small token holders, very serious dangers arise: it seems difficult to believe that, in these cases, the vast majority of participants, who benefit from the rules of the system, would be interested in modifying them for the good of a few individuals. The malfunction or the wrong suffered by the individual investor could remain without protection to the advantage of the well-being of the majority of the participants, who, being in a favourable condition, will have no interest in altering the *status quo* within the organization.

From what has been said, it can easily be deduced that in the absence of a real legal framework of rules and principles that cannot be changed by parties, the "justice" within the DAO could turn (Bechini 2022: 507-508) into a totally arbitrary system, governed by selfish logic and inspired by mechanisms that are at the same time populist and plutocratic. The subjects who, from time to time, come to constitute the minority within the organization could be deprived of any right or guarantee and their requests could thus be completely ignored.

Furthermore, DAOs do not seem to have solved the problem of majority abuses. Within these organizations this can take on a double meaning: on the one hand, the monopoly in the choice of investment proposals and, on the other, the power to modify the governance rules and the IT protocol of the entire organization (Nielsen 2019: 1110-1111; Buterin 2013).

So, even within these organizations, not all crypto-asset subscribers are really equal to each other and, consequently, control positions remain, since most of the tokens issued are actually attributable to a small number of participants (World Economic Forum 2022: 7-8).

Technological algocracy thus assumes the features of real despotism (Chohan 2022: 13): the large token holders, in fact, not only assume the powers of the directors of listed companies (Hacker 2019: 148-153; Piselli 2019: 388-389), but they also obtain the power to *condere legem*, since they are able to modify the rules of the game and restore a hierarchical logic within the organization.

The problem of the abuses of the majority, therefore, would seem to be even more amplified. Finally, it should be noted that DAOs do not ensure the effective participation of the members in the management of the organization: only a small part of token holders play a managerial role in a continuous and significant way[41].

There does not appear to be a direct link between the adoption of this organizational model and the enhancement of the participation of members, but neither is there any concrete data demonstrating that this particular application of blockchain technology can encourage the participation of members in the life of the organization, and thus constitute

[41] See Lund 2022.

a useful tool for counteracting the phenomenon of shareholder passivity (Piselli 2019: 382; Emmett 2019; Faqir-Rhazoui, Arroyo & Hassan 2021: 12 ff.; World Economic Forum 2022: 8). On the contrary, most token holders do not have a real influence in governance choices and deem it entirely rational and convenient not to exercise their voting rights at all.

An even more discouraging scenario emerges. Considering the members' lack of interest in the organization's life and an attitude aimed at maximizing profit in the short term, the subjects intending to get their proposal approved could buy the votes of a large number of token holders for a completely negligible sum (so-called "bribe attack")[42]; this could be done by directing their votes through blogs and thus vitiating the entire deliberative process.

Moreover, the problem of the token holders' low participation in the life of DAOs is well known by the developers of these virtual organizations, who, in an attempt to stem the apathy of the members and protect minorities, have already begun to introduce reward mechanisms to stimulate their participation (Wright 2021: 165-166).

Once again, however, one cannot avoid noting that these solutions – or at least those that simply reward members with any utility as remuneration for their participation – could make voting random and deprive investors of liability, especially considering the ease with which it is possible to vote in the DAOs. The exercise of the voting right, in other words, could be conceived exclusively as a fulfilment necessary to obtain a profit[43].

Lastly, the absence of any form of control or – more specifically – the absence of any form of legality control by a public authority could make a DAO the ideal environment for carrying out criminal activities: the choice of investment proposals would be oriented on the basis of purely lucrative criteria and, possibly, compliance with the organization's IT protocol. An investment proposal, which on paper is compliant with IT codes and reasonably profitable, could thus be selected and voted on even where it conceals illegal purposes such as, for example, money laundering or terrorist financing[44].

Therefore, these new organizational models could jeopardize the current regulatory framework by generating subversive phenomena and are potentially suitable for distorting the very concept of a state company. Furthermore, the DAOs, at least at the current state of technological development, do not seem to offer adequate guarantees either for their

[42] See Buterin 2017; García Mandaloniz 2020b: 298 ff.

[43] Alternative voting mechanisms have also been introduced (e.g. "Conviction Voting" and "Quadratic Voting"). These new voting mechanisms try to solve the problems arising from the one-token-one-vote design, such as the passivity of token holders, risks concentrating voting power in the hands of a few large token holders, and abuses perpetrated by majorities against minorities. However, due to the anonymity of the token holders and the duplication of digital identities, their effectiveness seems to be decidedly limited. See Emmett 2019; Thorstensson 2021; Siri 2020; Faqir-Rhazoui, Arroyo & Hassan 2021: 6 ff.; Kaal 2021: 18 ff.; Bellavitis et al. 2021: 4 ff.

[44] See Damiani 2020: 234; Kaal 2020: 21; Marchegiani 2022: 114 ff.; García Mandaloniz 2020b: 198-200.

members or for third parties who come into contact with them and could constitute a danger to the freedom to conduct a business.

The above demonstrates that the blockchain is in itself an inert tool, but if associated with other technologies – in particular with smart contracts and oracles (Werbach & Cornell 2017: 336; Möslein 2020: 242) – it can give rise to "autonomous agents" (Wright 2021: 153,169), i.e. independent and autonomous organizational infrastructures, suitable for totally excluding the relevance of the human contribution in all or certain phases of the organization's life (Petrin 2019: 969-970, 996-997, 1022-1025; Lener & Furnari 2021: 4-5).

5. Blockchain as a tool at the service of shareholders

5.1. The current intermediated shareholder engagement system and its related problems

Due to its intrinsic characteristics, permissioned blockchain offers interesting scenarios if applied as a tool within the corporate structure. We will now try to investigate the potential impact that the application of the blockchain could have on listed companies (Palá Laguna 2021: 130 ff.; Peinado Gracia 2021: 108-110; Farias Battle & Pérez Bastida 2021: 77 ff.).

Indeed, the blockchain's promise is not only to facilitate the exercise of shareholders' rights by simplifying it, eliminating some inefficiencies and reducing costs (Van Der Elst & Lafarre 2019: 125-127), but also to revitalize the very conduct of the shareholders' meeting (Allotti & Spatola 2022: 38; Abriani 2022a: 95).

Such an application seems particularly suitable for large companies that present a more articulated, geographically distributed corporate structure, characterized by a plethora of distinct interests and, very frequently, by a widespread apathy of a significant part of their members, who are totally disinterested in the fate of the company and do not participate in its life (Cantisani 2019: 421; Van Der Elst & Lafarre 2017b: 4-11).

At present, the process of shareholder engagement and the exercise of shareholder rights imply the involvement of a long chain of intermediaries[45], which sees the participation of a varied series of subjects: central securities depositories and other intermediaries (investment firms, credit institutions, brokers, etc.). Therefore, it is very common for end investors to have no direct relationship with issuers and, sometimes, precisely because of the complex articulation of the chain, not even with the CSDs.

