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*Is Public Sector Ready for Blockchain? Is Blockchain Ready for the Public Sector?**

Magdalena Cordero Valdavida

Mirko Iaconisi

Spyridon Pilos

(European Court of Auditors**)

ABSTRACT The emergence of the blockchain technology generated many expectations in the public sector due to the need to offer services within a framework of transparency and accountability, generating guarantees of information integrity and provenance and reinforcing the trust of citizens. Multiple use cases have been identified and, years later, we observe that very few have reached the implementation phase. This paper presents an analysis of some of these expectations based, above all, on our experience from being actively involved in initiatives at the European level primarily as participants in the European Blockchain Services Infrastructure (EBSI) since its inception. It describes our lessons learned, starting by the need to establish a "bridge with the existing world" in order to leverage the potential of blockchain more smoothly and quickly. It continues with the way to address the challenges of decentralization, transparency and accountability, and the approach to law and technology, while it underlines the importance of making a clear value proposition to attract the interest of public administrations and the requirement of putting in place an appropriate governance early enough in the process.

1. *Introduction*

It is clearly recognised that new technologies have recently emerged which are transforming all sectors of the society. The public sector has to count on these technologies both for its modernisation projects, in order to be capable to offer the services requested by the citizens, and for playing its role as generator of innovation and progress, which is part of its responsibilities. Governments base their digital transformation on the use of technologies and data to create an open, innovative, efficient and effective public sector. And they must carry out this evolution within a framework of transparency and accountability, generating guarantees and reinforcing the trust of the citizens in their administration.

There is a long list of emerging technologies, all of them having transformative and even disruptive potential. The list includes cloud computing, big data analysis, artificial intelligence, the internet of things, robotic process automation, drones, 3D printing and blockchain, the object of this article[1]. The number of use cases in the public sector is enormous, due to the long number of services likely to be modified by a digitization process or even to be completely digitized. The paperless interactions between citizens and the administration, the digital identity, the electronic signature, the electronic payments, are examples; smart cities capable of optimizing processes and offering services based on information collected by a multiplicity of sensors is another one. In this process, the digital reality must offer, however, the same guarantees of uniqueness, existence and reality. This digital reality entails also risks: the falsification of documents, the theft of identities, the distribution of fake information are only some examples.

Blockchain is one of the most innovative technologies considered in digital government strategies. It emerged at the end of the first decade of the century to support the so-called crypto-currencies[2]. The motivation for its creation was as old as the one that already

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** This text expresses the personal opinion of the authors and not that of the European Court of Auditors.

[1] The World Bank, *Disruptive technologies in public procurement*, Washington, DC, 2021.
[2] S. Nakamoto, *Bitcoin: A Peer-to-Peer Electronic Cash System,* in *Cryptography mailing list*, 2008, in https://metzdowd.com.

prevailed in commerce since ancient times: to give confidence to the transaction, that is, to the product and the parties. While that "traditional" trust had a personal and almost intimate or family basis, with blockchain the paradigm is very different, since it is built on a technological, multidimensional, automated, universal and almost direct environment, without intermediaries[3]. The basic question is, will citizens trust an administration where certification or validation processes are not involving anymore people, who are replaced by machines and algorithms making the decisions? The reply to this question has implications of all kinds, ranging from legal and economic to political and, of course, ethical[4].

Moreover, public administrations have always had the role, among others, to store and protect reliable information about individuals, organisations, assets, and activities. In many cases, the traditional trust on paper files has been reproduced in computer networks[5]. Many of the data produced by administrations become public data, published on their websites, or feeding open data sources. Such data should be trusted, but these open repositories are not exempt from attacks, both by external actors and from inside, aiming to manipulate information within a context where the demand for transparency is increasing. There are several well-known recent examples. The Trump administration deleted data from the website of the White House. Volkswagen cheated on tests emissions. Uber showed false information about available drivers to government employees. Airbnb tried to clean more than 1,000 lists that violated the New York State law, just before sharing your data with the public as part of a commitment to build an open and transparent community[6].

In this context, it is not surprising that blockchain has been put on the agenda of the public sector for several reasons. First, it is a technology characterized by building trust in information and processes in circumstances where the number of actors or users is large and heterogeneous. Second, blockchain creates traces that facilitate control and make it possible to know who has done what and when; thus, investing in a tool to contribute to transparency. Third, it does not require a centralised certifying authority to manage - access and the use of services by large populations. Finally, the development of blockchain-based systems, if successfully completed, could lead to significant cost savings. All these positive arguments generated big expectations on the use of blockchain in the public sector during the last decade, and the public sector started to identify potential use cases, to implement prototypes and to experiment with this technology. A few years after, the real cases implemented are very limited. This article is about how to manage the expectations, about our experience at the European Union level, about key success and failure factors and, definitely, about what we have learnt trying to promote the use of this technology.

