Hyperledger Technology in Public Organizations in Ecuador

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***abstract*— The globalization of information has been present in several contexts and required in digital lathes with cutting-edge technology, both for private and public institutions. In Ecuador the need has been observed to invest in new technologies, in public institutions, be it education, in the electoral field or companies of other services. The objective was to analyze the benefits of Hyperledger technology in public institutions in Ecuador. The deductive method was used and a quantitative criterion was maintained, through the study of research papers that allowed a description of the use of said technology and its applicability in said organizations. The problem was oriented to the need to apply a technology that provides better processes and with greater security. It turned out that Hyperledger technology allowed us to work faster, reduce costs, environmentally friendly and provide greater security. It was concluded that the application of Blockchain Hyperledger technology provides a framework for public administrations, because it has improved the different transactions made, helped reduce fraud by applying encryption, minimized the possibility of error, and improved communication between government and citizen services**.

Keywords*— Blockchain – Hyperledger, Security Information, Information integrity, Immutable Logs.

I. INTRODUCTION

At present, the globalization of information is present in various contexts, social, political, every day, even some work and live in digital environments. In Ecuador's public organizations, technology with its dizzying gap takes accelerated steps in different directions and a breakthrough that makes these changes even greater is Hyperledger Blockchain technology that, for some it is revolutionizing the world. According to Romo, organizations that wish to establish themselves in a globalized and competitive market such as today must have an infrastructure that allows them to interact with their environment in an appropriate way, facilitating the promotion, dissemination and / or provision of its products or services through said technological platform. However, not always the fate of such disclosure processes, processing and / or information are directed towards the external scope of the organization, but can and should be implemented towards the internal processes of the organization, in order to boost the process control channels, information (formal and informal), dissemination of policies and feedback of those nerve elements in which to do organizational [1].

The application of Hyperledger in the public sector generates positive changes, as it improves the management of resources, security in transactions.

The author Diaz A. believes that all public and private spheres require the implementation of appropriate technologies, due to the easy access to the information they provide and in addition to their easy handling, taking into account that ICTs have also arrived at the hands of each person through mobile phones, internet, among others, so that their use is daily and the connection with the different processes of each organization keeps them close [2].

Blockchain allows a great diversity of applications, due to its unique security properties. Some of Hyperledger's Open Source features through blockchain, focus on its decentralization, transparency, a robust system for information security, as well as the non-alteration of data, with accelerated response at low cost.

The objective is to establish the benefits of Hyperledger technology in public companies in Ecuador.

Can Hyperledger technology be successfully applied in public companies in Ecuador?

The technology is applied in several countries, in several areas of the public sector successfully. Hyperlegder is a technology under the tutelage of Linux founded since 2015, which enters into important economic areas, allows international organizations such as Microsoft and IBM, use the available technology to power this infrastructure towards open use

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directions. It is being applied in the Netherlands, in Germany, in electricity companies, also in primary elections.

The study using the deductive method with quantitative and descriptive criteria on the use of hyperledger and the development of its applicability in Ecuador.

It turns out that hyperlerdger technology allows you to work faster when you transact, with greater security measures, with greater use of data and easy to use in an ecosystem adaptable to public management companies.

It can be concluded that the application of Hyperledger blockchain technology provides a framework for public administrations, because it reduces fraud, minimizes the possibility of error. It reduces the cost in transactions, also the use of paper, takes care of the data of companies and citizens, improves communication between the government and the community, and creates a better climate of trust between those involved.

II. MATERIALS AND MÉTHDS

A. Materials

Several bibliographic materials have been reviewed, in relation to the proposed topic, identifying the initial success of blockchain technology in public companies in several countries of the world, taking into account that the information has been contrasted with studies carried out within Ecuador.

B. Méthds

The method used maintains a quantitative approach to provide objective information about the use of Hyperledger technology and the development of its applicability in Ecuador. A description of several studies carried out in the world and within Ecuador is given, to consider its success in various areas of the public sector.

Public Administration and Digital Identity

The Ecuadorian government has the challenge of introducing blockchain technology, allowing to reduce costs in management, storage of physical information. On the other hand, the digitalization of information makes available resources immediately to be consulted from a computer. The digital identity is being implemented within the computer ecosystem, this means having a decentralized identity in a blockchain.

