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What is Blockchain and How can it Help the Humanities?

1 Introduction to Blockchain and its Philosophy

First of all, a short definition of blockchain to introduce what this technology is. 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 distributed network of computers.

A blockchain is to a transaction, as the Internet is to information. Its qualities are attributed to it by its applications creating a network of value more than a mere information deployed in the network. The idea behind is to transfer information from simple networks to smart networks creating new added value (Swan & De Felipi 2017: 605).

This goes beyond the Internet Revolution and, for the first time in the history of technical revolutions, a technology has the capacity to affect the vertical and centralized power of states with regard to the economy: money, banks and financial transactions. But also we can define a decentralization in regard to energy, electricity, properties, and social and political institutions.

2 But, What is Blockchain?

From a technological point of view a blockchain is a distributed database, which is shared and agreed upon in a peer-to-peer network. It consists of a linked sequence of blocks, containing a timestamp (for each of the blocks) and the transactions secured by a cryptographic public key and verified by the entire network community. Once an item is added to the blockchain, it cannot be altered, becoming an immutable record of past activity.

The previous definition is the simplest way with which we have been able to define one of the technologies that is called to change society and, especially, the way in which we handle data of any kind. Despite this simplicity in the description, it hides many complexities, which make it abstract for the general public and, on many occasions, difficult to incorporate into the processes of companies and institutions.

Distributed ledger technologies (DLTs), currently make up a broad and complex ecosystem, which has multiple definitions, and according to literature reviews is quite inconsistent. As in the rest of all blockchain technology, we can affirm that there is still a lack of terminological standardization (Rauchs et al. 2018: 11).

As has happened in the history of computer science, before the emergence of a new technology or paradigm shift, such as the Internet, there have been previous works that paved the way for developing new disruptive models. Currently there are a large number of DLTs with different configurations and typologies, which on many occasions, make it very difficult to establish a clear taxonomy of how they operate and are constituted. There are a lot of new ways to build up new DLTs more efficiently and with new perspectives of use, but referring to current projects with a clear economic value, the two more used are Bitcoin and the Ethereum ecosystem. Both of them are just the starting point, and Ethereum was also the first platform to use smart contracts, the base of the actual *tokenomics* world (the tokenization of the crypto economic and social projects).

But before defining what is a smart contract, we want to define what is a DLT. The concept of distributed ledger technologies (DLT) has been established as a general term to designate multi-party systems that operate in an environment with no operator or central authority, even though the parties involved may be unreliable or malicious and in harsh environments. Blockchain technology is considered a specific subset of the broader DLT ecosystem, using a particular data structure consisting of a chain of linked data blocks with cryptographic hashing functions. Conceptually, DLTs were first described in 1982,¹ and the concept of blockchain in 1991 (Haber and Stornetta 1991). However, we are in their deployment phase, before they are massively incorporated into society.

It is necessary to clarify that a hostile environment in a DLT is characterized by the presence of malicious actors within the system or network, who undermine it by using it in a way that it was not intended. The prototype adversary in a DLT system is an entity that attempts to exploit consensus rules to transfer assets without authorization, censor the transactions of others, or otherwise disrupt or destroy the network. Adversaries can operate both inside (on-chain) and outside the system (off-chain). For all these reasons, the governance schemes to establish the management framework seem crucial in the management of any type of platform (Brown and Grant 2005).

What is a Smart Contract? Actually, the term refers to any script (the so-called smart contract), which is executed by itself, automatically, and without the

1 <http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.12.1697>.

need for any intermediary entity. Despite the “intelligent” name, no type of Artificial Intelligence process is involved in its execution. This is written as a computer program (the script) that is self-executing, instead of being written in the customary legal language of the physical world. The script can define processes, rules and strict consequences in the same way that it operates on a legal document. But unlike these, a smart contract can manage information that is provided to it externally in order to complete its routine successfully. That is, to effectively terminate the processes for which it has been programmed.

