# 1. Blockchains – perspectives and challenges

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## I    INTRODUCTION

A blockchain is a distributed ledger that allows for the storage and transmission of information over the Internet in a transparent and secure manner without the need to rely on a trusted third party. The database contains transactions that are publicly auditable, validated, executed and saved in a chronological, tamper-resistant manner by a network of computers.[1] Although blockchain technology originated with bitcoin, which remains the most prominent example, this technology can be used in a number of important fields that go beyond a decentralized cryptocurrency system. There are many blockchains; some are public, some private and some consortium.[2] A blockchain is to a transaction, as the Internet is to information;[3] its qualities are attributed to it by its applications.

Blockchain is of considerable importance given its potential to impact relations between persons (individuals and legal persons) around the world, as well as between governments and constituents and between governments. Blockchain technology has the potential to upset the organization of entire sectors of society, including the nation-State.[4] The Internet promised a decen-

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[1]    Aaron Wright and Primavera De Filippi, 'Decentralized Blockchain Technology and the Rise of Lex Cryptographia' (2015) 6 https://ssrn.com/abstract52580664, accessed 31 May 2018; Melanie Swand and Primavera De Filippi, 'Toward a philosophy of blockchain: A symposium, Introduction' in Armen T. Marsoobian (ed.), (2017) 48(5) *Metaphilosophy* 603.

[2]    See Blockchain France, 'La Blockchain décryptée, les clés de la révolution' (2016) 6 https://blockchainfrance.files.wordpress.com/2018/06/la-blockchain -decc81cryptecc81e-les-clefs-dune-recc81volution.pdf, accessed 31 May 2018.

[3]    See http://www.pwc.ch/fr/publications/these_blockchain.html, accessed 31 May 2018.

[4]    See 'Blockchain' *Le Temps* https://www.letemps.ch/economie/2016/09/11/ blockchain-augure-fin-letatnation, accessed 31 May 2018.

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tralization of power, but paradoxically has created multinational companies that are more powerful than certain States.[5] Blockchain can fulfil that democratic promise and complete what the TC/IP protocol started with the Internet, namely a more horizontal world where citizens can directly interact with each other, without geographical restrictions or intermediaries. This goes beyond the Internet Revolution and, for the first time in the history of technological revolutions, a technology has the capacity to affect the vertical, centralized power of States with regard to money, banks with regard to financial transactions, notaries with regard to sales of immovable property and energy monopolies with regard to electricity and fuel distribution.[6]

From the technology that lets bitcoins be used as electronic cash (blockchain 1.0), to decentralized autonomous programmes – 'smart contracts' – (blockchain 2.0), to applications that go beyond money, finance and markets, in particular in the fields of administration, health, science, literacy, culture, art, etc. (blockchain 3.0),[7] a revolution is underway that will make us question the very foundations of our society.[8]

Confidence in the State, institutions and other representations of concentrated power is declining. Today, confidence remains in two areas: family and community.[9] Blockchain coupled with the bitcoin protocol was originally intended to 'disrupt' confidence in the State and banks as part of an anarchistic movement. However, blockchain coupled with smart contracts and other decentralized, autonomous applications makes us question whether this new, democratic movement will 'recreate the State with blockchain'.[10]

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[5]    See https://fr.wikipedia.org/wiki/Géants_du_Web, accessed 31 May 2018.

[6]    Joël de Rosnay in 'La Blockchain décryptée, les clés de la révolution' (2016) preface (supra n 2).

[7]    See http://ieet.org/index.php/IEET/more/swan20141110, accessed 31 May 2018; some experts consider it Blockchain 4.0, see https://cointelegraph.com/press-releases/seele-build-the-value-network-of-blockchain-40-by-destruction-and-universality, accessed 31 May 2018.

[8]    For a critical analysis see Marcella Atzori, 'Blockchain Technology and Decentralized Governance: Is the State Still Necessary' (2015) https://doi.org/10.2139/ssrn.2709713, accessed 31 May 2018.

[9]    Yves Caseau and Serge Soudoplatoff, 'La blockchain ou la confiance distribuée' 13 http://www.fondapol.org/wp-content/uploads/2016/06/083-SOUDOPLATOF-2016-05-26-webDEF.pdf, accessed 31 May 2018.

[10]    See supra n 2, p. 56.

## II PRESENTATION OF SELECTED OPPORTUNITIES

### II.A Background

Blockchain brings with it some great opportunities that are capable of modifying entire sectors of our economy that rely on intermediaries or trusted third parties. The financial sector was the first to show interest in blockchain, but blockchain technology has almost limitless possibilities. This chapter, which has a legal focus, addresses three specific opportunities created by blockchain, namely: enabling new means of payment (Section II.B); new means of financing innovation (Section II.C) and new organizational structures (Section II.D).

### II.B A New Payment Method: Cryptocurrency

Blockchain originated with bitcoin, which can be considered to be the parent of cryptocurrencies.[11] Born out of the 2008 financial crisis, bitcoin is a payment system that facilitates online, peer-to-peer payments, meaning payment is made directly from one party to another without passing through a financial institution.[12] Bitcoin and other cryptocurrencies with similar functions (e.g., Litecoin) allow individuals to send digital units with a monetary value across an online network in a secure manner, without paying multiple fees. This opens the door to being able to send money without geographic or monetary limits, as well as to people who do not have a bank account.