The author Vitaly, gives his opinion on the role of computers in business management is also changing.

The vision of the role of computers in business and administration is also changing. The view on the methods and means of industrial automation are changing, from sensors and automation of technological processes for the integration and visualization of data and intellectual support [3].; on the other hand, in the decentralized digital identity, the user must not lose his identity and only the user has the right to share it by using his own key.

Hyperledger and Blockchain

For the realization of this research, the relevance of the use of technology within public institutions was considered, as well as the benefits of its blockchain implementation in the Ecuadorian environment.

Being Hyperledger an open source technology and under the tutelage of Linux Foundation since 2015, enter important economic areas. Currently, Hyperledger allows international organizations such as Microsoft and IBM, to use the available technology to power this infrastructure towards open use routes.

Author Jinping Li considers Blockchain to be a reliable database technology that is collectively held in decentralized mode [4].

Blockchain types

The blockchain has the ability to adapt to different environments and needs within a network and there is a public, private and hybrid or mixed network.

Also, public organizations have available the incorporation of this platform with broader securities than traditional ones. As for the maintenance of the network where blockchain works, it is supported by mining, which implies an expense for each transaction made, this requires the collection of a commission.

Blockchain in Public Services

It is the initial platform of use and its structure is open data, with availability of resources so you can develop more applications, as well as the opening to perform audits and improvements.

The author Oksana, The introduction of this technology will help solve some problems that are currently not completely transparent to all parties in the relationship [5].

The availability of improved security allows tolerant actions or Byzantine failures (programming), do not alter the operation of the system remain intact and with immutable registration, this with the establishment of solid consensus protocols, including robust DDoS protection against possible attacks, this allows the network to continue in a decentralized manner.

In addition, public blockchains have the facility that users can belong to the network individually, by mining or managing a network (node).

- Public Blockchain.- Any device can access freely, without restrictions. Your registration will be transparent and shared.

- Private Blockchain.- Before entering the network, you must be authorized by the blockchain authority. Through an invitation each user can join.

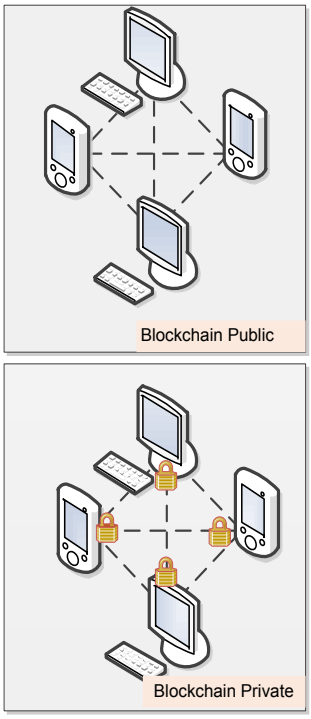

Fig. 1. Blockchain types

In Figure 1 Public Blockchain networks anyone can enter without restriction, access and collaborate in the blockchain. On the other hand, private blockchains are restricted and require permits and invitation to access or make contributions to the blockchain.

Two can be considered, work and participation. In a chain of PoW blocks, the miners collect the transactions they receive through the network. The author Pandey thinks that while blockchain is not composed of a single technology or platform that we can define a structure and a set of processes that accurately capture a generic blockchain system [6].

It should be added that the transactions that are collected by each miner are stored. Both the miners and the nodes are responsible for verifying that the blocks that have been recently made are valid. However, in a PoS chain, no blocks are mined as in the PoW chain, but they forge the blocks.

Usability of the Blockchain

There is a worldwide trend on the usability of the functions of blockchain technology and its benefits in the public sector. On the other hand, the characteristics and specifications should be aimed at automatic processing, unified information and updated with personal or institutional background, which will allow a public organization to have immediate and accurate access, secure and un manipulated information to perform certain operations and administrative procedures.

The author Yang, Blockchain has the following main characteristics: (i) anti-modification ability (ii) tolerance capacity since some nodes are defective (iii) the ability to achieve collaborative trust between nodes in this peer-to-peer distributed system without the third-party certification agency (iv) the ability to access blockchain information on any node of this network [7].

Tokenized Data and Data Protection

One of the advantages that has added value in the use of Hyperledger is the use of Smart Contracts that facilitate automation in certain tasks, taking scheduled actions, reducing bureaucratic. This allows to accelerate operations that do not require an on-site approval, but rather the fulfillment of the technical requirements with the automatic payment of the respective processing fee.

