Blockchain Standards and Government Applications

Christiana Aristidou and Evdokia Marcou

80, Griva Digeni, Swepco Court 6, 2nd Floor, 3101 Limassol, Cyprus
E-mail: christiana@aristidou.com

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Abstract

Many people talk about blockchain but very few understand its true nature and potential. Blockchain seems very exciting yet simultaneously a bit confusing, and naturally many people, businesses, and governments approach it with high expectations while also exhibiting some hesitancy. This article will deal with the use of blockchain in relation to government applications. A proper assessment of such use requires a discussion on blockchain standards, which are currently developed, or may develop in the future. Without blockchain standards, any potential use of blockchain in government will be of limited and restricted value. This would render our discussion on government applications rather limited too. Standards enable us to appreciate blockchain applications in a useful way for future applications outside the context of government. Focusing our attention to government applications is deliberate. Blockchain, obviously, provides amazing opportunities for the private sector. Over the last years there has been widespread public disbelief in many public and government institutions. Corruption, fraud, lack of transparency, alienation and disconnection of citizen from decision-making centres oblige governments to change and offer proper governance conditions for their citizens. Further, higher consumer expectations in all sectors of the economy naturally affect the expectations of citizens vis-à-vis their governments. For the above reasons, governments could leverage the positive features of blockchain to restore their

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reputation and efficiency towards citizens, by using blockchain. Of course, governments can use blockchain for many of their applications. To decide the proper application of blockchain within their operations, governments must embark on a need-based approach. Standards are extremely useful in such a need-based approach.

Keywords: Blockchain, Blockchain Standards, Government and Blockchain, Government Applications.

List of Abbreviations

CEN	European Committee for Standardization
CENELEC	European Committee for Electrotechnical Standardization
DLT	Distributed Ledger Technology
ETSI	European Telecommunications Standards Institute
ISO	International Organization for Standardization
ITU	International Telecommunication Union

1 Introduction

Blockchain has drawn considerable attention over the years, owing to its unique features and tremendous potential. While the interest in this technology increases, the amount of knowledge and understanding over it seems to remain static, or at least not as developed as expected. Much of the scepticism surrounding blockchain stems from its perception as a, mainly, financial tool linked with Bitcoin and other cryptocurrencies [1]. Many people fail to appreciate the fact that blockchain is a technology, itself belonging to the family of DLT, which has no necessary connection with Bitcoin [1]. Indeed, it is a technology that may be used outside the context of cryptocurrencies, such as Bitcoin. Even where we appreciate blockchain for its potential application in many sectors of the economy, and in many contexts within the society, any blockchain use must be made with caution. Blockchain is still a developing technology, and its decentralized nature has the capacity to cause dramatic changes in the way transactions take place. All relevant and involved constituencies will benefit from an organized and thought-through use of blockchain. Naturally, governments will be called to address and leverage blockchain to enhance their operation, while simultaneously deliberate over, and prepare a regulatory framework that would accommodate blockchain.

Having the above in mind, in this article the potential and future of blockchain in relation to government applications will be examined. Doing this, we argue, presupposes a thorough discussion of blockchain standards. Without such standards, the blockchain potential in Government applications and indeed any widespread blockchain application is significantly hindered. Standards offer the conditions for a disciplined and standardized use of blockchain. Further, standards are essential in relation to government applications, because governments may appropriately decide the way to use blockchain by embarking on a need-based approach. Standards are tailored to such endeavor.

In the first part, we shall discuss certain general aspects of blockchain and issues relating to government. This discussion will allow us to appreciate the main operation of the technology of blockchain and the reasons for which governments are in need of such technology. Following this, we shall focus on the importance and even, as we shall argue the necessity of standards in achieving consistent and widespread application of blockchain. Within the scope of this section, the basic issues that need to be addressed via blockchain standards will be examined. Further, potential governmental uses will be discussed. Instead of offering a list of possible government applications, we discuss that governments need to decide whether to integrate blockchain based on a need-based approach, i.e. on their needs. This will then enable us to appreciate the role of blockchain standards in government. We will argue that standards are useful because they enable the efficient and meaningful implementation of government applications by helping governments engage in a much-required need-based approach. Also, the endorsement of standards by the government will send positive signal towards markets and encourage investment, especially considering the absence of regulatory framework. We will demonstrate that standards enable governments to appreciate the issues related to blockchain, and accordingly prepare plans for its proper integration within the society, through for example, an appropriate regulatory framework. Thus, standardization of blockchain is generally important, but particularly important for governments.

The discussion of all the above issues will lead to the conclusion that blockchain as a governmental tool should not be looked at as a distant possibility. Indeed, it is to government's benefit to prepare and implement plans for use of blockchain within their operations, soon. This conclusion does not oversee the potential problems associated with blockchain. Instead, this conclusion is supported by the view that perfect solutions are unattainable. However, any development and use of blockchain necessitates the creation

of standards that will accommodate and facilitate the widespread use of blockchain. Therefore, while perfect solutions are illusory, governments should take the importance of standards into consideration before proceeding with the widespread implementation of blockchain.

2 Blockchain and Relation to Government

2.1 Explanation of Blockchain

We will not embark on a thorough examination and analysis of all the mechanics, and the operational and technical details of blockchain. This has been usefully discussed elsewhere with precision, and is outside the scope of this paper. Still, a brief explanation of blockchain is useful for the purposes of this paper.