From a legal point of view, bitcoin is the first technology that directly questions States' sovereign power to issue money; computer code replaces central banks. Semantically speaking, bitcoin is a cryptographically encrypted digital unit. Due to its use as digital cash, bitcoin is often referred to as a 'cryptocurrency'. Today, there are many other cryptographs with their own blockchains (resulting from forks in the bitcoin blockchain or relying on its technology,[13] or based on completely different blockchains started from scratch),[14] often referred to as altcoins. Some blockchains, like Ethereum, are programmable in the sense that they permit the execution of autonomous programmes capable of generating other cryptographic assets. The is called a smart contract. The idea of a smart contract is false, because the software is not 'smart', it simply exe-

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[11]   See Adli Takkal Bataille and Jacques Favier, *Bitcoin, monnaie acéphale* (Paris, 2017), 189 et seq.

[12]   See Satoshi Nakamoto, 'White paper' (bitcoin) https://bitcoin.org/bitcoin.pdf, accessed 31 May 2018.

[13]   E.g., Litecoin, Bitcoin Cash, Dogecoin, Peercoin, etc.

[14]   E.g., Ethereum, Ripple, NEO, etc.

cutes already programmed code in an automatic and autonomous manner and because, legally speaking, it is not a contract. Tokens are assets that evolved on a different blockchain.[15] A simple classification of cryptocurrencies would be to distinguish altcoins from tokens; altcoins can be based on the bitcoin blockchain, but token blockchains start from scratch. However, this is not true terminological rigor and in the etymological sense of the term all cryptocurrencies are tokens.[16]

Historically, blockchain technology, through the use of bitcoins, represents the first use of a global and secure cryptographic currency, in this case bitcoin. However, Ethereum blockchains, which permit the execution of smart contracts, have pushed the boundaries in the domain of cryptographic assets.

**II.C     A New Financing Method: the ICO or the TGE**

In recent months smart contracts, which are generally executed on the Ethereum blockchain, have enabled businesses active in the blockchain sector to raise funds through the use of cryptocurrencies; this is referred to as an initial coin offering (ICO) or a token generating event (TGE).

More precisely, an ICO or TGE is a way of financing with cryptocurrency; they operate on standalone software and are generated and saved on a blockchain, in this case the Ethereum blockchain. In this scenario, 'investors' send cryptocurrency to the software, which collects the funds and automatically generates 'tokens' that are given to the 'investors', based on a ratio predefined by the project promotors. It is a new way to finance innovation.

The main advantage of this financing mechanism is that start-ups can quickly[17] and directly receive money from investors, without relying on an intermediary (bank or venture capitalist (VC)), without capital dilution, without (in principle) having to make a binding commitment to achieve a certain result, return on investment or follow the investors' agenda and while retaining control over the project. To date, there is no specific legal framework

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[15]    E.g., Augur, Golem and Gnosis on the Ethereum blockchain or Trinity Network Credit, Qlink and Deepbrain Chain on the NEO blockchain.

[16]    For an attempt to classify tokens see: Vaïk Müller and Vincent Mignon, 'La qualification juridique des tokens: aspects réglementaires' 2018 (4) *GesKR*, 486 et seq.

[17]    Many ICOs last only several seconds or minutes and raise tens of millions of US dollars; for instance, Basic Attention Token raised the equivalent of 35 million US dollars in 30 seconds (https://www.coindesk.com/35-million-30-seconds-token-sale -internet-browser-brave-sells, accessed 31 May 2018) and Bancor raised around 153 million US dollars in less than three hours (https://medium.com/@bancor/a-historic -token-generation-event-tge-f446110f3b1c, accessed 31 May 2018).

that applies to ICOs[18] and many of the original actors imagined that they could avoid having a legal structure for fundraising or having to be accountable to someone. This is an extension of the philosophy of the 'cyberpunks' who were active at the start of bitcoin[19] (in particular the abolition of trusted third parties and being free from the 'yoke' of the State). However, the paradigm has changed and States are not inclined to tolerate lawless zones within their territory, especially when the stakes, such as investor protection, begin to become important (see Section III.A).

In 2017, for the first time, this type of financing overtook VC financing. According to the website www.coinschedule.com, there were 235 ICOs in 2017, which raised over 3.7 billion US dollars.[20] Filecoin, Tezos, EOS, Paragon and Bancor alone raised 257, 232, 185, 183 and 153 million US dollars respectively.

In this respect, it is interesting to note that the blockchain ecosystem, which consists of players active in the blockchain sector, has been able to use the technology provided by distributed networks and their applications to self-finance start-up companies at an unprecedented rate. The blockchain has thus freed up investment and, to a certain extent, taken on the role of banks and other financial institutions active in this field.

## II.D    A New Organizational Structure: the DAO

Blockchain and smart contracts permit the organization of immutable community governance rules formed around a common goal. This new form of social and corporatist organization is called a Decentralized Autonomous Organization (DAO). It is decentralized because the organization's statutes are incorporated in the smart contracts and executed on the blockchain; it is autonomous because once deployed on the blockchain, it is regulated by the rules fixed in the smart contracts and removed from its creators. The first Decentralized Autonomous Organization, 'the DAO', was created in 2016, but failed after being attacked. The DAO was conceived as a decentralized investment fund, in which the token holders could evaluate and decide on the financing projects.[21] Voting rights were granted to token holders, and in

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18    For Switzerland, see Finma, Guidelines for enquiries regarding the regulatory framework for initial coin offerings (ICOs), published 16 February 2018, https://www .finma.ch/en/news/2018/02/20180216-mm-ico-wegleitung/, accessed 31 May 2018.