There are a lot of more properties and items in a DLT as we explain in a recent publication (Romero-Frias et al. 2021), but understand what is a blockchain, a DLT and a smart contract is the basis to understand which means the concept of tokenization to understand what is a Non Fungible Token.

3 NFTs and Tokenization

In recent years, there are hundreds of cryptocurrencies on the market. Only very few get a quotation base with fiat money on it. Most of them have been implemented on the Ethereum platform, and the way in which they manage the mining of their cryptocurrencies is through Smart Contracts that generate a token, and each of them can present different properties, according to the rules that have been applied, and they have been defined in the governance system of its “White paper”. The standard token is the ERC-20, which is also the most popular within the aforementioned platform. The work of Chen et al. (2020) reviews the ICOs that have been based on this token, which exceed 80%, which demonstrates the weight that this standard has within the Ethereum platform.

It is important to point out the differences between cryptocurrency and token. Terms that are often confused, due to the influence of fintech solutions in the current blockchain market. Cryptocurrencies are the form of digital money that are created by blockchain solutions, while the token represents an asset or a utility that has a specific value (tangible or not) within the community that has created it. They are usually transferable goods that can range from loyalty points, game bonuses, or future rights to a service that can be redeemed when the agreed result occurs.

What is a token? We can define that **a token is a digital asset that operates “on top” of a cryptocurrency or a blockchain**, which often runs as a programmable asset thanks to a Smart Contract, to be used within a project or a dApp.²

When we consider that cryptographic tokens represent the right to something, we are defining the tokenization of a digital asset. Tokenization is a way of turning the rights of something or someone into a digital artifact, which takes on the digital format of a token. With crypto tokens, the benefits of tokenization lie primarily in greater versatility, greater liquidity, improved programmability, and immutable proof of ownership (di Angelo and Salzer 2020). However, there is still a great lack of tokenization standards and, above all, in most states there is also a lack of a legal infrastructure and a legal framework that regularizes and legally defines the concept of tokenization.

Following the taxonomy of Ritchey (2005) we will find the perspective of fungibility and regarding this, in economics, fungibility refers to the interchangeability of each unit of a product with other units of the same product. Examples of these could be durable goods, such as precious metals or fiat money. Expendable assets have two key properties: a) only quantity matters, which means that units of expendable assets of the same type are indistinguishable; and, b) any amount can be merged or split into a larger or smaller amount, making it indistinguishable from the rest. Fungible crypto tokens can represent any physical or digital asset that is identical to each other and therefore can be easily replaced. They are not unique and are perfectly interchangeable with other tokens of their type. If two parties have the same amount, they can exchange it without losing or gaining anything. Unique tokens, by contrast, are not fungible. Examples of this are identification cards, a token that represents ownership of a house, car, work of art or membership in a club, community or entity. If you lend a non-fungible token that is transferable to someone, you would expect them to return the same token, with the inherent properties that it confers. So, we are defining a Non Fungible Token (NFT).

What is a NFT? A NFT is a kind of ERC token. The most popular ERC token in Ethereum is the ERC-20 because it is widely used in the crypto market, but we are referring to a fungible token.

² A decentralized Application (dApp) is an application that is stored and executable in a distributed environment. Early examples may be found in the blockchain environment of widespread systems like Bitcoin and Ethereum. While users may access a dApp like a traditional app via a user interface (front-end), the program logic and the data are not located on a centralized server, but rather on a peer-to-peer network (P2P), such as a blockchain or a DLT. Thus, dApps require no centralized services or platforms, which implies that no intermediary is necessary. In the financial context, many dApps have emerged under the umbrella of decentralized finance.

But a NFT is referred to as the ERC-721, the Non Fungible Token Standard. According to Entriken et al. (2018), it refers to the token that is different and distinctive from the rest and therefore allows the tracking of distinguishable and unique assets. Each asset must have its property tracked individually and indivisible. This standard requires compatible tokens to implement 10 mandatory functions and three events, which are associated with their execution.

Which means “standard” in this definition? A standard interface allows wallet/auction applications to work with any NFT on Ethereum. The smart contracts used track an arbitrarily large number of NFTs. This standard is inspired by the ERC-20 token standard.

