

*Blockchain opportunities in supply chain.*

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Blockchain has the potential to create new foundations for economic and social systems and building economic coordination using distributed ledgers augmented with computational features such as money (cryptocurrencies), programmable contracts (e.g., smart contracts), and organizations made of software (DAOs, or distributed autonomous organizations). It redefines how data is stored, updates, and moved across networks. Instead of trusted third parties incentivizing appropriate behavior of participants, it uses cryptographic techniques. Blockchain is a peer-to-peer network architecture meaning that all participants are equal in their role on the network, and its topology is flat; in other words, unlike, for example, a client's server, it is without hierarchy. It is enabling an entirely new way to write and deploy applications. It has the potential to improve online security and trust.

For the supply chain, blockchain is a ground-breaking innovative solution set to transform supply chain activities. Scholars have heavily discussed blockchain applications in the supply chain, and there are calls on in-depth identifying how to bridge the gap between expectations on blockchain opportunities and its successful implementations in the supply chain, as well as theoretical considerations and practical successful case studies (Treiblmaier, 2018).

One fast-moving consumer good company with fully outsourced transport operations identified blockchain opportunities in a transportation network.

The main issue is visibility on the key performance indicators, including on-time delivery and on-time collection. Lack of visibility regarding the on-time performance of carriers results in internal customers issues mirrored with poor service of internal customers, including factories and end customers. Entities involved in the shipment process waste time finding out where a shipment is since there is no single version of truth amongst them. No single version of truth translates into exceptions and informal practices in order to make the operations work. Exceptions attract over 80% of attention, stress, and workload for parties involved (de-

murrage, extra distance). Informal practices lead to a fragile supply chain depending on people and their relationships, making any change difficult and risky. Multiple outsourcing with little oversight and black box of shipment execution result in unreliable data regarding the on-time performance of transport service providers, which translates into convenient long-term relationships between shipper and carrier. Despite the annual tender process, changes of transport service providers are infrequent. The solution for these issues was to implement a visibility platform based on blockchain to deliver updated real-time mode statuses of shipments and expected time of arrival and delivery.

The deployment of blockchain addresses short trust amongst entities in a decentralized transportation network with multi-level subcontracting. Once the transaction is entered in the database and the accounts are updated, the records cannot be altered. The latter, in turn, translates into complete visibility of asset transactions history.

The mechanism of reaching consensus amongst shippers, freight forwarders, subcontractors paves the way to control once internal commitments and contractual agreements are fulfilled.

Editor written with the benefit of the experience of exception flows among many shippers and carriers enables to achieve such standardization quickly, simply because the commercial implications of exceptions are made transparent. They are automated without a need for further human intervention. On top of that, portable and immutable reputation scores of transport services providers translate into higher transparency and a clear view of which transport service provider delivers the best performance.

Based on the scoring mechanism smart bidding agent, the bot can execute an instruction to find the optimal carrier, or the driver can feed smart contracts. Over time smart bots can self-optimize to find the best bidders and secure capacity within their operating limits. Smart bids enable to replacement of human decisions with a selection of simple and infallible algorithms that promote the best interest of buyers and sellers.

The underlying asset is shipments, and on the shared ledger are entered check-in and check-out timestamps, loading and unloading times, detention charges, and penalty charges. Blockchain participants should accept statuses like picked up and delivered. In order to make enhanced with blockchain visibility platform work; a new capability should be reflected with dashboards within which each transaction is irreversible and can and be followed by transport planners, customer service specialists, transport service providers, drivers, end customers. Shipment should be turned into a digital asset powered by a smart contract that auto-executes the payment on valid delivery. The transportation visibility platform based on the blockchain should also be expanded with smart contract capability. The latter would allow the creation of portable and immutable reputation scores based on the execution of smart contracts. The

driver will carry immutable and portable reputation scores on various criteria to unlock additional business opportunities with specific ranks/scores. As a result of digitized performance records and corresponding reputation scores on the platform, drivers will be able to join certain spot shipment bids directly, if so configured by shippers and carriers who prefer direct payment to a driver. Adding scenarios on detention costs with smart contracts would allow having control over it. For example, X hours of delay may result in -y % of freight, damage/loss of specific cargo can be calculated automatically as per liability terms & cargo value, etc. The other idea with smart contracts is to optimize the routes, and once a truck leaves the route, the notifications are sent to transport service providers. The live tracking of temperature according to contract requirements is also enabled by smart contracts. The smart contract can enable more disciplined and automated execution of transport operations, reducing reliance on ad-hoc decisions of human operators.

Smart contracts can perform the role of a smart bidding agent. If so required, instead of pre-assigning a specific subcontractor, authorized users can choose from various bidding/auction mechanisms to let a specific set of subcontractors compete for a specific shipment or set of shipments (periodical assignment). Over time smart bots can self-optimize to find the best bidders and secure capacity within their operation limits pre-set. Deployment of smart contracts in transport scenarios enables automating most of the work performed by humans, often without consistency, solid logic, and compliance with formally made agreements. Implementing smart bidding agents would also support digital freight matching capability and reach savings on the spot market. The visibility platform can be extended with functionalities on accepting the statuses, displaying the detention costs, and sending notifications when trucks leave the optimal route. Automation of delivery confirmation with immutable ePOD (proof of delivery) would significantly reduce the admin cost of handling paper documents and speed up order to cash cycle for carriers and in some cases. What is more, payments in tokens or cryptocurrencies would reduce the total transport cost. Early adopters get free tokens: an incentive to reward their carriers and drivers for promoting good behavior and forming new habits. Over time, as token acceptance increases, its raising value enables it to substitute fiat currency rewards and penalties, decreasing the cost further and rewarding early adopters most.

Building systems on the blockchain is non-trivial due to the steep learning curve of blockchain technology. Blockchain requires the newest skills to implement in any technology area. On top of that, adopting common standards is the challenge that blockchain needs to face in the future. Blockchain, with its core concepts of distributed ledger, consensus-based validation, smart contracts, can accelerate the changes in the transportation network and help build a resilient and sustainable supply chain.

## References

Treiblmaier, H. (2018). The impact of the blockchain on the supply chain: a theory-based research framework and a call for action. *Supply Chain Management: An International Journal*.