19    For a detailed analysis of bitcoin see Vincent Mignon, 'Le '[B]itcoin', un nouveau défi pour le juriste suisse?' *Jusletter* (4th May 2015).

20    See https://www.coinschedule.com/stats.html, accessed 31 May 2018.

21    See https://en.wikipedia.org/wiki/The_DAO_(organization), accessed 31 May 2018.

accordance with the majority rules provided for in the DAO's code, the funds that it held could be released to entities that submitted a request for financing.

These new forms of organizations bring to mind the nineteenth-century efforts to grant legal personality to groups of people and/or property during the Second Industrial Revolution, leading to the recognition of legal persons. In this Fourth Industrial Revolution, are we at the dawn of a new era in which we will have to recognize organizations governed by computer code as a new form of legal persons?

Today, it is undeniable that a group of people can come together with a common goal and that the rules governing the organization can be immutably fixed on the blockchain, so that they are distinct from the individual interest of any of the group members. The community, through the network of smart contracts that comprise it, can hold funds needed to carry out its purpose. Its members are like shareholders in a new kind of organization, holding social (e.g., voting rights) and/or patrimonial rights (right to receive income related to the organization's activity, similar to dividends), which are incorporated in the token that replaces shares as a fraction of the organization's capital.

However, a DAO is not a legal person, which would address the issue of representation of the DAO, as well as its ability to enter into contracts, initiate legal proceedings and to have legal proceedings initiated against it. From the point of view of Swiss law, such a group of persons would be governed by the provisions applicable to a simple society (Article 531 et seq. of the Swiss Code of Obligations), a contractual form unsuitable for large groups of people who may be spread out around the world. The partners can only initiate legal proceedings or be sued jointly, sometimes unanimously, which is impossible in practice in the context of decentralized entities.

As in the nineteenth century, legal structures must adapt to fulfil the needs of business, which in the long term is in their interest. The legal order was established to govern collective community life. One of its primordial tasks is to define legal subjects, that is the circle of subjects capable of having rights and obligations. Today, DAOs are neither individuals, nor legal persons. A legal person only exists because a legal construct makes it possible to consider a group of persons or goods as a legal entity, that is, as a single entity. There is no law, at least not in Switzerland, that grants the status of legal person on a group of persons and/or goods organized and managed by computer code.

To this end, the European Parliament's Committee on Legal Affairs proposed, in a report dated 27 January 2017, the creation of a legal personality for robots, as well as a tax on work carried out by robots.[22] The European

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22    See European Parliament, 'Report of the European Parliament Committee on Legal Affairs with recommendations to the Commission on Civil Law Rules on

Parliament stated in its resolution of 16 February 2017 with recommendations to the Commission on Civil Law Rules on Robotics, that in the long term, a specific legal personality should be considered for robots, allowing at least the more advanced to be considered electronic persons, but excluded a tax on work carried out by robots.[23] In Switzerland, on 1 March 2017, National Council member Mathias Reynard tabled two postulates asking the Federal Council to evaluate the relevance of creating a legal personality for robots[24] and the possibility of taxing robots.[25] The Swiss Federal Council recommended rejecting the two postulates, opting to wait for the results of the work undertaken by the European Union (EU). Although these efforts mainly concern robots with a physical form from the standpoint of civil liability law, it is only one step away from recognizing new organizations, managed by computer code, as legal persons and taxpayers. After Internet currency (bitcoin) and its fundraising method (ICOs), the next legal challenge facing lawmakers is to decide on whether to grant legal personality to these new forms of organizations stored on blockchains.

## III    PRESENTATION OF SELECTED CHALLENGES

Although blockchain technology has enormous potential to fundamentally change how people organize business[26] and social relations, it also faces a number of challenges. We will cover what we currently consider to be three of the principle challenges: the regulatory challenge (Section III.A), the environmental challenge (Section III.B) and the governance challenge (Section III.C).

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Robotics of 27 January 2017' http://www.europarl.europa.eu/sides/getDoc.do?pubRef =-//EP//NONSGML+REPORT+A8-2017-0005+0+DOC+PDF+V0//FR, accessed 31 May 2018.

[23]    European Parliament, 'European Parliament Resolution of 16 February with recommendations to the Commission on Civil Law Rules on Robotics' http://www .europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//NONSGML+TA+P8-TA-2017 -0051+0+DOC+PDF+V0//FR, accessed 31 May 2018, ch. 59, let. F.

[24]    Postulate 17.3040 of Matthias Reynard, 'To evaluate the pertinence of creating legal personality for robots' of 1 March 2017, https://www.parlament.ch/fr/ratsbetrieb/ suche-curia-vista/geschaeft?AffairId=20173040, accessed 31 May 2018.

