DECENTRALIZED SUPPLY CHAIN

[1]Kush Aggarwal, [2]Devesh Khandelwal, [3]Lakshay Sangar, [4]Ms. Aashita Chhabra,
[1, 2, 3] Student, [4]Assistant Professor
Department of Information Technology
Dr. Akhilesh Das Gupta Institute of Technology and Management, New Delhi, India

Abstract: This project represents a distributed, decentralized supply chain system. A supply chain can be decentralized when various decisions are made in different companies trying to optimize their own objectives. The proposed approach is applied to a product retail supply chain network. The supply chain design discussed during this paper is an integrated multi- echelon, multi-product problem considering total costs of shopping for raw materials/returned product, transportation of raw materials, and inventory holding of raw materials. A coordination mechanism is designed to share information between the retailer and the manufacturer called decentralized planning. The main contributions of this paper are summarized as follows: (1) presenting a decentralized (distributed) approach in order to address the production and distribution problem in supply chain including manufacturer and retailers and (2) proposing a decentralized coordination mechanism in order to handle problems related to production and distribution in a transparent supply chain network through a decentralized approach. The proposed coordination mechanism provides high-quality solutions in reasonable manner. This coordination mechanism can be applied in other supply chains such as natural gas and oil, water resource management, and crisis and disaster planning, agriculture etc.

1. INTRODUCTION

Block chain delivers a plethora of built-in features including distributed ledger, decentralized storage, authentication, security, and immutability. Supply chain systems are a domain which stands to gain significant positive impacts by utilizing this technology. Presently, the nature of Block chain is put to work majorly in the field of finance and fiscal transactions following its boom in the Bit coin era. Features such as Immutability, Interoperability, Mobility, Authentication and Cryptography facilitate the supply chain sector. Block chain is a system with a record of transactions maintained across several nodes linked in a peer -to-peer network. It is an Architectural Consesus-based Platform, launched in 2009, which works by storing information in distributed recording ledgers in a decentralized way spread out across all computing devices that are part of its infrastructure (Zheng et al, 2017). Blockhain made its way into popularity as the underlying technology for bit coin (Cornelius et al, 2019). Centralized approach to transactions of currencies or data, involving a mediator or a third party, had drawbacks such as unreliability on third party, vulnerability to malicious attacks , transaction delay , malfunction etc. Such drawbacks were solved by block chain by dissociating itself with any kind of centralized structure.

Block chain first appeared as a mechanism supporting the concept behind the working of Bit coin. Bit coin was a decentralized approach to monetary transactions, proposing a system in which currency can be transferred without the interception of a third party or authority, making it, in a true sense, a peer -to-peer mechanism. It got referred to as Block chain 1.0, and paved a way to a plethora of its applications including projects such as Monero , Dash and Litecoin

After its early success, block chain lead to the inception of smart contracts, which got referred to as Block chain 2.0 in block chain technology. Smart contract is a computer program or a transactional protocol, stored in a block chain network which automatically executes relevant events and actions, when predetermined terms are met, in a public block chain.

Smart properties are assests that are owned and controlled by a block chain entity. Block chain 2.0 encapsulates technologies such as Ethereum, Ethereum Classic, NEO and QTUM.
Following the evolution of Block chain 2.0, non – financial applications were introduced as Block chain 3.0 that encompasses use cases such as identity management, dispute resolution, contract management, supply chain management.

Block chain 3.0 entailed several perceptions of the technology which could be seen applied in non – financial fields, and supply chain industry is best suited to be the epicenter of it, where a number of use cases have been identified.

2. CONCEPT OF BLOCKCHAIN

The extensive details of block chain are not explained at length in this paper. However, understanding the functionality of this technology is crucial in the context of this paper.
In simple words, the role of block chain technology is of authorizing transactions or information passed between to or more peers, without the need of a third party being involved. There is no involvement of a centralized organization, monitoring the transaction.
The key features of block chain are:

- **Authentication** : Using a public and private key pair, and assigning a unique hash ID to every user

which gets identifies after establishing proof of work, authentication is promised by block chain.

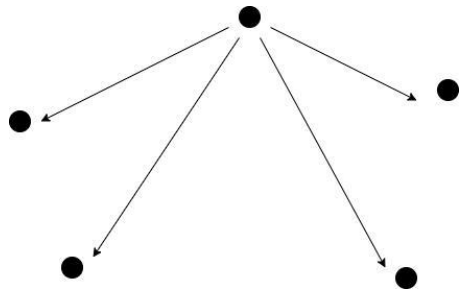
- **Interoperability:** which is accomplished by facilitating transfer of data payloads brokered through APIs to help communicate multiple networks with each other.

