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Use of Blockchain technology as a support tool in economic and financial processes.

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ABSTRACT

In view of the current advantages of using blockchain technology, among which stand out the efficient management of data and information security, it is highlighted as a key factor the management of data blocks, which according to its structure and operation, allow organizations to raise possibilities associated with the action of sharing information in a context oriented to the commercial management of goods and services, while enabling the construction of consortia, working groups or associations. This paper seeks to present the results of a study that has been oriented towards the identification of the way in which Blockchain technology is being adopted, seen as an emerging tool in the field of transactions in different economic and financial sectors, and consequently, in the territorial synergy that is being generated in the framework of the transparent and secure articulation of actors sharing information. The work methodology has been framed in the literature search, the analysis of the information found, and the proposal that from the area of software engineering is made at a conceptual level, with respect to a simulation in the economic sector.

KEYWORDS: Economic sector, blockchain technology, simulation, technology trend

INTRODUCTION

The results presented in this document are aimed at demonstrating the benefits that can be obtained by including and implementing blockchain technology in different initiatives associated with the economic sectors that belong to a territory, or even that can positively affect an organization. In addition to the above, a characterization was made regarding the object of study of the blockchain, which allowed to obtain the theoretical foundation in the understanding of the use of this new technology. Likewise, and based on the analysis of the documentary results found through the search for information in the database engine Redalyc, org, it has been proposed as an initiative, to carry out a simulation project that subsequently allows to carry out the validation of the information generated that is of value for both internal and external management to an economic sector to be selected, or even to a specific organization.

This research and simulation process, mentioned above, arose as a study opportunity because companies currently suffer from the lack of transparency in the management of business processes, which involve economic and financial attributes, so that they can become truly auditable. Thus, it has been identified that blockchain technology provides a timely and reliable solution to the exposed problem, since it presents a decentralized structure, which, in turn, from the point of view of efficiency and transparency in the processes, is presented as a secure tool

that cryptographically contributes to the generation of competitive advantages of an organization or sector, compared to others. In addition, this technology prevents information from being modified after being recorded in a blockchain (Gómez, 2018), an aspect that generates trust to strengthen the collaborative networks that can be generated at an economic and commercial level, in a given context.

METHODS

Blockchain technology was created with the purpose of sharing electronic transactions without the need to use any type of centralized network or trust system. This type of technology "provides an immutable distributed database based on a growing sequence of blocks", and these blocks being public generate trust, transparency and solidity in the information of each of the transactions carried out (Dolader, Bel Roig, & Muñoz, 2017). In this sense, and to promote the adoption of this technology, it is proposed to take into account the implementation of the global innovation ecosystem that works "as a tool for innovation and thus recognize which entities and experts to ally with and for what purpose and, in this way, be more competitive" (Silva & Bermúdez, 2018), and it is possible that this initiative will allow improving all the processes related to electronic transactions, since it provides robustness, security, transparency and scalability to large and robust data systems.

Each of the technical fundamentals of blockchain, which support the Blockchain concept, are detailed below, among which are: Block structure, the structure of a transaction, nodes and security.

Block structure

The blocks within the chains have a structure that allows validating and identifying most of the stored information without the need to download it, such structure is known as Merkle tree, which among other things "allows storing various pieces of independent information in the leaves of a tree structure", in each leaf a hash of information contained in each (It is a mathematical algorithm that transforms any arbitrary block of data into a new series of characters with a fixed length), node is made. To generate the nodes of the upper level of the tree, the hash values of the lower level are concatenated and the hash function is applied to the concatenation, the repetition of this process results in arriving at a single node, called "root" (Dolader, Bel Roig, & Muñoz, 2017), as presented in **FIGURE 1**.