2. *Potential use of blockchain in the public sector*

Although the origin of blockchain was the introduction of bitcoin and crypto-currencies, today it has evolved and its application focuses on the problems in which trust is necessary in a set of transactions; for this reason, it is a technology with potential applications in the public sector[7]. Use cases can be found in several public domains. Identity management, assets and titles registry, digital currency and payments, health care, education, auditing, supply chain traceability, electronic voting, market monitoring and regulation, taxes, procurement, smart cities, notarisation, integrity of official publications, are only examples[8]. And, despite all the interest this technology has generated and all the potential use cases that have been identified, implementation in the public sector is still very limited.

The main question here is why there are so

[3] C.R. López-Zambrano, M. Camberos-Castro and E.M. Villarreal-Peralta, *The determinants of trust and perceived risk on bitcoin users*, in *Retos/Revista de Ciencias de la Administración y Economía*, vol. 11, n. 22, 2021,199-215.

[4] Available on https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12527-Artificial-ntelligence-ethical-and-legal-requirements_.

[5] M. Cordero Valdavida, *Blockchain in public sector, an international view,* in *Revista Vasca de Gestión de Personas y Organizaciones Públicas*, n. 16, 2019, 20-21.

[6] B. Forde, *Using Blockchain to keep public data public*, in *Harvard Business Review*, 2017, https://hbr. org /2017/03/using-blockchain-to-keep-public-data-public.

[7] According to the European Blockchain Observatory, there are 229 use cases possible registered.

[8] For more details see M. Cordero Valdavida, *Blockchain in public sector, an international view*, 23-26.

few operational blockchain implementations in public administrations. One reason is the already mentioned lack of explicit statement of the problem to be solved. Another could be that the problems identified can be solved with other, already existing technologies. Some studies highlight several adoption challenges such as lack of regulation, security and privacy concerns, insufficient and lack of interoperable infrastructure, the need for value-driven transitions in administrative processes, and the absence of governance models[9].

In a recent report with the telling title "The uncertain promise of blockchain for government"[10], the OECD looked into public sector experiences with blockchain and analysed the reasons for their success or failure to reach the implemention phase and to actually be used. Based on this analysis the OECD identified five success factors (clear value proposals, appropriate technology, stakeholder management, user focus and experimentation) and three non-success factors (legal uncertainty, limited scalability, and disruptiveness).

The report also discusses 10 recurring myths related to public sector blockchain which "are not always voiced in exactly these ways, but communicated as unspoken assumptions". These myths are presented in Table 1.

	Myth	Answer
1	Public blockchains are disrupting the public sector all around the world	Blockchain-related public services that have actual users are very rare
2	It is impossible to build successful blockchain applications for the public sector	There is no obvious reason the public sector could not develop, implement and use blockchain solutions
3	There is one obvious way to apply blockchain technology in the public sector	Blockchain could bring benefits to a number of areas
4	If you build it, users will come	Users need to be presented with the benefits of the services
5	If it is blockchain, it needs to be big and disruptive	Small, pragmatic and evolutive blockchain implementations are just as valuable
6	Nobody knows how blockchains are implemented	Technology and corresponding skills have developed in both the public and private sectors in recent years and there is greater access to external skills
7	Blockchain is a generic technological solution, similar to AI	Uses for blockchain technologies are much more limited in their scopes
8	We are not tech people and should not care about detailed design decisions such as blockchain	Decoupling design from the implementation does not seem warranted
9	Results of blockchain projects contribute to blockchain knowledge	Experimentation is important but those lessons and takeaways should be shared
10	Users are interested that services are based on blockchain	All other things being equal, service end users do not generally care which technological infrastructure provides them with a service

Table 1. Ten myths about blockchain in the public sector - Source OECD[11]

The main conclusion is that, up to now blockchain has not disrupted the public services as there are very few successful blockchain-based services in operation. Although the public sector has the capacity to work with blockchain technology, the main challenge is to present clear benefits for the users even through small implementations, as users do not care which technological infrastructure is behind the service they are using.

3. *Managing expectations*

The blockchain industry and ecosystem keep developing at a staggering pace, with new use cases and applications emerging almost on a daily basis. As underlined by Gartner[12], public blockchains are maturing faster than enterprise permissioned blockchains. While the former remove central authorities and spur innovation, the latter

[9] E. Tan, S. Mahula and J. Vrompvoets, *Blockchain governance in the public sector: A conceptual framework for public management*, in *Government Information Quarterly*, Belgium, Elesevier, 2021, https://doi.org/10.1016/j.giq.2021.101625.

[10] J. Lindman, *The uncertain promise of blockchain for government*, in *OECD Working Papers on Public Governance*, Paris, OECD Publishing, 2020, https://doi.org/10.1787/d031cd67-en.