This situation causes very serious negative repercussions (Panisi, Buckley & Arner 2019: 204-206): high costs, the possibility of incurring errors in counting the votes, technical difficulties in verifying the legitimacy[46], the concrete impossibility for the end

[45] See Article 1 of the Directive (EU) 2017/828; Lafarre & Van Der Elst 2021: 33-35.
[46] See Recital 9 of the Commission Implementing Regulation (EU) 2018/1212.

investors to exercise their rights, the issues related to the transmission of the proxy vote (Micheler 2015: 506 ff.), the possibility that information is not correctly transmitted between the company and the shareholders[47], inaccuracies in the voting lists, information asymmetries[48], empty voting[49] and decoupling[50].

It will then often be very difficult even just to distinguish who is the final investor and who, on the other hand, is the intermediary and, consequently, it may happen that the subject registered in the shareholders' register does not coincide with the beneficial owner of the economic and administrative rights related to shares (Van Der Elst & Lafarre 2018: 2-4; Gargantini 2021: 42 ff.).

The end investors, having purchased their shares through financial intermediaries, will thus not be able to exercise their rights directly towards the company: it will be the intermediaries who will be formally registered as shareholders in the company's register of shareholders and, consequently, they will be able to directly exercise the rights of the shareholders (Portellano Díez 2021: 186-188; Panisi, Buckley & Arner, 2019: 196 ff.). Conversely, the end investors will be able to exercise the rights incorporated in the shares only by contacting an intermediary[51].

Furthermore, remote voting practices introduce further problems: the expression of the vote electronically by some shareholders before the shareholders' meeting, on the one hand, generates information asymmetries – since the outcome of the vote could be disclosed in advance to some subjects of the intermediation chain (Van Der Elst & Lafarre 2019: 122) – and, on the other hand, in the event of a subsequent change in the object of the vote during the course of the shareholders' meeting, it could completely frustrate the intentions of those who had previously exercised it (Matera 2018: 7; Van Der Elst & Lafarre 2019: 122 ff.).

To what has been said it must be added that large shareholders often enjoy direct communication channels as they are able to converse with the top management of the company outside of the shareholders' meeting. This gives them priority over the small shareholders who do not have the same option (Matera 2018: 7-8; Strampelli 2018: 393-397).

The shareholders' meeting is thus stripped of its traditional functions as a place for discussion and confrontation among shareholders and it is no longer the place where decisions are taken. The moment of the shareholders' meeting, consequently, is reduced, most of the time, to a mere matter of form (Van Der Elst & Lafarre 2017b: 3-4).

This situation inevitably leads to an aggravation of the apathy of small shareholders[52] who rationally choose to withdraw from it, renouncing active participation as they are

[47] See Recital 8 of the Directive (EU) 2017/828.
[48] See Comitato Blockchain per la Corporate Governance 2022: 9.
[49] See Yermack 2017: 24; Cantisani 2019: 423.
[50] See Panisi, Buckley & Arner 2019: 205.
[51] See Micheler 2015: 507; Díaz Moreno 2017: 3-4.
[52] See Van Der Elst & Lafarre 2017a: 172; Lafarre & Van Der Elst 2021: 30 ff.

aware that their vote could remain unexpressed in the various steps of the intermediaries' chain and, in any case, that they cannot exercise real control over the company or that they will have a very limited impact on the formation of the will of the shareholders' meeting (García Mandaloniz 2020b: 236 ff.; Van Der Elst & Lafarre 2017b: 7).

5.2. Advantages of adopting the permissioned blockchain

The use of permissioned blockchain (Van Der Elst & Lafarre 2019: 126 ff.) could allow companies to identify shareholders[53] directly and in real-time and, therefore, to identify the end investors in a simple and immediate way, bypassing the complex communications that currently exist between the applicant company and the intermediaries (Möslein 2020: 239-241; Cantisani 2019: 422), and would make it possible to constantly report on the updating of the composition of the corporate structure and of the shareholders' register.

The distributed ledger would then guarantee the automation of communications with a guarantee of the origin of the information and would consequently ensure a clear reduction in transmission errors: due to the traceability and transparency of its records, all the steps would be instantly visible and unalterable. Furthermore, it will be enough to simply view the ledger and all shares will be immediately traceable (Geis 2018: 254 ff.).

This use of blockchain technology seems potentially suitable for substantially fulfilling the provisions of the Shareholder Rights Directive II[54] and of the Commission Implementing Regulation (EU) 2018/1212[55], with which the European legislator hoped for a greater long-term shareholder engagement, a simplification and rationalization of the procedures aimed at their identification[56], a better transmission of information along the chain of intermediaries[57], as well as a facilitation of the exercise of voting rights.

Moreover, the Commission Implementing Regulation at Recital 4 encourages "the use of modern technologies in communication between issuers and their shareholders and by intermediaries"[58] and would seem to pave the way for the use of blockchain technology.

Due to its very characteristics, a permissioned blockchain ideally lends itself to fulfilling the three fundamental goals of SHRD II, namely the identification of shareholders, the transmission of information and the facilitation of the exercise of shareholders' rights[59], thus overcoming (at least partly) the problems generated by long chains of intermediaries.

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[53] See Recital 4 of the Directive (EU) 2017/828; Spindler 2019: 142 ff.; Palá Laguna 2021: 138-140.
[54] Directive (EU) 2017/828 of the European Parliament and of the Council of 17 May 2017 amending Directive 2007/36/EC as regards the encouragement of long-term shareholder engagement.
[55] Commission Implementing Regulation (EU) 2018/1212 of 3 September 2018 laying down minimum requirements implementing the provisions of Directive 2007/36/EC of the European Parliament and of the Council as regards shareholder identification, the transmission of information and the facilitation of the exercise of shareholders rights.
[56] See Article 3 of the Directive (EU) 2017/828.
[57] See Article 3b of the Directive (EU) 2017/828.
[58] See Recitals 3 and 4 of the Commission Implementing Regulation (EU) 2018/1212.
[59] See Articles 3a, 3b and 3c of the Directive (EU) 2017/828; Van Der Elst & Lafarre 2017b: 2-3.

Indeed, access to the blockchain would be subject to prior authorization by the administrator nodes and, consequently, the right of companies to identify their shareholders could be directly and immediately satisfied[60], thus contributing significantly to the fight against the anonymity of shareholders which is currently generated both by the size of the corporate structure and by the intermediated shareholder engagement system (Peinado Gracia 2021: 109).

This is of fundamental importance and the Directive itself considers the identification of shareholders "a prerequisite to direct communication between the shareholders and the company and […] essential to facilitating the exercise of shareholder rights (Möslein 2020: 239-241) and shareholder engagement"[61]. The obligation – enshrined in the second and third paragraphs of the Art. 3a of the Directive – for intermediaries to promptly communicate to the company the information regarding the identity of the shareholders would be satisfied.

Similarly, the provision of Article 5 of the Commission Implementing Regulation would be satisfied. Article 5 introduces the obligation towards the last intermediary to confirm, upon specific request, "to the shareholder or third party nominated by the shareholder, the entitled position appearing in its records", or to ensure, in the presence of several intermediaries in the chain, "that the entitled positions in its records are reconciled with those of the first intermediary". This obligation could be fulfilled through blockchain technology.

Precisely because of the continuous control that the administrator nodes can exercise over the user nodes, it would also be possible to ascertain the legitimacy to participate and vote in the shareholders' meeting. The entry of new members into the company could be constantly monitored and their registration in the shareholders' register could be fully automated. Even for them, access to the blockchain and the possibility of exercising the rights incorporated in the tokens would equally be subject to the authorization of the administrator nodes (Comitato Blockchain per la Corporate Governance 2022: 11).