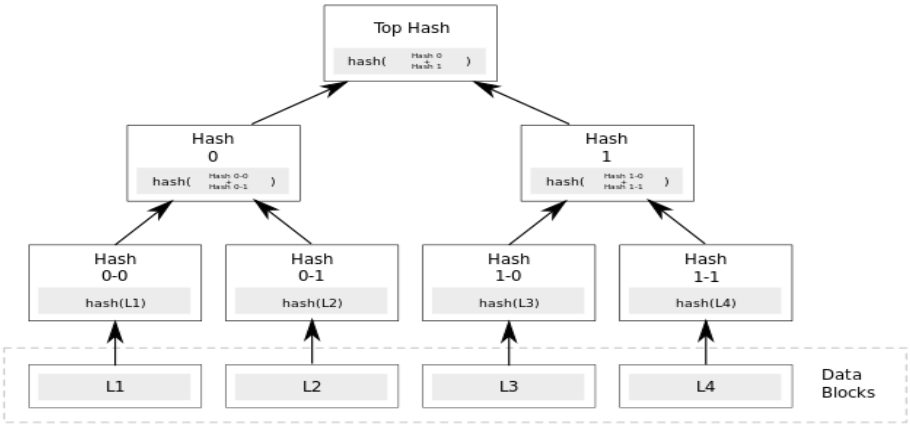

FIGURE 1. Merkle tree.

The structure of the Merkle tree allows traversing any point of its structure through the hash pointers, thus verifying that the data has not been modified, generating that any data that has

been modified without authorization in the transactions, causes the data not to match, since each hash is linked to the root, this being the input.

Blocks can be identified by reference to the hash, as noted above, or they can be identified to block height through their position in the block chain. The first block that is created is always at the height of zero (0), each block that is added from that position will have a higher position. Sometimes blocks share position within the chain competing to remain and/or surpass the previous position (Toledo, 2018).

Structure of a transaction

Transactions within blockchains can be divided into three parts: header, input and output. As (Perez, 2015) presents it below:

- The header: is composed of four parts: the transaction hash, the version of the software validating the block, the number of inputs and outputs, and the height of the block indicating the date the transaction was performed.
- The input: includes the previous output hash that points to unused transaction outputs, a list of previous outputs identifying which can be used in the new input, and a small unlocking program that requests the recipient's personal private key.
- The exit: exits create unspent transaction exits, UTXOs: Unspent Transaction Outputs, which are recognized by the entire network and remain available until the owner makes use of them. In turn, the outputs consist of two parts: the amount of satoshis (Minimum unit of measure that can be used in the Bitcoin system), and the block program written in script language.

Nodes

Nodes are the computers that receive the information and allow assertive communication between them, depending on the complexity of the transactions this can be a personal computer or a megacomputer. Nodes are also identified depending on the type of blockchain network they share, whether public, private or hybrid. In case of a public blockchain the nodes should not be identified, the opposite case happens when they are private, taking into account that the nodes may know each other or be equal to each other (Preukschat, 2017). Then, the nodes are computers that work with each other with a peer-to-peer (P2P)(equipment participating in the network are equal to each other), network architecture, which in turn share the responsibility of providing network services, this because the interconnection of the nodes is what allows the operation of this. A node may represent an end state within the chain of transactions and communications. However, there are nodes that are assigned different roles, in some cases the nodes will not store or validate transactions (Maldonado J. , ¿Qué son Nodos y Supernodos?, 2017).

Types of nodes

Mining nodes: These nodes verify and check that each transaction is correct. That is to say, this type of nodes emit, transmit and create new blocks, within the nodes they are the most important ones taking into account that they guarantee security despite having a high cost (Maldonado J. , ¿Qué son Nodos y Supernodos?, 2017), (Rochina, 2018).

Full nodes: Full nodes maintain copies of the complete blockchain, keeping the history of each transaction. This type of nodes validate all transactions made since the first blockchain created, they also allow the network to remain decentralized because each node keeps a copy of the transactions and this prevents any kind of hacking of the information or any kind of change on a node, thus the network can remain unsupervised (Maldonado J. , ¿Qué son Nodos y Supernodos?, 2017), (Rochina, 2018).

Super nodes: Super nodes have similar functions to full nodes, the difference between these two is the number of inputs and outputs, they also work 24 hours a day with the aim of helping other nodes to connect with each other, which increases the speed of transactions. In other words, super nodes work as information relays ensuring that each node has the correct copy of the transactions (Maldonado J. , ¿Qué son Nodos y Supernodos?, 2017), (Rochina, 2018).