[11] J. Lindman, *The uncertain promise of blockchain for government*, in *OECD Working Papers on Public Governance*, 2020, doi.org/10.1787/d031cd67-en.

[12] A. Litan and A. Leow, *Hype Cycle for Blockchain,* in *Gartner,* 2021, https://www.gartner.com/interactive/hc/4003463?ref=solrAll&refval=325005556.

replace them with "task force authorities", thus making governance particularly difficult. Successful enterprise (permissioned) blockchain projects are still scarce. Public blockchain use cases, on the other hand, are thriving and have grown in complexity, giving birth to specialized niches with their own communities and ecosystems. Some examples are decentralized finance (DeFi), Non-fungible tokens (NFTs) powering "creator economies", Self-Sovereign Identity and Decentralised Autonomous Organisations (DAOs).

As the blockchain industry grows in complexity, it is increasingly difficult to have a comprehensive overview. It is important to start looking at use cases individually, as they have different levels of maturity and adoption. Some are still at their very early stages, while others are already climbing through the slope of enlightenment of the Gartner hype cycle and moving towards the plateau of productivity. Cryptocurrencies, for example, are entering their early mainstream phase on the tailwinds of recent developments. With a controversial decision, in June 2021 El Salvador was the first nation state to declare Bitcoin legal tender[13]. Several publicly listed companies recently disclosed holding Bitcoin as part of their treasury reserves[14]. In addition, several countries, including Germany, the USA and Canada, approved Exchange Traded Funds and other financial products giving traditional financial actors some exposure to cryptocurrencies.

NFTs, instead, are an example of a promising use case reaching the peak of inflated expectation. While fungible tokens like Ether or Bitcoin have all the same value and properties, NFTs are tokens with unique characteristics. Each NFT has its specific properties and clear proof of provenance (e.g. originating from the wallet of a well-known artist), making them well suited to represent digital artworks or other unique artefacts. In a digital world in which content is abundant and can be endlessly copied and reproduced, NFTs introduce digital uniqueness and scarcity. NFTs could have a significant impact on creative industries, such as art, music and gaming, to mention a few. Although NFTs exist since 2014, they have become extremely popular in the past year as a way to buy and sell digital art. As a result, the NFT market is in a phase of frenzy, with extremely high valuations across the board. In March 2021, a digital artwork sold at Christies for a record-breaking $69.3 million[15].

Regardless of their nature and maturity, all blockchain use cases depend on the efficiency and effectiveness of the underlying infrastructure. A blockchain, by its very nature, is more redundant, complex and slower than traditional databases. Limited capacity (in terms of transactions per second) and poor user experience have so far been slowing factors to the broader adoption of this technology. We must be aware that these issues still persist, but solutions have been in development for the past few years and are finally starting to become available. To mention an example, the constantly congested Ethereum blockchain is undergoing a radical transformation. This includes changes in its consensus algorithm and monetary policy, and the introduction of a modular architecture that should considerably increase the number of transactions that the network can process, without sacrificing its decentralisation.

High energy consumption is one of the key criticisms against blockchains. The argument originates from Bitcoin's consensus mechanism, that is based on the so-called "proof of work" (PoW). To mine a block, Bitcoin miners compete against each other to solve very complex mathematical problems. This "work" requires a high number of computations, and therefore high energy. However, this is also the mechanism that secures the network from attacks. The higher the hashrate (i.e. the computational power) of the network, the higher is its security. Lowering the energy consumption of a PoW blockchain would undermine its security, therefore it is not a viable option. But is this high energy consumption a net negative? The answer is not so straight forwards, as the arguments are complex and nuanced. For example, Bitcoin advocates consider mining as an excellent complement to renewable energy sources, due to its capacity to absorb (otherwise wasted) excess energy and act as

[13] N. Renteria, T. Wilson and Karin Strohecker, *In a world first, El Salvador makes bitcoin legal tender,* in *Reuters*, 2021, in https://www.reuters.com/world/americas/el-salvador-approves-first-law-bitcoin-legal-tender-2021-06-09.

[14] Available on https://bitcointreasuries.org.

[15] E. Howcroft, *Digital-only artwork fetches nearly $70 million at Christie's*, in *Reuters*, 2021, available on www.reuters.com/article/us-auction-christie-s-nft-idUSKBN2B3275.

an "energy buyer of last resort"[16]. Such mechanism could increase profitability, and therefore adoption of renewable sources. While it is difficult to predict the outcome of this debate, it is important to mention that there are less energy-intensive alternatives to PoW. The main one is Proof of Stake (PoS), which requires participants to commit a sizable amount of assets to the network. These assets can be seized ("slashed" in jargon) if participants do not behave according to the rules. Several blockchains already adopt PoS, and the second biggest network, Ethereum, plans to move from PoW to PoS within a year time. Should PoS prove to be as secure as PoW in the long term, it could represent a solution to the energy debate.