A NFT (ERC-721) standardizes a safe transfer function within its framework in order to secure the transfers (transactions) in the applications that use a large number of NFTs. Note that we are talking about only the transactions, not about how to transmit the final possession of the original asset, and how to securize the transmission of this asset from A to B. The ERC-721 token would play a role very similar to that of title or writing, which assigns ownership to whoever owns it.

So, the objective behind this is to develop unique tokens, where their intrinsic value is given by their weirdness. This property makes an ERC-721 a collectable token.

The first project to use the ERC-721 was the CryptoKitties³ card collectible platform (using Metamask⁴ as the wallet to store and sell/buy these tokens), it was officially launched on December 3, 2017. CryptoKitties makes you a collector of virtual cats that base their value on its rarity (The CryptoKitties Genesis Card was sold on December 2, 2017 by an amount of 247 ETH).⁵ And after that it was used also in Decentraland,⁶ a project based in Ethereum where the users can create and trade with their NFTs and also this entire platform is owned by them. This platform was the first one where the users can trade their creations and artworks as digital assets. Following this market OpenSea⁷ was created, where actually the most of the trade of NFTs is deployed.

³ <https://www.cryptokitties.co/>.

⁴ <https://metamask.io/>.

⁵ The ETH is Ether, the cryptocurrency of the Ethereum platform. In April of 2022 a ETH has an approximate value of 2.900 US\$.

⁶ <https://decentraland.org/>.

⁷ <https://opensea.io/>.

4 Web4: Blockchain, NFTs and their Impact in Arts

Nowadays, NFTs are scaling into the limelight, inspiring a surge of enthusiasm and money around the technology, and the NFT community is still navigating its move into the mainstream. Estimates of total NFT sales in 2021 vary from \$25⁸ billion to \$41⁹ billion both a tremendous increase from 2020, when sales totaled more than \$250¹⁰ million. So, definitely we are not talking about just economic hype. The study of Nadini et al. (2021) is the most comprehensive work to date on its economic impact and future predictability.

But NFTs also have a dark side, not all the stories about NFT are about money and success. As they have become increasingly entrenched in the society, multiple digital platforms that facilitate the sale of NFTs must face allegations of fraud, plagiarism, service errors, and also environmental issues as described in the work of Rehman et al. (2021). Despite this, NFTs are an opportunity to represent a permanent shift in how artists, creators, and craftsmen can change their relationship with final consumers, avoiding third parties and adding new value to their work/creations.

One of the problems to face off is the gap to understand the complexity of NFTs in relation with blockchain technology. But also, the new regulations and how to create solid platforms that will avoid this complexity, not only for the consumers but also for creators as stated in the Vasan et al. (2022) work with the mapping of the Foundation platform.¹¹

Actually, most NFTs trade in the marketplaces have zero value, because of the lack of security (technologically and in terms of regulation) on these platforms. Remember that value of a NFT is not in the transaction but in the security that it is not reproducible, that is it is unique and rare. So, securize a transaction in a block to transmit property from A to B without having the certainty that the property and the unique digital object are transmitted, is a problem for the future of this niche in Web3.¹²

8 <https://www.reuters.com/markets/europe/nft-sales-hit-25-billion-2021-growth-shows-signs-slowing-2022-01-10/>.

9 <https://www.ft.com/content/e95f5ac2-0476-41f4-abd4-8a99faa7737d>.

10 <https://www.insider.com/nft-nfts-art-history-what-are-can-help-explain-hype-2021-3?amp>.

11 <https://foundation.app/>.

12 This combination of the World Wide Web (WWW) and the third generation has evolved with decentralized technologies, such as blockchain and distributed ledgers. It recognizes the early phase of the WWW from 1992 until the beginning of the 2000s as first distributed ledgers from centralized platform providers to the users themselves, thus leading to more decentralization and democratization in the web. Web3 questions the role of established third parties such as

The combination of real products with a NFT to develop new characteristics of an item is the real base for the future of crafts and Arts. Web3 is an opportunity to add new value to any kind of data stored and signed by its owner. The path started by Toymint¹³ is a good one to be deployed in future projects.