All these transactions, in the public and financial spheres, demand the appropriate use of the information, a correct citizen participation and the State.

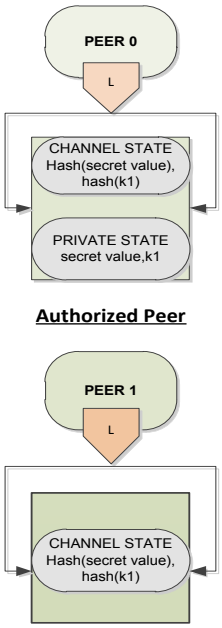

Fig. 2. Hash channel

Figure 2 describes the tokenization process to be fulfilled:

- Linking the data to your personal information.
- Validation of the payment method data associated with personal information.
- Validated permits that allow network authorization.

Tokenizar is to represent a right in a private or public blockchain, the chain of data that is recorded in a private blockchain network applied to public organizations the available information, linked and protected, increases trust and improves the client-company relationship, which is reflected in services that generate passive and active income.

The author Metwally, an editor receives income from a payment instrument, for example, a bank account, for actions in the ads that are shown, for example, views or clicks of Internet users [8].

The versatility in the operations within a public institution allows flexibility of the usage channels and the requirements are managed in a specific way.

The author Moscola, such a chain is able to detect specific chains in data streams [9].

If a token is specifically configured for a particular feature, it cannot be used in a different ecosystem for which it was created, this ensures quality and cannot be misused to harm customers, decreasing information leakage. One of the qualities of security is that someone steals the token, this is only useful in a certain relationship, which must be fulfilled so that it can be deciphered, and on the other hand, there is the token replacement without losing the information or having to be re-entered.

PCI DSS Standard and Tokenization Process

One of the characteristics of the use of a PCI DSS standard is the protection of data PAN (Primary Account Number), it is necessary to consider that a PAN is not a token. They can be used by means of:

- Index Assemblers
- Tokens
- Hash One Way Values
- Cryptography
- Truncation

The author Diallo considers that, to provide a simple and convenient interface, the government allocates human and financial resources, but results in minimal transparency in governance. In this scenario, blockchain technology would increase transparency and trust, reduce costs and simplify the process. The system is managed with securities that are linked to establish direct and indirect use mechanisms but that are managed by security routes [10].

Figure 3 shows the mentioned process:

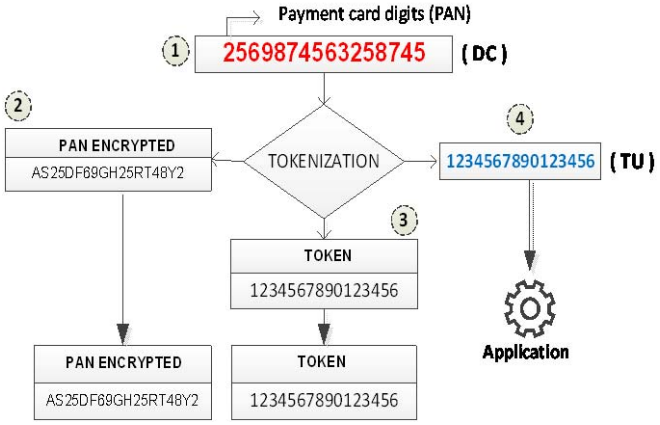

Fig. 3. Tokenization Process

Description of figure 3

1. The tokens are receipts confidentially, a location is generated, each interface correspondingly imports a form generated by a request from a user or a system
2. Private data is stored centrally in a Data Vault (DV) protected with encryption
3. Unique Token (TU), generated by the system, which is stored in advance, which will be used as an alias, for confidential data (DC), allows dual reference via tables stored on the DV between DC and TU.
4. Flow of operations where the Token takes the place of the DC.
5. The tokens (TU) are the central axis of the process, the token being a non-confidential data and from an orphan token it is not possible to relate the data to the information of its confidential DC partner. Likewise, DC is linked to TU, and this is transmitted from TU to DC, taking as its root origin, the referential dual table, whose interpretation is called detokenization.

