

Supply sense - An implementation of trust, transparency and traceability in a supply chain

Abstract

Supply chains and value networks have grown in complexity over the past couple of decades. Governments and authorities have reacted by piling up various regulations, and the customer has been demanding greater transparency into the value chain and the origins of the products they use. While the regulations make the value chain more reliable, it has added a tremendous cost to the value chain participants, which is ultimately borne by the customer. Further, the existing infrastructure fails to provide desired amount of transparency and traceability into the value chain. Supply Sense leverages blockchain technology to build trust, provide transparency and traceability across the supply chain value network. It ensures that immutable data about every stage of the value chain is available through the blockchain to all participants and regulators.

Supply Chain

Supply chain, the system a business uses to get their product to the end customer is today a complex network of highly disjointed players geographically spread across the globe. From obtaining the raw materials to processing them, to assembling a finished product, to getting them packaged in the right manner, to ensuring that the final product is delivered to the end customer through a retailer introduces many opportunities for lags to creep into the flow of both information and time. Further, the increasing complexities on both demand and supply side make the processes followed by one participant opaque to the others.

This lack of visibility makes quality control across the value chain difficult, increases the working capital and risk locked up in the supply chain as the reconciliation between participants becomes lengthy and tenuous, increasing the total cost of the end product.

For supply chain efficiencies to increase, it is imperative that the cost and operational difficulties involved in managing trust, transparency, and traceability of the supply chain participants is brought down. This can be achieved through the use of blockchain technology.

Blockchain

A blockchain, in the simple terms, is a distributed ledger that is updated continuously to record transfer and creation of supply chain certificates- and thus to record transactions between the

participants. Traditionally, ledgers have a master copy maintained by a central authority - like a bank in case of currency which all participants refer to. The distributed ledger, instead, is made up of multiple copies of the same ledger present at all the nodes in the network, i.e. each participant has the complete ledger and no one copy is considered superior to other. These replicated ledgers or databases are synced over the network and all participants have visibility into them. That said, it is important to note that just like networks can either be public allowing anyone to join or private with a restricted members – so can the blockchain be private or public.

A private permissioned blockchains ensures -

1. All participants are verified and operate in a controlled environment
2. Strict access control rules [ACL] are implemented on a per participant basis
3. Unique industry specific business rules can be enforced such as
 - a. Mass balance for production,
 - b. Temperature controls for shipping goods
 - c. Expiry date for perishable goods
4. Data is untamperable and a strong and transparent audit trail is maintained
5. Participants may at any point independently verify the business rules and audit trails

To address the first aspect, blockchain uses private-public key pairs. This is not a new thing and the traditional ways of transferring anything of value online have been using this technique for decades now. The trickier part is to check if the entity has the authority to perform the action they intend to – in case of value chains, it boils down to whether the participant owns the value it intends to transfer. Further, in case of a disruption or dispute, it should be possible to trace the item/ value to its origins and check that all participants had the right authority.

Blockchain solves this problem through consensus. That is, if most of the participants maintaining their own replicated copies of the database believe the entity has the right authorization, then they must have had the authorization. The multiple copies ensure that the cost of hacking the system to carry out a fraudulent transaction is too high. Any attempt to change a transaction already recorded in the blockchain will have to be carried out across all the copies, one at a time. Given that the number of participants in the blockchain can run into millions – in theory – it is impossible to achieve this without the network`s knowledge. Further, as the details of all the transactions are recorded into blockchain, they can be used to trackback any transaction that needs to be verified by authorities for discrepancies.

Key concerns to be addressed

One may assume that the supply chains across various industries and use cases will face different challenges. While this is true at a micro level, from a systems standpoint these

challenges can be surprisingly similar. As we have moved towards the world where businesses are interested in addressing needs of segment of one using global resources, as envisioned by C. K. Prahalad in his seminal work *The New Age of Innovation*, the supply chains have only spread wider and become more complex as a distributed cloud-based architecture allows each participant to work independently. This has given rise to plethora of regulations including Universal Product Code (UPC), United Nations Standard Products and Services Code (UNSPSC), need to comply with Country of Origin related regulations, and ensuring Restriction of Hazardous Substances is maintained. Further, a huge number of clearing houses and escrow services have become embedded into the value chain. While this does ensure that the supply chain is reliable, it not only adds to the overall cost of the end product but also makes the value chain opaque to participants. It is no more a surprise to anyone that most of the price Indians pay for their food goes to the supply chain intermediaries and a very small percentage goes to the farmer who actually produced the food – so much so that even offering them a 50% margin in their input costs is challenging.

Think of the many global supply chains that have become part of our everyday existence, and ask if one can answer the following questions:

Apparel – Is child labor, slavery or labor exploitation involved in manufacturing / weaving?

Diamonds – Does the gem aid / promote terrorism in anyway?

Food products – What sort of fertilizers and chemicals were used in the production? How were the animals raised? How hygienic were the various processes involved? Were ecological concerns addressed and sustainability ensured?

Automotives/ Electronics – Can all the components be traced to their origins? What is the environmental cost of manufacture? What happens after the items are disposed off?

Furniture – Where was the timber sourced from and what was the ecological cost of the same?

Paper – Can it be traced to the forests where the supply chain begins and if it was destructive for the local ecosystem?

Cosmetics - Was animal testing done?

These key concerns that the supply chain management today has to address can be summed up as:

1. Availability of better information and transparency across all supply chain participants which means ensuring accountability for sourcing decisions
2. Availability of better information and transparency to the final customers allowing them to check the provenance of the product delivered to them
3. Ability to enforce checks and balances automatically across the value chain through smart contracts
4. High integrity of the mechanisms by which the above needs are met, ensuring trust in the system and forbiddingly high cost of gaming it.

How Supply Sense works

Supply Sense is a provenance and traceability platform built on top of Hyperledger Fabric - a permissioned blockchain. This utilizes the underlying blockchain architecture to ensure trust, transparency and traceability across the value chain. The application provides permission - based access to all the participants in the value chain to the blockchain ledger. These include: raw material supplier, packers, processors, exporters, integrators, certifiers, regulators, importers, and other enablers like call-center executives who can assist with queries from other participants.

The primary value chain issues that Supply Sense addresses are:

1. Tagging and tracking of raw material right from the source to the moment they are processed into a finished good to packaging and distribution of finished good and products
2. Account for all inputs going into the raw material `harvesting`
3. Ensuring that the value chain is official and the products go through only registers and known entities at every stage
4. Maintain a dynamic reputation scoring for each of the value chain members based on key metrics
5. Maintain a strict checksum for certifying authorities so that integrity of data is maintained
6. Create a map of all certification and test reports generated at the various stages of a shipments life cycle throughout the value chain
7. Hence, provide a single point access to all test results and certifications associated with a product, and provide for traceability through the value chain and network
8. Provide a simple way to identify any supply chain disruptions, so that time is spent on resolving the disruption rather than identifying the same

Supply Sense achieves this by ensuring that all the data related to the shipment is updated through the blockchain by the parties carrying out the action. This ensures that the data and transactions are recorded by the parties who are responsible for the action and therefore, can be held accountable with no way of denying their actions. Further, the blockchain ensures that the transactions are immutably recorded and chances of retrograde tampering of the data are non-existent. Supply Sense has the flexibility to allow regulator / certifier integration to have visibility into the history of all the participants and, therefore, decide which participants/ shipments need additional scrutiny. All the shipments can be traced back to their origins addressing all concerns around country of origin and source verifiability.

Supply Sense creates a world view by making all members of the value chain trustable data sources and uses that unique opportunity to build provenance, custom business rules and integrate with various sources