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# Transparency Challenges in Blockchain

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*Abstract: The increasing interest in crypto-coins has provided greater visibility of blockchain and started discussions on its application in different forms of inter-organizational cooperation. Such technology provides a growing record of all transactions that have occurred in a specific domain, thereby allowing for the stored information reliability and real-time access. The potential of blockchain for transparency promotion is recognized, but discussions about its use and impact still require more attention. This paper presents a preliminary discussion about the importance of thinking about transparency in blockchain, thus allowing to identify challenges and opportunities for its implementation in democratic environments.*

*Keywords: transparency, blockchain, Research challenges*

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## 1. Introduction

Transparency International (2016) states that initiatives in transparency are more evident in countries that share key characteristics such as access to information and citizen participation. Access to information allows creating an open democratic society, providing citizens with tools to understand and use information, and stimulating critical thinking about the information and services provided (Fung et al, 2007; Harrison et al, 2011). For this reason, transparency, or lack thereof, has been widely discussed by both public/private organizations and academia, and its importance has been highlighted by the increasing demand for e-government provision (Denis et al, 2017; Holzner & Holzner, 2006). Initiatives such as the Brazilians laws of Access to Information (Brazil, 2011) and Transparency(Brazil, 2009), which state that data and information are public assets that should be available to society, have encouraged active transparency. It has resulted in greater availability of public information, thus enabling society's analysis and anomalies identification.

Blockchain has the potential to open information and contribute to transparency. The popularization of the crypto-coins provided a greater visibility of this technology and started

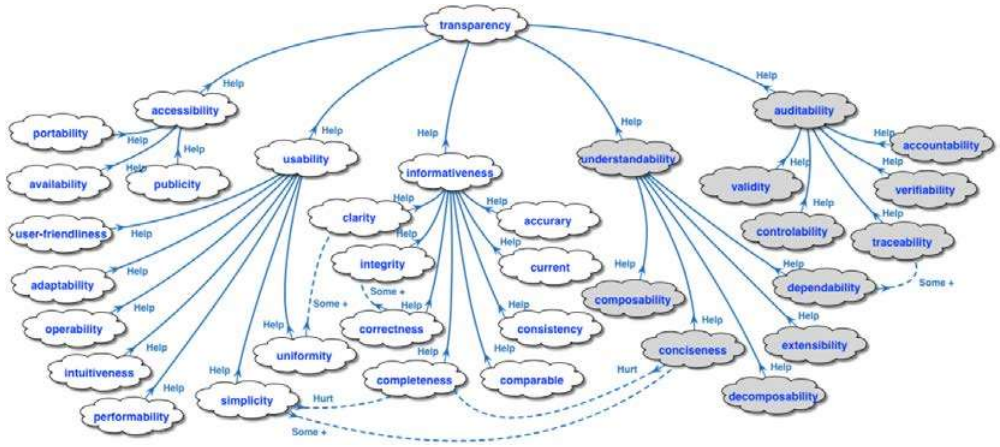
discussions on its application far beyond its original purpose in financial operations (Ølnes & Jansen, 2017; Tapscott & Tapscott, 2016). Blockchain provides a growing record of all transactions that have already occurred in a domain, which are protected from modification and adulteration, thereby allowing for the stored information reliability and real time access to these transactions (Deshpande et al, 2017; Lin & Liao, 2017). Despite information opening, discussions about blockchain use and impact to effectively support transparency in democratic environments still require further study. Moreover, it is important to understand how transparent blockchain can be.

This paper presents a preliminary discussion about the importance of thinking about transparency in blockchain, thus allowing the identification of challenges and opportunities for its implementation in democratic environments. For this, Section 2 discusses transparency, detailing different characteristics that need to be met to effectively achieve it; Section 3 introduces this concept in the context of blockchain; Section 4 presents challenges and opportunities for its implementation in democratic environments; Section 5 concludes the paper.