Blockchain security and transparency

The following factors must be taken into account for the provision of blockchain: costs, speed, dependency, risk reduction, sustainability and flexibility (Linares-Barber, 2018). One of the attributes that stand out the most within the blockchain is the power to reduce intermediary costs, which are not required to authorize the operation, thanks to the access between the two parties that sign a transaction in the blockchain system, which makes each transaction authenticated and makes the database "virtually unalterable".

Among the most representative characteristics that provide transparency and reliability in the use of blockchain technology is that it presents a speed and efficiency that reduces costs by not requiring greater monitoring and control; the transparency of public accounting reduces the complexity of multiple accounting; transactions cannot be modified or deleted because the data are globally available, are verifiable and are transmitted in real time (Parrondo, 2018).

Data security in blockchain

Blockchain ensures the integrity of the information being one of the most significant features why more and more organizations are adopting this technology. Likewise, it is necessary to take into account the open and distributed alternative, and the access of the nodes, to obtain the possibility of modifying, deleting or censoring data, thus demonstrating the reliability and safeguarding of the data that are stored in each of the transactions and blocks (Bolaños, 2018).

The security of blockchains depends to a large extent on the cryptography of the data, which is also related to hashing, conceptualized as "a process whereby an algorithm called a hash function receives input data of any size and returns a specific result (output) containing a value of a fixed length". Hashes guarantee the security and immutability of the blockchain since each block is formed from the transactions belonging to it and the block that follows (Binance-Academy, 2018). The evolution of cryptography has allowed the development of new systems in this area, which facilitate the exchange of information. Among the systems that arise from cryptography is asymmetric cryptography, which works with public and private elements, the public one is presented freely for all interested parties to know, and the private one is kept in a secure place, where each user has a pair of keys (Maldonado J. , 2019).

Consensus mechanisms

Consensus mechanisms allow all network participants to agree and validate the content of the blockchain, which provides security with the transaction that takes place in the next block, seeking that this is correct and constant. The most representative consensus mechanisms in blockchain technology are: Proof of Work (Proof of Work) PoW [14], Proof of Stake (Proof of Stake) PoS, Delegated Proof of Stake (Delegated Proof of Stake) DPoS, and Proof of Authority (Proof of Authority) PoA (Maldonado J. , 2019).

The scientific information system REDALYC.org was used to search for information, due to the following selection criteria:

a. It is freely accessible.
b. Within its documents, in numbers, it has the following figures: 1355 online journals; 670 institutions; 26 countries; 662584 articles; 51230 fascicles; and 75410 articles generated with XML.

c. "... is an indexing system that integrates into its index journals of high scientific and editorial quality of the region..." .

With respect to the search equation applied in the Redalyc.org database engine, the following was used: "blockchain". Which turns out to be the main term, due to the purpose of this work, which is to consult the current state of the subject in the different academic, industrial and social sectors.

The process applied to obtain the information results can be seen in **FIGURE 2**.

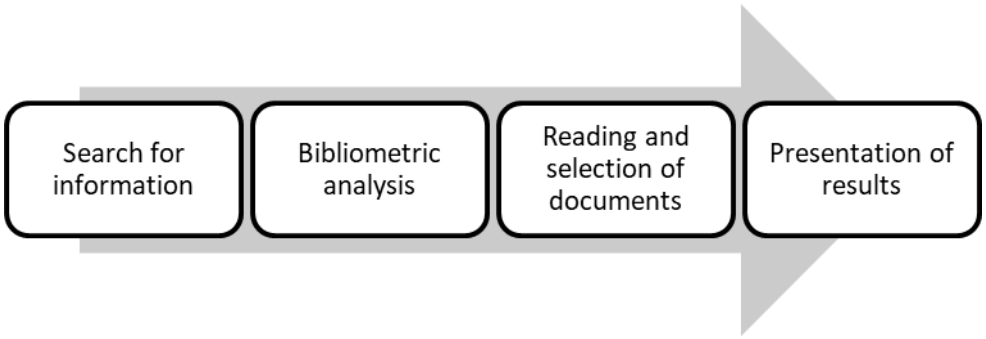

FIGURE 2. Phases for the development of the work.

