INTELLECTUAL PROPERTY AND BLOCKCHAIN: THE CASE OF DIGITAL ART

Abstract

Blockchain is a revolutionary technology the full potentiality of which is understood when analysed in connection with Intellectual Property ("IP") law. Not only IP is relevant when it comes to the protection of this innovative technology, but also can this technology be applied in several areas for the purpose of improving the exploitation of IP rights. In this respect, digital art offers interesting examples of how the technology can be used to provide digital artists with unprecedented protection of their IP rights, in so doing, contributing in promoting creativity in this particular field.

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B.   Introduction

In recent years, "blockchain" has become a preeminent buzzword in several legal circles.[1] For its alleged ability to store information and revolutionize the way in which transactions are made, the excitement about this technology is soaring in many fields, from finance to art. Especially in traditionally unregulated markets, like the art one, this seems to implies greater opportunities for people to appreciate, own and sale goods, as well as for companies to start profitable businesses. Yet, there is still great unfamiliarity with the underpinning technology, while there is low awareness about the important role of Intellectual Property ("IP") law in the process of full exploitation of the potentialities of this technology.

Starting from clarifying which are the main features of this technology, the purpose of this work is emphasizing the relevance of IP law in the protection of this innovative technology, as well as critically assessing the potential uses of this technology for the purpose of management and enforcement of IP rights. In this respect, digital art[2] offers interesting examples of how the technology can be used to ensure stronger protection to these rights and, in so doing, contributing in promoting creativity in this particular field.

For the sake of clarity, the work is divided in two parts. Part 1 frameworks the topic of the intersection between IP and blockchain. In particular, Chapter 1 contains an explanation of the functioning of the technology and introduces the important concept of tokenisation of physical and digital properties. Then, Chapter 2 includes an overview of the IP rights that are relevant in the protection this technology, including the topics of open source software, patentability of software-related inventions and the possible qualification of the information recorded on blockchain as copyrightable subject-matter. Due to the potential application of the technology across national borders, reference is made to IP laws of different jurisdictions. Finally, Chapter 3 is dedicated to the use of blockchain technology in the context of management, protection and enforcement of IP rights, in particular, in the digital

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[1] 'Survey: 'Blockchain' Was Most Overrated Buzzword' (*Bitcoin.com*, 18 February 2019) <https://news.bitcoin.com/survey-blockchain-was-most-overrated-buzzword-of-2018/> accessed 17 August 2020

[2] Digital Art differs from traditional art because it is made or presented using digital technology. See 'Digital Art' (*Tate Modern, Art Term*) <https://www.tate.org.uk/art/art-terms/d/digital-art > accessed 17 August 2020

environment. Afterword, Part 2 of this work focuses on the possible applications of blockchain technology in the field of digital art, assessed under an international and comparative copyright law prospective. In particular, Chapter 4 starts from a study conducted on the subject of copyright and digital art which showed how hard is for digital artists to enforce the copyright in their works in a world of 'digital abundance'. Based on that, it is assessed whether blockchain can help to resolve this problem. Finally, in Chapter 5 it is examined the possibility of tokenizing copyright on future artworks for the purpose of obtaining funds for proceeding with the creation thereof. A number of legal issues, including copyright ownership, assignment of rights on future works and copyright assignment formalities, are subject to examination. The conclusions take into account either the legal and the practical aspects of all these issues.

C.   Part I

1.   Blockchain Technology

Blockchain technology is a type of database, meaning a structured collection of information, which is managed by an algorithm and utilizes certain cryptographic functions in order to achieve the identity authentication of those who operate on the blockchain, as well as the integrity of the data recorded therein. Due to its features, this technology is commonly used to track transactions and, therefore, it is often referred to as a *ledger*.[3] The requirement of the identity authentication is achieved through a system of public and private keys which allows the authentication of the party or parties associated with each transaction.[4] In terms of data integrity, the relevant technical component is the hash function, which creates a persistent, temper-evident record of the transactions.[5] Another important feature of the

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[3] Jean Bacon, Johan David Michels, Christopher Millard and Jatinder Singh, 'Blockchain Demystified: a Technical and Legal Introduction to Distributed and Centralized Ledgers' (2018) 25 Rich JL & Tech 1, 5

[4] *Ibid*, 14

[5] Hashing involves putting a data item (e.g. the content of a document) through a hash function. This function creates a string of digits that are unique to the input data item. Because it is practically impossible for two different data items to have the same hash value, hashing can be used to prove integrity of the input data. Hash factions can also be used to link together multiple data items ("blocks"), thought a system which combine the latest data item with the hash value of the precedent data item (i.e. hash pointer function), in order to prove the integrity of the data items, as well as their content and their sequence. *Ibid*, 12

technology is that the data are simultaneously stored on many computers (for this reason we often refer to blockchain as a *distributed* ledgers technology). The replication of the data makes the system resilient to attacks because, even if one or several nodes of the system fail, the data remain unaffected.[6]

It is important to remark that there is not a single kind of blockchain, but several of them, depending on who controls the transactions, whether the transactions are visible to the general public and whether its users can be identified.[7] This makes this technology extremely versatile and potentially useful in several fields, from finance to art.[8]

Cryptocurrencies, like Bitcoin and Ethereum, are the original and most well-known applications of blockchain technology.[9] One of the main features of these digital currencies is that the parties can transact directly (peer-to-peer) without the intermediation of a trusted third party which controls the transaction, but relying on a distributed consensus protocol that enables the verification of the transactions in the absence of a centralized point of control.[10] Another important feature which characterizes these blockchains is that the system is open and permissionless, in order to create a currency that can be used by anyone. As a

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[6] Michele Finck and Valentina Moscon, 'Copyright Law on Blockchains: Between New Forms of Rights Administration and Digital Rights Management 2.0' (2019) 50(1) International Review of Intellectual Property and Competition Law 77, 80

[7] The control over the technology implies the power to store the current version of the blockchain, the possibly add blocks in it and the control on the functioning of the system. In terms of visibility, we remark that the latest Bitcoin transactions, for example, are available to view online at <www.blockexplorer.com> (accessed 17 August 2020) which include information about the sending Bitcoin address, the receiving Bitcoin address and the amount of the transaction. However, there are no information linked to the real world identity of the parties. For differences between blockchains, see J. Bacon et al. (3), 12

