Medicon Engineering Themes
Volume 4 Issue 6 June 2023
Article Type: Review Article
ISSN: 2834-7218

Blockchain Application Methodology for Improving Trust in the Collaborative Supply Chain

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Received: April 24, 2023; **Published:** June 01, 2023

Abstract

The globalization of the economy, the major disruptions due to the COVID-19 crisis, customer requirements as well as the current context of war, are straining global supply chains, which must demonstrate resilience and constantly seek to improve their performance. performance. Among the essential approaches to achieve these objectives, collaboration between logistics partners through methods and tools that have proven themselves but also have shown limits, particularly in terms of trust. Blockchain technology, which appeared in 2008, now offers an opportunity to improve collaboration by providing answers to concerns about trust. However, its application is not generalized, indeed a large part of the companies do not apply the technology because of its shared database character because the companies have sensitive and confidential data. After an analysis of the literature to highlight the obstacles to the generalization of the use of the blockchain in the supply chain, a methodology of adoption and application of the Blockchain following eight steps is proposed with an emphasis on the smart contract.

Keywords: Collaboration; Supply chain; Blockchain; Smart contract; Trust

Introduction

Supply chain management is an approach which consists in making a global analysis of the value chain going from the first supplier to the last customer by making a global optimization of flows and not local [1]. The advent of this approach is due to the complexity and challenges of globalization which has forced companies to group together in order to create strong partnerships with their suppliers and their direct and indirect customers. Faced with this complexity of the logistics chain, companies are faced with the problems of product and information exchange. The effectiveness and efficiency of the supply chain (LC) is the major concern of the actors, it was underlined in the work of the peers that it all started with the finding of irrationality of the behavior of the actors of the CL made by Forrester in 1958 and thereafter other authors continued studies on the same subject but with different points of view. Among them we have Cachon and Fisher who worked on the sharing of information seeking to bring an improvement and coordination to the CL, Chen et al as for them propose that the concept of risk between customer and supplier is contractualized to improve the profile list of CL actors [2].

Collaboration is a process by which actors who are different in their problems and others agree to explore their differences in a constructive way in order to come up with effective and efficient solutions that go beyond their own vision and expectations, this is what underpins the vastness of the concept of business collaboration [3]. The success of the application of collaboration in the industrial sphere requires the fluidification of business structures, but the exponential instantaneous changes that the world is currently going through presents many agility constraints for the implementation of the concept of collaboration [4].

Based on previous studies, we want to analyze the impact of Blockchain technology on trust in the Collaborative Supply Chain. The objective in this document is to improve trust in business from a model based on Blockchain technology.

Literature review

Collaborative Supply Chain & Blockchain Technology

[5] raise the hypothesis that it will take a level of commitment from the partners to achieve a successful SCC and [6] will propose rules for decisions. In the same logic, [7] proposes a framework. According to [3] and in business, the evolution of trust is increasing in relation to the evolution of trade. But before that, the company must take the risk for the first exchanges.

The first application of Blockchain technology is Bitcoin created by Satoshi Naka-moto in 2008. Each time we have Bitcoin transactions from one node to another, the transaction is secured and certified by sending a cryptographic key whose decryption confirms the transaction. It takes a large number of confirmations of the transaction before it is validated; This is what makes it safe [8]. According to [9], Blockchain technology today is classified into three categories: Blockchain 1.0 (financial field), Blockchain 2.0 (Smart contracts) and Blockchain 3.0 (Any other business sector including the public sector). Each block constitutes a transaction and is composed of data, a hash and the previous hash. A block can consist of one or more transactions, it all depends on the rules of the block.

According to the explanations of [10] and [11], the technology ensures a change of orientation of the SCC, the actors of the chain would only have to trust the technology itself. Its application in the supply chain can provide answers to several issues:

- *Transparency*: Transparency in the supply chain is not easy because of the number of actors involved in production both upstream and downstream [12]. Blockchain has been proposed as a solution for traceability in the supply chain [13].
- *Traceability*: The reliability and traceability of information can be difficult to ensure due to the high presence of fraud and confidentiality between partners. To-day, the demands of customers and consumers on the authentication and transparency of the products they buy are essential [14].
- *Accessibility of information*: The inaccessibility of data by everyone due to centralized databases complicates the collaboration of actors in the chain. Block-chain technology's distributed ledger ensures better collaboration of supply chain platforms by facilitating data accessibility [15].
- *Networking*: The large number of actors involved in Supply Chain networks makes their treatment non-transparent and irresponsible [16] ; [17] presents the way in which supply chains are very fragmented and the disadvantage that this has on the collaboration between the actors of the chain by mentioning the harm-ful effect of intermediation on the transparency and the quality of the information exchanged [5], Blockchain is the proposed solution [18].

Despite these issues, the adoption and application of the Blockchain remains quite limited, companies are still reluctant for various reasons, and among the most important there is the character of a shared database [5].