Satoshi Nakamoto developed in 2008 a peer-to-peer form of electronic cash that would enable electronic payments, without the engagement of trusted third parties verifying the relevant transactions [2, p. 1]. In the relevant White Paper, Nakamoto recognized the increased costs associated with electronic payments due to the necessity of involving trusted third parties. Bitcoin was then famously born. Since then, bitcoin has intrigued the public interest, and has caused considerable debates, due to its novel and innovative operation. Despite the initial focus on bitcoin itself, the technology underpinning its operation seemed to attract interest on its own accord, in a considerably increasing way. Blockchain, as this technology is known, constituted a subject of discussion and interest, which extended well beyond the prospect of bitcoin. Indeed, blockchain has gained traction as a potentially business-changing technology [3].

Blockchain is an example of DLT. Blockchain is a ledger, but instead of a traditional, paper-based ledger, it is digital. In this ledger, transactions are recorded, and data are kept in a unique way due to the distributed and decentralized nature of blockchain. Blockchain enables the instant and synchronized replication and sharing of the state of the ledger to all blockchain participants, the so-called “nodes”. To be sure, any update to the blockchain database is immediately and instantaneously shared and distributed to all “nodes” in the database who then need to verify the transaction through a consensus mechanism process. The “nodes” verify the transaction by validating the current block’s cryptographic hash. A hash is created on the block using an algorithm. This hash “summarizes” all records of the previous blocks, on top of the new block’s records. If this hash is validated, then the new block can

form part of the blockchain database taking its place on top of the last verified block. This creates an immutable, irrevocable chain of blocks of transactions. This inspires confidence and trust to all blockchain participants that the state of ledger is kept in the same way within the whole database. The cryptographic hashing function ensures the integrity of the data. Furthermore, blocks are time-stamped, which enables blockchain data to function as chronologically accurate evidence [4]. Blockchain enables the peer-to-peer execution of transactions. The role of intermediaries is significantly reduced, or even eliminated within this context. The validation of transactions does not rest with a centralized authority, entrusted with this role, but with the participants through their consensus. It seems that the combination of decentralization, cryptographic block validation and transparency is what makes the blockchain system work in this unique way.

The operation of blockchain as explained above offers significant benefits. The consensus mechanism coupled with the distributed nature of blockchain render tampering with blockchain data very difficult, in theory [5, p. 16]. This in turn increases the trusted nature of the database, in a way that enables strangers to confidently transact with each other. Transparency is also achieved, within a blockchain system. The peer-to-peer mode of blockchain operation results in significant cost savings [example of cost-saving in land registry area in [5], p. 14]. The fast and secure way of transacting and information-exchanging on blockchain results in high efficiency gains.

It is easy to see that blockchain characteristics and resulting benefits have the potential to disrupt existing models of transacting and revolutionize the way various actors in society and economy interact with each other. The potential of blockchain is truly tremendous. Prior to assessing how this conclusion is particularly significant for government applications, it would be useful to briefly discuss the concept of Smart contracts to offer a complete picture of blockchain and its potential. It should be noted that Smart Contracts will be analyzed in detail, as part of the discussion on blockchain standards.

Smart contracts help materialize the potential of blockchain [6, p. 22]. Smart contracts are computer codes that run on DLT, such as blockchain. They contain certain conditions or instructions, as agreed between parties or as deployed and used by a single party, and automatically execute, once the set external trigger has indicated that the said conditions coded in the smart contract are met. In other words, once triggered, smart contracts execute without the need for any human intervention. Smart contracts are deterministic and responsive in nature. They can strictly execute automatically only the conditions that they contain. Therefore, not only do smart contracts benefit

from the characteristics of blockchain, but they also offer a further layer of efficiency in the execution of transactions. It goes without saying that smart contracts offer the potential for execution of agreements in a fast and automated way that minimizes enforcement costs.

2.2 Blockchain Importance in Government

As explained, blockchain offers use opportunities, virtually for any industry. It is, after all, a technology that may be tailored to the needs of various business sectors and industries. We maintain that an extremely significant area, where the use of blockchain becomes crucial, is the government [7, p. 12]. We trace the necessity for governments to rapidly consider and assess the integration of blockchain to their operations on two main pillars: (1) higher consumer expectations, in general, which inform and enhance citizens' expectations towards governments and public institutions and (2) current loss of trust and confidence of citizens in governments, with concomitant eroding effect on the regime's legitimacy.

Customers have become more sophisticated. Recent technological evolution has irrevocably altered customer's habits, and the expected, further development in technology will continue to increase customers' demands regarding the services they receive. Indeed, a commentator has not only highlighted the increasing customer expectations, but also the respective gap engendered by the failure of many businesses to meet them [8]. Convenience, timesaving, cost-efficiencies are some of the main characteristics that customers seek in their transactions. A prominent area which emerges as particularly "customer-centric" is financial services, where the customer's evolving habits and need for efficient, speedy, and mobile services are profound [9]. Amazon has also decisively influenced the way customers approach their expected services [8]. Within this context, it is unsurprising that businesses strive to provide seamless, personalized and efficient customer services seeking to create unique customer experiences.