[8] For an updated list of potential blockchain technology applications across finance, business, government, and other industries see 'The Growing List of Applications and Use Cases of Blockchain Technology in Business and Life' (Business Insider, 2 March 2020) <https://www.businessinsider.com/blockchain-technology-applications-use-cases?IR=T> accessed 17 August 2020

[9] Blockchain has been actually invented in 2008 by Satoshi Nakamoto (a pseudonym, probably adopted to represent a group of people) to serve as public ledger for cryptocurrency (i.e. Bitocoin) transactions, which used a peer-to-peer network to solve the double-spending problem without the need of a trusted authority or central server. The results of this research and development activity have been published in 2009 on the Bitcoin's website. See Satoshi Nakamoto, 'Bitcoin: A Peer-to-Peer Electronic Cash System', <https://bitcoin.org/en/bitcoin-paper> accessed 17 August 2020

[10] Bitcoin and Ethereum platforms are known for enabling a so called "trustless environment", because the participants to the transactions do not need to trust each others. See J. Bacon (3), 7

result, public visibility and user anonymity are also essential for the functioning of these payment systems.[11]

Then, blockchain technology's original properties and features have been adapted to serve purposes other then payment.[12] In these cases, blockchains may consist of closed or permissioned systems, where the participation is limited to a certain group of approved users. This generally requires the users to have a certain level of trust, either in a small number of them or toward a single centralized trusted third party which controls the transactions. These closed or permissioned systems, while avoiding costly consensus protocol by re-introducing a trusted intermediary that controls the transactions, can still offer a better transparency and safeguard as regards to data integrity compared to traditional databases. In addition, these more centralized systems can limit the visibility of the blockchain to a certain number of parties or requiring the real-world identity of the user to be established rather then hidden.[13]

In any case, it is important to remark that not only cryptocurrencies can be transferred via blockchain, but also other kind of digital property: the tokens. A token is a unique string of numbers that can be used as a digital representation of a physical or digital asset. What make blockchain-based tokens special is that they cannot be copied, forged or altered in any way. Also, tokens can be transferred from one person to another as they were physical goods, so that when someone transfers a token over the blockchain, they cannot transfer it twice or take it back without the consent of the transferee.[14]

Since tokens are unique piece of information which can be associated to a digital good and transferred (not simply copied) between two parties over the Internet, they are able to create

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[11] *Ibid.*, 6. Even though each transaction record is public, Bitcoin and Ethereum users enjoy anonymity by using their addresses as pseudonyms. Anonymity may represent either a incentive or barrier to the adoption of this technology, depending on the final aim of the users.

[12] We can distinguish the early platforms that have applied blockchain technology in open, permission-less ways to create distributed ledgers (e.g. Bitcoin), from new applications of the technology which implemented closed and permissioned platforms, including centralised ledgers systems. See J. Bacon et al. (3), 28-33

[13]*Ibid*, 30

[14] Katya Fisher, 'Once Upon a Time in NFT: Blockchain Copyright and the Right of First Sale' (2019) 37(3) Cardozo Arts & Entertainment Law Journal 629, 631

digital scarcity.[15] In fact, tokenization allows a digital good to become unique and immutably linked to its owner, who can have full control over it until transferred to another person. The possibility to verify ownership of tokenised digital goods allows their creator to decide the level of digital scarcity that he or she believes is right for the good to be sold, at a price level that makes the sale more convenient.[16]

Finally, it is important to remark that blockchain applications can either feature single standalone transactions, like a transfer of cryptocurrencies from one party to another, or more complex series of related, sequential or conditioned, transactions.[17] In fact, these series of transactions can be computerised and automated ("smart contracts")[18] and recorded on certain blockchains.[19] It is important to remark that a smart contract is not a contract in legal terms, but a computer program that automate agreements between parties according to the set of instructions written into their code.[20] Considering that smart contacts included on blockchain benefit from the temper-proof nature thereof, we see that this technology may enable transactions in situations devoid of human or institutional trust, reducing transaction costs and risks.

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[15] Digital scarcity is a fairly new concept and refers to the creation of scarcity in the digital landscape. For an insight on how the blockchain has introduced digital scarcity, see Alex Lielacher, 'How Virtual Cats Are Teaching Us About Digital Scarcity' (*Brave New Coin*, 19 December 2017) <https://bravenewcoin.com/insights/how-virtual-cats-are-teaching-us-about-digital-scarcity> accessed 17 August 2020

[16] Bitcoin and CryptoKitties are two examples of how digital scarcity can create value.

[17] For example, the process of international transfer of goods.

[18] A smart contract is a concept introduced by Nick Sazabo in 1994 and defined as a computerized transaction protocol that execute the terms of the contract. See Scott A McKinney and Rachel Landy and Rachel Wilka, 'Smart Contracts, Blockchain, and the Next Frontier of Transactional Law' (2018) 13 Wash J L Tech & Arts 313, 316.

[19] Ethereum can be used as a platfrom to run a wide array of applications expressed in smart contracts, while Bitcoin platfrom can not. As a result, we can differenciate between Ethereum as a platfrom and Bitcoin as a digital currency. See Paolo Tasca and Caudio Tassone, 'Taxonomy of Blockchain Technologies. Principles of Identification and Classification' (2017) <https://arxiv.org/abs/1708.04872> accessed 17 August 2020

[20] For example, the software can be used for automatic transfer of collateral in the event of default. Automated execution, however, also have disadvantages, because the unwanted transactions cannot be tolled back. See M. Finck and V. Moscon (6), 80

In light of the above, we realize that blockchain is a general-purpose technology that can be used for a wide variety of uses and, consequently, it is significant from a legal prospective under several point of views.[21]

One of the main area of interest, it is definitely IP law. In fact, on the one hand, several IP rights are relevant when it comes to the protection of such innovative technology, on the other hand, considering that this technology enables a secure and incorruptible chain of information, it can be applied in the context of management, protection and enforcement of IP rights.[22]

2.   Protection of Blockchain Technology Through IP Rights (*brief remarks*).

Various forms of IP may be applied to protect different aspects of blockchain technology.

