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Review Article

Building Supply Chain with Blockchain

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ABSTRACT

Blockchain, the digital record-keeping technology behind Bitcoin and other crypto currency networks, is a potential game changer in the financial world, but another area where it holds great promise is supply chain management. This paper explores various benefits and use cases for blockchain in supply chain management and discusses challenges while moving Supply Chain processes to block chain.

Keywords: Supply chain management; Business transformation; Block chain; Database

INTRODUCTION

Supply chain management plays an important role in the business growth of any industry. Nowadays, businesses are not competing, it's the supply chains that are competing. It is the reason companies are now shifting their focus on transforming supply chain management through technological advancements. New technologies are presenting promising opportunities for improvement across the supply chain. Using blockchain in the supply chain has the potential to improve supply chain transparency and traceability as well as reduce administrative costs with much secured networks.

WHAT IS BLOCKCHAIN?

Blockchain is a type of database to record digital transactions. The name comes from its structure, in which individual records, called blocks, are linked together in single list, called a chain. It differs from a typical database in the way it stores information. Blockchains store data in blocks that are then chained together. As new data comes in it is entered into a fresh block. Once the block is filled with data it is chained onto the previous block, which makes the data chained together in chronological order. Decentralized blockchain are immutable, which means that the data entered is irreversible. In context of financial transactions, Bitcoin, this means that transactions are permanently recorded and available to anyone in the network with same authenticity [1]. The unique advantage of blockchain is its capability to resist modifications and ensure end-to-end transaction transparency [2]. The ledger is an append-only structure, so once added; a record can't be changed or deleted. Using blockchain in supply chain allows users to trace the product throughout the life cycle of product from its origin to consumption [3].

VALUE OF BLOCKCHAIN IN SUPPLY CHAIN

Supply chain represents all links involved in creation and distribution of goods, from raw materials to finished product, which is in consumer's possession [4]. In today's fast paced, highly competitive global environment, circumstances are deriving the demand for a more effective model of delivering services to customers. The number of partners and suppliers that collaborate to deliver a product or service is very high in supply chain industry. The supply chain of today are highly fragmented with silos of information that make it nearly impossible to share information with trading partners in Real-time without compromising data quality [4]. Moreover, lack of transparency in supply chain makes it extremely difficult to investigate and hold people accountable for any illegal activities that have occurred along the chain, which explains numerous cases of fraud, forced labor and several scandals in supply chains that stain reputations and cost millions to the companies involved. Businesses need technology platforms that empower them to visualize a product in every stage of its lifecycle, in real time, from raw materials through delivery to end customer. A blockchain is a distributed, or decentralized, ledger-a digital system for recording transactions among multiple parties in a verifiable, tamperproof and transparent manner.

The ledger itself can also be programmed to trigger transactions automatically. For crypto currency networks that are designed to

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replace fiat currencies, the main function of blockchain is to enable an unlimited number of anonymous parties to transact privately and securely with one another without a central intermediary. For supply chains, it is to allow a limited number of known parties to protect their business operations against malicious actors while supporting better performance. Using blockchain in the supply chain can help participant's record price, date, location, quality, certification, and other relevant information to more effectively manage the supply chain.

TRADITIONAL VERSUS BLOCKCHAIN APPLICATIONS

The traditional financial ledgers and enterprise resource planning systems now used don't reliably allow the three parties involved in a simple supply-chain transaction to see all the relevant flows of information, inventory, and money. For example: A simple transaction involving a retailer that sources a product from a vendor, and a bank that provides the working capital to the vendor needs to fill the order [5].

The transaction involves information flows, inventory flows and financial flows. Note that a given flow does not result in financial-ledger entries at all three parties involved. And state-of-the-art ERP systems, manual audits, and inspections can't reliably connect the three flows, which make it hard to eliminate execution errors, improve decision-making, and resolve supply chain conflicts [4]. With blockchain application to support above business scenario – following steps are executed, and blocks are added on each step and same information is available to all the parties involved in Real-time.

- Retailer places order with Vendor. Vendor acknowledges receipt of purchase order.
- Vendor requests loan from bank. Bank provides financing to supplier.
- Vendor invoices and ships merchandise to retailer.
- Retailer pays Vendor for merchandise.
- Vendor repays bank. Bank closes loan record.
- Retailer returns unsold or damaged merchandise to vendor and invoices for it. Vendor pays invoice.