Governments provide various services to citizens, ranging from the provision of information and benefits, responses to their complaints, processing of their applications, assessment of their documents, provision benefits etc. It is hard to see how a well-informed, busy modern citizen, accustomed to receiving efficient and convenient services of higher quality, will be satisfied with services of inferior quality. In support of this, the UK Government Office for Science has acknowledged that citizens' expectations need to be met by governments in similar ways as the rest of their expectations by

other organizations; governments must carry out their services in real time, in a personal way, and in digital form [6, p. 25]. Further, Hancock has referred to the citizens of the UK as the government's customers [3]. Higher customer expectations create more demanding and sophisticated citizens that expect analogous behavior from their government. The bureaucratic government machine, which is typically slow and inefficient, contravenes citizens' expectations. For this reason, its operation requires serious reconsideration.

Potential disappointment of citizens in the governmental machinery is possibly connected with a form of general disappointment in the public institutions. Governments operate on a smooth and sustainable basis only when they manage to exert trust and confidence from citizens. Such faith in public institutions relates to the idea of political legitimacy. When a regime is legitimate, its citizens are committed to it [On the link between legitimacy and faith in public institutions see Weber, 1964, and legitimacy in general see [10]]. Such commitment means that citizens generally obey the system's laws, they trust and have confidence in its operation, and do not undermine or flout its authority. A state's inability to inspire trust signals a breakdown of legitimacy, which places states and societies at risk. Citizens are frustrated and disappointed at a government operating slowly, inefficiently, and through stiff bureaucratic processes. How can citizens trust in a government that fails to deliver on its tasks? Even more profound instances of loss of citizens' trust in their governments, include cases of corruption, fraud, and favoritism involving politicians. There is a general disconnection of citizens from their government for reasons that reveal a general disbelief and mistrust in the transparency and operation of public institutions. The lack of trust in public institutions raises questions about the regime's legitimacy, and its ability to inspire citizens' general obedience to law.

In light of the above, it is easy to deduce that immediate changes need to be instigated towards more transparent and efficient government. A more well-functioning legal system that inspires citizens' trust and confidence is likely to be perceived as more legitimate, with wide-ranging benefits for the entire regime. For these reasons we wish to stress the importance of the application of blockchain in government.

2.3 Centralized Government vs. Decentralized Blockchain

The application of blockchain poses unique issues in relation to governments. There is significant tension between the centralized nature of governments and the decentralized nature of blockchain. Governments are centralized. There

are various degrees and instances of decentralization pursued in relation to some governmental operations, but governments remain at large centralized. Blockchain is decentralized. In fact, much of blockchain's appeal rests on its decentralization, whereby the need to engage intermediaries or centralized authorities for verification purposes decreases. Reconciliation between the two seems, prima facie, difficult to achieve.

As explained above, blockchain seems appealing for governments, because it offers the opportunity to resolve issues of citizens' lack of trust in government's operations. Governments introducing blockchain in an extreme, open version with absolute decentralization would necessarily involve the alteration of their typically centralized role in the lives of citizens. Indeed, this is a blockchain vision pursued by "techno-libertarians" and "crypto-anarchists", [terms used by [11, p. 4]] who seek to marginalize the role of states by rendering them "irrelevant" [11, p. 10 citing bitnation-blog.com]. Atzori offers a forceful and convincing defense against the vision of an "irrelevant" state, who is practically displaced by the force of decentralized, peer-to-peer information exchange, and transaction systems. Atzori, in brief, alarms that an extreme liberalist, techno-based society, where state's role has evaporated, endangers civil rights, and paves the way for the establishment of oligarchies comprised of technology-expert entities. Without delving into the moral, philosophical, and political reasons underpinning her defense, for the purposes of this paper it merely suffices to note that potential implementation of blockchain, realistically, theoretically and practically speaking, shall take account of the existing institutional arrangements. Besides, despite the lack of trust in some of government's operation, it is disputable that businesses and citizens would trust the "complex and opaque mechanisms" behind blockchain [12, p. 39]. Governments still carry an authoritative role, which is for the most part, trusted. Governments shall maintain their central role, at large and operate within legitimate institutional confines. In this sense, this paper assumes no radical institutional, political, and/or philosophical changes brought about by the potential blockchain implementation. Instead, the assumption is that blockchain will be used as a tool that will enhance governmental services and operation in a way that will, ultimately, positively affect citizens' view of their governments. Blockchain technology does not create trust; [13, p. 360] it merely operates as a means to achieving such trust.

The above discussion is compliant with the actual implementation of blockchain, which may take various forms and types. Blockchain is not applied in a uniform method. Instead, it may take various forms with varying degrees of decentralization, and the database's permission status. Blockchains

may be permissionless, or permissioned, depending on the arrangements made in the particular blockchain database in relation to the members of the database that will be participating in the process of block verification to create consensus. Permissionless blockchain may be accessed by any participant with a computer, whereas in permissioned blockchain certain arrangements are usually made in relation to who are allowed to join the database and verify blocks. The consensus mechanism, however, can be the same both in permissionless and permissioned databases, although other arrangements can also be made. For example, permissioned blockchains may be designed to achieve specific purposes with specific consensus, control, access and verification methods [14, p. 6].

Blockchains may also be public, consortium, or private. This refers to the access in the blockchain database; public blockchains are fully open to potential users while private blockchains usually restrict the use to certain predefined users.