## 2. Transparency

Transparency has been a critical concern for modern society as it makes information about priorities, capabilities, and behaviour of powerful centers of authority widely available to the public (Fung et al, 2007; Holzner & Holzner, 2006). It can be defined as a set of characteristics that allow providing stakeholders with general information about (see Figure 1): *Accessibility*, the quality of being easy to deal with; *Usability*, the quality of providing good use; *Informativeness*, the quality of providing or conveying information; *Understandability*, the quality of comprehensible language; and *Auditability*, the ability to examine with the intent of verification (Leite & Cappelli, 2010).

*Figure 1: Transparency Softgoal Interdependency Graph (Leite & Cappelli, 2010)*




However, the implementation of this concept is difficult to achieve. As shown in Figure 1, the combination of these five characteristics creates the concept of transparency. Thus, these various characteristics must be considered so that a solution can be said to be effectively transparent. Moreover, transparency reaches different contexts, having as scope three levels (Leite & Cappelli,

2010): *organizational transparency*, which focuses on an organization's stakeholders; *target transparency*, which aims at consumers of some service or goods; and *social transparency*, which is geared towards citizens. Nonetheless, what is observed in practice is the attempt of applying transparency to a limited extent, just following the practices demanded by regulatory instruments.

## 3. Transparency in Blockchain

Blockchain is a shared ledger that provides a growing record of all transactions that have already occurred in a specific domain. It represents a series of chained blocks in which, at each block, it is possible to access: (a) structured data about transactions; (b) creation date/time; and (c) reference to its previous block. This reference allows identifying these blocks order and navigating to the first element of the blockchain. Additionally, it ensures that information is protected from adulteration because any change leads to the reference modification. Moreover, a new transaction is only added to the blockchain after being validated by all nodes in this distributed ledger network. It allows the stored information reliability, besides real-time access to all transactions (Deshpande et al, 2017; Lin & Liao, 2017). All this shows the potential of blockchain to contribute to transparency, thus allowing governmental systems to combat public resources misuse, facilitate auditing process and avoid frauds (Ølnes & Jansen, 2017; Tapscott & Tapscott, 2016).

Despite this technology simplicity and its capability of opening reliable information, new challenges may be imposed for its effective support to transparency in democratic environments. Moreover, it is important to understand how transparent blockchain can be. For this, an analysis of this technology was made based on the characteristics presented in Figure 1(see Table 1).

*Table 1: Blockchain Analysis Based on Transparency Characteristics*

| | **Accessibility** | | | **Usability** | | | | | | | **Informativeness** | | | | | | | | **Understandability** | | | | | **Auditability** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Availability* | *Portability* | *Publicity* | *Adaptability* | *Intuitiveness* | *Operability* | *Performability* | *Simplicity* | *Uniformity* | *User-friendliness* | *Accuracy* | *Clarity* | *Comparable* | *Completeness* | *Consistency* | *Correctness* | *Current* | *Integrity* | *Composability* | *Conciseness* | *Decomposability* | *Dependability* | *Extensibility* | *Accountability* | *Controllability* | *Traceability* | *Validity* | *Verifiability* |
| **Blockchain support** | ± | √ | - | ± | - | √ | √ | - | √ | ± | √ | - | √ | √ | ± | ± | ± | √ | ± | √ | ± | √ | ± | - | √ | √ | √ | √ |

√ Identified ± Partially identified - Not identified

Regarding *accessibility*, blockchain offers *availability* by enabling encrypted access to stored information by those who have access to it. This information is constantly available, as there are backups on multiple network nodes, also preventing any information loss. Blockchain also enables *portability*, allowing access through various sources as well as adoption of several programming languages. However, its high cost and energy expenditure can hinder its implementation, thus impacting *availability*. In addition, *publicity* is not supported by blockchain, with documentation being considered only during the creation of infrastructure that uses this ledger.