The possibilities that NFTs and new Web3 platforms have in the field of fine arts and crafts are endless, given the convergence between the creative capabilities of artists and the technological capabilities of distributed ledgers that we have only just begun to explore.

5 The Sociopolitical Properties of Blockchain

As we can see, blockchain is more than a promise (including its controversial topics: legal framework and its complicated understanding), offering various ways to imagine alternative models of politics and social schemes.

Blockchain appears as a powerful framework for a total decentralization with a great desintermediation, that includes an emerging tool beyond its actual use: the DAO, a decentralized autonomous organization. A DAO is an opportunity to transform the political institutions to develop new e-Voting or e-Participation (Benítez-Martínez et al. 2020) systems or to transform current procedures, as the procurement within the public administration platforms (Benítez-Martínez et al. 2022).

But, what is a DAO? We are defining a form of organization where multiple actors are organized by a decentralized software system. The concept has grown with distributed ledger technologies that include smart contracts for executing governance and the organizational rules. This allows many activities of a DAO to be carried out automatically without human intervention and without intermediaries. An example for new political bodies governed by a DAO is Bitnation,¹⁴ creating a new model of “nation”, the Decentralized Borderless Voluntary Nations (DBVN) within its Pangea Platform. Bitnation is self-considered as a new governance model. We are just seeing a new beginning.

banks, insurance companies and exchanges by replacing them with structures and processes of decentralized finance. Among the examples are electronic payments with cryptocurrencies, crowdfunding platforms, crypto exchanges for fungible and non-fungible tokens as well as decentralized organizations (DAO). However, it is still an open question to which extent Web3 solutions will replace existing structures.

¹³ toymint.co.

¹⁴ <https://tse.bitnation.co/>.

In the recent work of Bychkova and Kosmarski (2022) they consider how blockchain can affect in the fields of individual freedom, the consensus mechanisms, new methods for shared rules in a public ledger, and the transformation of common good with new political approaches. They concluded that blockchain can modify the *res publica* with more efficient processes to create new models of governance, some kind of a Democracy 2.0 (linked to the Web3).

Despite current projects, blockchain is an opportunity to build up new techno governance models, including the convergence of distributed ledger technologies with big data and artificial intelligence. The management of democracy procedures and eAdministration processes in complex scenarios needs new rules and cultural transformations. As Innerarity (2020: 339–348) pointed out, we need democratize Democracy creating a new cognitive infrastructure of Democracy; the blockchain can be used to do so.

We can affirm that there are some sociological properties of the blockchain that make it converge with any humanistic discipline and that they would be the following:

- Disintermediation. The blockchain makes it possible to dispense with intermediary or third-party entities that certify the content of the transactions or the data they store. In the field of documentation, education or philology, it allows the creation of networks of researchers and professionals who would not need to resort to third-party entities to validate or certify the contents, within a P2P¹⁵ network.
- Immutability. This property has the security of the certainty that the data and processes created will endure over time. Their sealing and their verifiability is intrinsic to a blockchain network. In the legal field, in historical studies and in social sciences, it allows to determine with certainty when, how and where a known data flow was produced.
- Trust. From the social point of view, it is the property that weaves social ties and security in the management of institutions. Without a doubt, it is one of the properties of the blockchain that is helping to create new forms of governance, since being distributed on a peer-to-peer basis, the certainty that what is certified is unalterable and immutable, allows to create that trust in the stored data. and secured throughout the blockchain.
- Transparency. The blockchain has the ability for all transactions to be known throughout the network. From the point of view of political science and legal

¹⁵ Peer-to-peer (P2P) computing or networking is a distributed application architecture that partitions tasks or workloads between peers. Peers are equally privileged, equipotent participants in the application. It is a network of balanced and equal nodes.

science, all the processes in which this property is necessary to obtain the trust of the stakeholders involved could be reinforced. Not to mention how it could revolutionize the way scientific research is shared or the administrative processes of any institution in the world.