- *Confidentiality of certain sensitive data*: Blockchain is a decentralized database technology that records all exchanges and all data between network players in a large shared register. So everyone has an encrypted copy of all the trades that have been made.
- *Cost of setting up the technology*: Financially, the development of the technology is expensive and requires a lot of investment. Only a few large multinationals like MAERSK, Carrefour who have been able to develop it.
- *Heterogeneity of the language of information*: since companies use different information systems by their language, it is difficult to exchange information or data
- *Involvement*: A Blockchain development project does not happen alone, to succeed it must have the involvement of the majority of the PPs in the chain. We can see the example of TradeLens [19].
- *Level of development of the technology*: Other companies, having seen that the Blockchain is very recent, they have decided to wait until it is well developed and there are facilitations of its application before embarking on it. Beyond these barriers to the adoption of the technology we also have the interoperability between two or more Blockchain technologies [14] and [5].

In view of these dysfunctions, what is the appropriate solution for an optimal application of Blockchain technology in order to improve trust in the collaborative supply chain?

We then propose a methodology for applying Blockchain technology (for the SCC). It is a question of adopting the technology in a progressive way compared to the evolution of the exchanges and the relations between partners because the adoption and the absolute application of the technology is function of the level of confidence in the chain.

Analysis and interpretation

Blockchain technology: smart contracts

The smart contract is a Blockchain-based technology that allows the establishment of a large number of digital files between people who do not know each other and who may not trust each other. According to [20], the smart contract is a computer protocol capable of self-executing, autonomous and which facilitates, executes and enforces commercial agreements between two or more parties. In addition to being operational 24 hours a day, 7 days a week, it reduces the cost of transactions and ultimately makes business more efficient in the long term. In terms of confidentiality, the smart contract reinforces it by allowing the actors to have the choice on the data to be shared on the distributed database. According to [21]. The construction of a smart contract system requires the identification of the elements, namely:

- *The Builders*: Businessmen, lawyers, designers and digitizers.
- *Users*: the (human) users of both the process (digital contract) and its result (hu-man-readable contract), business users (managers and corporate lawyers), computers: Users of the output machine readable.
- *Information Layers*: This is a back-end repository of codified contract templates, clauses, visualization libraries, and big data libraries of searchable past contracts.
- *Procurement life cycle*: This involves needs assessment, negotiation, re-engagement and terms, implementation, adjustment or dispute resolution.

One can develop thanks to Smart contracts libraries of clauses in a clear, coherent and simple language, libraries of updating of the documents of the contract in real time as well as libraries of visual design models which will be useful in other contracts [21]. So, the smart contract may hold the solution because we will no longer need to share all the data and we have some control over the information we share. However, it also has negative points and shortcomings.

Information Hacking easy

It is much easier to hack information in a decentralized database than that of a centralized database because with the centralized database, you must first have access to the server before having access to the encrypted data but for the decentralized one, we already have access to encrypted data.

The non-possibility of updating or modifying

In classic or traditional contracts, it happens that there are changes in the socio-economic, political, or legal environment of the PPs or that there is a crisis, they will seek to bring updates to the contract. This is not possible with the smart contract.

Diversity in legal, technological and level of internet access

Jurisdictionally, business and commerce differ from country to country. On the technological level, we are witnessing different computer languages in relation to the geo-graphical situation. (There is an inequality of access to the Internet in the world) hence the weakening of the verification of transactions.

Based on the above, here is a suggested solution. It is a technology application methodology that is suitable for the Supply Chain.

Results

In order to overcome the criticisms, we propose an application methodology (See Fig. 1) integrating an AI to automate the activities and the operation of the technology, a security system to reinforce the level of confidentiality and security. It will first go through the application of the smart contract to the absolute Blockchain once trust is established.

The proposed methodology is divided into 8 steps:

1. Global chain analysis; the project sponsor should perform a comprehensive analysis of the value chain and identify common issues.
2. Involvement plan for value chain actors; after the first step, it is then necessary to prove that the Blockchain is the optimal solution.
3. Theoretical design of the general model of technology and smart contract; after convincing all the PPs.
4. Theoretical design and the first smart contracts, it is a question here of defining the clauses of the contract, the obligations and the commitments of each one as well as the rules.
5. Define the graphical interface; the PPs, the contract specialists or the lawyers and the IT specialists will together define the graphic interface in relation to the PPs. Together, they must provide a backup or rescue system that will minimize the damage in the event of hacking.
6. Define the data library; the team must agree on the known of the library, it can contain the exchanges of goods and services, the financial transactions, the exchanges of information and it will feed the automatic updates of the system and the latter will propose to the PP information and optimization practices.
7. Define additional activities and exchanges; Since the idea is to migrate to an absolute Blockchain, the PPs will offer other activities or functionalities if possible that the system will be able to perform or accept.
8. Technology development; once everything is validated, the developer team or the IT specialist will start by developing the technology without forgetting to add a security system based on artificial intelligence (AI) to limit the risk of hacking.