In a blockchain context characterized by transparency and continuous control by highly qualified subjects, empty voting does not seem easily feasible, since any separation between the voting power and the real economic risk associated with the ownership of the share, although not perceivable by the other shareholders, would be immediately visible to the administrator nodes (e.g. Supervisory Authority and company management)[62], who will be able to promptly intervene to remedy it (Yermack 2017: 24).

The ambiguities and alterations that can invalidate the correct formation of the will of the shareholders could be avoided. A blockchain of this type, therefore, ensures that a sort of Panopticon is recreated in a purely digital context. In this way, a few highly

[60] See Recital 5 of the Commission Implementing Regulation (EU) 2018/1212; Palá Laguna 2021: 143-144; Comitato Blockchain per la Corporate Governance 2022: 13.
[61] See Recital 4 of the Directive (EU) 2017/828.
[62] See Lafarre & Van Der Elst 2021: 46 ff.

qualified nodes (administrator nodes) can constantly observe the behaviour of user nodes, which, in turn, will at least be discouraged from engaging in opaque or illegal behaviour, knowing that they are being observed and that their activities will be traced.

At the same time, the privacy of voters would be preserved and their voting intentions and identities could well remain hidden from all other user nodes (Peinado Gracia & Bednarz 2021: 135 ff.)[63].

A digital platform based on a permissioned blockchain 2.0, through the tokenization of shares, would allow shareholders to exercise their rights – both patrimonial and administrative (Informal Company Law Expert Group 2016: 25) – directly within the network. This solution would legitimize the token holder to participate and exercise rights directly through the blockchain, but would not alter the nature of the shares, which would continue to circulate according to current regulations (Bednarz 2020: 8 ff.).

Furthermore, such a technological infrastructure could ensure easier participation in the shareholders' meeting and a simplification in the exercise of voting rights (Van Der Elst & Lafarre 2019: 130 ff.; Fenwick & Vermeulen 2018: 14; Yermack 2017: 23; Comitato Blockchain per la Corporate Governance 2022: 16-17). By entrusting the shareholder with a number of vote tokens (Piazza 2017: 292-294) proportional to his participation in the company, it would be possible, through smart contracts, to register his will directly in the ledger.

Thus, at the end of the voting period, the votes cast would be entered in a block and the result of the vote could not be modified subsequently. Direct registration in the chain would prevent distorting the result of the vote or voting more than once, since it is not possible in the permissioned variant for user nodes to modify or rewrite the distributed ledger (Comitato Blockchain per la Corporate Governance 2022: 16-17).

In this way, the technological support would not only ensure a clear reduction in terms of costs and time both for shareholders and the company, but also a highly secure infrastructure for carrying out the voting process (Van Der Elst & Lafarre 2017b: 16 ff.).

The possibility of custom-programming the reading powers of the user nodes and letting them view only certain contents would allow the voter to be certain that the vote had been correctly taken into account[64] and to verify the vote cast in an instantaneous and completely transparent way. The use of automatic calculation systems would then ensure the resolution of the burdensome problem of counting the votes (Matera 2018: 15; Palá Laguna 2021: 145 ff.; Spindler 2019: 143-144).

[63] The permissioned blockchain could safeguard the privacy of the shareholders and prevent the acquisition of their personal or confidential data by third parties: the user nodes cannot view the entire copy of the register and nor can they have access to the votes and personal information of the other shareholders. See Article 3a of the Directive (EU) 828/2017.
[64] See Recital 10 of the Directive (EU) 2017/828.

The greater flexibility ensured by the permissioned blockchain would – in accordance with the provisions of the GDPR – also allow the permissioner to verify in advance the correctness of the data[65], to modify, if necessary, incomplete or inaccurate information regarding the identity of the shareholders[66] or, if where appropriate, to definitively eliminate them from the ledger, thus overcoming the critical issues that part of the doctrine had correctly attributed to the permissionless variant (Finck 2019: 101 ff.).

This is particularly important because one of the ways in which freedom to conduct a business can really be achieved concerns the possibility for all shareholders – as owners of the company – to correctly express their will and the need for this to be fully taken into account during the company life cycle.

Such a digital platform could constitute a truly democratic space for meetings and discussions between shareholders and directors (Van Der Elst & Lafarre 2019: 123-129). There are two possible ways it could be used: the first would imply carrying out the entire shareholders' meeting with the aid of blockchain technology alone, while the second would imply its use as a support to other means of telecommunication. The first solution has serious technical and legal limitations. From a purely IT point of view, the idea of translating the text messages representing all the communications that took place during the shareholders' meeting seems questionable. This could in fact overload the network. From a more strictly juridical point of view, such a solution could excessively dematerialise and, therefore, completely frustrate the moment of the meeting discussion (Portellano Díez 2021: 189 ff.).

To overcome these problems, it would be appropriate to use the blockchain in the background, holding the shareholders' meeting using traditional audio-visual means of communication. Thus, while the latter would ensure active participation in the shareholders' meeting debate, the blockchain would guarantee a valid and secure aid for the identification of shareholders, for the transmission of all information relating to the shareholders' meeting, for carrying out voting operations and, more generally, for the recording of the discussions among the participants. These communications, in order not to overload the blockchain, could be stored off-chain and inserted into the chain in the form of simple cryptographic hashes.

This second solution would also make it possible to completely avoid the technical problems that sometimes afflict traditional audio-visual means of telecommunication: think, for example, of deep fakes[67], which could easily alter the correct formation of the will of the shareholders' meeting[68]. In this sense, a blockchain could stimulate the engagement of all shareholders and, at the same time, keep track of the questions and requests formulated as well as the answers provided by the directors (Van Der Elst & Lafarre 2019: 128).

[65] See Recital 12 of the Commission Implementing Regulation (EU) 2018/1212.
[66] See Article 3a (5) of the Directive (EU) 2017/828.
[67] See Lener & Furnari 2020: 45 ff.
[68] See Article 8 of the Directive 2007/36/EC of the European Parliament and of the Council of 11 July 2007 on the exercise of certain rights of shareholders in listed companies.

This could then lead to an increase in the speed of the exchange of communication and better access to corporate information, allowing shareholders to make more informed decisions. At the same time, the directors could be held liable if inconsistencies should emerge from the records crystallized in the ledger (Piazza 2017: 288-292).

All these benefits could –almost by osmosis – have a positive impact on the shareholders' meeting, which could requalify in more democratic terms and reinvigorate itself (Peinado Gracia 2021: 104). The use of this new technology promises to reduce the gap currently existing between small and large shareholders, mitigate the crisis of participation in corporate life and increase the participation of shareholders within the shareholder's meeting, also stimulating the *affectio societatis* of minority shareholders.

This technological revolution could reasonably trigger an internal revolution of the *modus cogitandi* and the *modus agendi* of the shareholders, who could rationally re-evaluate the usefulness of their vote, and, consequently, abandon the idea that the expression of the vote and the exercise of the right to participate at the shareholders' meeting are completely unprofitable for them. The adoption of a permissioned blockchain could thus, in a medium-long term perspective, counteract and mitigate the traditional apathy of the shareholders and their disinterest in active and direct participation in the life of the company (Van Der Elst & Lafarre 2017b: 24; Comitato Blockchain per la Corporate Governance 2022: 4), simply by making the exercise of their voting right less onerous and offering concrete guarantees that the will of shareholders will really be taken into consideration.