Tokens and PCI DSS

Moreover, according to the author Yulianto, the data security standard of the payment card industry (PCI DSS), also known as PCI Security Standards, is an information security standard for any organization that manages cardholder information from major credit card providers such as American Express, Discover Financial Services, JCB International, MasterCard Worldwide and Visa Inc [11].

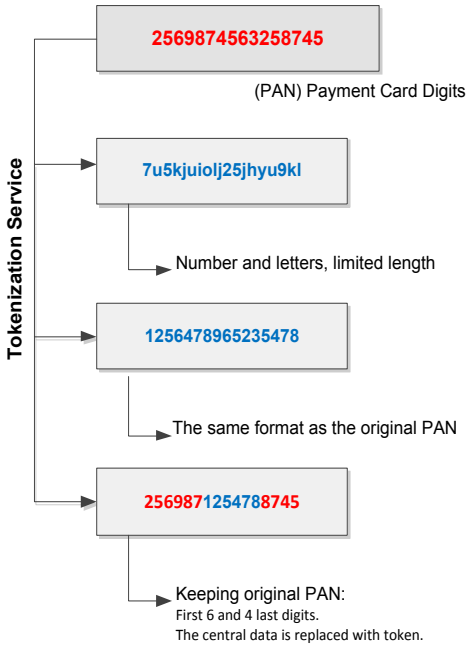

Fig. 4. Tokens and PCI DSS

In figure 4 the protection of the PAN data is described different patterns are followed, for which they can be followed according to need:

- Character string consisting of letters and numbers of free length.
- Character string composed of letters and numbers of the same size and format of the PAN represented through FPT (Format Preserving Tokenization) and FPE (Format Preserving Encryption) protocols.

- Partial replacement of the PAN code by means of a character string consisting of the first six and the last four similar positions.

According to the author Li & Wang Eliminated intermediaries and anthropogenic factors, all information is true and reliable [12].

Flexibility also considers a decrease in the procedure period, improvement and optimization of processes, savings, data integration, better communication between state companies and better communication with the community that uses it.

Hash in Hyperledger

In addition to the use of hash securities mentioned in previous Hyperledger lines, private data hash allows to evidence transactions, allowing to have a record and the manipulation of the information is avoided since the hash changes for security and can be used for audit purposes, as can be seen in figure 5.

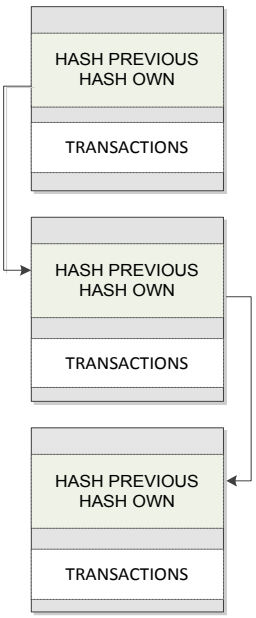

Fig. 5. Hash in Hyperledger

It is important to recognize that there is a lack of duplication of information on customer payment methods, requiring compliance with several processes for authentication and execution.

For figure 5, The author of the Aswini proposal, in blockchain should ensure that only authentic transactions are registered in blockchain and that they use previous hash functions to verify that the new transaction is valid or not, and that the new block of the transaction can be added in the blockchain terminal [13].

In the public sphere there are many types of transactions, framed in commerce, which leads to effective processes. For the proposed plans to be fulfilled, the advantages must be established in advance and thus justify the investment in the project.

The author Rostami, in particular, the modularity, programmability and flexibility and flexibility of the 5G system architecture allows the creation of 5G networks that support communication applications with heterogeneous requirements [14].

The business world presents different transactional styles and more dynamic movements and this requires companies, public and private, as well as society in general, to consider novel aspects in digital, because each business initiative has its own success, each investment produces shared benefits.

The author Hong Guo The field of EA (Enterprise Architecture) has evolved rapidly to address the challenge of executing business strategies [15].

For the technology to be aligned with the imperatives of the Public Administrations, it must be clear that the appropriate options are being chosen, so many technological, technical architecture, with trained personnel, to meet the requirements of the public sector, establishing improvement in the TPS (transactions per second), internal and external systems integration, as well as regulatory and compliance requirements.