All these properties allow us to develop cooperative systems to innovate in the research fields of the humanities with new processes and new tools. The path of distributed registry technologies has barely begun, and in the course of this decade we will see how they mutate and generate new perspectives on their use. The possibilities that these offer have only just begun to be explored and therefore we understand that there are new fields of research that mix projects in the Humanities with the blockchain.

6 Towards a Disintermediated Governance: Adhocratic Relations and New Rules of Creation and Hybridization

As we remarked before, blockchain can be used as a way to decentralize and build new political frameworks. We are not advocating replacing democratic electoral systems with new and unknown decentralized structures. However, we do see an opportunity in the promise that a DAO has, to build new tools and processes that eliminate inefficiencies (that due to human error, omission or spurious interests) may occur.

Integrate in the eAdministration, public institutions or political parties new paradigms of interaction can develop a new common trust amongst citizens, politicians and public servants. This interaction can be constructed under the umbrella of the DLTs, with specific DAOs developed for it. That means we can automate with no human intervention a lot of processes and procedures. Por instance, in the eAdministration everything with tax collection processes, to reinforce the trust of citizens in local authorities we can use new e-Participation tools with tokenized models, and regarding political parties they can present themselves to elections with automated political programs triggered in an automatic DAO to be deployed automatically after the election of the institutional bodies where they must govern.

Of course, those actions mean that we have the opportunity to deploy a new governance model with new roles of all the stakeholders involved in this new framework. If we are talking about transparency, decentralization and disinter-

mediation, we are talking about adhocatic schemes of administration, creating new rules, roles, and actions. Blockchain can be a reactor not only for the digital transformation but for new democratic frameworks.

A new key concept: techno-governance hybridization. Actually in Political Sciences concepts as a hybrid regime is not a positive one. A hybrid regime is a mixed type of a political system that is often a result of an incomplete transition from an authoritarian regime to a democratic one, although there are regular elections, these regimes hold political repressions. So, we are defining a new context of polymorphic views about what we can consider a legitimate democracy. In our post pandemic context, we can observe a new kind of a wave of democracy,¹⁶ emerging in the actual political context. On one side with the current situation of governments in Russia, Brazil or Hungary, but on the other side with the possibilities that new technologies such artificial intelligence and big data, together with blockchain offers a real digital transformation in public institutions to be more efficient, transparent, and cooperative.

Following Huntington's scheme, we could affirm that we are experiencing a new wave with two opposing directions. The one that is being directed by post-politics (disinformation, fake news, alternative facts, etc.) and the one that can develop a new type of more transparent governance, which is what we call techno-governance, thanks to the implication that the technologies of the 4th Industrial Revolution will have in the development of a new eDemocracy.

Building new processes and tools that allow the development of new and more resilient democratic scenarios, more participatory and more effective, is an opportunity that technologies such as blockchain offer us. Its ability to transform the channels of eParticipation (Benítez-Martínez et al. 2020), electronic voting (Holmes 2022), public contracting systems or the documentary certification of all eAdministration processes (Parenti et al. 2022), are already a reality to change the anti-democratic paths that some democracies are suffering in various countries of the world.

But disintermediation is not only a property that will impact political systems or the field of culture. Its ability to create new management systems, organize processes or develop new tools that allow resources and networks to be managed more effectively and efficiently, will be one of the fundamental premises of the impact of blockchain in multiple fields.

16 Wave of Democracy is a term that appeared in 1887 (Morse, "The Cause of Secession"), but popularized by Samuel P. Huntington in his article published in the *Journal of Democracy* and further explained in his 1991 book "The Third Wave: Democratization in the Late 20th Century". Democratization waves have been linked to sudden shifts in the distribution of power.

As we have seen before, this impact will create new fields of study, new formats and stories. The adhocratic capacity of the blockchain will allow the construction of new scenarios, following its sociological properties. And from these opportunities will arise to establish new epistemological paths in many disciplines of the Humanities and Social Sciences.