Selection criteria

For the final selection of results, only the language in which the documents resulting from the search were proposed was taken into account, excluding those in Portuguese, i.e., from an initial total of 31 articles, 20 were finally worked on. In addition, other documents obtained from the gray literature were taken into account, complementing the information found in the search process, and which, being of interest at both the global and national levels, were added as a snowball, making a total of 23.

RESULTS

This results section includes two parts, an initial analysis of the data retrieved from the information search, and a second one, which refers to the analysis of the documents read, from which it was possible to extract concepts and approaches that are currently being worked on in blockchain.

a) Bibliometric analysis

Within the results obtained we have the following bibliometric information of interest:

Years of publication:

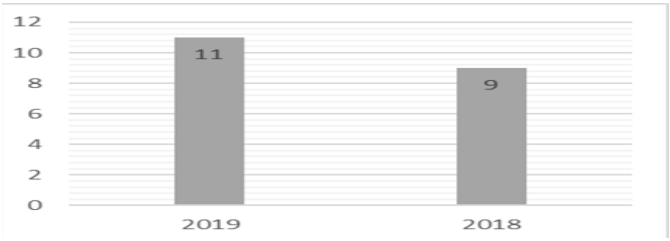

FIGURE 3. Years of publication. Source: Redalyc.org.

According to the results obtained through Redalyc.org, illustrated in Fig.1, the blockchain topic is emerging, and in Ibero-American publications, it is increasing in terms of published scientific studies.

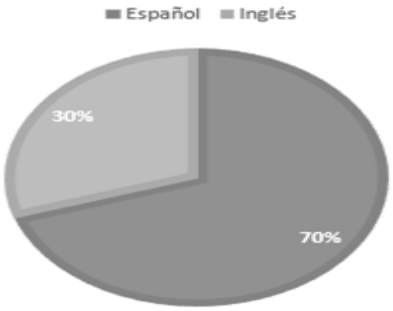

FIGURE 4. Years of publication. Source: Redalyc.org.

From **FIGURE 4**it is evident that the results obtained from the aforementioned source of information have an impact on Spanish-speaking countries, since 14 of the 20 results have Spanish as their main language of publication, and the remaining 6 have English as their main language of publication.

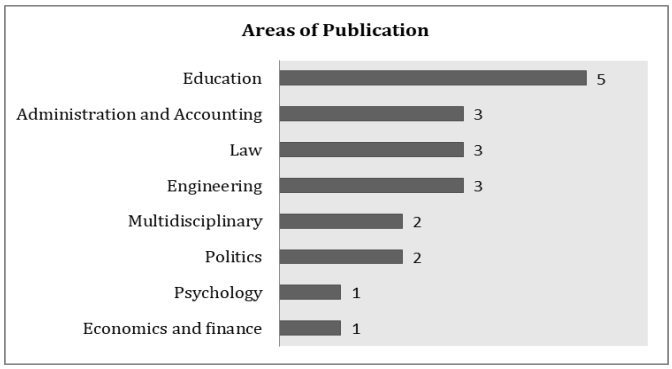

FIGURE 5. Years of publication. Source: Redalyc.org.

According to the data shown in **FIGURE 5**, the area of education has developed the largest number of publications in the sample of works obtained from the search, followed by other more industrial areas, such as engineering, law, and administration and accounting. With these data, it can be seen that the technology under study has been gaining strength in applied sciences, especially in those that affect the economic and territorial development sectors, such as engineering and education.

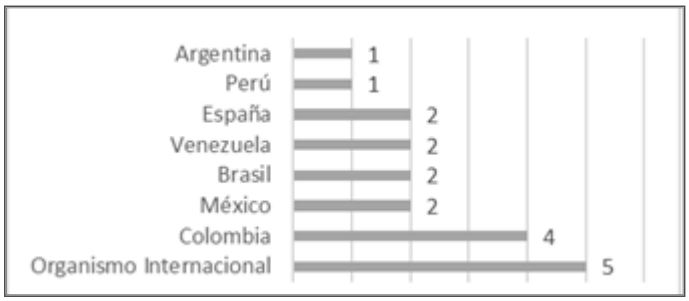

FIGURE 6. Years of publication. Source: Redalyc.org.