The integration of different types of companies

Adjacent business systems must also be considered, which require integration with the Public Administration of the specific case. The author Mathase thinks that the public sector is peculiar for its structure and general mandate that has a great influence on governance problems and the general perspective that the public sector is not really faithful in the execution of its mandate and is suffocated by a wide range of variables between them; maturity of risk, culture, organizational culture and strategy [16].

On the other hand, the idea is to ensure the elements of the transaction itself, trust and ownership, and consensus, lending itself to a trust system that helps eliminate redundant and duplicate processes.

The application of blockchain technology requires a previous transformation of companies because it can significantly alter the process to which it applies, the results, as well as the way the transactions are made.

Blockchain technology allows to reduce process costs, minimizes setbacks, creates security mechanisms with non-modifiable transaction records facilitate records almost immediately.

The stage of development in the organization and administration The author Di Pierro considers The stage of development in the organization and administration if the entire value chain process involved in the manufacturing industry is radically changing even the concept of Enterprise [17].

But its adoption must be a balancing act for governments and businesses, since they not only have to continue managing and maintaining existing infrastructure, but also pave the way for this new computational model that promises to change companies and even entire industries.

Singularities of the Public Sector

In the public sphere there is a wide range of aspects similar or different to the private sphere and must be taken into account for the implementation of blockchain technology, ranging from the governance model around management, its correct application, proper maintenance of technological infrastructure, as well as the management and monitoring of the processes applied.

The important thing is to ensure that the network has sustainable operational aspects and dynamic elements of the society that uses it and sustainable economic growth. This would involve several aspects, including the design of a model in which each participant can display the appropriate chain code that governs their own business process, by accepting / treating digital assets, putting the business participants, as the entities process changes, as well as their regulatory policies.

There are several blockchain application spaces, which can be identified:

1) Securities Transfer

Companies that want to guard the transfer of products to those who are going to distribute them, are using blockchain to track the starting line until arrival.

The author Demir, with the success of Bitcoin as a sustainable monetary platform, blockchain technology gained recognition to become a suitable technology for general implementation [18].

Consumers, business partners and companies of the Ecuadorian State can apply this mechanism, thus guaranteeing the desired results, reducing robberies, oversights that cause damage to the environment and labor exploitation.

2) Hiring and Financial Management

In public and private companies there is an effort to apply innovative, modern systems for contracting and financial management, regulations are established that replace paper-based mechanisms to avoid fraud, errors, reduce costs, complexity in transactions and achieve dynamism.

Blockchain reduces times, risks, which even allows for easier auditing, of processes and transactions, this ensures less investment in processes. Access to databases becomes more reliable, as state organizations can make better decisions, improving its reputation, increasing its level of reliability, reducing fraud and executing actions as deterrents in the threats that appear.

Together with other applications, blockchain facilitates knowledge of its client (KYX) and regulations against money laundering (AML) in companies of the financial system. Supply chains that rely on block systems can help ensure compliance with standards and rates, both import and export and similarly, produces greater security, thus avoiding the falsification of data.

3) Access to Services in Public Companies

A social reality has been observed and analyzed, even present in several countries of the world, of people without identity documents, cannot study, cannot open bank accounts, neither own a property or access government services.

There are people who consider themselves excluded from full participation in the economy and wealth creation. Ecuador has consistently worked to avoid this problem and the results have been important, because many literacy programs are not even required.

The author Chopra, the main work of blockchain focused mainly on the following:

- Confidence Issues.
- Digital signatures.
- Peer to peer network.
- Work test.
- Public Transaction History.
- The Manorial independent nodes control most of the computing power of the CPU [19].

Hence, Ecuadorians have been able to access business, banking transactions, that then with the use of blockchain a cross-reference is made and multiple data sources, events and transactions are verified securely.

Thus, the identity of an individual can be established and validated when traditional evidence is lacking. Citizen services are a high performance area for land applications, they will probably depend heavily on identity management and are unlikely to vary considerably without it.

Also, the scope of new services, safe and seamless, is dramatically expanded when asset management is introduced through blockchain technology.

III. RESULTS

Public entities are venturing into new challenges, of working with advanced technology, in spite of having a restricted budget, personnel that require more training, improvement of security standards, and even the establishment of regulations that regulate the appropriate use.

The proposing author of Kuciapski Fast and permanent access to professional knowledge requires the use of digital materials through applications on mobile devices [20].