Last but not least, limitations stemming from the intrinsic complexity of the technology, as well as legal and regulatory considerations should be always carefully considered.

Overall, the blockchain industry is vibrant: promising use cases continue to be proposed and refined, but there is always a risk of inflating expectations. Blockchains are not universal solutions, but are considered to be very effective in solving some specific issues. However, a peer reviewed study published by the Center for Evidence Based Blockchain concluded that almost half of the blockchain firms show no explicit evidence of the problem to be solved. Approximately one-third fail to cite a comparison and intervention analysis and less than 2 per cent demonstrate evidence of outcomes backed by filtered (critically appraised, peer reviewed) information[17].

4. *The European Union context*

The European Union and its Member States have already identified blockchain as a technology with great potential. The successful examples examined by the OECD include implementations by EU Member States such as the Stadjerspas vouchers issued in Groningen, in the Netherlands and the services provided by the Estonian Information Systems Authority (RIA) and the Swedish employment agency. At the European level the European Council asked the European Commission (the Commission) in October 2017 to present a European approach to blockchain. This triggered several actions in the following year.

The Commission launched the EU Observatory and Forum[18] in February 2018 while in April of the same year the Commission, 21 Member States and Norway created the European Blockchain Partnership (EBP)[19] to which have by now adhered the remaining EU Member States and Liechtenstein. The EBP partners agreed to work towards creating a European Blockchain Services Infrastructure (EBSI) "with governance involving public authorities, which should support interoperability and open interfaces, with the highest standards of security, confidentiality and data protection compliance while offering economies of scale as compared to a plethora of in-interoperable private blockchains".

The EBSI initiative[20] was launched in September 2018 aimed to support 4 use cases selected by the partner countries related to document notarisation and traceability, trusted data exchange, self-sovereign identity and educational credentials. In October the European Parliament adopted its "Resolution on distributed ledger technologies and blockchains: building trust with disintermediation"[21].

In April 2019 106 organisations and companies from all over the world in cooperation with the European Commission launched INATBA, the International Association of Trusted Blockchain Applications[22], aimed at promoting the use of blockchain technology by developing a predictable, transparent and trust-based framework. Another 3 use cases were added to the EBSI in 2020 (European social security identification number, asylum process management and SME financing). The EBSI

[16] Bitcoin Clean Energy Initiative memo: *Bitcoin is key to an abundant, clean energy future*, in *Square*, 2021, available on https://squareup.com/us/en/press/bcei-white-paper.

[17] N. Naqvi and M. Hussain, *Evidence-Based Blockchain: Findings form a Global Study of Blockchain Projects and Start-up Companies*, in *The Journal of The British Blockchain Association*, 2020, https://doi.org/10.31585/jbba-3-2-(8)2020

[18] Available on www.eublockchainforum.eu.

[19] Available on https://digitalstrategy.ec.europa.eu/en/policies/blockchain-partnership.

[20] Available on https://digitalstrategy.ec.europa.eu/en/policies/european-blockchain-services-infrastructure.

[21] European Parliament, *European Parliament resolution of 3 October 2018 on distributed ledger technologies and blockchains: building trust with disintermediation (2017/2772(RSP))*.

[22] Available on https://inatba.org.

activity was funded through the Connecting Europe Facility[23] program in 2019 and 2020 with a total of EUR 11 million for deploying a network of distributed nodes across Europe, and for supporting the development of the identified use cases and the work of the EBP.

The next year, 2021, was the first year of the new Multiannual Financial Framework (MFF), the seven-year framework regulating the annual budget of the European Union. This change typically involves a review and reorgansiation of actions and resources, which are adjusted in order to pursue new objectives addressing the latest challenges at all levels, aiming to support the progress of the European Union. Blockchain has been confirmed as being part of the new vision for the European Union as this is reflected in the new MFF.

In fact EBSI has been included in the new Digital Europe Programme which has already foreseen a total of EUR 38 million in its 2021-2022 work programme[24] for actions deploying the EBSI itself and funding a regulatory sandbox and standardization activities. It is also mentioned in other initiatives and actions as a potential technology to use such as the Commission proposal on the Path to the Digital Decade to deliver the EU's digital transformation by 2030[25]. EBSI is one of the potential areas of activity listed for multi-country projects, i.e. large-scale projects that no single Member State could develop on its own in areas that are fundamental for enhancing Europe's digital sovereignty and for fueling Europe's recovery.