As for the international organization, shown in **FIGURE 6**, it was found that it is the "Revista Iberoamericana de Educación a Distancia", which is the means of dissemination of information of the Ibero-American Association of Higher Distance Education (AIESAD), which according to (AIESAD, 2021) is "... an entity created to promote Distance Education for the benefit of the peoples of Ibero-America". Likewise, Colombia is highlighted as the country that has published the most publications in Latin America regarding blockchain technology.

b) Blockchain and its current status

From a territorial vision, appropriating an innovative technology such as blockchain requires the generation of initial efforts based on the practice of research, both academic and organizational, which can take as a starting point the analysis of different economic and financial aspects that contribute to the development and stability in different industrial and manufacturing sectors that make up the region, according to the financial regulations in place (Becerril & Ortigoza, 2018). In this same line, entrepreneurship and the joint work of the actors that make up the triple helix should be generated in the first place when it comes to motivating the appropriation of disruptive technologies that have been appearing in the last decade, such as blockchain (Da Silva, Sordi, Behr, & Lucena, 2019)], as expressed in his work (Varela & Ramírez, 2019), who states "The State must be an active promoter of business development and education centers must be the main transmitter of knowledge and technological development to companies, through collaboration agreements and learning processes", thus promoting the appropriation of technological developments that generate innovation, which in turn is a symbol of value generation for a sector, organization or individual. Thus, this same actor highlights the importance of investing in Research, Development and Innovation projects in the different helixes of the territorial economic, academic and social ecosystem, an example of this investment can be focused on the conversion of the university to a digital one (Adell & Esteve, 2018).

On the other hand, it is not only in the economic sphere that blockchain technology can have a disruptive impact; other approaches have also been found in which its incidence can generate a positive impact when managing information that must be shared and transparent for the actors that make up a network or complex system, the latter understood by (Montilva & Montilva, 2018) as those that "allow understanding technology as a whole composed of interacting parts, which are organized in a certain way, which perform a certain functionality and have a certain behavior that emerges from the interaction between the parts".

In these systems it is expected that the existence of intermediaries tends to disappear (Solis-Osorio, Pérez-Cortés, & Cervantes-Maceda, 2019), such is the case of: (i) political parties in Mexico, where they have found in this technology, a digital opportunity that facilitates both investment and the development of the processes that are managed in their political functional framework, especially, in electoral campaign processes (Valles, 2018); (ii) energy credits, managed by a blockchain-based currency (Jara & Cedeño, 2019); (iii) indicator management, supported on the topic of open government (Jara & Cedeño, 2019); (iv) Tracking the transport of packages and customer requests, in their shipping logistics (Hair Jr, Harrison, & Risher, 2018); (v) Smart contracts, which are accepted by both parties and are executed autonomously (Ortega-Gimenéz, Heredia-Ortíz, & Pellicer-Mollá, 2019), as mentioned by BBVA bank in (Corredor, Armando, & Díaz, 2018) with respect to the scripts they manage at the information system level; (vi) The agribusiness sector, which can look to blockchain technology as a means of solution to the possible problems that currently arise and that may grow over time, which even involve the welfare of people. A clear example of the aforementioned is supported by [30] who mentions in food marketing issues that: "It is estimated that every year some 600 million people in the world fall ill -almost 1 in 10 inhabitants- by eating contaminated food and that 420. 000 die from this same cause, with the consequent loss of 33 million disability-adjusted life years", for this situation, one of the most effective possible solutions may be the use of blockchain, supported by the transparency and auditability of data from food production to its

final customers, preserving the state and identifying if they are contaminated, the information of each of the products can be stored and verified by all parties working in the process.

Smart contracts are even presented, which are basically "smart contracts capable of executing and enforcing themselves, autonomously and automatically, without intermediaries or mediators through the use of blockchain technology" (Cortés, 2019), an action that will allow large-scale food quality, traceability, timing, and compliance with agreements to be recorded automatically, transparently and securely, enabling real-time verification of the product's status.