- **Data Sharing:** since the data on a block chain is data can be retrieved and shared with anyone on the block chain network while assuring its immutability.

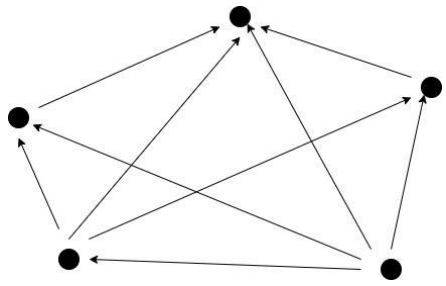
- **Non – Repudiation** : using the techniques of asymmetric encryption using elliptic curve equations , both the sender and receiver cannot deny information involved in a transaction, thus ensuring complete non – repudiation. (Weidong fang et al) .

The working of block chain is immaculate. Its foundation is the peer-to-peer architecture instead of a centralized architecture which makes it completely transparent. Communication is happening amongst nodes instead of a node to a central authority, information is passed to an adjacent node, which passes it on to another adjacent node, and information is spread to the whole network.

This also works to benefit the credibility of the block chain system in a way that one point of failure in a network will not result in the failure of the entire network.



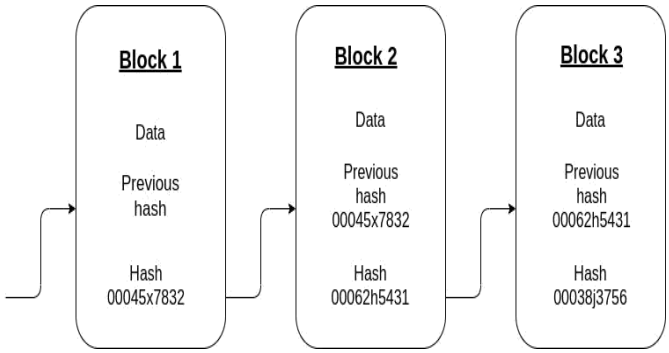
CENTRALIZED APPROACH



DECENTRALIZED PEER-TO-PEER APPROACH

Block chain, from its name, is a collection of blocks in a network of chain, where blocks are a form of distributed ledger that stores information.

The chain is formed using a combination of a unique hash assigned to every block which also contains record of the hash of its previous block, which ensures the continuity of a block chain in a linear fashion.



Information in a block chain is entered using a consensus mechanism. Most commonly used of consensus algorithm is the proof of work (POW) algorithm, which uses the proof of miners by solving mathematical computations, thus, validating the block in question? Other consensus algorithm includes Proof of Stake (POS) and Proof of Capacity (POC) .

- It is impossible to shut down a block chain network as there are nodes around the world that are distributed without any combined central party involved.

- A block cannot be faked in a block chain because of the electric consensus of nodes required to validate a block in the block chain.

  A drawback of this system is the amount of time taken to validate a block which can normally take 10-30 minutes in an established block chain.

- All transactions are peer-to-peer and copy of the transaction done is distributed to all nods participating in the block chain.

3. SUPPLY CHAIN APPLICATION

The four most important and distinct features that block chain provides is that make it highly applicable for the availability chain managers:

- Transparent and controlled transactions. Block chain has no intermediary (e.g., a bank). It leads to faster and more transparent settlements, because the ledger is updated automatically. Payment conditions are generally pre-programmed giving the visibility of a transaction, in order that it can only be visible to the authorized participants.
- Preapproved transaction fees. When making cross-border payments with Swift, the commission for the transaction is deducted only after the transaction completion — or, to be more exact, upon running

through an entire number of the intermediary banks, which are executing this transaction. In case of block chain, you recognize the fees beforehand.

- Auditability. All the transactions are immediately visible to authorized parties, meaning nobody can tamper, delete or conceal any information added to the block chain.
- Reliable. thanks to its distributed nature, block chain doesn't have one point of failure. Also, all the transactions processed on block chain are immutable and irrevocable, thus eliminating the risks of fraud.