In parallel the EU has been working on regulating decentralized finance, an area which is expanding. The proposal for a new European law on Markets in Crypto-assets[26] (MICA) aims to support innovation and fair competition by creating a framework for the issuance, and provision of services related to crypto-assets. The European Central Bank and the network of national central banks in the EU Member States have been considering the potential use and implications of blockchain and stablecoins in the context of its exploration of Central Bank Digital Currencies in view of the introduction of a digital euro.[27]

The use of blockchain has also been explored in other areas at the EU level, such as the financial transparency, with the European Financial Transparency Gateway pilot project[28]. It is worth noting the case of the European Intellectual Property Organisation, which launched in April 2021 the first ever European blockchain platform to better serve public IP institutions, connecting it to its two flagship search services, TMview and DesignView[29].

Does this mean that the EU and the public administrations of the Member States are ready to use extensively blockchain for delivering their services? This does not seem to be the case, at least based on our experience from our involvement in EBSI and exchanges with other European Union institutions and bodies as well as public bodies in the member states.

5. *Lessons learned from experience*

The European Court of Auditors proposed the document notarisation and traceability use case to the EBSI, one of the first 4 use cases selected in 2018. This was based on a proof-of-concept carried out between March and June of that year, the ECA registry, which confirmed the potential interest of using blockchain for establishing an immutable audit trail for documents and processes. This was responding to the real need of proving the existence in time and the integrity of documents that could be used as evidence during audit.

The ECA registry was introducing control-by-design in the process, for example, of receiving and using EU funding. The actors involved in such a process, either individuals or information systems, would register themselves the documents as well as information concerning these documents (metadata) and link these to registrations of

[23] Available on https://ec.europa.eu/cefdigital/wiki/display/CEFDIGITAL/Learn+about+EBSI.

[24] Available on https://digital-strategy.ec.europa.eu/en/activities/work-programmes-digital.

[25] European Commission, *State of the Union: Commission proposes a Path to the Digital Decade to deliver the EU's digital transformation by 2030,* in *European Commission Press Corner*, 2021, in https://ec.europa.eu/commission/presscorner/detail/en/ip_21_630.

[26] European Parliament Proposal for a Regulation of the European Parliament and of the Council on markets in crypto-assets, and amending Directive (EU) 2019/1937 (COM/2020/593 final).

[27] European Central Bank, *A digital euro*, in www.ecb.europa.eu/paym/digital_euro/html/index.en.html.

[28] Available on https://eftg.eu.

[29] Available on https://euipo.europa.eu/ohimportal/en/news/-/action/view/8662923.

other documents related to the same process, creating in this way a logical chain. These registrations could then be verified by anybody, while the metadata could be consulted by anybody, when defined as public, or by those who would be given the right by the registrars themselves, when defined as restricted. The actual registration was done without the documents ever leaving the premises of the registrar or the information systems of origin, as they were not even submitted to the middleware that was taking care of the registration, while the only thing that would go on the blockchain (ledger) itself was an algorithmic hash[30].

It was clear for us that for the concept of the ECA registry to be successful at the European scale for the main user scenario considered, i.e. the real time registration of supporting documents related to the use of EU funds that could then become audit evidence, it should involve all actors involved in a process. This means involving at least the public authorities in the Member States and the Commission. Moreover running a service at a scale that would make it possible to use at the European and even international level was beyond the mandate of the European Court of Auditors.

Therefore, the ECA submitted a proposal inspired by the ECA registry to be included in the EBSI. The EBP accepted the proposal as it considered that this use case had a broader interest for public administrations: ensuring traceability of official documents to support transparency, accountability and trust.

After the EBP selected our proposal, we have accepted in the beginning of 2019 to act as the "convener" for this use case. This included participating actively in the EBSI governance, facilitating collaboration between Member States participating in the notarisation and traceability use case group and working with the Commission to describe the functional requirements, to support legal and technical analysis and to contribute to the communication on the use case. We kept this role until September 2021 when we decided to step down. During this period we gained some experience which we share in case it can be useful for those working on introducing blockchain in public administration practice.

[30] More details in M. Cordero Valdavida, *Blockchain in public sector, an international view*, 30-32.

5.1. *Bridge with the existing world*

Public administrations do not like radical changes. A promise they could accept is: "You will be doing more or less the same things, only in an easier and more efficient and effective way." This is even more true when targeting cross-border use cases where different administrative cultures and contexts are involved as is the case in European initiatives such as the EBP, led by the EU Member States.

If we want to convince decision makers, who are meant to defend the public interests, to test and introduce emerging technologies such as the blockchain in their technological environment, we need to make it possible to connect blockchain-based capabilities to existing systems in a flexible and modular way. This would enable the gradual introduction of the technological innovation in the day-to-day practice in the different public administrations, albeit at different speeds depending in the conditions in each country. It would also allow administrations to exchange experience and confirm that the impact of the new technology on their services to citizens and enterprises is positive. This is very different from innovation in the private sector, where almost anything can be accepted provided it is not illegal and it makes money, and where a radically new idea may mean instant profit and a temporary competitive advantage.