Therefore, the application of this innovative technology would make it possible to avoid all those apparently revolutionary solutions which, by establishing a regime of direct democracy and by "cutting off the head of directors", inevitably lead to results that are antithetical to the initial expectations. On the other hand this technology can assume the features of a useful tool to give voice to the shareholders and, consequently, to give a more concrete implementation of the freedom to conduct a business.

6. Conclusions and possible future implications of Blockchain Technology

The present work has demonstrated the possibility of using a permissioned blockchain platform in listed companies and how this can be a potentially suitable tool to give a more concrete implementation of the provisions of the Shareholder Rights Directive II and concretize the freedom to conduct a business. Through this technology, companies, by at least partially overcoming the problems deriving from long chains of intermediaries, could directly identify the shareholders and have real-time knowledge of the update of the composition of the corporate structure.

Furthermore, the blockchain could ensure a faster and more secure transmission of corporate information and, by exploiting the potential of tokens and smart contracts, facilitate the exercise of shareholder rights. It has been highlighted that, by avoiding tampering with and cancellation of the votes cast, the blockchain could not only certify the correct formation of the will within the shareholders' meeting, but also reduce the onset of opportunistic behaviour. Finally, such a digital platform could "give a voice to

the shareholders" and constitute a truly democratic space for meetings and discussions between them, thus mitigating the crisis of participation in company life and strengthening the role of minority shareholders.

This article, however, has demonstrated the possibility – far from futuristic – of the emergence of new totally or partially autonomous entities which, by exploiting the potential of the synergistic use of permissionless blockchains, smart contracts and AI, are able to adopt their own rules and configure their own jurisdiction, placing themselves in open antithesis both to the traditional concept of company and state company law.

It has been pointed out that the problems of DAOs do not only concern their legal qualification. Most of the expectations that accompany the DAO phenomenon are destined to remain a dead letter. A technological infrastructure of this type does not yet seem to be able to provide adequate guarantees for members and third parties who come into contact with DAOs. It has been shown that flat governance is not in any way a step forward in the management of the company but re-proposes and amplifies its typical defects.

The idea of creating *ad hoc* a new type of entirely autonomous and virtual company on the model of the DAO does not seem at all convincing. This new organisational model risks creating entities that would be potentially harmful to the freedom to conduct a business and their action can hardly be stopped by state legislators. In fact, the decentralized nature of these systems undermines the very concept of state sovereignty and unilateral and top-down approaches adopted on a national basis do not seem in the least effective, since DLTs go beyond the borders of the States and spread via the network.

This peculiar application of permissionless blockchain leads to a "new state of nature"[69], inevitably dominated by the strongest subjects – because they have better IT skills – and in fact restores a constant and dangerous situation of "bellum omnium contra omnes", exposing token holders to the numerous pitfalls of the network: from the total absence of legal guarantees to the opportunistic behaviours of the new technological

[69] A DAO could turn into a highly dangerous environment characterized by a sort of "anarchy", in the sense of "absence of government". All members of the permissionless blockchain have unlimited powers, exactly as in Hobbes's doctrine of natural rights in which, in the state of nature, all individuals have unlimited rights ("ius in omnia"). This could lead to a war of every individual against every other individual (Hobbes 1651: 79; Baktygul 2023: 8). In the same way, a state of constant war could be generated between the members of a permissionless blockchain, which could lead to the prevalence of the most powerful nodes, as they have greater technological skills or greater computational power. Even in the "new state of nature" created by blockchain technology "the notions of right and wrong, justice and injustice, have there no place" (Bull 1981:722), just as the guarantees of positive law have no place in this digital dimension. In this sense, the adoption of a permissioned blockchain could be a logical and reasonable solution for counteracting opportunistic behavior and guaranteeing peace and security within the blockchain infrastructure. Indeed, as mentioned earlier, the blockchain infrastructure may be threatened by external attacks or malfunctions and these problems could be solved by a centralized Authority. In Hobbes's theory, individuals enter society and surrender this untrammeled liberty, by submitting themselves to the sovereign authority of the Leviathan in return for protection. In the same way the members of a blockchain could deprive themselves of many of their powers by handing them over to a centralized and superior authority. This will ensure security within the network and prevent a constant war situation between nodes from occurring.

oligarchy, from the impossibility of identifying token holders to the extreme difficulty of asserting liability for the omissions and actions of members of the organization.

The use of blockchain technology within companies is still in its early stages. However, albeit beyond the scope of this article, interesting application scenarios are expected, to which scholars of law and, more generally, experts of democratic processes in the broadest sense will have to pay attention to. Indeed, a greater democratic decision-making process can be achieved through this technology, avoiding the inefficiencies that characterize DAO's on-chain governance[70]. Already in the current state of technological development, permissioned blockchains make it possible not only to involve more actively the shareholders within the company, but also and more generally all the stakeholders who interact with it. Through blockchain technology also individuals outside the company could interact, propose and vote in a democratic way.

Therefore, this technology could be used for better stakeholder engagement in corporate decision making (Van Der Elst & Lafarre 2023: 18 ff.) for faster and more efficient transmission of information from the company to relevant stakeholders. In particular, an IT platform of this type could also guarantee the direct transmission of the proposals of all stakeholders to the board of directors and the general annual meeting. In this way, a company board could directly consult stakeholders on particularly important topics, such as ESG issues.

Consequentially, innovative ideas of individuals who are not formally part of the company could be valorised, stimulating efficiency and innovativeness: not only directors and shareholders, but also the community as a whole could take part in the decision-making process, contributing in this way to achieving innovative goals and knowledge-sharing, thus creating really sustainable and inclusive ecosystems. Stakeholders could then verify in real time whether the company is actually pursuing ESG goals, thanks to the transparency of the blockchain infrastructure.

This could establish unprecedented forms of collaboration and community engagement. Also, the democratic process outside the company could be strengthened, establishing a continuous dialogue and involving society on issues related to human rights, environmental sustainability and the impact of business strategies.

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[70] See Hassan 2022: 40.

References

ABRIANI, N. & SCHNEIDER, G. (2020), "Il diritto societario incontra il diritto dell'informazione. IT, Corporate governance e Corporate Social Responsibility", *Rivista delle società*, No. 5-6, pp. 1326-1397.

ABRIANI, N. (2022a), "L'impatto dell'intelligenza artificiale sulla governance societaria: sostenibilità e creazione di valore nel lungo termine", *Contratto e impresa Europa*, No. 1, pp. 89-125.

ABRIANI, N. (2022b), "Le categorie della moderna cibernetica societaria tra algoritmi e androritmi: 'fine' della società e 'fini' degli strumenti tecnologici", *Giurisprudenza Commerciale*, No. 5, pp. 743-765.

AHLBERG, L. & SORIA RUIZ-OGARRIOZ, J. (2020), "Mathematical and Economic Foundations of Bitcoin". http://dx.doi.org/10.2139/ssrn.3544047

AL SHAIKHLI, I., ALAHMAD, M. & MUNTHIR, K. (2013), "Hash Function of Finalist SHA-3: Analysis Study", *International Journal of Advanced Computer Science and Information Technology,* Vol. 2, No. 2, pp. 1-12, available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2376182 (accessed 25 March 2023).