The core component of this technology is represented by a software which source code is collaboratively produced, freely shared and transparently published (i.e. an open source software).[23] This does not mean that the software is in the public domain, because the software is still under copyright, but its authors grants users a license to freely use and modify the software.[24] Also, the copyright concerning any modification and improvement of the code shall be managed according to the same terms and conditions of the original software. [25]

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[21] A number of issues arise under contract law, security law, property law and company law, as well as intellectual property law. In addition, because the use of such technology entail the processing of data, also data protection law issue may arise. See J. Bacon et al. (3), 50

[22] 'Crypto-Pie in the Sky: How Blockchain Technology Is Impacting Intellectual Property Law' (2019) 2 Stan J Blockchain L & Pol'y 1

[23] This is the case for the major cryptocurrency and open blockchain project. In particular, the Bitcoin core is the result of over 15,000 unique code contributions from over 450 unaffiliated individual developers. See Peter Van Valkenburgh 'What Is Open Source and Why Is It Important?' (*Coin Center*, 17 October 2017) <https://www.coincenter.org/education/advanced-topics/open-source/> accessed 17 August 2020. For a definition of open source software, see the one provided by the Open Source Initiative, which is the the community-recognized body for reviewing and approving open source licenses. 'The Open Source Definition', <https://opensource.org/about> accessed 17 August 2020

[24] Open source software and public domain software are not the same thing, but there is some overlap. For a short explanation of the difference and similarities between the two, see: "Does Open Source Qualify as Being Part of the Public Domain?" (Open Source Stock Exchange, March 2020) <https://opensource.stackexchange.com/questions/55/does-open-source-qualify-as-being-part-of-the-public-domain> accessed 17 August 2020

[25] For example, Bitcoin core software is available for free use and modification under the permissive MIT copyright license. See Alessandro Mezzi, 'Open-source Licensing and its trends in Blockchain' (*Medium*

However, some companies could also file patent applications for improvements of the existing blockchain technology (for example, as to the security or encryption technique), provided that these are novel, non-obvious technical solutions capable of industrial application.[26] In this respect, it shall be remarked that blockchain-related invention applications need to be carefully drafted to ensure that the patent claims cover patentable subject matter. In fact, in several jurisdictions computer programs are expressly excluded from patent protection,[27] unless the computer program has a technical effect.[28]

Other companies might rely on trade secret to protect blockchain-related innovations, in preference to patents.[29] In fact, the patent application may excessively delay the bringing of the technology into the market, while the costs of filing a patent might just be prohibitive for start-up business. However, this choice might be not available for those who need to seek investments for their R&D activities, because applying for a registered patent and related monopoly may be a prerequisite for securing the funding. Furthermore, the protection of

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Corporation, 2 July 2018) <https://medium.com/@info_45047/open-source-licensing-and-its-trends-in-blockchain-b40e085c3749> accessed 17 August 2020

[26] Blockchain technology has generated the filing of numerous patent applications for blockchain-related inventions in recent years. For example, Accenture has obtained a patent for an editable blockchain technology. See Stan Higgings, 'Accenture has been awarded a patent tied to its work on an "editable blockchain' (*Coin Desk*, 28 September 2017) <https://www.coindesk.com/accenture-awarded-patent-editable-blockchain-tech>

[27] Together with schemes, rules and methods, software are expressly excluded from patentability in several jurisdictions, as well as at international level. See, for example, Section 1(2)(c) of the UK CDPA, Article L611-10 of the French IP code, as well as article 52(2)(c) of the European Patent Convention. In the US, instead, patent law does not expressly exclude the patentability of software and case law is still in the process of clarifying the boundary between patent-eligible and patent-ineligible subject matter in respect to computers and software. So far, patentability of software as such has been excluded in case All Voice Developments US, LLC v Microsoft Corp. (2015) 612 F. App'x 1009, while the United States Supreme Court ruled in Alice Corp. v CLS Bank International (2014) 573 U.S. 208 that software instructions as such are too intangible to fit within any of the statutory categories of patentable subject matter.

[28] In case Computer Program Product v IBM (1998) T 1173/97 of 1 July 1998, the Board of Appeals of the European Patent Office stated that not all computer programs are excluded for patentability, but only "computer programs as such" referring to those that have non-technical in character. For a short overview of patentability of software-related invention internationally, see Ania Jedrusik 'Patent protection for software-implemented inventions' (*WIPO Magazine*, February 2017) <https://www.wipo.int/wipo_magazine/en/2017/01/article_0002.html> accessed 17 August 2020

[29] Trade secrets are IP rights on confidential information. Generally, to qualify as a trade secret, the information must be: commercially valuable because it is secret, known only to a limited group of persons, and subject to reasonable steps taken by the rightful holder of the information to keep it secret, including the use of confidentiality agreements for business partners and employees. Trade secret protection has recently seen a renaissance due to the enactment of the US Defend Trade Secrets Act 2016 (18 U.S.C. § 1836) and the EU Directive 2016/943 on Trade Secrets. For an overview of the main features of trade secret protection, see: "Trade Secrets" < https://www.wipo.int/tradesecrets/en/ > accessed 17 August 2020

blockchain innovation via trade secret has been subject to criticism by those who believe that blockchain technology should be developed on an open innovation basis, because allowing interoperability of developments is considered the best way to support the success of this technology.[30]

Turning our attention to the content recorded on the blockchain, we remark that in many jurisdictions this mass of information could also be subject to separate copyright protection, as a database – provided that the selection and organization criteria are original. [31] In fact, since the blockchain technology records and organizes information in blocks, many blockchain applications could qualify as such. However, this is not the case when the selection and organization criteria are mandated by technical reasons, based on a platform's desired functionality. In fact, to attract copyright protection, the author of the database must have expressed his creative ability in an original manner by making free and creative choices in organizing the content.[32]

Finally, under EU copyright law, also the makers of a non-original blockchain database may obtain certain *sui generis* exclusive rights when they have undertook a substantial investment in obtaining, verifying and presenting the blockchain's content.[33] In fact, it can be argued that the operators of a new, *centralised* blockchain platform make a substantial investment in writing the blockchain software and then dedicating hardware to running the necessary

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[30] 'Crypto-Pie in the Sky: How Blockchain Technology Is Impacting Intellectual Property Law' (2019) 2 Stan J Blockchain L & Pol'y 1, 9

[31] Directive 96/9/EC on the Protection of Database defines a database as "*a collection of independent works, data or other materials which are arranged in a systematic or methodical way and individually accessible by electronic or other means*". According to the EU Court of Justice's case law, to attract copyright protection, the the author must have expressed his creative ability in an original manner by making free and creative choices in setting up the database. See Case C-604/10 *Football Dataco Ltd and Others v Yahoo! UK Ltd and Others* (Judgement of 1 March 2012) about the protection of database and case C-145/10 *Eva-Maria Painer v Standard VerlagsGmbH and Others* (7 Judgment of March 2013) on the requirement of "free and creative choices" for copyright protection under EU law. In the USA, databases can only also be protected by copyright as compilations (as defined in Section 101 of the US Copyright Act), provided that the selection of the material involves some creative expression. For an overview on this subject, see 'Database Protection in the USA' (*Ius Mentis, 2 October 2005*) <https://www.iusmentis.com/databases/us/> accessed 17 August 2020