The main differentiating factor in this regard is the degree of centralization. Public blockchain, typically permissionless as well, is the type associated with Bitcoin, where access and validation are open to participants, achieving high degree of decentralization. In private permissioned blockchain a trusted entity controls the validation and writing of data permissions. Permission to read data may be restricted by the controlling entity [15, p. 10]. Consortium blockchain resembles private blockchain, but instead of being comprised of a single controlling authority, it is controlled by a group. It is clearly seen that the oxymoron of decentralized blockchain implemented within a centralized government may be resolved by reference to the different blockchain design options. Governments may retain their central role, by implementing private permissioned blockchain databases, while reaping the blockchain's benefits of efficiency and transparency. This is a challenge, however, because as the governments' moving away from public premisionless blockchain to private permissioned blockchain, involves and inherent risk that blockchain ends up leveraged in a way that, does not improve transactions and processes and does not provide efficiency and transparency [16].

3 Role of Blockchain Standards in Government

Clearly, blockchain's potential cannot be overlooked in relation to government. Not only are governments in need of reinstating their relationship with citizens on firm grounds of trust and transparency but demands for governments' efficiency augment along with the increasing sophistication of citizens.

One should note, still, that there is concern that blockchain's integration with the public sector is premature, not least due to the still developing nature of blockchain, as a technology [6, p. 10]. Various examples of governments around the world investing, researching and even using blockchain are testament to the fact that blockchain has a role to play if not at the moment, then surely in the near future. The Chinese government has undertaken important initiatives with a view to developing blockchain for military purposes, the UAE government seeks to run many of its operations on blockchain by 2020, [17, p. 25] while Estonia has already introduced blockchain within its e-government framework. [https://e-estonia.com/tag/blockchain/]

Of course, the concern of blockchain raising issues due its immaturity is not entirely unfounded. Indeed, in our opinion there is some truth to this concern to the extent that blockchain is approached by governments in an undisciplined and haphazard means that omits serious consideration of the complex issues that surround and underpin blockchain. For this reason, we maintain that governments may be greatly benefited from the **standardization** in the area of blockchain. Such standardization is extremely significant to the successful and meaningful implementation of blockchain to government applications.

3.1 Blockchain Standards in General

Market, industry and government actors agree on, and highlight the importance of standardization in relation to blockchain [[4, 6, 7], Whigham, 2017 citing Head of Digital Transformation Agency, Alexander Peter]. Standards are developed for many industries as useful guidelines that impact and influence various actors involved in these industries such as regulators, customers, manufacturers etc. Also, standards may be produced in relation to new technologies. Standards constitute the product of lengthy deliberation, discussion, and ultimately consensus of experts involved in an area, and while not legally binding, per se, are highly influential to the operation and implementation of the subject they are concerned with. Influential and well-respected standards derive significant part of their authority from the processes they are subject to, including peer review [18, p. 12]. In some cases, standards are explicitly recognized by regulations and laws, and are thus granted the status of legal. In contrast with legal rules, which are typically rigid and inflexible, standards are viewed as flexible guidelines with rather general application on various concepts and subject matters. Of course, this does not take away from their robustness, when carefully produced.

Having in mind the above, it is unsurprising that many constituencies involved and affected by blockchain call for its standardization. Currently, a number of reputable standardization organizations are involved, and entrusted with the review and/or preparation of standards addressing issues that relate to blockchain. ISO, CEN-CENELEC, ETSI and ITU are leading the way, in this regard. Beyond these well-established and reputable organizations, private initiatives undertaken outside the context of standardization organizations demonstrate the urgency in adopting blockchain standards. Three well-known automobile corporations, Ford, GM and BMW, collaborate to ensure interoperability in the automotive industry, as part of the so-called Mobility Open Blockchain Initiative (MOBI) [17, p. 12]. The standards produced on a supranational level, either at an international level, such as ISO and ITU or at a European level, such as CEN-CENELEC and ETSI, are informative for the purposes of this paper. Such standards enjoy respect and are targeted towards alleviating problems encountered in society and businesses [18, p. 4].

Before discussing the main axes on which blockchain standards should develop, it must be stated that standardization in an ever-developing technology, like blockchain, is an extremely demanding endeavor. Striking the appropriate balance in terms of the timing in standards' development is equally difficult. Standards should be produced in a manner that elevates the potential implementation of blockchain. Naturally, concerns emerge as to the prematurity of standardizing blockchain [19, p. 19]. Standardization should be developed soon enough, so as to prevent inefficient application of blockchain, but not hastily, which would harm innovation. Different categories of blockchain standards should, and are expected to develop within a spread-out timeframe [20], considering the complexity of the issues involved, the interconnection of the said categories, meaning whether a given category of standards presupposes, or is facilitated by the development of another category and the maturity of blockchain technology during the development of the categories.

3.2 Blockchain Standards Categories

Consistent Terminology and Connection of Various Blockchain Concepts

Standardization should address fundamental concepts and components that underpin blockchain. The innovative nature of blockchain raises concerns over even its basic understanding. Lack of clarity and uncertainty in basic terminology of blockchain are often cited as significant challenges preventing

blockchain's implementation. It has been highlighted that in case of innovations "common vocabularies and agreed definitions of terms" enhance the confidence of investors and market actors impacted [21, p. 36]. Clarity as to blockchain terminology, particularly innovative and disruptive as it is, should not be underestimated. Indeed, development of any standards necessitates a standard of blockchain terminology [7, p. 17]. A survey produced by RAND Europe demonstrates that the task of offering standardized terminology and vocabulary should be, preferably, completed first [21, p. 46].