A number of successful researchers suggest that managers can realize big benefits from block chain, starting from cost-savings and increased efficiencies to new operational models, specifically within the following areas of supply chain management:

- Procurement
- Provenance and traceability
- Digital payments and contracts
- Logistics
- Manufacturing

All the given factors make supply chain a feasible use case of block chain technology.

4. RESULTS AND OBSERVATION

OBSERVATION

In this section, we evaluate the performance and functioning of our proposed decentralized supply chain system. To explore the plausible application of the proposed system, we have created a product retail supply chain system, which entails the track of the product's price, information regarding the product, and its current ownership. We have used Ethereum public block chain, due to its noteworthy stability and ability to handle 10000 transactions per second.

The frameworks used in the supply chain network are truffle, and ganache, along with solidity as the programming language. Using the ledgers created by ganache, one can easily track the ownership and price in ethers , for any given product . Our protocol achieves remarkable performance and ensures accurate provenance and traceability of a retail product, which can effectively reduce product frauds and price manipulations.

RESULT

Our analysis has provided with the following results as an outcome of our research. We were able to:

a) Analyze the correlation between centralization of supply chain functions

b) Identify factors and constraints that are major points in driving the centralization decisions in companies.

c) Understand and asses the influence of centralization and decentralization of functions associated with supply chain on the cost structure. Further, in-depth analysis of the results provided with the insights on the business strategy of companies that are adopted by the centralized decision-making over decentralized decision-making. We were also able to analyze and get hold of the tradeoffs that companies face while deciding the decision-making approach in the supply chain organization of companies.

5. CONCLUSION

The key findings of our research, identify contributions and limitations of our study, and suggest further research in this area.

We investigated the strategic and operational supply chain functions that were centralized or decentralized by various companies, the reasons companies chose to centralize or decentralize and the impact of centralization and decentralization on supply chain costs. The proposed decentralized supply chain system is capable of delivering many important aspects such as provenence, traceability, raw material procurement, and logistical features in a common consensus protocol.

Change management and risk management within centralization are some of the other important areas that have not been explored by researchers. Centralization is an important subject which influences corporate performance and sustainability. However, decentralized systems provide a compelling way of management using the positive traits of block chain technology. Hence any attempt to change organizational structure should be accompanied with appropriate change management and risk management strategies in order to omit any conflicts and disrupt the services provided by it. Therefore, additional research on the risk management and change management aspects of centralization can provide with a significant value in this area .

REFERENCES

1. Saveen A Abeyratne and Radmehr P Monfared. 2016. Blockchain ready manufacturing supply chain using distributed ledger. (2016).

2. Naif Alzahrani and Nirupama Bulusu. 2016. Securing Pharmaceutical and HighValue Products against Tag Reapplication Attacks Using NFC Tags. In Smart Computing (SMARTCOMP), 2016 IEEE International Conference on. IEEE.

3. Ethan Buchman. 2016. Tendermint: Byzantine fault tolerance in the age of blockchains. Ph.D. Dissertation.

4. Miguel Castro, Barbara Liskov, and others. 1999. Practical Byzantine fault tolerance. In OSDI, Vol. 99.

5. Hyperledger Community. 2018. hyperledger/fabric. https://github.com/hyperledger/fabric/tree/v0.6.

6. Niels Hackius and Moritz Petersen. 2017. Blockchain in logistics and supply chain: trick or treat?. In Proceedings of the Hamburg International Conference of Logistics (HICL). epubli.

7. Jae Kwon. 2014. Tendermint: Consensus without mining. Retrieved May 18 (2014).

8. Jae Kwon and E Buchman. 2016. Cosmos: A network of distributed ledgers. (2016).

9. Leslie Lamport and others. 2001. Paxos made simple. ACM Sigact News 32, 4 (2001).

10. Mikko Lehtonen, Thorsten Staake, and Florian Michahelles. 2008. From identification to authentication–a review of RFID product authentication techniques. In Networked RFID Systems and Lightweight Cryptography. Springer.

11. "Blockchain for supplychain." https://www2.deloitte.com/blockchainsupply-chain-innovation.html. Accessed: 2018-08-11.

12. H. M. Kim, M. S. Fox, and M. Gruninger, "An ontology of quality for enterprise modelling," in Enabling Technologies: Infrastructure for Collaborative Enterprises, 1995., Proceedings of the Fourth Workshop on, pp. 105–116, IEEE, 1995.

13. "Ethereum project." https://www.ethereum.org/. Accessed: 2018-08-14