[25]    Postulate 17.3036 of Matthias Reynard, 'To evaluate the opportunity to tax robots' of 1 March 2017, https://www.parlament.ch/fr/ratsbetrieb/suche-curia-vista/geschaeft ?AffairId=20173036, accessed 31 May 2018; additionally, Deputy Liza Mazzone introduced Postulate 17.3151, 'Tax the robots, Anticipate, don't suffer' https://www .parlament.ch/fr/ratsbetrieb/suche-curia-vista/geschaeft?AffairId=20173151, accessed 31 May 2018, to tax robots. The Federal Council proposed to reject this Postulate on 17 May 2018.

[26]    See supra n 1.

### III.A    Regulatory Challenges

Many people link the success of blockchain-based projects with how States will regulate these projects. Proponents of a hard-line approach put forth two arguments for legislating cryptographic assets, namely their volatility (and thus the need to protect investors) and their use in financing illegal activities, including terrorism.[27] Some of these individuals even speculate that bitcoin could be the worst bubble ever,[28] capable of jeopardizing the entire global financial system. This is by and large an exaggeration. At the time of writing, bitcoin's highest capitalization was just under $304 billion, with a total capitalization of all cryptographic assets totalling approximately $830 billion.[29] By comparison, Apple's capitalization briefly exceeded $900 billion at the end of 2017,[30] the market capitalization of gold was around $8 trillion,[31] while in the third quarter of 2017, global debt reached a record high of $233 trillion.[32] Cryptographic assets are a drop in the sea of global finance. Concerning the second argument, Europol published a report on 18 January 2016 stating that assertions that cryptographic currencies such as bitcoin financed terrorist activities had not been proven by the police.[33] An October 2017 report by the English Treasury reached the same conclusion.[34] A study published on 12 January 2018 by Elliptic, Center on Sanctions and Illicit Finance, showed that there has been an over 40 per cent reduction in bitcoin transactions asso-

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[27]   In early January 2018, the French Minister of the Economy, Bruno Le Marie, unveiled a plan to create a cryptomoney taskforce; see https://www.lesechos.fr/finance -marches/marches-financiers/0301151100963-le-gouvernement-nomme-un-monsieur -bitcoin-2144973.php, accessed 31 May 2018.

[28]   See    http://bourse.lefigaro.fr/derives/actu-conseils/le-bitcoin-est-il-devenu-la -pire-bulle-de-tous-les-temps-6381154, accessed 31 May 2018.

[29]   See https://coinmarketcap.com/charts, accessed 31 May 2018.

[30]   See https://www.bloomberg.com/news/articles/2017-11-03/apple-value-touches -900-billion-as-iphone-demand-boosts-stock, accessed 31 May 2018.

[31]   See http://onlygold.com/Info/All-The-Gold-In-The-World.asp, accessed 31 May 2018.

[32]   See    https://www.reuters.com/article/debt-iif-emerging/global-debt-level-hits -233-trillion-record-high-in-q3-2017iif-idUSL8N1OZ46E, accessed 31 May 2018.

[33]   Europol, 'Europol Report of 18 January 2016, Changes in modus operandi of Islamic State terrorist attacks' ch. 2.3, p. 7. See https://www.europol.europa.eu/ publications-documents/changes-in-modus-operandi-of-islamic-state-terrorist-attacks, accessed 21 August 2018.

[34]   See HM Treasury Report, 'National risk assessment of money laundering and terrorist financing 2017' (October 2017) ch. 5.12. See https://www.gov.uk/government/ uploads/system/uploads/attachment_data/file/655198/National_risk_assessment _of_money_laundering_and_terrorist_financing_2017_pdf_web.pdf, accessed 31 May 2018.

ciated with criminal activity since 2013 and estimated that transfers related to illicit activities accounted for only 0.61 per cent of all transactions.[35] However, European leaders, French President Emmanuel Macron and German Chancellor Angela Merkel, announced in early 2018 their joint intention to strictly 'regulate' bitcoin in a way that would not promote innovation.[36] Conversely, in early February 2018, Spain expressed its desire to be a bitcoin and cryptocurrency paradise.[37]

Regulate does not automatically mean forbid, limit or reduce. Regulation of the blockchain sector can be seen as a positive development if it creates conditions that allow serious projects to be promoted and punishes fraud. In this respect, it is necessary to distinguish the technology from the actors working with this technology (miners, exchanges, etc.). Technology, which is open source and fully distributed, cannot be stopped by a single State. Legislating 'blockchains' makes no legal sense, especially since blockchains are defined by their functionality. However, States can intervene when it comes to activities carried out on their territory and the actors carrying them out. For example, although it is not possible to prohibit bitcoin as such, it is possible to declare its use illegal on a given territory and/or to prohibit actors from trading bitcoins. The immediate consequence is the creation of international competition in choosing the most suitable location for the development of blockchain activities. For instance, when China stated at the end of 2017, that it might ban bitcoin mining on its territory, Chinese miners began moving their activities abroad.[38] States will have to fundamentally question whether they wish to promote this technology in a benevolent way in order to win market share on the world stage, or whether they will adopt an indiscriminate and repressive posture, without regard for the fact that in the long term they will never make up for their competitiveness gap, as we have seen with the emergence of the Internet.