ISO has introduced working groups devoted to the Foundations of Blockchain, which encompasses specific standardization axes, including Taxonomy and Ontology. Broadly speaking, the former mainly entails issues of identification, description, and classification of blockchain aspects and components, while the latter attends to issues of the kinds, properties and relations between these components within the blockchain system [22, p. 4]. Cumulatively, these categories strive to produce a consistent vocabulary of components, and the connection between them. Another foundational issue that merits consideration is the reference architecture standard. This standard would allow the development and use of blockchain-based systems within a standardized framework, operating under the same conditions [7, p. 16].

Terminology and interaction of blockchain components is of foundational and fundamental value for blockchain standardization, which only serves as indication of the expected difficulty in addressing them appropriately, even more so where a developing technology is involved. Still, these aspects will surely go a long way towards alleviating the confusion and inconsistency currently encountered in relation to blockchain implementation.

Interoperability

An important risk emanating from a non-standardized blockchain environment has already emerged with the appearance of many private blockchain systems that follow their own rules and protocols. This results in a fragmented ecosystem, where blockchain systems fail to communicate with each other [4]. This, naturally, hinders the widespread use of blockchain, as one system managing to interact, communicate and interoperate with other systems would entail costs and be unnecessarily difficult. Development of standards with an overarching objective of **interoperability** of systems would alleviate the problem of fragmentation [7, p. 19]. Blockchain has potential to create efficiency gains, where it benefits from the network effect utility [23], citing Millar Jeremy]. Niche and restricted uses of blockchain contravenes the vision of meaningful adoption of blockchain on a grand scale.

Broadly speaking relevant data, protocols, standards, interfaces that relate to the operation of blockchain need to be standardized to enable their interaction. This will pave the way for cooperation and competition between businesses. The main pillars of interoperability, in this regard, relate to data connectivity and trust management. Interoperability is also crucial in enabling and facilitating the interaction of blockchain systems with other technology-based systems [20]. Given the globalised interconnection and interaction of markets and countries, it is further suggested that interoperability is desirable and should be pursued as a way of ensuring blockchain communication between different countries.

Security, Privacy and Integrity

A significant challenge as to blockchain use obviously relates to issues of security and privacy, as with all technologies. As explained above, blockchain is praised for the enhanced security environment, within which it operates, due to instant replication of ledger data to all nodes, cryptographic protection, immutability. However, blockchain is not immune to security issues, considering the human factor involvement [17, p. 12]. Protection and security of keys used for cryptographic purposes, as well as ensuring the protection and non-tampering of data for privacy and integrity reasons should, thus, be subject to specific standardization. It must be noted that issues of security, privacy and integrity of data are connected with the type of, and permissions to blockchain systems involved. Public, permissionless blockchain are established on the basis of pseudonymity. Some argue that, this might indirectly enable illegal activities or render the detection of such illegal activities difficult. Permissioned blockchain might through its operation prevent or at least minimize the occurrence of such activities. A standardized approach would address these relevant issues. Further, standardization as to security and privacy is also extremely important if technical interoperability is to be achieved. Secure blockchain system operators would avoid connection with systems prone to data manipulation, private details' exposure and security issues. A non-standardized environment would fuel hesitancy in operating with systems for fear of security and privacy issues.

Governance of Data and System

Governance of data and blockchain systems should be subject to standardization. Guidance about consensus and control mechanisms in tandem with audit

processes [21, p. 40] is extremely beneficial. As we explained above, there are different types of blockchain, depending on permission, control, consensus, access mechanisms. Governance on data impact the methods of managing data, correcting data. System governance would also deal with responsibility in case of potential breakdown in the integrity of blockchain or its data.

Governance refers to the processes and systems used to facilitate oversight and decision making in any organization. Governance is a very important function in a decentralized blockchain and particularly significant in case of government. Governance applies to both permissionless and permissioned blockchain. The need for governance for the latter is more obvious [24]. In the context of government blockchain applications, as we explained above, governance is significant; governments will retain their central role in blockchain systems, despite the fact that blockchain offers decentralized potential. The extent of government's control, and the way access, consensus, viewing of data will be handled are issues addressed via governance. In this sense, governments will need to carefully assess governance, especially as their role might transform, depending on further technology evolution. Depending on the type of blockchain under implementation and the application type built on top of that blockchain, blockchain governance may become even more complex, and may possibly merit even further careful consideration, in case of widespread blockchain implementation within the government.

Smart Contracts

Smart contracts are very challenging, not only in their standardization, but importantly in their operation in compliance with existing laws and regulations [26]. As explained, smart contracts elevate the performance potential of blockchain. Their relationship with legally binding contracts has been the subject of interest and legal review. Because of the complexity of the legal issues involved, and the divergence of contract, business and consumer law of different jurisdictions, standardization in smart contracts should avoid focusing on matters closely connected with law [7, p. 20]. Still, clarity and certainty are useful at a basic level.