BENEFITS OF BLOCKCHAIN BASED SUPPLY CHAIN APPLICATIONS

Enhanced traceability

Traceability improves operational efficiency by mapping and visualizing enterprise supply chains [6]. Consumers, as well, are putting pressure on businesses to provide more insights about the products' provenance, authenticity and life before reaching the consumers. Blockchain helps organizations understand their supply chain and engage consumers with real, verifiable, and immutable data. Sometimes consumer products or raw ingredients need to be recalled preventing injury or illness. Between lost sales, replacement costs, and lawsuits; recalls on consumer products negatively impact millions of individuals around the world. Blockchain technology can enhance product traceability by reducing counterfeiting and by streamlining product recall. The Global Brand Counterfeiting Report, 2018 estimates that the losses suffered due to online counterfeiting globally have amounted to 323 Billion USD in the year 2017 [7]. Counterfeit consumer goods account for nearly 188 billion dollars of lost revenue regarding prescription drugs alone. Blockchain enables an individual to verify that a product was sourced accurately and ethically. Documentation counterfeiting and fraud are also common among diplomas, certifications, and official identification. Blockchain records can transparently verify certifications, official legal documents, and coordinate record-keeping immutably, which prevents counterfeiting or fraud.

Transparency

Managing today's supply chains-all the links to creating and distributing goods is extraordinarily complex. Depending on the product, the supply chain can span over hundreds of stages, multiple geographical (international) locations, a multitude of invoices and payments have several individuals and entities involved, and extend over months of time. Due to the complexity and lack of transparency of our current supply chains, there is interest in how blockchains might transform the supply chain and logistics industry. Transparency builds trust by capturing key data points, such as certifications and claims, and then provides open access to this data publicly. Once registered on the blockchain platform, its authenticity can be verified by third-party attestors. The information can be updated and validated in real-time. Almost every industry uses third-party manufacturers or various products from multiple vendors before creating and labeling the final finished goods. In some cases, white-label products are sold before being repackaged and relabeled under another brand. Transparency in process tracking gives producers a bird-eye view into their value chain introduced the first blockchain-fueled shipping platform called TradeLens in 2018 [3]. The Danish shipping giant that has approximately allowing them to guarantee the proper handoff of third-party goods and final product labeling. Blockchain can track the progression of assets, record the information, and show previous asset records

Enhanced regulatory compliance and reporting

Regulatory and compliance reporting is a severe concern for pharmaceutical companies given many patient's reliance on prescription drugs. The supply chain must remain efficient while avoiding under or overstocked medications. Automated compliance and reporting will reduce friction, reporting costs, and eliminate errors associated with manual activities. Blockchain compliance will further enhance corporate governance by providing information in real-time and seamlessly distributing data to the proper stakeholders. Lastly, blockchain improves compliance and reporting for medical devices, prescriptions, drugs, manufacturers, and other consumer goods.

Tradeability

Tradeability is a unique blockchain offering that redefines the conventional marketplace concept. Using blockchain, one may "tokenize" an asset by splitting an object into shares that

digitally represent ownership. Similar to how a stock exchange allows trading of a company's shares, this fractional ownership allows tokens to represent the value of a shareholder's stake of a given object [2]. These tokens are tradeable and users can transfer ownership without the physical asset changing hands. This concept can be used in Supply chain funding businesses; where in a supplier can take loans against their orders from multiple institutions by tokening the volume of orders or invoice value. Blockchain provides consensus, which means there is no dispute in the chain regarding transactions by design [8]. All entities on the chain have the same version of the ledger, giving it the unique potential to track ownership records for real estate, automobiles, and digital assets.

Secured applications and data

Blockchain technology is built with secure blocks. These are copies of the document that are chronologically stored and linked to the previous blocks. This makes them highly secure and challenging to falsify. A hacker would have to change hundreds of copies at the same time, which is nearly impossible without the software picking up on it. This is what makes blockchain the technology used by Bitcoin and major financial services and banks. If you want to ensure your supply chain data stays guarded against cyber-attacks (which are becoming more regular these days), blockchain is an ideal solution.

Improved customer engagement

Blockchain excels at data analytics and reporting, those analytics can also be used to boost customer satisfaction. Retailers can use the blockchain database to see where items are in production and shipment to better build a delivery timeline for their shop. Moreover, customers can also have access to certain data on the blockchain. For example, a clothing brand with a dedication to fighting sweatshops may give their customers access to the blockchain, showing them a social consciousness approval form, a labour union sheet, and even a how-to launder guide. This kind of data sharing creates a new level of transparency with the consumer in a way that builds deeper client relationships and loyalty.