ALLOTTI, V. & SPATOLA, P. (2022), "L'utilizzo delle ICT nel procedimento assembleare delle società quotate", in M. Bianchini, G. Gasparri, G. Resta, G. Trovatore & A. Zoppini (eds.), *CONSOB, Quaderni giuridici. Gli sviluppi tecnologici del diritto societario*, No. 3, pp. 29-55, available at: https://www.consob.it/documents/1912911/1916538/qg23.pdf/0dd21cd7-8da8-d929-e2f7-57b95d13a565 (accessed 27 March 2023).

ANNUNZIATA, F. (2019), *Speak, If You Can: What Are You? An Alternative Approach to the Qualification of Tokens and Initial Coin Offerings*, *Bocconi Legal Studies research paper series, No. 2636561*.

ANTONACCHIO, F. (2022), "Web3 ed economia decentralizzata nuove sfide fiscali", *il fisco*, No. 39, pp. 3753-3760.

BAKTYGUL, K. (2023), "International Law in The Era of Blockchain: Law Semiotics", *International Journal for the Semiotics of Law*, pp. 1-18, available at: https://doi.org/10.1007/s11196-023-10017-y (accessed 28 May 2023).

BECHINI, U. (2022), "Bitcoin e la paura dell'innominato (noterelle su criptovalute e metodo)", *Nuova Giurisprudenza Civile Commentata*, 2022, No. 2, pp. 503-510.

BEDNARZ, Z. (2020), "La representación de acciones en forma de tokens en la blockchain", *Revista de Derecho del Mercado de Valores*, No. 26, pp. 9 ff., viewed through *laleydigital*, 6371/2020, pp. 1-23.

BELLAVITIS, C. et al. (2023), "The rise of decentralized autonomous organizations (DAOs): a first empirical glimpse", *Venture Capital*, Vol. 25, Issue 2, pp. 187-203, available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4074833 (accessed 28 May 2023).

BERBERICH, M. & STEINER, M. (2016), "Practitioner's Corner Blockchain Technology and the GDPR – How to Reconcile Privacy and Distributed Ledgers?", *European Data Protection Law Review*, Vol. 2, Issue 3, pp. 422-426.

BITFURY GROUP & GARZIK, J. (2015), *Public versus Private Blockchains. Part 1: Permissioned Blockchains*. *White Paper*, available at: https://bitfury.com/content/downloads/public-vs-private-pt1-1.pdf (accessed 24 March 2023).

BRAKEVILLE, S. & PEREPA, B. (2016), *Blockchain basics: Introduction to business ledgers*, available at: https://www.finyear.com/Blockchain-basics-Introduction-to-business-ledgers_a36159.html (accessed 27 March 2023).

BRUNELLI, L. & GASPARRI, G. (2022), "La digital transformation nel sistema di controllo interno e di gestione dei rischi", in M. Bianchini, G. Gasparri, G. Resta, G. Trovatore & A. Zoppini (eds.), *CONSOB, Quaderni giuridici. Gli sviluppi tecnologici del diritto societario* No. 3, pp. 56-67, available at: https://www.consob.it/documents/1912911/1916538/qg23.pdf/0dd21cd7-8da8-d929-e2f7-57b95d13a565 (accessed 22 March 2023).

BULL, H. (1981), "Hobbes and the International Anarchy", *Social Research*, Vol. 48, No. 4, pp. 717-738.

BUTERIN, V. (2013), "Bootstrapping an Autonomous Decentralized Corporation, part 2: interacting with the world", *Bitcoin Magazine*, available at: https://bitcoinmagazine.com/technical/bootstrapping-an-autonomous-decentralized-corporation-part-2-interacting-with-the-world-1379808279 (accessed 27 March 2023).

BUTERIN, V. (2014), "DAOs, DACs, DAs and More: An Incomplete Terminology Guide", available at: https://blog.ethereum.org/2014/05/06/daos-dacs-das-and-more-an-incomplete-terminology-guide (accessed 19 March 2023).

BUTERIN, V. (2017), "Notes on Blockchain Governance", *Vitalik Buterin's website*, available at: https://vitalik.ca/general/2017/12/17/voting.html (accessed 27 March 2023).

CANTISANI, L. (2019), "L'uso della blockchain per la corporate governance nelle società per azioni", in R. Battaglini & M. T. Giordano (eds.), *Blockchain e Smart Contract*, Giuffrè Francis Lefebvre, Milano, pp. 419-431.

CASARRUBEA, S. (2022), "Il ruolo del white paper sulle offerte al pubblico di cripto-attività alla luce della proposta MiCA", *Orizzonti del Diritto Commerciale*, Fascicolo 1, pp. 215-253.

CHOHAN, U. W. (2022), "The Decentralized Autonomous Organization and Governance Issues", *Discussion Paper Series: Notes on the 21st Century.* http://dx.doi.org/10.2139/ssrn.3082055

CLUSIT (2019), "Blockchain & Distributed Ledger: aspetti di governance, security e compliance", available at: https://clusit.it/wp-content/uploads/docs/BC-e-DLT-Governance-Security-Compliance-v1.pdf (accessed 26 March 2023).

COALITION OF AUTOMATED LEGAL APPLICATIONS (2021), *Model Law for Decentralized Autonomous Organizations*, available at: https://coala.global/wp-content/uploads/2022/03/DAO-Model-Law.pdf (accessed 28 May 2023).

COMITATO BLOCKCHAIN PER LA CORPORATE GOVERNANCE (2022), "L'applicazione della blockchain alle assemblee delle società. Position paper", available at: https://irp.cdn-website.com/605128c2/files/uploaded/Position_paper_Comitato%20Blockchain%20per%20la%20Corporate%20Governance.pdf (accessed 27 March 2023).

COMMISION NATIONALE INFORMATIQUE & LIBERTES (2018), "Premiers éléments d'analyse de la Blockchain", available at: https://www.cnil.fr/sites/default/files/atoms/files/la_blockchain.pdf (accessed 27 March 2023).

DAMIANI, E. (2020), "Blockchain Application in General Private Law: The Notarchain Case", in A. Caligiuri (ed.), *Legal Technology Transformation. A Practical Assessment,* Editoriale Scientifica, Napoli, pp. 229-236.

DAVINSON, S., DE FILIPPI, P. & POTTS, J. (2018), "Blockchain and the economic institutions of capitalism", *Journal of Institutional Economics*, Vol. 14, Issue 4, pp. 639-658.

DE FILIPPI, P. & WRIGHT, A. (2018), *Blockchain and the Law. The Rule of Code*, Harvard University Press, Cambridge.

DÍAZ MORENO, A. (2017), "Directiva (UE) 2017/828: identificación de los accionistas, transmisión de información y facilitación del ejercicio de los derechos de los socios", *Publicaciones Gómez-Acebo & Pombo*, available at: https://www.ga-p.com/wp-content/uploads/2018/03/directiva-ue-2017-828-identificacion-de-los-accionistas-transmision-de-informacion-y-facilitacion-del-ejercicio-de-los-derechos-de-los-socios.pdf (accessed 21 March 2023).