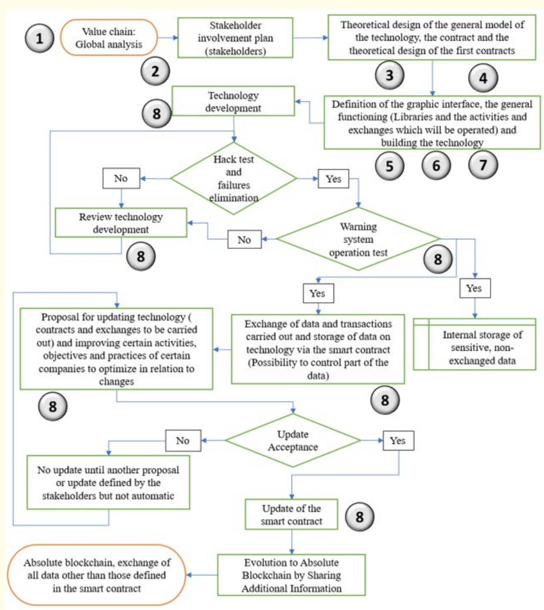

Figure 1: Method of application of the Blockchain in the collaborative supply chain.

Indeed, smart contracts bring the same advantages as those brought by absolute Blockchain technology with the only difference that only the information (clauses, obligations, etc.) mentioned in the smart contract will be executed and shared on one side; this will allow PPs to have a shared database (Blockchain) and a non-shared one. Here is a *technical design* of the system that will show the tools to strengthen the security of the system (see fig.2). Here are a few in the following lines:

The user server made up of the commerce server, everything relating to commercial activities and the application server. This comes from the work of IBM and MAERSK (TradeLens - Solution Brief).

The Library, Inspired by the work of (Marcelo Corrales et al, 2020).

AI (Artificial Intelligence), This last part will allow the system to self-manage, self-regulate and act in case of emergency, danger, following this the AI will trigger the alert system that will automatically block the system.

The firewall which will contribute to the respect of the network security policy and will monitor and control the different types of network activities, the azure data brick which has the role of triggering the alarm in the event of detection of a hacking attempt and machine learning which aims to bring the system to self-learn on the environment of the PPs of the network.

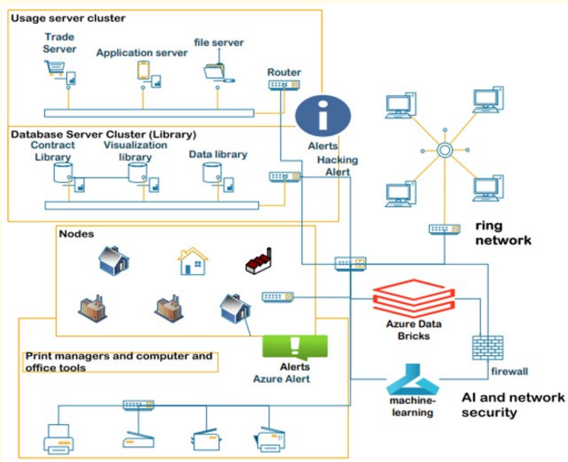

Figure 2: Technical design of the system and its operation.

Conclusion

Our work focused on the treatment of the spirit of trust and collaboration in the sup-ply chain by trying to analyze the contribution and the limits that Blockchain technology could bring. Several limitations have been observed in relation to its use, in particular of smart contracts, and this was mainly due to the lack of trust in relation to the sharing of information. We have proposed a methodology which consists of moving from the second version of the Blockchain to the third in order to promote the sharing and exchange of data and transactions in the supply chain by improving confidentiality through the mastery and control of part of the data of the PPs by the PPs and for the PPs. Behind this technology we are adding an artificial intelligence and an alert system that will allow companies in this ecosystem to be more flexible and agile in relation to changes in the ecosystem and to block the operation and access of the system in the event of threat detection. The system's automatic updates system will lead companies to Blockchain 3.0 where they can exchange everything with each other as they see fit. What will be the consequences after the implementation of our solution? will it be effective and efficient? Or will it give us new avenues of research?

The problem of interoperability between two Blockchain technologies is a size limit of when companies from different supply chains can also exchange, so how should it be ensured? The high cost of technology development is a major challenge. The company seeks to maximize its profit so what solution for this challenge? In addition, applying technology within the company supposes the change of the computer system where the personnel will be confronted with a new world. So how should the Blockchain solution be integrated within the company while minimizing the negative impact on the company's personnel?

Based on the above, we plan to continue our research in order to find solutions to the mentioned limitations. Since we are looking to improve trust in the collaborative sup-ply chain, we are going to look at the study of the necessary time of exchange that it will take before having a higher level of trust compared to that of other companies, following see how many years of business two companies make before thinking of other alternatives and what are the causes.

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Citation: Kotongo Koffi Augustin., et al. "Blockchain Application Methodology for Improving Trust in the Collaborative Supply Chain". Medicon Engineering Themes 4.6 (2023): 38-43.