3.3 Government Applications

The discussion above, centered around the main issues that standards would need to address, demonstrates the way governments, businesses, consumers may benefit from such standardization. These issues are of paramount importance in fueling widespread blockchain implementation, without fear

of fragmentation and unnecessary operational complications. Within this context governments benefit, too. Some governments have demonstrated their willingness to approach blockchain in a controlled manner [6]. This, we suggest, is facilitated by the operation of standards. Still, it is useful to examine the specific importance of blockchain standards in relation to government. To do so requires an examination of the potential of blockchain in government.

As already touched upon, above, blockchain provides the opportunity for secure, efficient, fast and transparent transacting and data exchange. As a general-purpose technology [13, p. 355], blockchain may be used by governments for a wide range of their activities. Governments may benefit with an intra-government implementation of blockchain but also on a government-with-citizens or government-with-businesses interaction.

Due to the volume of potential blockchain government applications and for the purposes of assessing the importance of blockchain standards, we would not embark on a detailed account of government use cases [6]. A categorized overview reveals the width of potential government use cases:

Data Storing – Data Sharing

Governments maintain huge records of data. Data of citizens, businesses, but also governmental employees are currently held on databases, which are not shared. Sharing data from one governmental department to another, or between government and private entities entails costs, and time. Where different government agencies require certain data, then these are duplicated within different databases. Blockchain dispenses with the unnecessary manual keeping of data in multiple copies, by enabling sharing features on an intra-governmental-departments basis. Also, where the appropriate blockchain design is chosen, blockchain may provide scalability to reflect the great volume of such data. In this regard, a public permissionless blockchain would prove inefficient, due to its scalability limitations although solutions are currently under exploration. Further, much of data held by governments are sensitive (such as health-related). With appropriate security standards, such data may be protected and maintained, properly.

Identity Management

Blockchain has been enthusiastically accepted, not least due to its potential to enable the secure identification of participants. The financial industry anticipated the beneficial use of blockchain as a means of achieving KYC-compliance through the identification, authentication and recording of clients'

details on blockchain [19, p. 18]. In a government's context, citizens may also be identified by the recording of their details on blockchain prior to engaging with government. Citizens' identity could be maintained and managed on blockchain databases and become available to selected governmental departments. Governments need to be able to unambiguously identify citizens and stakeholders such as organizations, companies, associations, assets, if they are to provide services to them [16]. In a similar way, any assets sought to be transacted on blockchain need to be digitally identified. Identity management is, in this regard, not only a use case in itself, but also enables the implementation of blockchain in order to carry out other government applications.

Tax Collection – Welfare Distribution

A significant part of citizens' and businesses' interaction with government entails payments made between them. Blockchain provides important opportunities to streamline payments, while enabling the efficient distribution of benefits and transparent collection of taxes [21, p. 2]. This, obviously, is not an easy task from an implementation perspective, but if achieved, it will definitely resolve issues of mistrust towards government agencies. At the same time, the allocation of resources will be easier to maintain, for transparency purposes. As it is discussed by Oliver Rikken, there seems to be two major hurdles to effectively implement blockchain-enabled streamlined payments, while enabling at the same time the efficient distribution of benefits and transparent collection of taxes; first is the need to properly leverage smart contracts towards that effect and secondly is the need of a stable coin that would be used, otherwise such implementation would not operate successfully and would probably not bring the required added value in cost savings etc [27]. In any case, effective tax collection is instrumental to the operation of government, while proper welfare distribution is at the core of government's role as a redistribution authority.

Supply Chain Management

An ambitious, yet possible blockchain implementation is in the sector of supply chain. Disputes are quite common in relation to the circulation of goods within a supply chain. This is possibly attributed to the entities involved in the chain, the complexity of the potential legal issues that might arise and the international aspect underpinning the supply process. Blockchain databases may be updated by the relevant entity involved in each step and shared with

the rest of the participants for the purposes of tracking and controlling the state of the relevant goods. Due to the audit trail securely maintained on blockchain, disputes might be minimized and resolved more easily. Supply chain management also exemplifies the potential of combining blockchain with other technologies, such as the IoT, for tracking purposes. Governments could make use of this application for these purposes. In a specific case study, it was explained that in a supply chain and customs context, information sharing between businesses and government could be facilitated via blockchain. In that case study, it was carefully explained that the blockchain framework will be designed under a specific architecture model that would enable the smooth and seamless exchange of information [25].

Need-based Approach

The possibilities for government applications are vast. It is within this scope that many identify the public sector, as a potential beneficiary of blockchain technology [7, p. 12]. To select the appropriate blockchain application, governments, we suggest, should embark on a **need-based approach**. We stress, for these purposes, that blockchain implementation is not an objective in itself, but merely a means for governments to carry out their operations.

Governmental decisions are expected to vary in relation to blockchain implementation. All governmental decisions involve delicate deliberation of all issues involved. Governments are accountable to the electorate body and are obliged to follow prudent resource allocation. With this in mind, it is expected that blockchain implementation by governments will follow a process, whereby the public value of such implementation will need to be evaluated relatively to the costs involved [13, p. 357].

Different countries have different needs, and priorities. Governments are entrusted with meeting societal needs but also mandates, as they derive from their government programs. Governments do not operate nor decide in a vacuum; indeed, they make use of such technologies that reflect their citizens' and businesses' needs, and which accord with their financial and social conditions. Further, governments' needs and challenges are not static but are ever evolving. Priorities in countries pre-crisis were very different from their priorities during, and post-crisis. Immigration in Mediterranean countries was not as acute as in the past few years. Similar examples of evolving government needs are countless and should remain so.