The use of Hyperledger technology allows you to work faster and more comfortably when you transact.

On the other hand the author Toapanta considers that we have two options of application of the Hashing:

A. By waste

As a route for registration. It is considered a simple function where K is the key and N the size of the array, as follows:

$$H(K) = (K \bmod N) + 1 \quad (1)$$

Here the residue of the operation is taken by adding 1,

It is also expressed as follows:

$$H(K) = K+1 \quad (2)$$

Where, the last 2 numbers of the key will be taken into account where it would be the place where it was reserved for the data.

B. Fold Hashing

Where the key is divided into several parts, with the exception of the last one, which has the same number of elements as the relative path, then, these divisions are joined over other additions, resulting in the relative path. In the same way the direct address develops better when the set of keys is small. So for example in a total set U= (0, 1, 2, 3, 4,... m-1) with m medium large. In addition, the keys should not be repeated or duplicated, so the table would be as follows T (0, 1, 2, 3, 4… m-1) having a place corresponding to the position with the key within the total set. Linear programming equation According to S.M.T. Tapapanta [21].

Table - Hash - search (T,K)

Return $T[K]$

Table - hash - insert (T,X) (3)

$$T[\text{Key}(X)] \rightarrow X$$

Table-Hash-remove (T,X)

$$T[\text{Key}(X)] \rightarrow \text{Nulo}$$

Hyperledger blockchain technology shows significant benefits, since it can be applied to commerce and other public spheres, as in the voting, use character string composed of letters and numbers to achieve more effective transactions.

Security measures quickly detect hacker intrusion, that even when there are malicious threats, hackers can observe tokens and not user data, because tokens do not require association of confidential data.

IV. DISCUSSIÓN

In the XXI century significant changes are observed in relation to digital communication and blockchain provides this benefit. But the demands that the community is requesting, are increasing, it is even necessary to expand the services it provides. The internet has changed communication in the twentieth century, he revolutionized it in the XXI, but changes are required more and more often, with less time, with more security measures, that even some technologies quickly become obsolete.

This technology has managed to expand and improve the value to the network that has even managed to establish better business and transactions. But the security measures also work in tandem, because strategic hacks are occurring, which have managed to maliciously penetrate the databases of several companies.

In a broad and technical look at technological management, there are reasons to estimate the use of blockchain-based platforms, one of them is the cost such as maintenance of servers and the network. Although there are frameworks that allow a wide deployment of smart contract (SC), the possibilities of low-cost applications are scarce, since transactions or information exchange generates value.

V. FUTURE WORK AND CONCLUSIONS

A. Future Work

- Application of blockchain technology for medium and small businesses.
- Advanced security measures to mitigate damages in transactions made with blockchain.

B. Conclusions

The application of Hyperledger blockchain technology provides the referential framework for Public Administrations, because it offers help to reduce fraud, minimizes the possibility of error, produces low cost in transactions, decreases the use of paper and its unnecessary printing and improves the Communication between the Government and the community, in data exchange processes, with transparency and greater confidence.

Hyperledger blockchain technology uses tokens for greater security, character string composed of letters and numbers of the same size of the PAN and all this causes a direct impact on transactions, data care, facilitates economic movements and reach a society that uses mechanisms more dynamic and effective in your business.

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REFERENCES

[1] S. Moisés et al., "Analysis of Information Security for a Voting Process for Sectional Governments in Ecuador," Adv. Sci. Technol. Eng. Syst. J., vol. 4, no. 5, pp. 352–359, 2019.

[2] S. M. T. Toapanta, A. F. G. Diaz, D. F. H. Subia, and L. E. M. Gallegos, "Proposal for a security model for a popular voting system process in Latin America," Adv. Sci. Technol. Eng. Syst., vol. 4, no. 5, pp. 53–

60, 2019.

[3] V. V Martynov, D. N. Shavaleeva, and A. A. Zaytseva, "Information Technology as the Basis for Transformation into a Digital Society and Industry 5 . 0," pp. 539–543, 2020.

[4] L. Li and X. Wu, "Research on school teaching platform based on blockchain technology," 14th Int. Conf. Comput. Sci. Educ. ICCSE 2019, no. Iccse, pp. 38–43, 2019.