7 Blockchain and Humanities

As we have seen so far, the blockchain has great applications in the world of the arts or in the definition of new governance systems, from the point of view of political science or sociology, but there are many more fields where it can have a great impact. Let's see in some fields it can generate new possibilities.

Blockchain for Libraries

Regarding its properties, using blockchain in libraries can have a great impact in the digital preservation and tracking of books and digital copies with the tokenization of the digital assets – the cultural works – and the way as the community-based collections are shared.

The way that the inter library loan and actual voucher system can be shifted also, including a strong and updated verification of credentials via a dApp (instead the current library card).

Also we can organize the keeping of the corporate library records in a different manner, including the provenance and authenticity of valued items. And of course, all of these items allow data management (Frederick 2019) more efficiently and with no loss of information (or misinformation caused by a breach in data custody).

Blockchain for Scientific Publishing

Think about the opportunity to establish new models of scholarly publishing (and the way as this type of works are shown and recorded). With the new DLTs we can deploy easy tools for users with a low cost implementation, that will be an independently and verifiable method that could be widely and readily used to audit and confirm the reliability of scientific studies. This is because we treat information by creating a cryptographic hashing of every record (with plain text)

in a scientific work adding this on the blockchain. This creates a time-stamped record in the network, which other researchers can quickly verify in the future. No data of the document can be changed or altered from the stored record, so a verifiable network of scientists around the globe can store and preserve all this information in a P2P platform owned by researchers, librarians and academic institutions at the same time. With a framework like this no third parties are needed (publishers, for instance).

Therefore, this technology is the best fit for academia and gets a potential pace in libraries and authors, to connect them with its final users, and can be used to change the actual status quo within the scholars and publishers bringing the opportunity to the universities and authors to hold their own rights for their scientific contributions.

Blockchain in Museums and Archeology

The ability of the blockchain to be able to secure data and preserve it without the possibility of altering it has a great impact on museology and archaeology.

The possibility of being able to manage museum collections through a tokenized system that assigns the value of the data and the origin of each work or element of a museum is an intrinsic value for its chain of custody.

In addition to guaranteeing custody, by being secured in a blockchain network, the data will be more transparent than ever for any stakeholder that intervenes in the value chain of each of the pieces in custody.

Examples such as the one used in Indonesia with the Prabu Geusan Ulun Museum, using Hyperledger Composer (a certification system based on the Ethereum ecosystem) is a successful case study. To prove that the system worked, it was divided so that one part of it needed human intervention and the other part was fully automated to serve as a testing tool. (Hongo et al. 2021).

And in the field of archeology a based blockchain network can be used to assure the traceability of the archaeological remains from the field where they are collected to the laboratories where these items are going to be studied, dated and secured. Actually, there is not an ongoing project published in the major databases. But we are sure that blockchain will have a huge impact in this field regarding the promise of its properties.

8 Future Landscapes: Convergences

One of the great challenges that society faces is how the convergence of several of the technologies of the 4th Industrial Revolution will impact it. If we refer to Big Data, that is, the capacity that our society currently has to create, store and analyze huge amounts of data, the challenge is enormous.

Therefore, one of the main challenges is knowing how we are going to treat this data and how we are going to use it. The ethical, philosophical and political dimensions are a great challenge. In order to advance in solutions that restore confidence to citizens in how these data are treated and that they will not be used against them, the role of the blockchain is decisive, due to the properties it has.

In addition, being Big Data the fuel that feeds the tools and algorithms that are created through artificial intelligence, it is necessary to have technological tools that can guarantee us levels of security in the treatment and custody of data.

We are not only talking about a technological implication of this convergence between blockchain and AI, something that is being considered as the work of Ekramifard et al. (2020) pointed out. We are talking about the need in how the humanities, with philosophy at the forefront, have to help this convergence to occur in accordance with ethical principles that determine the regulatory framework, present and future.

The social and political implications of how we are going to work in this technological-humanistic convergence is decisive for the future of our societies. The trend towards dataism in our society cannot lead us to a dataclism, where biases and programming failures can cause social or political gaps. Or what is worse, cause systemic failures that are difficult to repair or ignore.