Another significant consideration that may impact the decision of blockchain implementation and the extent of such implementation is the assessment of existing infrastructure. In financial services, for example, the

disruptive nature of blockchain, and the necessity of ensuring blockchains interoperation with existing technologies and infrastructure might hinder blockchain implementation. While more and more countries seem to adapt to the necessity of establishing frameworks that may accommodate ICT solutions in delivering public services, divergence between different countries sustains. Some countries may be unable to effectively implement blockchain due to lack of general ICT development. On the other hand, it may be argued that, countries that lack general ICT development or have no or little legacy may find it easier to start from scratch. But even in countries with developed ICT infrastructure, transition to blockchain might entail increased costs. Altering existing structures for the mere purposes of implementing a newer technology might not be worth it. Under the prism of "if it ain't broke don't fix it", well-established means and methods of serving governmental needs might be preferably maintained over the introduction of blockchain. Transitioning to blockchain should benefit governments in a way that existing infrastructure fails to do so.

3.4 Importance of Blockchain Standards in Government

As explained above, blockchain standards have the potential to assist all industries in achieving successful, widespread, and meaningful implementation of blockchain, not least due to the issues mainly addressed in the standardization process, as discussed above. Standards offer certain added and unique benefits in relation to governments.

(A) Consistent with need-based Approach

Standardization is a useful tool in government deliberation over examining the need for blockchain implementation. Addressing citizens' and businesses' needs is a complex process. Standards enable governments to appreciate the issues involved, such as those explained above, and potential means to address them. In this way, it facilitates them deciding on potential transition to blockchain compared to their existing state of affairs. Citizens' needs might be catered more effectively with existing affairs, than with blockchain implementation. It could be argued that, absent standardization, governments might be led to engage in a need-based approach rather haphazardly, on very speculative grounds as to costs involved and expected efficiency gains.

Further, a need-based approach takes account of the fact that specific government applications prioritize different considerations. For example, certain applications are necessarily connected with international aspects, such

as the case of supply chain management. Standards of international aspect would cater the need of assessing blockchain implementation, in this regard. Also, certain legal and regulatory conditions may influence the decision of blockchain implementation. Standards may cater this consideration too. Taking the example of privacy-related standards, such standards will impact the adoption of blockchain in an EU-country in a very different way compared to other jurisdictions. In the EU, following the GDPR coming into force, entities, including governments, need to offer citizens the right to have their personal details deleted. EU governments will need to take this into account in their assessment of the relevant standards. Where offering this option is inefficient, then EU governments may be restricted from applying blockchain in some cases. Governments outside EU will not face this restriction.

Standardization, also, enables governments to decide on the design of specific blockchain applications for their needs. Control, permissions, and other relevant issues are addressed via standardization. With this in mind, governments may assess the specific design of their uses, according to any needs, as they arise at a given point in time, and in relation to specific cases. The spectrum of solutions is such that an examination of business and security requirements as to the specific type of blockchain used is imminent [p. 48]. In this regard, governments will be able to assess their role, and accordingly decide the degree of centralization by reference to established standards.

Importantly, the flexible nature of standards is in full compliance with the ever-changing character of government needs. Standards are not rigid; indeed, they should be sufficiently flexible [20]. In this way, government needs of today but also of tomorrow may be assessed through the lens of the same standards, in much the same way as government needs for a specific government application may undergo comparable assessment with another application by reference to the same standards. Flexible government assessment accords with standards' flexibility. Of course, it is extremely significant to explain that standards are not expected to remain the same and static. Indeed, the "continued utility and legitimacy" of standards encompasses their systematic review [18, p. 37]. Governments' role, if blockchain is to be implemented and deployed in its full capacity, might change in the future. This will render existing standards inoperative or unhelpful to a significant extent. As government's role progresses, progress should be expected in relation to standards, which, however, will maintain their role as an important point of reference.

(B) Market Confidence and Increase of Investment

The legal status of certain aspects of blockchain and smart contracts may raise concerns which in turn may engender hesitancy and concern for markets in relation to potential deployment of, or investment in blockchain. Endorsement and embracing of standards by governments will not only assist governments in achieving their goals, but at the same time will positively signal towards blockchain implementation. Confidence of markets in blockchain will increase, considering that governments endorsing standardization offer a degree of certainty and security as to blockchain implementation. Interestingly, even stakeholders who favor laissez-faire and non-interventionist government approaches, insist that blockchain deployment by governments provide "institutional endorsement", which is valuable [19, p. 27]. This point cannot be stressed enough. Standards pave the way for alleviating fragmentation of blockchain's ecosystem, and further enhance the potential for blockchain investment. Considering that governments seek to facilitate the business environment and enhance the conditions for the increase of capital investment, endorsing reputable, and carefully examined standards will surely signal towards enhanced market confidence in blockchain.

Beyond the potential increase in investment, businesses may be prompted to adopt similar blockchain uses, following the same standards having confidence in governments' option in using these standards. This will fuel the widespread implementation of blockchain. Innovation and growth will, thus, be achieved.