[5] O. Lukmanova, E. Volkova, A. Zabolotnyi, and A. Gorelik, "Blockchain technology for public utilities," Proc. 2019 IEEE Conf. Russ. Young Res. Electr. Electron. Eng. ElConRus 2019, pp. 1790–1793, 2019.

[6] S. Pandey, G. Ojha, B. Shrestha, and R. Kumar, "Blocksim: A practical simulation tool for optimal network design, stability and planning.," ICBC 2019 - IEEE Int. Conf. Blockchain Cryptocurrency, pp. 133–137, 2019.

[7] C. N. Yang, Y. C. Chen, S. Y. Chen, and S. Y. Wu, "A Reliable E-commerce Business Model Using Blockchain Based Product Grading System," 2019 4th IEEE Int. Conf. Big Data Anal. ICBDA 2019, no. i, pp. 341–344, 2019.

[8] A. Metwally and C. H. Huang, "Scalable similarity joins of tokenized strings," Proc. - Int. Conf. Data Eng., vol. 2019-April, pp. 1766–1777, 2019.

[9] J. Moscola, Y. H. Cho, and J. W. Lockwood, "Reconfigurable context-free grammar based data processing hardware with error recovery," 20th Int. Parallel Distrib. Process. Symp. IPDPS 2006, vol. 2006, pp. 1–4, 2006.

[10] N. Diallo et al., "EGov-DAO: A Better Government using Blockchain based Decentralized Autonomous Organization," 2018 5th Int. Conf. eDemocracy eGovernment, ICEDEG 2018, pp. 166–171, 2018.

[11] S. Yulianto, C. Lim, and B. Soewito, "Information security maturity model: A best practice driven approach to PCI DSS compliance," Proc. - 2016 IEEE Reg. 10 Symp. TENSYMP 2016, pp. 65–70, 2016.

[12] J. Li and X. Wang, "Research on the Application of Blockchain in the Traceability System of Agricultural Products," Proc. 2018 2nd IEEE Adv. Inf. Manag. Commun. Electron. Autom. Control Conf. IMCEC 2018, no. Imcec, pp. 2637–2640, 2018.

[13] R. Aswini and K. Kiruba, "College fees transaction using hash functions of blockchain model," 2019 IEEE Int. Conf. Syst. Comput. Autom. Networking, ICSCAN 2019, pp. 1–6, 2019.

[14] A. Rostami, "Private 5G Networks for Vertical Industries : Deployment and Operation Models," 2019 IEEE 2nd 5G World Forum, pp. 433–439, 2019.

[15] H. Guo, J. Li, and S. Gao, "Understanding challenges of applying enterprise architecture in public sectors: A technology acceptance perspective," Proc. - IEEE Int. Enterp. Distrib. Object Comput. Work. EDOCW, vol. 2019-Octob, pp. 38–43, 2019.

[16] E. Mathase, M. Phahlane, P. Nixon, and M. Ochara, "Review of IT Governance Frameworks Public Sector," 2019 Open Innov. pp. 351–355, 2019.

[17] B. Di Pierro, V. Sangiorgio, G. Fiume, and M. P. Fanti, "Analysis of Industrial Changes and Enabling Technologies in Industry 4 0," 2019 IEEE Int. Conf. Syst. Man Cybern., pp. 581–586, 2020.

[18] M. Demir, M. Alalfi, O. Turetken, and A. Ferworn, "Security Smells in Smart Contracts," Proc. - Companion 19th IEEE Int. Conf. Softw. Qual. Reliab. Secur. QRS-C 2019, pp. 442–449, 2019.

[19] K. Chopra, K. Gupta, and A. Lambora, "Proof of Existence Using Blockchain," Proc. Int. Conf. Mach. Learn. Big Data, Cloud Parallel Comput. Trends, Prespectives Prospect. Com. 2019, pp. 429–431, 2019.

[20] M. Kuciapski, "How the type of job position influences technology acceptance : a study of employees ' intention to use mobile technologies for knowledge transfer," 2019.

[21] S. M. T. Toapanta, M. A. P. Sánchez, D. W. B. Valencia, and L. E. M. Gallegos, "An approach of models of information technologies suitable to optimize management in a public organization of Ecuador," Proc. 3rd World Conf. Smart Trends Syst. Secur. Sustain. WorldS4 2019, no. July, pp. 207–214, 2019