[32] J. Bacon et al. (3), 97

[33] The database *sui generis right* is owned by the maker of the database, meaning the person who takes the initiative and the risk of investing. According to Article 7 of Directive 96/9/EC on the Protection of Database, the maker is the one who made qualitatively and/or quantitatively substantial investments in either obtaining, verifying or presenting the database contents and, consequently, he has the right to prevent extraction and/or re-utilization of the whole or of a substantial part thereof.

technology for the verification of the transactions.[34] Given the above, certain blockchain databases may be protected under the *sui generis* right. In this case, the right holders of a centralised platform would have the right to prevent extraction and re-utilization of (all or a substantial part of) the contents of that database.[35] This may be relevant where a third-party takes an existing blockchain database as the basis for starting a new blockchain platform.

On the other hand, it seems more difficult for *distributed* ledger platforms to qualify for this *sui generis* protection. In fact, various groups of people generally contribute in the creation of this open, distributed blockchain, with developers writing the initial software and users investing in hardware that stores and updates the database – and it is unclear whether these activities, taken separately, amount to substantial investments and, if so, which of these activities would suffice for a party to qualify as one of the database makers.[36]

In light of the above, it is suggested that those investing in a blockchain-based platform consider the essential role that IP law has in the profitable exploitation of this technology, taking into account that several IP rights may protect different aspects of this technology, so it is important for them to implement a comprehensive IP strategy from the beginning.

3.   Use of Blockchain Technology in the Context of Management, Protection and Enforcement of IP Rights

The potential use of blockchain technology in the context of IP management, protection and enforcement is vast.

First of all, IP offices may consider recording IP rights on a blockchain rather then a traditional database in order to better tracking the life cycle thereof (application, first use, licensing or assignment), reducing the costs related to IP auditing or due diligence exercise in the context

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[34] As clarified by the EU Court of Justice, an investment in the presentation of the content of a database concerns "*the resources used for the purpose of giving the database its function of processing information, that is to say those used for the systematic or methodical arrangement of the materials contained in that database and the organisation of their individual accessibility*". See Case C338-02 *Fixtures Marketing Ltd v Svenska Spel AB* (Judgment of 9 November 2004).
[35] Article 7 Directive 96/9/EC on the Protection of Database
[36] J. Bacon et al. (3), 98

of IP transactions. In this respect, it can be argued that the public nature of the information recorded via distributed ledger technology is in contrast with the need for confidentiality required by some IP owners. However, this need can be addressed with the IP offices implementing op-in schemes, according to which only the IP owners who are interested in improving the "smartness" of their IP rights can join in, while the others are free to remain with their traditional and less-smart titles. [37] Then, the newest generation of blockchain, which combines private and public elements, could also help to address this concern.[38]

Secondly, products incorporating IP rights (e.g. fashion apparel, artworks, innovative devices) might be embedded with blockchain-connected tags or engravings, including legal and other information from the IP owners as to the provenance of the products. Here, blockchain technology could allows for provenance authentication since it can record objectively verifiable details about when and where products are made, as well as details about their manufacturing. While the idea of using interactive tags for anti-counterfeiting purposes is not new, the benefit of using blockchain-connected tags is that the information recorded are unable to be altered, corrupted or copied by bad actors.[39]

Thirdly, blockchain technology could play an important role in the context of protection of unregistered IP rights, such as copyright, since it can provide evidence of the creation of the work and other protection requirements, as well as whether the right is still in the period of protection. In fact, blockchain can be used to create a time-stamped record and a solid evidence to prove these matters, so that each creative work is provided with a unique cryptographic identity verifiable with a blockchain solution.[40]

The potentiality of this technology for IP enforcement becomes then extremely evident in fields in which the management and enforcement of the rights has been traditionally very

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[37] Recording IP rights in a distributed ledger rather then a traditional database could effectively turn them into "smart" IP rights. See Birgit Clark 'Blockchain and IP Law: A Match made in Crypto Heaven?' (WIPO Magazine, February 2018) <https://www.wipo.int/wipo_magazine/en/2018/01/article_0005.html> accessed 17 August 2020
[38] 'Crypto-Pie in the Sky' (30), 4
[39] Traditional anti-counterfeiting tags are more prone to corruption because are linked to a single source of information. See *Ibid*, 5
[40] *Ibid*, 5

difficult to achieve, like in the case of copyright in the digital environment. In fact, while digital technologies have radically changed the way in which creative contents are created and disseminated, copyright has faced considerate challenges to adapting its contours to in this new environment and ensuring effective protection to copyright owners. Blockchain is a technology which is particularly suited to meet this challenges, because it can allow a control over the reproduction and tracking of dissemination of the copyrighted work online.[41]

Lastly, smart contacts executed and monitored by blockchain platforms could be used to establish and enforce IP agreements, such as licenses, and to allow transmissions of payments in real time to IP owners. In this prospective, by allowing instant and secure micropayment, blockchain technology could redefine how creators are remunerated and consequently, incentivise the creative process. This is particularly important in the copyright domain, when blockchain and blockchain-based smart contracts may become an alternative to the current forms of Digital Right Management ("DPM").[42]

The above considerations demonstrate that blockchain applications in the field of IP have great promise and it is suggested to IP owners to benefit from the adoption of this new technology for the purpose of management, protection and enforcement of their rights.[43]

D.   Part II

4.   Enforcement of Economic and Moral Rights in Digital Artworks Through Bockchain Technology

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[41] Frederick Mostert, 'Digital tools of Intellectual Property Enforcement: their intended and unintended norm setting consequences' in Tanya Aplin (edited by) Research Handbook on Intellectual Property and Digital Technologies, January 2020, 4

[42] DRM refers to software and hardware that defines, protects and manages the rules for accessing and using a digital content, together with the information concerning its use. This system has been used since the 1990s to enforce copyright and neighbouring rights protection, after that the dematerialization of copyrighted materials has made them more easily accessible, copy-able and editable. See M. Finck and V. Moscon (6), 81.