(C) Towards Regulation

Governments are instrumental in developing regulations. While blockchain-specific regulatory and legal framework does not exist at the moment, it is possible that the said framework will develop in time, subject, of course, to the need of such a specialized framework. In many cases, existing legislation and regulations could suffice in regulating blockchain. Standards should not and cannot replace legislation [7, p. 16].

Subject to the limitation of standards falling short from operating as substitute of legislation, they still provide the conditions for the adoption of a blockchain regulatory framework. Future legislation may directly refer to standards or direct and/or oblige industries to observe them. This presupposes a certain degree of robustness and high quality of standards. In this regard, standards that engage national delegates, involved constituencies, beneficiaries and operate on consensus bases carry an increased degree of

authority. Standards may offer technical support for regulation. Taking the example of smart contracts, it is demonstrated that standardization will be of great assistance for subsequent regulation. Smart contract standardization is inadequate. As explained, smart contracts could raise issues in relation to domestic pieces of legislation, such as contract law. The issues of legal enforceability, legal construction and implementation of smart contracts in any given jurisdiction will differ based on the domestic legal issues involved. A standardized basis, however, will inform subsequent legislation on smart contracts, despite the distinctions and special circumstances encountered in different jurisdictions.

In general, blockchain standards will increase understanding over blockchain. Politicians should seek to inform their agencies as to the nature, importance and use of blockchain. A standardized version of blockchain is likely to assist government leaders in their endeavor. Any government applications deployed via blockchain should be used with confidence by the government's employees.

4 Conclusion

Blockchain's appeal is undeniable. It is an innovative technology capable of disrupting existing business models in a profound manner. The significant benefits blockchain, generally, presents result in market and business actors demonstrating considerable interest in grasping and integrating this technology within their operations.

Naturally, governments are interested in assessing the potential of blockchain. We have explained certain basic characteristics of blockchain, and smart contracts, which are programs that assist in the carrying out of transactions on blockchain. We have argued that blockchain use in government is extremely useful, not least due to the decrease of citizen trust in government and public institutions, and the constantly evolving expectations of citizens in the quality of services they receive. Blockchain may offer the conditions for a more secure, efficient and fast system of data storing and recording, and transactions.

A potentially conflicting circumstance regarding blockchain implementation to government, is the decentralized nature of blockchain, which contrasts the centralized role of government. We have assumed, and strongly support, for that matter, that blockchain implementation will take place within the confines of existing institutional arrangements. This is possible, because blockchain exists in different kinds with varying of control, access, validation methods.

Governments may leverage blockchain's positive aspects to improve their role and services and regain citizens' trust.

We have maintained that blockchain standards are essential in governments' potential implementation of blockchain. In general, standards enhance the understanding, and offer useful guidelines over the subject they review. Also, they are created following very robust processes. Blockchain standards should focus on certain significant areas, because these will help address fundamental issues underpinning its blockchain's application. We have discussed these areas to demonstrate the importance of assessing basic areas in blockchain.

Governments may use blockchain for many of their services and applications. We have focused on certain categories of these, such as data storing, identity management, payment or collection of money, and supply chain as an indication. However, due to the numerous potential government applications of blockchain, we preferred to focus on the approach that governments must always take in deliberating potential blockchain implementation, i.e. a need-based approach. Governments must use blockchain where this is necessary and helpful to achieve their citizens' objectives. We maintained that standards are very useful in assisting governments in their need-based approach. Also, absent a regulatory framework, governmental endorsement of standards will encourage investment in blockchain, while helping blockchain understanding. This is crucial for governments to, ultimately, prepare a regulatory framework, where and if this is necessary.

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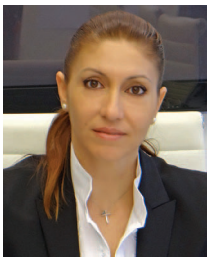
Biographies



Christiana Aristidou is a technology and business Lawyer and litigator with 22 years of practice. She holds an LLB (Athens-Greece) and three (3) LLM degrees (Queen Mary College-UEA-UK). She also holds a Certificate in Digital Currencies (UNIC-Cyprus). Christiana has been heading the Technology-Business Law Division of Democritos AristidouLLC for the last 17 years and as a certified legal project practitioner (IILPM) with exceptional skills in comparative law, has advised numerous innovative complex business and technology legal projects in all major legal jurisdictions. Christiana is a national delegate to ISO/TC 307 with active participation in the drafting of the technical specification for smart contracts and a member of ITU focus Group on application of DLT. She is also a founding member and Vice-Chair of Cyprus Blockchain Association (CBA). Christiana is a frequent speaker at conferences and summits and a legal author with numerous articles published in international legal databases, journals, magazines and the social media.

Evdokia Marcou has been working as a lawyer for the past year, after having completed her studies in the UK. She holds an LLB from Queen Mary University and an LLM from LSE. Her academic background and her dynamic training enabled her to immediately take part in complex, multi-sectoral

projects. She has been involved with corporate law, banking and finance, and IP-related matters, while focusing, at the same time, on technology-oriented issues. Within this context she conducts research in blockchain and law, including blockchain-based uses and applications for public and private sector, and participates in partner-led work on standardizing blockchain. She is also involved in innovative start-up projects. She has provided legal opinions and consultation on the areas of banking and finance, IP law, and corporate law. Evdokia is driven, hardworking, and committed to constant self-improvement and learning.