DIFFIE, B. W. & Hellman, M. E. (1976), "New Directions in Cryptography", *IEEE Transactions On Information Theory*, Vol. 22, No. 6, pp. 644-654, available at: https://ee.stanford.edu/~hellman/publications/24.pdf (accessed 24 March 2023).

EMMETT, J. (2019), "Conviction Voting: A Novel Continuous Decision Making Alternative to Governance", *Medium*, available at: https://medium.com/giveth/conviction-voting-a-novel-continuous-decision-making-alternative-to-governance-aa746cfb9475 (accessed 27 March 2023).

EUROPEAN SECURITIES AND MARKETS AUTHORITY (2016), "Discussion Paper. The Distributed Ledger Technology Applied to Securities Markets", 2016, available at: https://www.esma.europa.eu/sites/default/files/library/2016-773_dp_dlt.pdf (accessed 25 March 2023).

FAQIR-RHAZOUI, Y., ARROYO, J. & HASSAN, S. (2021), "A comparative analysis of the platforms for decentralized autonomous organizations in the Ethereum blockchain", *Journal of Internet Services and Applications*, Vol. 12, Issue 9, pp. 1-20.

FARIAS BATTLE, M. & PÉREZ BASTIDA, J. A. (2021), "Tecnologías de registro distribuido (DLT): una aproximación a su tipología y funcionalidad en relación con las sociedades cerradas", *Revista Cuadernos de Derecho y Comercio*, No. 76, pp. 77-127.

FENWICK, M. & VERMEULEN, E. P. M. (2018), "Technology and Corporate Governance: Blockchain, Crypto and Artificial Intelligence", *ECGI Law Working Paper No. 424*. http://dx.doi.org/10.2139/ssrn.3263222

FENWICK, M., KAAL, W. A. & VERMEULEN, E. P. M. (2019), "The 'Unmediated' and 'Tech-Driven' Corporate Governance of Today's Winning Companies", *New York University Journal of Law & Business*, Vol. 16, Issue 1, pp. 75-121.

FENWICK, M., MCCAHERY, J. A. & VERMEULEN, E. P. M. (2019), "The End of 'Corporate' Governance: Hello 'Platform' Governance", *European Business Organization Law Review*, Vol. 20, Issue 1, pp. 172-198.

FINCK, M. (2019), "Blockchain and the General Data Protection Regulation. Can distributed ledgers be squared with European data protection law?", *European Parliamentary Research Service*, available at: https://www.europarl.europa.eu/stoa/en/document/EPRS_STU(2019)634445 (accessed 27 March 2023).

GARAVAGLIA, R. (2018), *Tutto su blockchain. Capire la tecnologia e le nuove opportunità*, Hoepli, Milano.

GARCÍA MANDALONIZ, M. (2020a), "Desde la digitalización hacia la blockchainización de la constitución de la sociedad de capital: una revisión de la legislación pendiente de abordar", *Revista de Derecho del Mercado de Valores*, No. 26, pp. 155-181, viewed though *laleydigital,* 6370/2020, pp. 1-26.

GARCÍA MANDALONIZ, M. (2020b), *Una sociedad mercantil simplificada y digitalizada. Un ecosistema emprendedor innovador, inclusivo y sostenible*, Dykinson, Madrid.

GARGANTINI, M. (2021), "Article 3a: Identification of shareholders", in H. S. Birkmose & K. Sergakis (eds.), *The Shareholder Rights Directive II. A Commentary*, Edward Elgar, Cheltenham, pp. 42-73.

GEIS, G. S. (2018), "Traceable Shares and Corporate Law", *Northwestern University Law Review,* Vol. 113, No. 2, pp. 227-278.

GIACCAGLIA, M. (2019), "Considerazioni su Blockchain e smart contracts (oltre le criptovalute)"*, Contratto e impresa*, 2019, No. 3, pp. 941-970.

GIORDANO, M. T. (2019), "La blockchain ed il trattamento dei dati personali"*,* in R. Battaglini & M. T. Giordano (eds.), *Blockchain e Smart Contract*, Giuffrè Francis Lefebvre, Milano, pp. 99-117.

GITTI, G. (2020), "Emissione e circolazione di criptoattività tra tipicità e atipicità nei nuovi mercati finanziari", *Banca Borsa Titoli di Credito*, No. 1, pp. 13-40.

HABER, S. & STORNETTA, W. S. (1991), "How to time-stamp a digital document", *Journal of Cryptology*, Vol. 3, No. 2, pp. 99-111.

HACKER, P. (2019), "Corporate Governance for Complex Cryptocurrencies? A Framework for Stability and Decision Making in Blockchain-Based Organizations"*,* in P. Hacker, I. Lianos, G. Dimitropoulos & S. Eich (eds.), *Regulating Blockchain: Techno-Social and Legal Challenges*, Oxford University Press, Oxford, pp. 140-168.

HASSAN, G. (2022), "Towards analysing governance and legal issues related to decentralized autonomous organizations, awaiting for further legislative intervention", *Rivista di Diritto del Risparmio*, No. 1, pp. 32-48.

HOBBES, T. (1651), *Leviathan or The Matter, Forme & Power of a Common-wealth Ecclesiasticall and Civil*, printed for Andrew Crooke, London.

IBÁÑEZ JIMÉNEZ, J. W. (2021), "Financiación digital distribuida", in J. de Rábago Marín & S. Martínez Garrido (eds.), *Cuadernos de derecho para ingenieros No. 54. Digitalización de sociedades* (eBook), Wolters Kluwer, Madrid, pp. 43-76.

JENTZSCH, C. (2016a), "Decentralized Autonomous Organization to Automate Governance", available at: https://lawofthelevel.lexblogplatformthree.com/wp-content/uploads/sites/187/2017/07/WhitePaper-1.pdf (accessed 23 March 2023).

JENTZSCH, C. (2016b), "The History of the DAO and Lessons Learned", *slock.it Blog*, available at: https://blog.slock.it/the-history-of-the-dao-and-lessons-learned-d06740f8cfa5 (accessed 23 March 2023).

JOHNSTON, D. et al. (2014), "The General Theory of Decentralized Applications, DApps", *GitHub*, available at: https://github.com/DavidJohnstonCEO/DecentralizedApplications (accessed 27 March 2023).

KAAL, W. A. & CALCATERRA, C. (2018), "Crypto Transaction Dispute Resolution", *The Business Lawyer*, Vol. 73, No. 1, pp. 109-152.

KAAL, W. A. (2020), "Decentralized Autonomous Organizations – Internal Governance and External Legal Design", *Annals of Corporate Governance*, University of St. Thomas (Minnesota), Legal Studies Research Paper No. 20-14. http://dx.doi.org/10.2139/ssrn.3652481

KAAL, W. A. (2021), "A Decentralized Autonomous Organization (DAO) of DAOs", available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3799320 (accessed 28 May 2023).

KRAUSE, S. K., NATARAJAN, H. & GRADSTEIN, H. L. (2017), *Distributed Ledger Technology (DLT) and blockchain*, FinTech note No. 1, World Bank Group, available at: http://documents.worldbank.org/curated/en/177911513714062215/Distributed-Ledger-Technology-DLT-and-blockchain (accessed 30 March 2023).