[43] It is actually essential for IP owners to exploit as soon as possible the potentiality of this technology for strengthening the protection of their intangible assets. In fact, considering the anonymity feature which characterize some blockchain, some concerns have been raised about the possibility of using of cryptocurrency for hiding financial gain deriving from counterfeiting activities, so as that strengthening the protection is actually a matter of urgency. See F. Moster (41), 8

Interesting examples of how blockchain technology can be used to ensure full exploitation and protection to IP rights can be found in the field of digital art. In fact, more than in other fields in which creative content is created or disseminated in digital form, digital artists appear extremely affected by the proliferation of unauthorized copies of their works online.

A recent study on this subject has shown that those artists tend to consider the enforcement of their economic rights[44] as neither personally important nor crucial for funding and sustaining their creative activities.[45] However, the reason for this scepticism toward the copyright system is found in a general lack of belief among digital artists about their ability to effectively prevent the unauthorized copying and distribution of their artworks. This is not only the result of the actual difficulty to control any potential copying or sharing of their works on the net, [46] but also because copyright is perceived to be useful only for those who can afford the costs of its enforcement. As a matter of fact, the majority of digital artists do not have the money to afford lawyers and to bring matters to court.[47]

One of the consequences of this lax approach, however, is that digital art is often not perceived by the general public as something valuable and, as a result, it is not truly profitable for the artists.[48]

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[44] In terms of economic rights, national laws adopt different definition thereof. In some countries, copyright legislation provides detailed media-specific definition of the various restricted acts (e.g. UK). Other, apply a broader and more abstract notion of "reproduction" and "communication to the public" (e.g. France). However, in terms of reproduction, Article 9 (1) of the 1971 Berne Convention defines it as the exclusive right to make copies of the copyrighted work in any manner or form. According to the WIPO Guide to the Bene Convention, this definition is wide enough to include all methods of reproduction and al process known or yet to be discovered and in the WIPO Copyright treaty has been clarified that this article fully applies also in the digital environment. As a result, also storing work in any medium by electronic means consist of an act of reproduction.

[45] Smita Kheria, 'Copyright and Digital Art: Through the Looking Glass' (2015) University of Edinburgh Research Paper, 2012/19, 6

[46] The intangible nature of the piece of art, together with the potentiality of the net, which knows no boundaries between countries, make copying extremely easy in terms of quantity, quality and time wise. Consequently, it is often not convenient for the copyright owner to enforce the copyright in court – supporting high costs – to stop the single sale of a pirated content on line. See Advisory Committee on Enforcement, *Study on IP Enforcement Measures, Especially Anti-Piracy Measures in the Digital Environment*, document prepared by Frederick Mostert, 23 July 2019, 2

[47] S. Kheria (44) , 13

[48] As long as a digital artwork can be copied identically, it is difficult for the artist to build a market around its digital art. In fact, if one could very easily make an identical copy of a digital artwork, it is questioned how the artist can prove his or her work is the original and sell it as a unique piece. 'Understanding Digital Art & Blockchain — the basics for digital artists' (*Medium*, 27 November 2019) <https://medium.com/codexprotocol/understanding-digital-art-blockchain-the-basics-for-digital-artists-457eacbb23e6)> accessed 17 August 2020

Based on the fact that digital artists appear to challenge the importance of copyright law more for practical reasons, it is submitted that blockchain could really help them to gain trust in the copyright system again, because they may exploit the potentiality of this technology to control the reproduction and tracking of dissemination of their works online. [49] In fact, by recording a digital artwork on a blockchain, the piece of digital art actually becomes associated with a token that cannot be replicated or transferred unless there a consensus as to the validity of the related transaction. In other words, artists can exploit the ability of blockchain technology to produce digital scarcity to create unique pieces of digital art which cannot be replicated or disseminated without permission, and this would make copyright enforcement easier and more accessible to them.

Another benefit of having a piece of digital art recorded on blockchain is that it becomes attributable to its author.[50] In fact, acting as a public record, blockchain would makes possible for anyone to verify the authenticity and the provenance of a digital work in a way that was impossible before. As a result, I would argue that blockchain does not only permit digital artist to better enforce their economic rights, but also their moral right of attribution[51] – which is something they consider particularly valuable despite their scientism toward the copyright system.[52] This would definitely contribute in making digital art perceived as something more valuable by potential buyers.[53]

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[49] Jessica Bookout, Lauren Cimbol, Shannon Leigh Collin and Devin L. Newman, 'Brief Introduction to Digital Art & Blockchain' (2019) Cardozo Arts and Entertainment Law Journal 553, 555
[50] *Ibid*. 557
[51] Moral rights are recognized in most jurisdictions, especially to authors of visual arts, and essentially comprise the right of attribution and the right of integrity (against modifications that damage the reputation of the author), as defined in Art. 6-bis of the Berne Convention. Like the economic rights, moral rights are also challenged by the digital environment. Also note that no legal developments have taken place to clarify, harmonize or strengthen the scope of moral rights protection and some countries (like the UK and the US) take a rather minimalist approach to moral rights, so as that the protection awarded is weaker than many European countries, and remains so after the digital invasion. For an insight into moral rights in UK and US, see Jane Ginsubrg, 'Moral right in the common law system' (1990) 1 Entertainment Law Review 121-122. For an insight into moral rights in France see Elizabeth Adeney, 'The Moral Rights of Authors and Performers', Oxford, OUP, [2006], 163 - 215.
[52] S. Kheria (44), 16. The study recently conducted on the subject shows that digital artists perceive the right of attribution (including its other side, the right of false attribution) as necessary for promoting and building their artistic reputation, which is considered their main asset.
[53] An artwork has value when it is unique or authentic, and with blockchain, digital art can be measured within the same parameters as physical or traditional art.

In addition, when a token is created to represent a piece of digital art, each time the token is transferred, a smart contract can be used to automatically make a micropayment back to the artist, so as that digital artists can also benefit for the increasing value of their artworks over time, even when they no longer have control on them. As a result, I would also argue that blockchain could provide digital artists with as a sort of contractually-based resale right.[54]

All the above considerations can evidently have a practical impact on the work of digital artists, who can start finally benefitting from their creative activity to the fullest extent. As a result, we see that a number of companies applying blockchain for this purpose have already sprung.