Almost systematically, the first reflex when something new appears is to try and classify it and regulate it. This is a mistake, as it creates a compartmentalization of law and ultimately risks a fragmentation of legal orders. Moreover, the absence of a specific rule (*lex specialis*) does not mean that there is no regulation. Existing general legal rules apply and, in many cases, address the

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[35] See https://info.elliptic.co/thank-you-whitepaper-fdd-bitcoin-laundering?sub missionGuid=4ab2d202-2380-4d75-a594-97fa6386b3a0, accessed 31 May 2018.

[36] See https://cryptovest.com/news/merkel-macron-join-forces-on-regulating-cry ptos, accessed 31 May 2018.

[37] See http://www.cnewsmatin.fr/monde/2018-02-16/lespagne-veut-etre-le-paradis -du-bitcoin-et-des-cryptomonnaies-774902, accessed 31 May 2018.

[38] See https://www.crypto-france.com/par-crainte-dune-interdiction-les-mineurs -chinois-songent-a-delocaliser-leurs-activites-a-letranger, accessed 31 May 2018.

legal challenges. The Swiss Federal Council, for example, indicated in 2014 in its report on virtual currencies that it was not necessary to introduce specific legislation, since cryptocurrencies played an insignificant role as a means of payment in Switzerland. However, this does not mean they exist in a space of lawlessness.[39]

Current discussions focus on regulation of blockchain technology with regard to financial markets. The very first question was whether bitcoin was legal.[40] Japan, for example, has recognized bitcoin as a legal means of payment[41] while Algeria banned it at the beginning of 2018.[42] 2017, as we have already noted (see Section II.C), was the year of cryptographic currency, which brought scrutiny from regulators around the world.[43] The United States Securities and Exchange Commission (SEC) published a report in mid 2017 concluding that in some cases ICOs could be considered as an issuing of financial securities and must, unless exempted, be declared to the authorities; violators could face sanctions.[44] Canadian securities regulators followed suit a few days later.[45] Additionally, the SEC also lodged a complaint against two

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[39]    Swiss Federal Council, https://www.news.admin.ch/NSBSubscriber/message/attachments/35353.pdf, accessed 31 May 2018; however, with the growing interest in cryptoassets and ICOs, on 25 February 2017 the Swiss Federal Council declared that cryptomoney, including ICOs, must be better regulated and worked with the Swiss Financial Market Supervisory Authority (FINMA) to 'elaborate a solution'; see https://www.parlament.ch/fr/services/news/Pages/2017/20170925182428095194158159041_bsf160.aspx, accessed 31 May 2018.

[40]    For a country by country overview see https://en.wikipedia.org/wiki/Legality_of_bitcoin_by_country_or_territory, accessed 31 May 2018.

[41]    See https://www.coindesk.com/japan-bitcoin-law-effect-tomorrow, accessed 31 May 2018.

[42]    Art. 117 of the 2018 Finance Law, 'The purchase, sale, use and detention of virtual money is forbidden': see https://www.mfdgi.gov.dz/images/pdf/lois_de_finances/LF2018F.pdf, accessed 31 May 2018.

[43]    For a synthesis see: Karsten Wöckener, Carsten Lösing, Thilo Diehl and Annekatrin Kutzbach, 'Regulation of Initial Coin Offerings', https://www.whitecase.com/sites/whitecase/files/files/download/publications/regulation-of-initial-coin-offerings.pdf, accessed 31 May 2018.

[44]    See https://www.sec.gov/litigation/investreport/34-81207.pdf, accessed 31 May 2018.

[45]    See    https://www.autorites-valeurs-mobilieres.ca/default.aspx?langtype=1036, accessed 31 May 2018.

ICOs it considers fraudulent.[46] China[47] and South Korea[48] have banned ICOs from their respective territories. Australia has issued guidelines on fundraising with ICOs,[49] England has issued a bulletin warning investors against the risks associated with ICOs[50] and Gibraltar has enacted regulations effective from 1 January 2018 legalizing ICOs.[51] In Switzerland, the Financial Market Supervisory Authority (FINMA) issued a communication at the end of 2017 on oversight of cryptographic currency. While recognizing its innovation potential, the communication states that laws concerning oversight could apply to certain aspects.[52] In mid February 2018, the FINMA published a practical guide explaining how it would deal with tax issues related to ICOs and the minimum information required to process submitted applications.[53] Although certain elements of this guide are debatable (in our opinion, the extension of the definition of securities so as to be able to apply it to certain categories of tokens), the FINMA wants to bring transparency and therefore predictability to the market actors. In addition, the FINMA considers that current Swiss law can respond to the new regulatory challenges raised by ICOs. This is a positive example of finding a balance between respect for existing legal rules and promotion of innovation.

## III.B    The Environmental Challenge

Environmental concerns have been at the heart of recent arguments against bitcoin. Environmental concerns about cryptocurrency in general, and bitcoin

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[46]    See https://www.sec.gov/news/press-release/2017-185-0, accessed 11 October 2017.

[47]    See https://techcrunch.com/2017/09/04/chinas-central-bank-has-banned-icos/?ncid=mobilenavtrend, accessed 31 May 2018; Communiqué of the Central Bank of China, http://www.pbc.gov.cn/goutongjiaoliu/113456/113469/3374222/index.htm, accessed 31 May 2018.

