Blockchain Technology Applications in Supply Chain Management

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Managing the flow of the products, services, information, and money from the suppliers to the final consumers became a challenging task due to the globalized connectivity. In the rise of Bitcoin's success, researchers and practitioners in the field of supply chain management see potential in using Blockchain technology to tackle some of these challenges ahead.

Blockchain technology was introduced in 2008 as the concept behind the Bitcoin digital currency. At its beginning, Bitcoins struggled to get any traction until the currency price increased by 6900% in one year in 2013. Since then, researchers and practitioners started to ask what makes this currency so unique, and how can we harness the technology behind it?

To simplify how Blockchain technology works, imagine a chain of blocks where each block contains transaction information. Blockchain works as a network of participants where each one has the exact same chain decentralized to its database. So, when there is a transaction, it is time stamped, signed with a unique serial number, and attached to a newly created block. The serial numbers represent a link between the blocks through a mathematical function. This forms a robust chain of blocks because it is almost impossible to tamper with one of the transactions without altering the serial number of that block, hence damaging the link between all the blocks in the chain.

The result is a system where transactions can be made between individuals without the need for a trusted third party. All blocks can be traced back to the moment they were created with a high level of irreversibility and trust of records, which ensures that everyone agrees on all historical events. Additionally, the Blockchain can be used with a computational logic known as the smart contract. This means the transactions can be digitally signed and occurred automatically and anonymously based on the blockchain's data and some pre-defined conditions.

In the field of supply chain management, it is not uncommon for a company to spend months to tackle a defected object for a recall. The roots for such a problem lie in the reliance on multiple suppliers. This comes with a severe lack of transparency as companies cannot monitor their suppliers in real time. It is thus challenging to tackle a recall issue in a focused way after it is discovered. This can be solved if Blockchain technology is used to keep a tamperproof, trusted and permeant history of all the transactions. In fact, many types of research talked about using the Blockchain in such cases which are related to *Supply Chain Traceability*. After all, is this the only application of Blockchain technology in supply chain management?

For instance, if sensors were used to keep records of all the physical attributes on the Blockchain, then decisions on the physical movements of the products can be made based on the Blockchain's trusted data which will ultimately improve *Compliance to quality and sustainability standards*. Furthermore, it is not impossible to see a higher level of *Supply Chain Integration* where a self-dependent shipment could manage itself autonomously and optimize for revenue, directly pay its fees to different service providers and cost centers based on the smart contracts and the data from the Blockchain.

So, going from a literature review, this study shed light on other Blockchain applications besides *Supply Chain Traceability* such as *Compliance to quality and sustainability standards*, *Supply Chain Integration*, *Digitalization of transactions and Supply Chain Finance* applications.

A framework is developed with collaboration from four cases: IBM and Maersk, IBM Global Financing, Modum, and Volvo. The framework firstly identifies the supply chain drivers to use the Blockchain technology, then goes through the limitations and success factors for each application which are essential to discover before the implementation phase. Then, it goes through the evaluation of the impacts on the supply chain objectives such as cost, quality, speed, risk reduction, sustainability, and flexibility. Finally, the framework evaluated the applicability of each Blockchain application.

Using this framework, companies will be able to select the easiest applicable and most beneficial Blockchain application(s) for their supply chain needs.