KWON, J. (2014), "Tendermint: Consensus without Mining", available at: https://tendermint.com/static/docs/tendermint.pdf (accessed 27 March 2023).

LAFARRE, A. & VAN DER ELST, C. (2021), "Shareholder voice in complex intermediated proxy systems: Blockchain technology as a solution?", *The Stanford Journal of Blockchain Law and Policy*, Vol. 4, Issue 1, pp. 29-52.

LEIBNIZ, G. W. (1985), *Theodicy. Essays on the Goodness of God, the Freedom of Man, and the Origin of Evil*, Open Court Classics, La Salle.

LENER, R. & FURNARI, S. L. (2020), "Company law during the blockchain revolution. The rise of 'CorpTech'", *Open Review of Management, Banking and Finance*, Vol. 6, Issue 2, pp. 33-52.

LENER, R. & FURNARI, S. L. (2021), "Modelli organizzativi alla prova delle nuove tecnologie. Prime riflessioni su DAO e i principi generali del diritto dell'impresa", in *XII Convegno annuale dell'Associazione Italiana dei Professori Universitari*

di Diritto Commerciale 'Orizzonti del Diritto Commerciale'. La Libertà d'impresa, Roma, Italy, available at: https://www.orizzontideldirittocommerciale.it/wp-content/uploads/2021/04/Lener-Raffaele-Furnari-Salvatore-Luciano.pdf (accessed 27 March 2023).

LESSIG, L. (1999), *Code and other laws of cyberspace*, Basic Books, New York.

LESSIG, L. (2000), "Code Is Law. On Liberty in Cyberspace", *Harvard Magazine*, available at: https://www.harvardmagazine.com/2000/01/code-is-law-html (accessed 22 March 2023).

LESSIG, L. (2006), *Code: And Other Laws of Cyberspace, Version 2.0*, Basic Books, New York.

LUND, D. (2022), "DAO Governance Primer: Flat DAOs", available at: https://lund.mirror.xyz/Fe5BYyO5oMcVeXyXUK1iZX4QM-KVBc4azAG5jjU6ETM (accessed 27 March 2023).

MARCHEGIANI, L. (2022), "Automazione della governance societaria e discrezionalità amministrativa", *Rivista delle società*, No. 1, pp. 99-125.

MARCHIONNI, P. (2018), "Distributed Ledger Technologies. Consensus Mechanisms". http://dx.doi.org/10.2139/ssrn.3389871

MATERA, P. (2018), "Note in tema di blockchain e assemblee delle società quotate nell'età della disintermediazione", available at: https://www.orizzontideldirittocommerciale.it/wp-content/uploads/2021/04/Matera_Leta-della-disintermediazione_blockchain-e-assemblee-delle-societa-quotate.pdf (accessed 25 March 2023).

MENÉNDEZ ARIAS, M. J., RODRÍGUEZ GARCÍA, T. & ALCAIDE SOLER, F. (2018), "Blockchain y derecho societario", in P. García Mexía (dir.), *Criptoderecho. La regulación de Blockchain*, Wolters Kluwer, Laz Rozas, pp. 489-534.

METJAHIC, L. (2018), "Deconstructing the DAO: The Need for Legal Recognition and the Application of Securities Law to Decentralised Organisations", *Cardozo Law Review*, Vol. 39, Issue 4, pp. 1533-1567.

MICHELER, E. (2015), "Custody Chains and Asset Values: Why Crypto-Securities are Worth Contemplating", *Cambridge Law Journal*, Vol. 74, Issue 3, pp. 505-533.

MIENERT, B. (2022), *Dezentrale autonome Organisationen (DAOs) und Gesellschaftsrecht. Zum Spannungsverhältnis Blockchain-basierter und juristischer Regeln*, Mohr Siebeck, Tübingen.

MONDOH, B. S. et al. (2022), "Decentralised Autonomous Organisations: The Future of Corporate Governance or an Illusion?", available at: https://www.researchgate.net/publication/361442162_DECENTRALISED_AUTONOMOUS_ORGANISATIONS_The_Future_of_Corporate_Governance_or_an_Illusion (accessed 24 March 2023).

MÖSLEIN, F. (2020), "Blockchain applications and Company Law", in A. Caligiuri (ed.), *Legal Technology Transformation. A Practical Assessment*, Editoriale Scientifica, Napoli, pp. 237-244.

NAKAMOTO, S. (2008), "Bitcoin: A Peer-to-Peer Electronic Cash System", available at: https://nakamotoinstitute.org/bitcoin/ (accessed 27 March 2023).

NAVARRO LÉRIDA, M. S. (2018), "Gobierno corporativo, blockchain y smart contracts. Digitalización de las empresas y nuevos modelos decentralizados (DAOS)", *Revista de derecho del mercado de valores*, No. 23, pp. 1-20.

NIELSEN, T. (2019), "Cryptocorporations: A Proposal for Legitimizing Decentralized Autonomous Organizations", *Utah Law Review*, Vol. 2019, Issue 5, pp. 1105-1129.

OICV-IOSCO (2020), *Investor Education on Crypto-Assets. Final Report*, FR12/2020, available at: https://www.iosco.org/library/pubdocs/pdf/IOSCOPD668.pdf (accessed 30 March 2023).

OSSERVATORIO BLOCKCHAIN & DISTRIBUTED LEDGER (2021), "Blockchain: the hype is over, get ready for ecosystems", available at: https://www.osservatori.net/it/prodotti/formato/infografiche/blockchain-hype-is-over-get-ready-ecosystems-infografica (accessed 26 March 2023).

PALÁ LAGUNA, R. (2021), "Digitalización de registros societarios (blockchain)", in J. de Rábago Marín & S. Martínez Garrido (eds.), *Cuadernos de derecho para ingenieros No. 54. Digitalización de sociedades* (eBook), Wolters Kluwer, Madrid, pp. 129-157.

PANISI, F., BUCKLEY, R. P. & ARNER, D. (2019), "Blockchain and Public Companies: A Revolution in Share Ownership Transparency, Proxy-Voting and Corporate Governance?", *Stanford Journal of Blockchain Law & Policy*, Vol. 2, Issue 2, pp. 189-220.

PEINADO GRACIA, J. I. & BEDNARZ, Z. (2021), "Cuestionando las bondades de la blockchain en las juntas generales", *Revista de Derecho de sociedades*, No. 61, pp. 135-189.

PEINADO GRACIA, J. I. (2021), "Las juntas generales en blockchain. Un apunte de gobierno corporativo", in J. de Rábago Marín & S. Martínez Garrido (eds.), *Cuadernos de derecho para ingenieros No. 54. Digitalización de sociedades* (eBook), Wolters Kluwer, Madrid, pp. 103-128.

PETRIN, M. (2019), "Corporate Management in the Age of AI", *Columbia Business Law Review*, No. 3, pp. 965-1030.

PIAZZA, F. S. (2017), "Bitcoin and the Blockchain as Possible Corporate Governance Tools: Strengths and Weaknesses", *Penn State Journal of Law & International Affairs*, Vol. 5, Issue 2, pp. 262-301.

PICCIAU, C. (2021), "The (Un)Predictable Impact of Technology on Corporate Governance", *Hastings Business Law Journal*, Vol. 17, Issue 1, pp. 67-136.