Digital solutions are also required in many cases to reflect concepts of the real physical world and to apply on real objects. This need is reflected for example in the concept of the NFTs, where the notion of a unique digital original has been introduced for digital assets also as means to create value in a way applicable in the real work, similar to the signed original works of art. An interesting approach in this context is the notion of "digital twins" which is proposed in order "to capture the relationship between a real-world asset and its on-chain representation" allowing that the digital assets to flow freely between heterogeneous systems"[31] and which largely corresponds to the concept tested by ECA.

In our opinion, blockchain-based solutions should avoid being inspired primarily by

[31] D. Alvrilionis and T. Hardjono, *Towards Blockchain-enabled Open Architectures for Scalable Digital Asset Platforms*, in *ArXiv*, 2021, available on https://arxiv.org /abs/2110.12553.

technological principles and ideology on what would be possible in an ideal blockchain-based environment. They should move towards corresponding to the real world business needs of users and public administrations, taking into account their existing technological and institutional environments. This seems to be the only way to see more such solutions moving from successful demos, proofs-of-concept and pilots to successful services, which are put in production and are appreciated by their users.

5.2. *Law and technology*

Blockchain is still an "emerging technology". Therefore, the legal and regulatory environment is not yet sufficiently developed and established, although legal instruments are being put in place at national and European level. A critical risk is that technical solutions are decided and implemented without taking into account early enough the existing legal environment and the potential challenges it may represent. This corresponds to what can be called technical fundamentalism, which "consists of designing technology without relying on legal rules, and sometimes is a way of avoiding it"[32] and can put at risk not only the implementation and the uptake but even the survival of the underlying technology.

The appropriate solution for blockchain from our experience seems to be what is called "law and technology approach" in a very recent study carried out for the European Commission[33]. Although the study is focusing on one of the holy grails of blockchain world, the smart contracts, its recommendations are applicable, in our opinion, to the overall approach to blockchain implementation. The advice is that those working on the development and implementation of blockchain-based technological solutions and those working on the development and implementation of the legal and regulatory aspects should start working hand in hand early enough in the process. While doing this, both the legal and technical experts should be taking into account the real needs of the end users (citizens, enterprises) and the specific institutional context and reality of the public administrations themselves, as well as the overall economic and social environment.

To illustrate the importance of legal issues in the implementation of blockchain technologies, it is worth noting that among the 20 proposals and actions included in the aforementioned European Commission study on Smart contracts, six refer to changes in hard law, four call for the harmonization of rules or interpretation of concepts and one suggests the use of soft law[34].

5.3. *Decentralization, transparency and accountability*

Decentralization "is seen as the architectural guarantee of censorship resistance, and a safeguard against the coercive influence of any centralized, top-down force. The external forces of control -- institutions, intermediaries, rules, laws, and norms-- prevent the ideal, purely technological modes of private ordering, based on the horizontal self-organization of equal peers. The social order that is expected to emerge on decentralized technologies is seen as inherently superior." [35]

One of the most influential architects of the blockchain technology space gives the following definition: "Blockchains are politically decentralized (no one controls them) and architecturally decentralized (no infrastructural central point of failure) but they are logically centralized (there is one commonly agreed state and the system behaves like a single computer)"[36]. A leading expert in Bitcoin and open blockchain technologies, made the following statement: "Is it open, borderless, censorship resistant, decentralized, publicly verifiable and neutral? If it's not, it's not a blockchain. It's

[32] T. Schrepel, *Smart Contracts and the Digital Single Market Through the Lens of a 'Law + Technology' Approach*, in *European Commission*, 2021, available on https://ssrn.com/abstract=3947174.

[33] T. Schrepel, *Smart Contracts and the Digital Single Market Through the Lens of a 'Law + Technology' Approach.*

[34] As for the rest: 5 suggest policy actions, 2 invite for experimentation in comfort zones and 2 refer to using AI and language processing for better managing smart contracts.

[35] B. Bodó and A. Giannopoulou, *The Logics of Technology Decentralization - The Case of Distributed Ledger Technologies,* in *Blockchain and Web 3.0: Social, Economic, and Technological Challenges Routledge,* M. Ragnedda & G. Destefanis (eds.), University of Amsterdam, 2019, available on https://ssrn.com/abstract=3330590.

[36] V. Buterin, *The meaning of decentralization*, in *Medium.com*, 2017, available on https://medium.com/@VitalikButerin/the-meaning-of-decentralization-a0c92b76a274.

bullshit."[37] These statements are illustrative of the ideological weight given to decentralization by blockchain enthusiasts.