A notable example is Rare,[55] which uses blockchain technology to offers digital artists and collectors a secured market place to trade artworks.[56] The solution offered by Rare consists in providing digital artists with the possibility to tokenise a piece of their art, so as that the corresponding token attest that the work is authentic and truly rare, and then to trade them in a safe environment. Rare's business model includes three steps. First, the artist makes an artwork using any digital form of expression and uploads it on the platform. Then, Rare actively works to verify that the art is authentic,[57] meaning that it truly comes from the said artist, and only then it creates a token using the Ethereum platform, which uniquely identify the file with an hash function. Finally, collectors can buy the artworks using their ordinary credit card, receiving an high resolution file of the artwork, as well as the corresponding token.[58]

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[54] Resale right entitles visual artists or their heirs to receive a percentage of the value of certain resale of their works, in order to permit them to benefit from the increasing value of their works overtime. The royalty is paid by the seller of the work and is usually calculated as a percentage of the sale price. The right proved especially popular in civil law countries. For example, the resale right has been codified in France in 1920, while in the UK this right has been introduced only in 2006, following the EU Directive 2001/84/CE on the resale right for the benefit of the author of an original work of art. In the USA, no resale right exists to date, except for the State of California, but there is currently a proposal to introduce a federal resale royalty law for American artists. See Stephanie B. Turner, 'The Artist's Resale Royalty Right: Overcoming the Information Problem' (2012) UCLA Entertainment Law Review, Vol.19:2 330, 338

[55] 'R.A.R.E. Discover, Collect and Display Limited-Edition Digital Art' <https://www.rareart.io/> accessed 17 August 2020. Similar initiatives are those of Codex and KnownOrigin.

[56] Rare funders realized that the problem for most digital artist is that digital art does not pay: the primary mean of making money is free lance and work on project commissioned by other people. Only the highest level of artists can find their own voice and express themselves freely.

[57] There is an application process, where Rare verify the artist portfolio, then they decide to represent the artist.

[58] The token is delivered in an easy on demand crypto-wallet which service is provided by Portis.

By providing digital scarcity and authenticity verification of digital artworks, blockchain-based platforms as Rare appear to finally permit digital artists to effectively enforce their economic and moral rights on their creations. If we also consider that the all process does not seem to involve high costs on the artist's side, it is easy to image that more and more digital artists will adopt this solution. As a consequence, it is reasonable to argue that in the near future the value of digital art will increase and digital artists will be likely to increase the production of digital piece of art. Ultimately, this is one of the purpose of granting effective copyright protection.[59]

5.   Art Projects & Copyright Tokenization

Like other form of technology, blockchain could also play an important role in the process of creation of digital artworks, further promoting and incentivizing the creation thereof.

For example, it seems that artists can use blockchain to tokenise the copyright in their future artworks and sell the tokens to a crowd of investors to attract funds to sustain their creative activity. This opportunity seems possible thanks to a blockchain-based platforms which allows creators and innovators to tokenise and sell the IP in their future creations or innovative projects. [60]

This practice rises however a number of issues under a copyright law prospective, which need to be examined.

Tokenization and Copyright Ownership

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[59] The economic justification for copyright protection focuses on the need to provide incentives for creation and dissemination of creative works. See "Justifying Copyright" in D. Mc Clean and K. Schubert (eds.) Dear Images: Art, Copyright and Culture (*Manchester: Ridinghouse*, 2020) 389- 403.
[60] Innovation Network is said to be the world first blockchain-powered crowdfunding platform, which empowers innovators to tokenize the IP in their innovative projects and to sell to investors those tokens in a systematic and compliant manner. See 'Innovation Network, Tokenizing Innovation' <https://www.innovation.net> accessed 17 August 2020

The first issue to be examined is whether copyright can be divided into multiple shares (tokens) and owned by different persons.

In most jurisdictions, copyright in a single work can be divided and simultaneously owned by different persons. This situation can either emerge as a consequence of the participation of multiple people in the creative process or due to a subsequent partial assignment of exclusive rights.

In case of multiple people participating in the creative process, this may entail they become joint authors of the resulting work. Depending on the jurisdictions, there are different requirements and consequences for a finding of joint authorship,[61] however the common principle is that joint authors hold their rights as owners in common (in equal shares), so the consent of all is required before any right be exercised. [62]

It has been noted that the legal framework surrounding works of joint authorship does not suit the case of copyright tokenisation, as it would result in all token-holding parties having equal share in the copyright and this is unlikely to fit the purpose of the artist who would need their prior permission before using the work in a manner that triggers copyright (e.g. reproduce, perform, make available online, etc.).[63] I agree with is conclusion and I also note that the purchase of a copyright token alone cannot be considered as a creative contribution in the resulting work, so as that a finding of joint authorship would not possible in any case.

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[61] For example, in the UK, a "work of joint authorship" is a work produced by collaboration of two or more authors in which the contribution of each is not distinct from that of other authors (section 10(1) of the UK CDPA). In the US, a "joint work" is a work prepared by two or more authors with the intention that their contributions be merged into inseparable or interdependent parts of a unitary whole (section 101 of the Copyright Act). In France a "collaborative work" is a work in the creation of which more than one natural person has participated (Art 113-2 of the of Intellectual Property Code).

[62] Under UK copyright law all joint owners shall consent to any exploitation of the work (Section 173 (2) CDPA). See also Robin Ray v Classic FM [1988] FRS 622. In France, according to article 113-3 of the French IP code a collaborative work is a common property of its co-authors, who can exercise their rights by common agreement. In the US, absent an agreement to the contrary, the authors of the joint work are co-owners of the copyright in the work, each one enjoying an undivided ownership interest in the entire work. However, while each co-owner may freely utilize the work subject only to a duty to account to the other co-owner, they cannot assign or grant exclusive licenses. (§ 201 US Copyright Act). See also F. Jay Dougherty, 'Not A Spike Lee Joint? Issues in the Authorship of Motion Pictures Under U.S. Copyright Law' (2001) 49 UCLA Law Review 225, 254

[63] R. Matulionyte (60), 104

Another multiple ownership scenario which seems not suitable for governing copyright tokenization schemes is the one applied in some jurisdictions to collective works. Several copyright laws use to distinguish works of joint-authorship from collective works, when the contribute of each people participating in the creative process consists in creating separate and independent works in themselves, and these are then assembled into a collective whole. While the conditions and the consequences of a qualification as collective work differ from country to country,[64] the common denominator is that - under certain conditions - the exercise and enforcement of the copyright in the resulting work do not require permission of the creators of the contributions.[65]