We have to jointly build a “social algorithm” that is based on a clear (and safe) ethical framework. The challenges faced by the so-called Metaverse and the way in which decentralized digital identities are created (many of them based on AI engines, that is, avatars that will be a digital twin of us), pose an even greater challenge of how we must regulate and secure those artificial intelligences that will intercede for us, with an impact on a personal level that we are not yet able to fully imagine.

We have to be able to properly discern the advantages, benefits, threats and challenges that all these convergences entail. The power of Big Data and artificial intelligence is tremendous, but they need the blockchain and its ability to preserve, seal and secure data in a distributed way, so as not to cause a “dataclism”.

There is no clearly established path. Both blockchain and artificial intelligence capabilities are at an early stage to be democratized. That is, the possibility that they have a great social capillarity, between citizens and small businesses, so

that they do not cause social or economic gaps and are an engine of social and economic rebalancing.

9 Epilog: How Humanities can Help Blockchain?

In relation to what we have exposed in this work, we invert the order of the sentence in the title of this chapter and we consider how the humanities can help the blockchain.

The question is not trivial, since more than ever it is necessary to critically question the impact of technologies in our society, as we have already explained.

Indeed, the Humanities can (must) be the vector that does not allow the dehumanization of technology. In this sense, the intrinsic properties of the blockchain are of great contribution, due to the great sociological and political burden that its use entails.

Although the construction of the narrative of the blockchain policy is highly conditioned by the first blockchain network, bitcoin, and its impact on the creation of crypto finance, there is an economistic preconditioning of its philosophy. In the work of Golumbia (2016: 50–63) a very good approximation is made on this issue and how polarized this debate is in society.

But, we must go further and establish multidisciplinary and hybrid channels that allow us to develop a polyhedral conversation about the impact that the blockchain will have on society.

We cannot forget that this technology is very young (it was born in 2009) and that it is still developing its first steps. DLTs will have to adapt to provide solutions to new challenges and social and economic problems, and this implies constant adaptation and innovation. Beyond the need to create scalable and interoperable systems, there will be the need to analyze how problems are solved without creating new ones. The convergence here of sociology, political science, law, history, anthropology and the humanities in general with the blockchain seems to us to be something decisive for the future evolution of our society.

The challenge is enormous, and therefore this hybridization and generation of new contexts and meta-narratives between different fields of knowledge is more necessary than ever.