USE CASES

Leading Retailer leverages blockchain for traceability

In 2019, Global Retailer Company in USA executed a blockchain-first strategy to reduce costs, improve traceability to enforce safety standards. Prior this transformation, company was using multiple databases to trace products to their source. With supply chain spanning throughout the world, it was challenging to maintain records and quickly respond in case of any product issues/recall. As it takes time to locate the origin of an outbreak, many retailers are often forced to throw out their entire inventories of produce. These four entities hope to increase food transparency and shipment efficiency with blockchain technology [6]. The firm worked with leading blockchain experts to leverage new platform for traceability and quickly developed block chain applications to keep track of its food products. Block chain stores each piece of the information about its source and is used to enforce regulations. With block chain technologies, retailer is able to track their products within 16 hours, which used to take 72 hours on a traditional application. Similar initiatives have been taken by Unilever, Nestle, Tyson and Dole to achieve efficiency and accountability of their products.

Global mining company uses block chain

BHP Billiton, the world's largest mining firm, announced it will use blockchain to better track and record data throughout the mining process with its vendors. Not only will it increase efficiency internally, but it allows the company to have more effective communication with its partners. The transparency of blockchain is also crucial to allow consumers to know they are supporting companies who they share the same values of environmental stewardship and sustainable manufacturing [4]. This is what the project Provenance hopes to provide with its blockchain record of transparency. The success and speed of the transformation was paramount to the success of their operations. Diamond-giant De Beers uses blockchain technology to track stones from the point they are minded right up to the point when they are sold to consumers. This ensures the company avoids 'conflict' or 'blood diamonds' and assures the consumers that they are buying the genuine article.

Blockchain to streamline oil supply chain

United Arab Emirate's state-owned oil company, has successfully launched a blockchain supply chain system pilot program to track oil from well to customers, while simultaneously automating transactions along the way. While still in its early stages, it hopes to eventually expand the chain to include customers and investors, making its business more transparent in the process. Oil company produces about 3 million barrels of oil a day, and by fully implementing blockchain technology, they will be able to keep track of all oil produced, reducing the time and costs associated with shipping.

Container company using blockchain to bring transparency in global trade

An European container company, introduced the first blockchain-fueled shipping platform called TradeLens in 2018 [3]. The Danish shipping giant that has approximately 20 percent of the global market share created its advanced solution on top of Blockchain Platform, which in turn uses the open source Hyper Ledger Fabric codebase from the Linux Foundation [1]. As for the end of 2019, over 100 organizations, including large ocean carriers, joined the platform, representing nearly 60 percent of global container freight.

CHALLENGES AND WAY FORWARD

Adopting blockchain for a supply chain application requires a lot of groundwork. IT managers and developers may be tempted to experiment with a proof of concept to gain a better understanding of the technology, but it won't always disclose

many of the underlying challenges in a real working solution. A good practice to avoid blockchain problems is to collaborate with other organizations, even those outside of the industry, to identify technologies, practices and business processes that can be adapted to working supply chain solution [2]. Blockchain applications used in supply chains are far more efficient than currencies like bitcoin, but they still require more computing resources or overhead than traditional databases. This means some of the operations of these applications, such as reading from the blockchain, may be significantly slower compared to those operations in traditional databases.

Although blockchain technology could support decentralized applications managed by separate vendors, they most likely won't be as easy to manage as more centralized, industry focused exchanges. Blockchain application exchanges may not be popular with enterprises at first, much like when music distribution services, including Apple Music, received pushback in the beginning. But, over time, enterprises may have to adapt to these new exchanges, just like the music industry did.

A blockchain application stores every transaction in a distributed ledger, which can add up, particularly when it is used by multiple parties. The cryptographic algorithms used to guarantee trust also add some data overhead. These factors can lead to larger data structures that each enterprise might have to manage. Enterprises can reduce the risk of such blockchain problems by finding an appropriate balance between data stored in a decentralized ledger and other data stored in more traditional data stores used by ERP systems.

Way forward: Several large players of the supply chain industry are already embracing blockchain-based distributed systems and setting up resources to encourage its use [9]. We are likely to see global supply chain platforms leveraging blockchain technology to streamline the way companies share information as products and materials move around. Blockchain technology can transform organizations in many ways, from production and processing to logistics and accountability. Every event can be registered and verified to create transparent and immutable records. Therefore, the use of blockchain in supply chain networks certainly has the potential to eliminate areas of inefficiency that are so common in the traditional management models

CONCLUSION

As discussed, there is considerable room to improve supply chains in terms of end-to-end traceability, speed of product delivery, coordination, and financing. Blockchain can be a powerful tool for addressing the deficiencies. A Digital Supply Chain Strategy requires inclusion of a Blockchain technological capability. Blockchain will be the enabling platform to provide full end to end electronic connectivity across the entire Supply Chain. Supply chain businesses need to collaborate the efforts to develop new rules, experiment with different technologies, conduct pilots with various blockchain platforms, and build an ecosystem with other firms. Yes, this will require a commitment of resources, but the investment promises to generate enormous returns.

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