While being more flexible, since it would allow the artist issuing the tokens to exercise his exclusive rights on the artwork independently from the token holders, also this legal framework does not entirely suit the purposes of copyright tokenisation schemes. In fact, equity crowdfunding platforms, like the one under investigation, are likely to result in the creation of one work only (e.g. a digital artwork) since each token is not intended to represent a separate work, but rather a share in an entire creative project. Thus, although this model seems to be more attractive for its flexibility, it is designed for situations where several independent works are created by different authors, which is not necessarily the case of

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[64] Under French law, a "collective work" is a work created at the initiative of a natural or legal person who edits it, publishes it and discloses it under his direction and name and in which the personal contributions of the various authors who participated in its production are merged in the overall work for which they were conceived, without it being possible to attribute to each author a separate right in the work as created (Article L113-2, French IP code). Under US copyright law, a "collective work" is a work in which a number of contributions, constituting separate and independent works in themselves, are assembled into a collective whole (Section 101, US Copyright Act). In the UK, while the term "collective work" refer to both, there is a distinction between (a) a work of joint authorship and (b) a work in which there are distinct contributions by different authors or in which works or parts of works of different authors are incorporated (section 178 of the CDPA).

[65] Under French copyright law, a collective work shall be the property, unless proved otherwise, of the natural or legal person under whose name it has been disclosed (Article L113-5 French IP code). Under US law, the copyright in a collective work is separate from that in the individual contributions, which vests in the authors of the contributions. However, section 201(c) of the 1976 Act provides a statutory presumption in the absence of an express agreement that the collective work owner has "the privilege of reproducing and distributing the contribution as part of that particular collective work, any revisions of that collective work, and any later collective work in the same series. Under UK case law, contributors to a collective work will obtain copyright for their individual contributors and the editor responsible for the selection and arrangement of the contributors will receive a separate copyright for his effort, as long as they the governing originality standard. See Paul Goldstein and P. Bernt Hugenholtz, *International Copyright: Principles, Law, and Practice* (Oxford University Press, 2012) 382

copyright tokenization.[66]

The above discussion shows that legal schemes regulating the participation of multiple people in the creative process, like in case of works of joint-authorship or collective works, do not suit the needs of copyright tokenization. As a result, it is argued that the rules governing copyright tokenization shall be defined by contract.

This is possible because most of copyright laws do not restrict how copyright can be assigned.[67] Thus, the freedom to assign copyright by contract could be read to imply that a copyright in a single work could be divided into shares (tokens) and those shares could be assigned to multiple persons.[68] Such a partial assignment by contact shall be carefully drafted by lawyers, taking into account the interests of the artists seeking to tokenize their future copyright in their works, and the one of the investors. It is suggested that these contracts should clearly define which rights each token holder acquires and which rights the artist retains. Also, it would be convenient to specify that that token holders can sell their tokens and assign their share of copyright without prior permission from other token holders.

However, it can be argued that drafting a copyright tokenization contract which only let token holders to benefit from the royalties deriving from the exploitation of the works, without giving them any control over the way in which the work is exploited (because the exclusive rights remain all vested on the artist), would not actually implement a copyright tokenization scheme, but rather a tokenization of the artist's profit deriving therefrom.

Tokenization and Assignment of Rights in Future Works

Another aspect which is related to the copyright tokenization issue, is whether of not the assignment of copyright can concern future works. In fact, these equity-crowdfunding

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[66] R. Matulionyte (60), 104

[67] For example, under French copyright law, economic rights may be wholly or partially transferred by contract according to L. 122-7 IP code and this may occur gratuitously or for compensation. The sole formal requisite for the transfer is the writing form (L 131-2). Under US law, any or all of the copyright owner's exclusive rights, or parts of those rights, can be transferred (Section 201 Copyright Act). Also under UK law, copyright can be assign either wholly or partial, according to section 90 CDPA. However, the assignment must be in writing to and signed by the assignor to be effective (CDPA s. 90(3)). See Paul Geller and Melville B. Nimmer International Copyright Law and Practice, (Lexis Nexis 2008) FRA-61. See also Taya Aplin and Jennifer Devis, Intellectual Property Law, (Oxford University Press, 2017) 150

[68] R. Matulionyte (60), 105

platforms based on blockchain seems to permit tokenization of future copyright.[69]

The answer to this question, essentially depends on the jurisdiction. In most common law jurisdictions, the person who will be the copyright owner in a coming-into-existence work can assign such future copyright (wholly or partially) to another person with no limitation, except for the written form requirement.[70] This is essentially because of the utilitarian justification which underpins copyright laws in these jurisdictions, in which the freedom of contract is favoured over the need to protect authors.[71] Instead, in civil law countries there are often restrictions with regard to the assignment of rights related to future works,[72] essentially because of the paternalistic approach of their legislators who tend to impose constrains on authors' contractual autonomy in order to protect them.[73] However, civil law courts tend to interpret these restrictions so as that the assignment is possible when the future work is identified with precision.[74]

As a result, it is suggested that the art projects promoted via blockchain-based crowdfunding platforms had better be specific and well described before the artist-promoter can validly

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[69]*Ibid*. Also the copyright in present works can be tokenized. Such a service is mainly offered by Mecenas, which offers a possibility to tokenise existing (high value) works; see 'Maecenas, Participate in Blockchain-based Auctions of Fine Art' < http://www.maecenas.co > accessed 18 August 2020.

[70] For example, according to Section 91 of the UK CDPA, by written agreement, a copyright prospective owner can assign the future copyright (wholly or partially) to another person, copyright which will or may come into existence in respect of a future work or class of works or on the occurrence of a future event. Also US copyright law place no bar to the transfer of rights in future works. See P. Goldstein and P. Hugenholtz (63) 408.