Thus, when understanding blockchain conceptually as a disruptive technology that seeks to strengthen the articulation of actors in a system, through the transfer of valid and reliable information (Solis-Osorio, Pérez-Cortés, & Cervantes-Maceda, 2019), since it seeks to prevent information from being modified after being recorded in a blockchain (Gómez, 2018), it can be understood that its value contribution, either at the organizational or territorial level, can be framed in getting to understand it as a technology that works fast and without intermediaries, in different academic, industrial and social sectors; It presents different characteristics such as the opportunity to achieve the decentralization of tasks, and at the same time the possibility of providing through its implementation, the generation of different levels of security based on cryptographic principles, which allow the actors of an organizational or territorial system to act in an articulated way when transmitting and storing information.

However, it is necessary to highlight its advantages and disadvantages, which are (Solis-Osorio, Pérez-Cortés, & Cervantes-Maceda, 2019):

(i)Advantages: distributed data storage; Decentralization; Transparency; Immutability; and, Automation.

(ii) Disadvantages: High energy consumption; Storage; Performance; and, Confidentiality.

Having clear its advantages and disadvantages, in obtaining competitiveness, those who adopt it for entrepreneurship and marketing purposes, can see blockchain technology as a trend that is materializing on a par with others such as artificial intelligence (Restrepo, Ocampo, & Gómez, 2019), (García, 2019). Therefore, actors such as the Corporación Colombia Digital (C.C.D.Corporación Colombia Digital, 2017), recognize in this technology the ideal opportunity to manage articulation processes that support the generation of actions for the commercialization of goods and services, taking into account that all members of the network have the possibility of visualizing the information records generated within a system, in a transparent and secure way, thus mitigating one of the barriers that most affect the markets, which is trust (Restrepo, Ocampo, & Gómez, 2019). From the technical point of view, blockchain has another important factor in terms of security, this is the validity of the information, which is algorithmically generated in real time, in order to prevent any modification or deletion after being checked and recorded.

The appropriation of this technology in Russia has not been as expected due to its regulations, especially in banking issues (Prasolov, 2018), in contrast to Colombia, a country where it has been observed as of great interest, according to the initiatives for the integration of Information Technology components in all fields of the financial sector, both public and private. Some examples of the above mentioned and that justify the development of the present research in the country, are: the start of the RegTech project led by the Financial Superintendence of Colombia in which blockchain technology is integrated in order to optimize the transmission of the entities supervised by this entity; another specific case is the agreement between the firm R3 and the Banco de la República who seek that the development of blockchain includes the exchange of securities and the digitization of collateral promissory notes; and finally, the Ministry of ICT in collaboration with Innpulsa Colombia launched the initiative Apps. co initiative that promotes entrepreneurship, innovation and productivity, all linked to the development of blockchain technology (Numpaque, C., & R., 2017).

DISCUSSION and CONCLUSIONS

This research work intends to demonstrate the viability of blockchain technology as a secure engine that sustains the financial sectors at each of its levels, taking into account that "it offers a system in which transactions are public and participants confirm that there is only one truth" (ACCID, Asociación Catalande Contadores, 2019). Likewise, going into the economic and financial sectors of the department of Santander, and providing a beneficial approach for the region with the implementation of technology and smart contracts that facilitate marketing processes at the national and international level, implies taking into account the various structures of the economic and financial system, identified for the territory, in terms of products and services demanded and offered by the various organizations. Examples of these economic organizations are: Primary sectors (agriculture and livestock), secondary (mining, energy, construction, industrial), tertiary (services, transport, commerce, financial, solidarity, communications), as for those financial organizations, we can mention: Banking establishments, financial corporations, financial cooperatives, trust companies, insurance companies, etc).