[48]    See https://www.coindesk.com/south-korean-regulator-issues-ico-ban, accessed 31 May 2018; Communication on the Commission on Financial Services (in Korean), http://www.fsc.go.kr/info/ntc_news_view.jsp?bbsid=BBS0030&page=1&sch1=&sword=&r_url=&menu=7210100&no=32085, accessed 31 May 2018.

[49]    See http://asic.gov.au/regulatory-resources/digital-transformation/initial-coin-offerings/#derivatives, accessed 31 May 2018.

[50]    See https://www.sec.gov/oiea/investor-alerts-and-bulletins/ib_coinofferings, accessed 31 May 2018.

[51]    See https://journalducoin.com/altcoins/gibraltar-devient-premiere-juridiction-a-reguler-ico, accessed 31 May 2018.

[52]    See https://www.finma.ch/fr/news/2017/09/20170929-mm-ico, accessed 31 May 2018.

[53]    See https://www.finma.ch/en/news/2018/02/20180216-mm-ico-wegleitung, accessed 31 May 2018.

specifically, have surpassed concerns related to money laundering and terrorism. This concern applies to all blockchains that validate transactions using *Proof of Work*.[54] The concern is that the energy required to validate transactions made by miners will have disastrous environmental consequences[55] and, thus, bitcoins cause pollution. There are many examples that demonstrate the environmental effects: a bitcoin transaction consumes as much electricity as the average American household does in one week;[56] bitcoin's average electricity consumption is just behind that of Peru;[57] bitcoin consumes more electricity than 159 States;[58] and bitcoin consumes more electricity than the VISA payment system.[59]

It is indisputable that validating transactions with the *Proof of Work* system consumes a lot of electricity and an enormous amount of energy. However, certain elements should be put in perspective. First, critics are assuming that energy consumption is always synonymous with pollution, which is incorrect. Pollution from electricity does not come from the electricity itself, but from how it is produced. A hydropower station does not have the same carbon footprint as a coal power plant when producing one kilowatt-hour of electricity. Presenting consumption figures without specifying how the electricity was produced only gives an abridged view of reality. According to some experts, 70 per cent of the electrical energy used by miners comes from coal power and 30 per cent from clean energy sources.[60] Other experts claim the opposite, since miners approving the transactions are located in countries with cheap energy and few hydroelectric plants.[61] In reality, it is difficult to know, since data

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[54]   For a presentation on Proof of Work and its alternative Proof of Stake see https://blockgeeks.com/guides/proof-of-work-vs-proof-of-stake, accessed 31 May 2018.
[55]   For a presentation on Proof of Work and its alternative Proof of Stake see http://www.phonandroid.com/bitcoin-consommation-energetique-pourrait-causer-mort.html, accessed 31 May 2018.
[56]   See https://www.lesechos.fr/16/01/2018/lesechos.fr/0301129195928_le-bitcoin-est-il-vraiment-une-plaie-pour-la-planete--.htm, accessed 31 May 2018.
[57]   See https://www.theguardian.com/technology/2018/jan/17/bitcoin-electricity-usage-huge-climate-cryptocurrency, accessed 31 May 2018.
[58]   See https://www.sciencesetavenir.fr/high-tech/la-crypto-monnaie-bitcoin-consomme-plus-d-electricite-que-159-etats-dans-le-monde_118729, accessed 31 May 2018.
[59]   See https://www.sciencesetavenir.fr/high-tech/la-crypto-monnaie-bitcoin-consomme-plus-d-electricite-que-159-etats-dans-le-monde_118729, accessed 31 May 2018.
[60]   See https://digiconomist.net/bitcoin-carbon-footprint, accessed 31 May 2018.
[61]   See https://ploum.net/le-bitcoin-va-t-il-detruire-la-planete, accessed 31 May 2018; Andreas M. Antonopoulos explained at a conference in Chicago in October 2017 that if electricity is cheaper in one part of the world it is because the production does not correspond with the local demand. A power plant is not built to cover current

changes based on the quality and performance of the computers being used are hard to verify. Additionally, electricity consumption originating from bitcoin mining constitutes only 0.14 per cent of worldwide electricity consumption, a relatively small amount.[62] In comparison, electronic devices in sleep mode consume between 3 and 12 per cent of domestic electricity consumption.[63]

Only the comparable should be compared. It makes no sense to compare electricity consumption resulting from a full worldwide payment system like bitcoin with household electricity consumption in the USA. The comparison with VISA is also not that relevant, since VISA is only part of the payment system and you would need to take into account the electricity consumed by banks (servers, data centres, infrastructure, clearing houses, etc.).[64] If the entirety of the transaction is taken into account, and not just the part operated by VISA, the electricity consumption is higher than a bitcoin transaction.[65] In 2017, miners consumed approximately 8.27 terawatt-hours, which is less than is used in the global production of cash and coins (11 terawatt-hours per year) and around four times less than for gold mining (32 terawatt-hours per year).[66] Finally, improvements to the *Proof of Stake* validation system are currently being studied and have been implemented by some blockchains (e.g., Dash).

Currently, it cannot be denied that the bitcoin network consumes a significant amount of electricity and that in the long run, it will not be possible to have multiple networks consuming such significant amounts of electricity. However, most current arguments against bitcoin with regard to its power

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consumption, but rather the consumption needs over the next fifteen years. If the plant produces 50 megawatts in a location where the current demand is only 15 megawatts, it cannot be turned off or slowed down. The energy is wasted unless it can be converted to into something with an alternative value, allowing the installation cost to be reimbursed in less time. Bitcoin could thus be thought of as a global environmental subsidy, since it would make it possible to amortize investments in alternative energies in less time; see https://www.youtube.com/watch?v=2T0OUIW89II&feature=youtu.be, accessed 31 May 2018.