Bibliography

- Benítez Martínez, F.L., Hurtado Torres, M.V. & Romero Frías, E. (2020): “The Tokenization of the eParticipation in Public Governance: An Opportunity to Hack Democracy”, in Prieto, J., Das, A., Ferretti, S., Pinto, A., Corchado, J. (eds), *Blockchain and Applications. BLOCKCHAIN 2019. Advances in Intelligent Systems and Computing*, vol. 1010. Cham: Springer. doi: 10.1007/978-3-030-23813-1_14.
- Benítez Martínez, F.L., Hurtado Torres, M.V. & Romero Frías, E. (2020b): “A neural blockchain for a tokenizable e-Participation model”, in *Neurocomputing*, 423, pp. 703–712. doi: 10.1016/j.neucom.2020.03.116.
- Benítez-Martínez, F.L., Romero-Frías, E., & Hurtado-Torres, M.V. (2022): “Neural blockchain technology for a new anticorruption token: towards a novel governance model”, in *Journal of Information Technology & Politics*. doi: 10.1080/19331681.2022.2027317.
- Brown, Allen E., and Gerald G. Grant. (2005): “Framing the frameworks: A review of IT governance research”, in *Communications of the Association for Information Systems*, 15, 38.
- Chen, W., Zhang, T., Chen, Z. et al. (2020): “Traveling the token world: A graph analysis of Ethereum ERC20 token ecosystem”, in *WWW'20: Proceedings of The Web Conference 2020*, pp. 1411–1421. doi: 10.1145/3366423.3380215.
- Di Angelo, M., and Salzer, G. (2020): “Tokens, Types, and Standards: Identification and Utilization in Ethereum”, in *2020 IEEE International Conference on Decentralized Applications and Infrastructures (DAPPS)*, pp. 1–10. doi: 10.1109/DAPPS49028.2020.00001.
- Ekramifard, A., Amintoosi, H., Seno, A.H., Dehghantanha, A. & Parizi, R.M. (2020): “A Systematic Literature Review of Integration of Blockchain and Artificial Intelligence”. In Choo, KK., Dehghantanha, A., Parizi, R. (eds), *Blockchain Cybersecurity, Trust and Privacy. Advances in Information Security*, 79. Cham: Springer. doi:10.1007/978-3-030-38181-3_8.
- Entriken, W., Shirley, D., Evans, E. & Sachs, N. (2018): “ERC-721 non-fungible token standard”. <<https://eips.ethereum.org/EIPS/eip-721>> (03-03-2022).
- Frederick, D.E. (2019): “Blockchain, libraries and the data deluge”, in *Library Hi Tech News*, 36, pp. 1–7. doi: 10.1108/LHTN-09-2019-0059.
- Golumbia, D. (2016): *The Politics of Bitcoin. Software as Right-Wing Extremism*. Minneapolis: University of Minnesota.
- Haber, S., and Stornetta, W.S. (1991): “How to time-stamp a digital document”, in *Journal of Cryptology* 3, pp. 99–111. <https://doi.org/10.1007/BF00196791>.
- Hongo, S., Sudrajat, R., and Yulita, I.N (2021): “Design of Museum Historical Heritage Management System Using Blockchain Digital Certificate and Hyperledger Composer”. *International Conference on Artificial Intelligence and Big Data Analytics*, 2021, pp. 231–235. doi: 10.1109/ICAIBDA53487.2021.9689733.
- Innerarity, D. (2020): *Una teoría de la democracia compleja. Gobernar en el siglo XXI. III Democratizar la Democracia*. Barcelona: Galaxia Gutenberg.
- Holmes, C. (2022): “How Blockchain Technology could support Democracy and E-Voting”, in *The Journal of The British Blockchain Association*, 33960.
- Nadini, M., Alessandretti, L., Di Giacinto, F. et al. (2021): “Mapping the NFT revolution: market trends, trade networks, and visual features”, in *Sci Rep*, 11, 20902. doi: 10.1038/s41598-021-00053-8.
- Parenti, C., Noori, N., and Janssen M. (2022): “A Smart Governance Diffusion Model for Blockchain as an Anti-corruption Tool in Smart Cities”, in *Journal of Smart Cities and Society*, 1, pp. 71–92. doi: 10.3233/SCS-210122.

- Rauchs, Michel, et al. (2018): *Distributed ledger technology systems: A conceptual framework*. Cambridge: University of Cambridge.
- Rehman, W., Zainab, H., Imran, J. & Bawany, N. Z. (2021): “NFTs: Applications and Challenges”, in *2021 22nd International Arab Conference on Information Technology (ACIT)*, IEEE. pp. 1–7.
- Ritchey, T. (2005): “Problem structuring using computer-aided morphological analysis”, in *Journal of the Operational Research Society*, 57, pp. 792–801. doi: 10.1057/palgrave.jors.2602177.
- Romero-Frías, Esteban, et al. (2021): “Fundamentals of Blockchain and New Generations of Distributed Ledger Technologies. Circular Economy Case Uses in Spain”, in Muthu, S.S. (ed.), *Blockchain Technologies for Sustainability. Environmental Footprints and Eco-design of Products and Processes*. Singapore: Springer. doi: 10.1007/978-981-16-6301-7_2.
- Swan, Melanie, and Primavera De Filippi. (2017): “Toward a philosophy of blockchain: a symposium: introduction”, in *Metaphilosophy*, 48, pp. 603–619.
- Vasan, K., Janosov, M. & Barabási, AL. (2022): “Quantifying NFT-driven networks in crypto art”, in *Sci Rep*, 12, 2769. doi: 10.1038/s41598-022-05146-6