Currently, Colombia is positioned as one of the best countries for the use and implementation of blockchain technology in economic and financial sectors, as stated by MinTIC, this is why together with Fedesoft, during 2019, different training workshops on blockchain technology have been held in order to support different sectors in the country. However, only "1% of companies in Colombia have fully adopted the technology and 3% are in the process of implementation", according to MinTIC's Digital Economy Observatory (Bastardo, 2019). Reason for which, several of the economic sectors in the country, have set their sights on blockchain technology, taking into account the advantages it offers for each of the monetary exchange and security processes, (SEMANA, 2019) mentions that "projections point to this business going from US$4.8 million registered in 2018 to US$92.7 million in 2024, according to data from the consulting firm Frost & Sullivan and calculations by the Vice Presidency of Innovation and Sectoral Intelligence of Procolombia".

Consequently, and with the purpose of consolidating the concepts on blockchain technology, worked on in this research process, a proposal has been made to carry out a future simulation.

Proposal to implement a blockchain simulator

Given the advantages and benefits identified around the technology under study, the option of developing a simulator that allows the visualization of values and the analysis of behavior in different economic sectors through the processing of data collected in transactions and blocks has been proposed. In this sense, the following are two main areas of work to achieve the objective of simulating what has been described above: methodology and development of the application.

Development methodology

The development of the simulator must take as support one of the classic methodologies that allows the development of each phase of the project in a sequential way, this methodology will be supported in a life cycle model for the development of systems, possibly becoming the one known as Cascade or Warterfall. That is to say, each stage is carried out after the previous one has been completed, with the only requirement that each phase must be finished before starting the next one.

The cascading life cycle methodology allows each phase or stage to fulfill each of the defined goals and activities, where the fulfillment of each of these contributes to the satisfaction of the next one. The activities that represent the life cycle are the following, as described in (UNIWEBSIDAD, 2013):

- System engineering and analysis.
- Software requirements analysis.

- Design focused on four attributes comprising data structure, software architecture, procedure and system interface.
- Coding, recognized as the translation to machine language, depending on the detail of the system, the mechanical coding is generated.
- Tests oriented to verify if the results are as expected.
- Maintenance required after the results are delivered.

Development of the application

The development will be based on the parameters and standards of the PHP programming language, making use of the MySQL database engine, which manages all the information concentrated on the relational model. The functionalities that will frame the validator model of the blockchain technology are listed below:

- Visualization of the price of the Bitcoin electronic currency: it allows to know in real time the price of the currency in dollars, Colombian pesos and euros.
- Information regarding the Bitcoin electronic currency: through the implementation of external links that redirect to the official Bitcoin website, as well as a virtual wallet that allows to store and save the Bitcoin, as well as the identification of the Bitcoin through the code that identifies it and the corresponding documentation.
- Historical information of the Bitcoin: comprising the starting date, the initial price, the maximum price reached and the difficulty of mining a Bitcoin block. In addition, external links to sites where you can buy, sell and exchange Bitcoin.
- Real-time interactive chart: allows you to visualize the Bitcoin price in real time in an interactive way in order to change different values such as the time interval shown on the chart, the way it is displayed, among others.

CONCLUSIONS

This research project allowed to deepen the knowledge and implementation of new electronic payment technologies, such as those supported by blockchain technology, which adapted to an economic sector, in a given context, can facilitate the articulation processes of the actors that are part of a territorial development ecosystem. Additionally, for these sectors, blockchain technology is one of the technologies that currently provide greater security, trust and convenience in aspects of money transfer.

However, and according to the results found in the literature search, this topic is still in an emerging state, which is in the process of documentary and experimental strengthening in the various scientific and organizational fields, which is why today it shows in a still limited way, The publication of literature that supports the benefits and advantages of the implementation and use of technology in the different economic sectors is still limited, although there are different international references that have shown how organizations choose to update their payment and monetary exchange processes in which they find advantages by not needing the use of intermediaries to carry out the work.

Likewise, it is important to highlight that technology offers veracity in the information and transactions since it allows the reading of the information, as well as adding, but not modifying or eliminating the information that has been stored under inclusion criteria managed in the transactions. In addition to the above (impossibility of deleting and modifying data), the redundancy of the information and the non-existence of a central authority make it more difficult to attack the data chain, to a large extent thanks to the consensus mechanisms.

Finally, blockchain technology has generated a great impact on internal business processes, especially at international level, supporting the creation of information transfer networks, which already goes beyond the mere economic nature.

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