Regarding *usability*, blockchain offers *uniformity* by using standardizations and frameworks during its development. The *operability* and *performability* are served by the blockchain processing

power to carry out transactions validation in different network nodes, besides security and efficiency increase. *Adaptability* is also identified by using easy and open source technologies, applying different programming languages and creating forks in the chain that reflect necessary changes. In addition, *user-friendliness* is observed by having access to details of the information present in blocks. However, *simplicity*, *intuitiveness* and *user-friendliness* have challenges associated with the infrastructure that uses blockchain, thus requiring interfaces that highlight the most used operations and information; present simple ways to view and use smart contracts, and show visual details that facilitate use, clarity and with usual symbols/texts/metaphors. In addition, *adaptability* is impacted by the lack of a standard that guides the smart contract flexibilization.

Regarding *informativeness*, blockchain offers *completeness* since the information is permanently stored in blocks and any modification in such information leads to a new block, which references the block with the original information in the blockchain. It also ensures *current* and *integrity*. The *correctness*, *comparable*, *consistency,* and *accuracy* are observed by transactions being stored in blockchain only after their verification with other network nodes. However, the *correctness* can be compromised if it is not possible to guarantee that information and smart contract are correct. Associated with the *current*, it is also necessary to make the modification policy, such as update periods and dates for next updates, available to blockchain users. In addition, the infrastructure that uses blockchain is responsible to cover rules that ensure integrity, thus impacting *consistency*.

Regarding *understandability*, blockchain offers *conciseness* since it only stores information that is relevant to smart contracts and transactions contained in the blocks as well as necessary data for future validations. Frameworks also enable it as well as *extensibility*, which provides glossaries and rules for blockchain development. *Composability*, *decomposability*, and *dependability* also occur, with blocks linked to other blocks through a chain. However, the lack of a specification that identifies parts of code in a software or firmware can impact *composability* and *decomposability*. Moreover, the lack of obligation to explain the developed infrastructure can negatively impact *extensibility*.

Regarding *auditability*, blockchain guarantees *validity* through algorithms that prove conditions and requirements before adding new blocks to the chain. *Controllability* and *verifiability* are observed in this environment that allows errors and problems monitoring. Blockchain also makes it easier to *traceability* since information is permanently stored. However, it does not offer much advantage in *accountability* issues, such as the use of available resources, conditions for performing actions, information sources., which is just associated to the infrastructure that uses this ledger.

## 4. The Research Agenda of Transparency in Blockchain

The prior analysis shows that transparency characteristics are not fully met by blockchain. Thus, this research proposes an initial research agenda for exploring transparency in blockchain.

Blockchain high cost and energy expenditure can hinder its implementation. In addition, the ledger correctness can be compromised if it is not possible to guarantee that transactions verification and smart contract are correct. It is also necessary to make the modification policy available to blockchain users. Besides that, many issues are only addressed during the creation of

infrastructure that uses this ledger, such as documentation or interfaces that highlight the most used operations and information, present simple ways to view and use smart contracts, and show visual details that facilitate use and with usual symbols/texts/metaphors. Moreover, there is no obligation to explain this infrastructure, which leads to lack of documentation about the code in software or firmware, how to use the available resources, conditions for performing actions, information sources, rules and restrictions to ensure integrity. Thus, it is necessary that all these issues be considered during the infrastructure implementation so that blockchain is implemented in democratic environments and can effectively support transparency.

Therefore, a first initiative of blockchain as a support for transparency proposes the identification and evaluation of the main tools for its implementation. Based on this analysis, we aim to operationalize the transparency characteristics in the selected tool as well as its application in a democratic environment. It will allow a greater understanding of blockchain effective support for transparency as well as allowing observations that lead to future research

## 5. Final Considerations

This paper had presented a preliminary discussion about transparency in blockchain, thus highlighting challenges and opportunities for its implementation in democratic environments. It is possible to notice that blockchain brings advances in terms of transparency, which are mainly associated with how it was implemented. It ensures the constant availability of information about all transactions that have occurred in a domain, also including modifications made and backups on multiple network nodes. It makes easier for information traceability and ensures the existence of a complete transaction base. Additionally, by using great processing power to carry out transactions in different network nodes, it is guaranteed that the information is valid and correct before its permanent storing as well as enabling problems monitoring in this distributed environment. However, some challenges still need to be investigated and implemented in this technology, thus opening opportunities for papers that provides an in-depth analysis of the identified challenges.

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