PISELLI, R. (2019), "Quando la decentralizzazione delle DLT incontra il mercato dei capitali. Appunti sulle organizzazioni decentralizzate", *Analisi Giuridica dell'Economia*, No. 1, pp. 373-393.

PORTELLANO DÍEZ, P. (2021), "Repercusión de la tecnología «blockchain» sobre el órgano de administración", in J. de Rábago Marín & S. Martínez Garrido (eds.),

Cuadernos de derecho para ingenieros No. 54. Digitalización de sociedades (eBook), Wolters Kluwer, Madrid, pp. 183-205.

PRITESHKUMAR, P., KRUTARTH, D. & PARTH, S. (2020), "A Review of Recent Blockchain Applications", *International Journal of Scientific & Technology Research*, Vol. 9, Issue 1, pp. 897-903.

RAMPONE, F. (2018), "I dati personali in ambiente blockchain tra anonimato e pseudonimato", *Ciberspazio e Diritto*, Vol. 19, No. 61, pp. 457-478.

RIGAZIO, S. (2021), "Smart contracts e tecnologie basate su registri distribuiti nella l. 12/2019"*, Diritto dell'informazione e dell'informatica*, No. 2, pp. 369-395.

ROHR, J. & WRIGHT, A. (2019), "Blockchain-Based Token Sales, Initial Coin Offerings, and the Democratization of Public Capital Markets", *Hastings Law Journal*, Vol. 70, Issue 2, pp. 463-524.

SARZANA DI SANT'IPPOLITO, F. & NICOTRA, M. (2018), *Diritto della blockchain, intelligenza artificiale e IoT*, Wolters Kluwer, Milano.

SICIGNANO, G. J. (2021), "I modelli di comportamento dell'ente nel riciclaggio mediante criptovalute", *Le Società*, No. 11, pp. 1271-1284.

SIRI, S. (2020), "Polish, Test and Deploy a Quadratic Voting DAO", available at: https://github.com/DemocracyEarth/dao/issues/1 (accessed 27 March 2023).

SPINDLER, G. (2019), "Digitalization and Corporate Law – A View from Germany", *European Company and Financial Law Review*, Vol. 16, No. 1-2, pp. 106-148.

STRAMPELLI, G. (2018), "Engagement degli investitori istituzionali e colloqui riservati con gli emittenti", *Banca, borsa, titoli di credito*, No. 3, pp. 393-434.

SWAN, M. (2015), *Blockchain. Blueprint for a New Economy*, O'Reilly, Sebastopol.

THE EUROPEAN UNION BLOCKCHAIN OBSERVATORY AND FORUM (2019), *Legal and Regulatory Framework of Blockchains and Smart Contracts*, available at: https://www.eublockchainforum.eu/sites/default/files/reports/report_legal_v1.0.pdf (accessed 22 March 2023).

THE INFORMAL COMPANY LAW EXPERT GROUP (2016), "Report on digitalisation in company law", available at: https://orbilu.uni.lu/bitstream/10993/31152/1/2016-03-24%20icleg-report-on-digitalisation-24-march-2016.pdf (accessed 21 March 2023).

THOMPSON, C. (2016), "The DAO of Ethereum. Analyzing the DAO hack, the Blockchain, Smart contracts, and the Law", available at: https://medium.com/blockchain-review/the-dao-of-ethereum-e228b93afc79 (accessed 27 March 2023).

THORSTENSSON, J. (2021), "Trust minimized, off-chain conviction voting"*,* available at: https://blog.ceramic.network/trust-minimized-off-chain-conviction-voting/ (accessed 27 March 2023).

URBAN, M. C. & PINEDA, D. (2018), "Inside the Black Blocks. A policymaker's introduction to blockchain, distributed ledger technology and the "Internet of Value",

Mowat Publication, No. 168, available at: https://www.academia.edu/37254619/Inside_the_Black_Blocks_A_policymaker_s_introduction_to_blockchain_distributed_ledger_technology_and_the_Internet_of_Value_ (accessed 23 March 2023).

VAN DER ELST, C. & LAFARRE, A. (2017a), "Blockchain and the 21st century annual general meeting", *European Company Law*, Vol. 14, Issue 4, pp. 167-176.

VAN DER ELST, C. & LAFARRE, A. (2017b), "Bringing the AGM to the 21st Century: Blockchain and Smart Contracting Tech for Shareholder Involvement", *European Corporate Governance Institute (ECGI) Law Working Paper No. 358*. http://dx.doi.org/10.2139/ssrn.2992804

VAN DER ELST, C. & LAFARRE, A. (2018), "Blockchain Technology for Corporate Governance and Shareholder Activism", *Tilburg Law School Legal Studies Research Paper Series No. 07/2018*. http://dx.doi.org/10.2139/ssrn.3135209

VAN DER ELST, C. & LAFARRE, A. (2019), "Blockchain and smart contracting for the shareholder community", *European Business Organization Law Review*, Vol. 20, Issue 1, pp. 111-137.

VAN DER ELST, C. & LAFARRE, A. (2023), "The Viability of Blockchain in Corporate Governance", *ECGI Law Working Paper No. 712*, available at: https://www.ecgi.global/working-paper/viability-blockchain-corporate-governance (accessed 7 July 2023).

VERMEULEN, E. P. M. (2018), "Is There a Future for Blockchain?", *Hackernoon*, 2018, available at: https://hackernoon.com/is-there-a-future-for-blockchain-dbc86f205d6f (accessed 27 March 2023).

WERBACH, K. & CORNELL, N. (2017), "Contracts Ex Machina", *Duke Law Journal*, Vol. 67, No. 2, pp. 313-382.

WERBACH, K. (2018), "Trust, but Verify: Why The Blockchain Needs The Law?", *Berkeley Technology Law Journal*, Vol. 33, No. 2, pp. 487-550.

WORLD ECONOMIC FORUM (2022), *Decentralized Autonomous Organizations: Beyond the Hype. White paper*, available at: https://www3.weforum.org/docs/WEF_Decentralized_Autonomous_Organizations_Beyond_the_Hype_2022.pdf (accessed 22 March 2023).

WRIGHT, A. & DE FILIPPI, P. (2015), "Decentralized Blockchain Technology and the Rise of Lex Cryptographia". http://dx.doi.org/10.2139/ssrn.2580664

WRIGHT, A. (2021), "The Rise of Decentralized Autonomous Organizations: Opportunities and Challenges", *Stanford Journal of Blockchain Law & Policy*, Vol. 4, Issue 2, pp. 152-176.

YANG, F. et al. (2019), "Delegated Proof of Stake with Downgrade: A Secure and Efficient Blockchain Consensus Algorithm with Downgrade Mechanism", *IEEE Access*, Vol. 7, pp. 118541-118555, available at: https://ieeexplore.ieee.org/document/8798621 (accessed 27 March 2023).

YERMACK, D. (2017), "Corporate Governance and Blockchains", *Review of Finance*, Vol. 21, Issue 1, pp. 7-31.

ZETZSCHE, D. A., BUCKLEY, R. P. & ARNER, D. W. (2018), "The Distributed Liability of Distributed Ledgers: Legal Risks of Blockchain", *University of Illinois Law Review*, Vol. 2018, No. 4, pp. 1361-1407.

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