The current situation is well reflected in the acknowledgement that "at the moment there is a wide gap between the forms and extent of decentralization as prescribed by the ideology, and the practical forms in which it manifests in various blockchain networks."[38]

As far as transparency is concerned, this is one of the big promises that blockchain technology made and can already deliver as it provides a reliable and fully verifiable, immutable record of transactions. This is particularly important for public administrations as it can improve the trust in the services they offer, while reducing the cost of verification both for them and for their users. However, on-chain transparency does not automatically support accountability if it is not coupled with clear replies to the six foundational questions which, according to Mashaw[39], "can frame an "accountability regime" and help us approach accountability in its institutional guise". These are: (1) *Who* is accountable; (2) *to whom*; (3) *for what* is the person accountable; (4) *through what processes* is accountability ensured; (5) *by what standards* will the conduct be assessed; and (6) *what are the potential effects* if these standards are not met. Ideally this information which is key for public institutions and decision-makers to be trusted by citizens and enterprises and for avoiding fraud and tackling corruption, should also be registered and available through the blockchain-based system itself. Given that accountability is essentially at the level of the individual, we can support the statement that "the efficiency and sustainability of the accountability ensured by this technology will depend on its ability to address the challenge of decentralised storage and processing of information in a way that respects the General Data Protection Regulation (GDPR)."[40]

The challenge for public administrations is to be able to rip the benefits of blockchain, while ensuring transparency, protection of privacy and accountability.

5.4. *Value proposition*

"Blockchain will only survive if it retains strong elements of differentiation to gain competitive advantage over other species in a given environment."[41] This statement is inspired from evolutionary theory and is valid for all users, including public administrations. Any new technology has to demonstrate that it solves a problem that remained unsolved or that was solved but not in a cost-efficient way. The case of digital identity is indicative as a challenge for blockchain uptake.

The Commission proposed in June 2021 a framework for a European Digital Identity. Under the new Regulation, Member States will offer citizens and businesses digital wallets that will be able to link their national digital identities with proof of other personal attributes (e.g. driving licence, educational qualifications, bank account). This is expected to contribute to achieving some of the targets set out in the Commission's 2030 Digital Compass, which is part of the vision towards a digitally empowered Europe by 2030: all key public services should be available online, all citizens will have access to electronic medical records; and 80% citizens should use an eID solution.

The new European Digital Identity Wallets will enable all Europeans to access services online without having to use private identification methods or unnecessarily sharing personal data. With this solution they will have full control of the data they share. In practice, we could say that the EU wants to offer a European solution to Europeans to use instead of Google, Facebook or similar accounts.

The European Digital Identity will be available to any EU citizen, resident, and business in the EU who would like to use it. The European Digital Identity wallets will be useable widely as a way either to identify users or to prove certain personal attributes, for accessing public and private digital services across the EU. Its' users will be able

[37] A. Antonopoulos, available on *https://twitter.com /aantonop/status/1257319103527698434.*

[38] B. Bodó and A. Giannopoulou, *The Logics of Technology Decentralization - The Case of Distributed Ledger Technologies*, 2019, available on https://ssrn.com/abstract=3330590.

[39] J. L. Mashaw, *Accountability and Institutional Design: Some Thoughts on the Grammar of Governance*, in *Public Accountability, Designs, Dilemmas and Experiences*, Michael W. Dowdle (ed.), Cambridge University Press, 2006, 115-156.

[40] N. Milionis, *Accountability in the EU - the financial dimension,* (in Greek language), Legal Library, 2021, 72.

[41] T. Schrepel, *Smart Contracts and the Digital Single Market Through the Lens of a 'Law + Technology' Approach*, in *European Commission*, 2021.

to choose which aspects of their identity, data and certificates they share with third parties, and to keep track of such sharing. User control ensures that only information that needs to be shared will be shared.

The whole conception and terminology used for the EU digital identity is very close (if not identical) to the concept of self-sovereign identity, or SSI, which is a key concept for blockchain. The European SSI framework has also been given a central role in the design of EBSI and most of its existing use cases. However the regulation is technology agnostic, while the commercial non-European competitors of EU identities have been implemented successfully over the past years without using blockchain.

To make it a reality as soon as possible, the Commission invited Member States to establish a common toolbox by September 2022 and to start the necessary preparatory work immediately. Whether SSI will be included in this EU digital identity toolbox or not will be decisive for the future of ESSIF and EBSI.

5.5. *Governance*

Blockchain, as well as other emerging technologies "are already tacitly or explicitly imposing their own governance norms, when seen from the perspective of Lessig's "Code is Law"[42]. However, closer investigation is required in order to ascertain whether these imposed norms of governance also need regulation and governance themselves. There is a need to strike a balance between the new power distributions and the tacit governance norms and structures imposed by technology, vis-à-vis the existent normative framework and governance structure surrounding our democratic principles."[43]

This statement describes quite well our own experience. Having a balanced approach is a prerequisite for designing and implementing a system that can reach production in an efficient way. In fact, the governance model depends on the type of the blockchain, which is defined based on whether it is permissioned or not, i.e. who can write on it, and on whether it is public or private, i.e. who has the right to read the registrations, as presented in Table 2.