[62] See https://themerkle.com/the-real-carbon-footprint-of-cryptocurrency, accessed 31 May 2018.

[63] See Alan K. Meier, 'A Worldwide Review of Standby Power Use in Homes' https://pubarchive.lbl.gov/islandora/object/ir%3A118581/datastream/PDF/view, accessed 31 May 2018; Paolo Bertoldi et al., 'Standby Power Use: How Big Is the Problem? What Policies and Technical Solutions Can Address It?' https://aceee.org/files/proceedings/2002/data/papers/SS02_Panel7_Paper04.pdf, accessed 31 May 2018.

[64] See https://hackernoon.com/the-bitcoin-vs-visa-electricity-consumption-fallacy-8cf194987a50, accessed 31 May 2018.

[65] See https://hackernoon.com/the-bitcoin-vs-visa-electricity-consumption-fallacy-8cf194987a50, accessed 31 May 2018.

[66] See https://www.bloomberg.com/view/articles/2017-12-07/bitcoin-is-greener-than-its-critics-think, accessed 31 May 2018.

consumption are unfair. Power consumption is not always synonymous with pollution and it does not make sense to compare the bitcoin network's power consumption with unrelated consumption figures. However, this should not preclude searching for improvements to a technology as new as bitcoin.

### III.C    The Governance Challenge

Governance is a way of organizing and exercising power by implementing rules that allow an organization to make coordinated decisions within that organization. There is not one, but several layers of governance that interact with each other in the field of the blockchain. Blockchain integrates multiple layers of governance that interact with each other. The first layer consists of the Internet and its protocol (e.g., TCP/IP) and is followed by the actual blockchain layer (e.g., Ethereum) on which smart contracts and decentralized applications are carried out.[67] Each layer obeys its own rules of governance.

Some experts distinguish, correctly in our opinion, two separate mechanisms operating on the blockchain layer: governance by infrastructure embedded in the technology itself and governance of that infrastructure by the community of developers.[68] Governance by the infrastructure embedded in the code of the blockchain implies the technical rules embedded in the blockchain code of the blockchain are themselves self-sufficient and the technology can define and apply the rules immutably and without any external intervention. On the contrary, governance of the infrastructures implies that technology cannot do everything and that the code can, and sometimes must, be modified to adapt to new circumstances. However, the problem is that only a small number of developers are recognized as having the technical skills and legitimacy required to implement such changes, so de facto changes happen in a non-democratic process by a small community of developers.

Human beings cannot be replicated and social interactions cannot solely be governed by code. A minority of developers cannot autocratically make decisions for the majority. The decision-making process cannot only involve those who build the technology (e.g., developers), but must also include those who will ultimately use it and be affected by these decisions (i.e., the users of

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[67]    See   https://maniacgeek.net/forums/topic/le-code-est-la-loi-mais-ce-nest-pas-la-seule-loi-pour- blockchains, accessed 31 May 2018.

[68]    See Primavera De Filippi and Benjamin Loveluck, 'The Invisible Politics of Bitcoin: Governance Crisis of a Decentralised Infrastructure' (2016) 5(3) *Internet Policy Review*, 10 et seq. https://policyreview.info/articles/analysis/invisible-politics-bitcoin-governance-crisis-decentralised-infrastructure, accessed 31 May 2018.

this technology).[69] Projects, such as Dfinity and Tezos, which are currently being developed, embed governance rules with voting systems that make it possible to amend or make retroactive changes to the blockchain based on user votes (on-chain governance).[70] At present, however, the prevailing mode of governance is one in which the decisions are made at a social level between individuals, and then executed and implemented in the protocol by the developers (off-chain governance).

Governance of the blockchain is a major challenge; users must not be reduced to mere spectators and the rules must not be decided by a technocratic minority considering only technical aspects.[71] More than 2 billion people around the world do not have a bank account and do not have access to a financial institution. Never in the history of humanity have social and economic inequalities been so pronounced.[72] A report published by the British non-governmental organization (NGO) Oxfam in January 2018, ahead of the World Economic Forum (WEF), found that in 2017 82 per cent of worldwide wealth benefited the richest one per cent, while the situation remained unchanged for the poorest 50 per cent.[73] Oxfam had already noted in a previous report that eight people hold as much wealth as the poorest 50 per cent (3.6 billion people).[74] Never have inequalities been so stark as in 2017, which saw an increase of $762 billion in wealth held by billionaires, which equates to seven times the amount that would be needed to end extreme poverty worldwide.[75] In a 2018 report on global inequality, researchers with the World Wealth and Income Database (WID) project found that global inequality has been increasing since 1980 and

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[69]  See Primavera De Filippi and Benjamin Loveluck, 'The Invisible Politics of Bitcoin: Governance Crisis of a Decentralised Infrastructure' (2016) 5(3) *Internet Policy Review* 17 https://policyreview.info/articles/analysis/invisible-politics-bitcoin -governance-crisis-decentralised-infrastructure, accessed 31 May 2018.