[71] The arguments in favour of the freedom of contract have been voiced by a number of commentators in common law jurisdictions, because the focus of copyright law in these countries is the copyright owner rather than the author. As a result, they have condemned as overly paternalistic those provisions aimed at re-establishing balance between authors and intermediaries as violating the freedom of contract principle. See Rita Matulionyte, 'Empowering Authors via Fairer Copyright Contract Law' (2019) UNSW Law Journal 42(2) 681, 691

[72] For example, Article L. 131-1 of the French IP code prohibits total transfer of all rights in future works. The rationale behind this provision is to protect authors against the temptation to over burden their future creation contractually. Similar limits apply in some other European countries where, restrictions to operation of future assignment consist in requiring mandatory time limits and allowing scope for renegotiation, or imposing an obligation to pay additional remuneration (e.g. in Germany or Italy). See Europe Economics IViR, Lucie Guibault and Olivia Salamanca, 'Remuneration of authors of books and scientific journals, translators, journalists and visual artists for the use of their works', Study Prepared for the European Commission Directorate-General of Communications Networks, Content & Technology (2016), 47

[73] The reason for protecting authors in their contractual relations with publishers, broadcasters or other intermediaries generally depends on the natural or social justice justification which historically underlie copyright law in civil law jurisdictions. More practical rationales, such as the desire to protect author against unfair terms in standard author's contract – in a way similar to consumer protection or labour law – are also relevant today. See Paul and P. Hugenholtz (63), 395

[74] Courts often do not interpret this provision literally, but rather reconstruct the contract so that, rather then transferring all rights in future works, the contract affect the rights in future works identified with precision. See P. Geller and M. Nimmer (65) FRA-70.

issue tokens corresponding to the copyright therein. In fact, as long as the art projects are sufficiently defined, the assignment of rights into such future works is unlikely to cause problems even in author-protective civil law countries. Otherwise, an art tokenisation platform that allows the tokenisation of copyright in unspecified works, might cause problems in these jurisdictions. Considering that art tokenisation platforms operate across borders, compliance with all the relevant copyright regulations in each jurisdictions is essential.[75]

Smart Contracts and Copyright Assignment Formalities

The third and final question to address is whether smart contracts which are used in blockchain-based crowdfunding platforms for the purpose of copyright tokenization met the formalities required for copyright assignment.[76] In fact, in many jurisdictions assignment of copyright (whether total or partial) must be in writing and signed.[77] It is therefore essential that any transaction concerning a copyright token also occur by contracts that are written and signed by both parties. The question is therefore whether smart contracts are able to satisfy the formalities for copyright assignment.

According to Szabo (who introduced the concept of smart contracts in 1994), a smart contract is "*a computerised transaction protocol that executes the terms of a contract*".[78] For this reasons, some scholars believe that a smart contract is not a legally enforceable promise, but only an automated mechanical process, and therefore does not qualify as legal contract *per se*.[79] However, in practice the computer-readable code which performs the smart contact is ordinarily explained in human-intelligible language. Therefore, it can be argued that this explanation can form the basis of the agreement between the parties and thereby determines

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[75] R. Matulionyte (60), 106
[76] *Ibid.*
[77] For example, Article L 131-2 of the French IP code requires that the transfer of copyright shall be evidenced in writing. Note that this provision is subject to strict interpretation by French courts when it is in the interest of the author (e.g. author's obligations). As to UK copyright law, according to Section 90 (3), in order to be effective a copyright assignment must be in writing signed by or on behalf of the assignor. According to Section 204 of the US Copyright Act, a transfer of copyright ownership, other than by operation of law, is not valid unless an instrument of conveyance, or a note or memorandum of the transfer, is in writing and signed by the owner of the rights conveyed or such owner's duly authorized agent. For an overview about formalities in case of copyright transfer in either common law and civil law counties, P. Goldstein and P. Hugenholtz (63), 408
[78] See Scott A McKinney and Rachel Landy and Rachel Wilka, 'Smart Contracts, Blockchain, and the Next Frontier of Transactional Law' (2018) 13 Wash J L Tech & Arts 313, 316
[79] Kevin Werbach and Nicolas Cornell, 'Contracts Ex. Machina' (2017) 67 Duke L.J. 313, 339–340.

the terms of the contract.[80] Yet, I also note that such instructions can be apt for defining the terms of the assignment, as long as they are sufficiently definitive of the copyright's owner's will to assign his rights, as well as specific in terms of the rights assigned. This is particularly important in those jurisdictions which tend to protect authors in their contractual relations.[81] As a result, either the artist-promoter and the investors had better recur to legal advice to better define the terms of the agreement before entering these transactions.

All the above considerations on copyright tokenization show how blockchain technology can be used to commercialize copyright and fund art, and such use appear quite revolutionary. Yet, from the perspective of copyright law there are a number of issues that do not have straightforward answers and, while copyright tokenization seems feasible in theory, it probably requires artists to seek expensive legal assistance. Therefore, it seems that, for the time being, this could disincentive especially digital artists from using this technology for the purpose of funding their art.

E. Conclusions

Thanks to its features which allow the identity authentication of the parties operating on the platform and the integrity of the data recorded therein, blockchain is a general-purpose technology that can be used in many fields. The most revolutionary uses rely on the ability of blockchain to create tokens, which are digital representations of a physical or digital asset which cannot be copied or forged and can be transferred from one person to another as they were physical goods.

IP law plays an essential role in the full exploitation of this innovative technology. On the one hand, several IP rights are relevant when it comes to the protection of the underpinning technology (e.g. copyright, patents, trade secrets). On the other hand, considering that blockchain technology enables the creation of a secure and incorruptible chain of information, it can be applied in the context of management, protection and enforcement of

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[80] J. Bacon et al. (3) para.95.
[81] For example, Article L131-3 of the French IP code prohibits total transfer of rights, but each of the assigned rights shall be being separately mentioned in the assignment agreement. See P. Goldstein and P. Hugenholtz (63), 395

IP rights. In particular, we remarked the importance of blockchain for the enforcement of copyright in the digital environment - because it can allow a control over the reproduction and dissemination of the copyrighted work online. This can finally allow effective IP enforcement, especially in those areas where proceeding with the traditional routes for exploiting and enforcing IP was infrequent or almost impossible.

For example, this is the case of digital art. While digital artists are almost resigned against the proliferation of unauthorized copies of their works, we found that blockchain technology permit creating digital scarcity and authenticity verification of digital artworks. It is therefore argued that this allows digital artists to effectively enforce their economic and moral rights on their creations and, consequently, the production of digital pieces of art is likely to increase in the near future.

Further incentive in the creation of digital art may derive from the possibility for digital artists to tokenise the copyright in their future artworks and sell the tokens to a crowd of investors to attract funds for the creative activity. While this possibility appears possible under the copyrights laws of many jurisdictions, this study also highlights that artists would probably need to seek legal assistance for carefully drafting the terms and conditions of this complex copyright assignment. Therefore, the widespread application of this technology for this particular purpose seems quite unlikely at this stage.

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