		Who reads	
		Only autho-rised	*Anybody*
Who writes	*Only autho-rised*	Private	Public permis-sioned
	Anybody	n.a.	Public

Table 2: Types of blockchain

In the case of a public permissioned blockchain, such as the EBSI, this means that only known authorized entities should be able to write on the chain and everyone should be able to read/verify the information. It means that somebody - typically the owner of the data infrastructure – gives the permission to somebody else to do something specific on chain, for example to issue or register a specific type of official document.

Who and why is entitled to grant a permission? Who and why is entitled to receive a permission? What is the recipient of the permission authorized to do and what not? The replies to all these questions should be documented and transparent to stakeholders and users of the system, so that they can trust it. Ideally the blockchain-based system itself should be used to trace all necessary documents and actions underpinning this trust.

It is essential to answer these questions already at the design phase of a system. As mentioned in a recent article analyzing literature on blockchain governance in the public sector, questions such as "'who will be authorized to make changes in the system?', and 'what are the rules/procedures to follow in the change of the system?' are key governance considerations for blockchain-based systems. Vili Lehdonvirta calls these inherent contradictions of blockchain governance as 'governance paradox' as once you address these problems of governance, blockchain loses its value over conventional technologies and means where a trusted central party enforces the rules because you are already trusting some organization or process to make the rules."[44]

The actors, roles, and responsibilities of the governance should be specified early enough to enable efficient decision making during development and deployment. The

[42] L. Lessig, *Code Is Law: On Liberty in Cyberspace*, in *Harvard Magazine*, 2000, in https://harvardmagazine.com/2000/01/code-is-law-html.

[43] A. Zwitter and J. Hazenberg, *Decentralized Network Governance: Blockchain Technology and the Future of Regulation*, in *Frontiers in Blockchain*, vol. 3, 2020, available on www.frontiersin.org/article/10.3389/fbloc.2020.00012.

[44] K. Werbach, *The blockchain and the new architecture of trust,* Cambridge, MA, MIT Press, 2018.

governance structure should guarantee that the operational, organisational and institutional aspects of the target system accommodate the needs of the different use contexts and domains, as well as the specific conditions of the different public administrations and domains. These are the main challenges when aiming to develop and put in production a blockchain-based system and they should be the ones to be translated into technical choices - and not vice-versa.

It is also very important to ensure that the vision, the scope and the expected outcome of the blockchain initiative are clearly specified since the beginning and that they are understood and shared by all stakeholders.

5.6. *Summary of experience*

Table 3 lists the lessons learned from our experience and proposes an approach that we consider may foster the uptake of the blockchain by public administrations. These can be summarized into a single phrase: move to the future without turning the back on the present (i.e. existing information systems as well as legal and institutional environment) and focusing our attention to the added value created by the use of blockchain.

Lesson	Proposed approach
Bridge with the existing world	Offer seamless connectivity to existing systems. Enable free flow of digital assets in heterogeneous systems.
Law and technology	Technology and legal experts to work together early enough, taking into account the needs of users and public administrations and the economic and social environment.
Decentralisation, transparency and accountability	Implement solutions, if possible decentralised, that guarantee transparency, protection of privacy and accountability.
Value pro position	Focus on the competitive advantage of blockchain for existing and emerging use cases.
Governance	Specify very early, already at the design phase, the roles, responsibilities, decision-making processes and governance structures. Ensure that the vision and expected results are understood and shared by all stakeholders.

Table 3: Lessons learned and proposed approach

6. *Conclusion*

In our opinion, the public sector does not seem to be ready yet to start using and proposing blockchain-based services extensively. A limited appetite for disruption, the still unclear interpretation of the legal and regulatory environment and the need to demonstrate clear benefits for public administrations prevents senior management to take decisions towards solutions that could entail more risks. We think that, if blockchain would be introduced as a new building block, as a complement to enhance existing systems and processes for traceability and transparency, reducing the cost of the services provided while improving their effectiveness, it would have an opportunity to enter in the realm of the public sector, to demonstrate its value in day-to-day activities and to take-off.

Maybe it is true that blockchain for the public sector is now in the "trough of disillusionment"[45]. However, it could move upwards to the "plateau of productivity" in a few years, if all actors, i.e. all those looking into law, business processes and technology, work hand in hand, avoiding both technological fundamentalism and rigid formalism. All this must be reflected in adapted governance structures, aimed at delivering feasible and acceptable solutions to real-world problems.

[45] A. Litan and A. Leow, *Hype-Cycle for Blockchain*.