[70]  See https://medium.com/@FEhrsam/blockchain-governance-programming-our -future-c3bfe30f2d74, accessed 31 May 2018.

[71]  Marcella Atzori, 'Blockchain Technology and Decentralized Governance: Is the State Still Necessary?' (2015) 27 et seq., https://ssrn.com/abstract52709713, accessed 31 May 2018.

[72]  See http://www.businessinsider.fr/uk/the-worlds-unbanked-population-in-6-ch arts-2017-8, accessed 31 May 2018.

[73]  See https://d1tn3vj7xz9fdh.cloudfront.net/s3fs-public/file_attachments/bp-re ward-work-not-wealth-220118-fr.pdf, accessed 31 May 2018.

[74]  See Oxfam Press Release of 16 January 2017, https://www.oxfam.org/en/ pressroom/pressreleases/2017-01-16/just-8-men-own-same-wealth-half-world, accessed 31 May 2018.

[75]  See https://d1tn3vj7xz9fdh.cloudfront.net/s3fs-public/file_attachments/bp-re ward-work-not-wealth-220118-fr.pdf, accessed 31 May 2018.

that 1 per cent of the richest individuals in the world have experienced twice as much growth in wealth as the poorest 50 per cent.[76]

Blockchain has the potential to let individuals directly interact with each other on a global scale, without needing trusted third parties. These individuals will have the power to define their own governance systems in which centralization, coercion and hierarchy are replaced by a distributed consensus mechanism.[77] There is a question as to the responsibility of creators of the technology in promoting civil rights and human rights.[78] Otherwise, the central power will move from failed States to developers and coders, negating the ideology of horizontal governance over a distributed network.

## IV    BLOCKCHAIN: THE BRIDGE BETWEEN THE THIRD AND THE FOURTH INDUSTRIAL REVOLUTIONS?

The situation is similar to that described by the quote attributed to the nineteenth-century German philosopher Arthur Schopenhauer, which states that '[A]ll truth passes through three stages: First, it is ridiculed. Second, it is violently opposed. Third, it is accepted as self-evident'; a revolutionary event usually passes through five steps: denial, anger, negotiation, depression and finally acceptance. Starting with blockchain and the bitcoin, there is no doubt that we are in the presence of a revolution.

First, bitcoin was largely ignored since it was seen as an Internet-based 'geek' money, without mainstream interest or a future. Then came the anger; bitcoin was presented (and still often is) as the money of terrorists, money launderers and drug dealers. Next was negotiation: bitcoins was unsavoury, but blockchain technology was a revolutionary invention, a cog allowing the bitcoin protocol to function. In 2017, bitcoin entered into the depression phase, and then, after ten years of existence, general awareness took hold, with many people imagining that bitcoin could work and be widely used. All that remains is the last stage, acceptance and widespread usage. Does this mean that this revolution is part of a new industrial revolution? We think so.

The Industrial Revolution at the end of the eighteenth century in England started with the advent of the extraction of coal and the construction of steam

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[76]   See WID's Report, http://wir2018.wid.world/files/download/wir2018-summary-english.pdf, accessed 31 May 2018.

[77]   Marcella Atzori, 'Blockchain Technology and Decentralized Governance: Is the State Still Necessary?' (2015) 27 et seq., https://ssrn.com/abstract52709713, accessed 31 May 2018.

[78]   See Kobina Hugues, 'Blockchain, the greater good, and human and civil rights' in Armen T. Marsoobian (ed.), (2017) 48(5) *Metaphilosophy* 654.

engines, which led to a change from small-scale production to a mechanical production system. The Second Industrial Revolution in the late nineteenth century and early twentieth century gave rise to the exploitation of new energy sources, such as oil and electricity, leading to an explosion in productivity and the beginning of globalization. The Third Industrial Revolution, generally considered to be at the end of the twentieth century, was launched by new information and communication technologies (ICT) using information technology to automate production. The Fourth Industrial Revolution is digital and will radically change our way of life, thinking, working, travelling and communicating. Its speed is exponential and without precedent. As far as a paradigm change, Satoshi Nakamoto's blockchain (although his 2008 white paper did not use the term)[79] can be considered to be the symbol of the Fourth Industrial Revolution, similar to James Watt's 1781 steam engine and the First Industrial Revolution.[80] Coupled with robotics, artificial intelligence, the Internet of objects, etc., blockchain will profoundly modify the social, cultural, political and legal landscape.

## V    CONCLUSION

Blockchain is not restricted to bitcoin-based money transfers and its use goes well beyond being a payment method. In some ways, blockchain technology can be considered a symbol of the Fourth Industrial Revolution. Blockchain, in conjunction with smart contracts, has the potential to create new forms of organizations that will eventually lead to the recognition of a new type of digital enterprise whose Articles of Association will be encoded and whose shares will replaced by tokens. However, blockchain will also have to address some inherent problems, such as technical, regulatory, environmental and governance challenges. The opportunities and challenges are many, but they are exciting.

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[79]   See https://bitcoin.o/bitcoin.pdf, accessed 31 May 2018.
[80]   See Kobina Hugues, 'Blockchain, the greater good, and human and civil rights' in Armen T. Marsoobian (ed.), (2017) 48(5) *Metaphilosophy* 654.