

Growth of Supply chain with Technological advancement

Shweta Kini, Malavika Menon
RV College of Engineering,
Bangalore, Karnataka, India.

Abstract : Supply chain networks are global, multi-modal platforms that are expected to facilitate seamless exchange of physical goods, information across multiple industries and enterprises and stakeholders. Current supply chain information systems are limited in term of providing validated, real-time asset specific business relevant information during its lifecycle. Only one or few stakeholders have information access privilege causing both information asymmetry and inefficiencies in the \$35T global supply chain market. Emerging technologies such as IoT and Blockchain democratize “trustworthy” data availability and empower stakeholders to make the right decision at the right time in the most cost-effective manner. Digital supply chain integration is progressively becoming a competitive differentiation of enterprises. Organizations leading to this approach of digital supply chain are rapidly improving their asset utilization and enabling new databased services. This paper presents the idea about relevance of complementary technologies like IoT and Blockchain technology for complete digitization of supply chain. The business case of pallet renting vendor is taken to showcase the use of technology integration to improve efficiency of its supply chain and asset management.

Index Terms - Supply chain visibility, IoT, Blockchain technology, Asset Management, Digitization, Integration Introduction.

I. INTRODUCTION

In this paper, we primarily focus on integration of IoT & Blockchain for making supply chain management more efficient, transparent, and cost effective.

A. Pain Points in Supply Chain

Supply chain comprises of the flow of goods, information and money in a network that consists of many stakeholders. End-to-end visibility into the inventory and well as in-transit goods is becoming a business demand. The changing financial aspects of manufacturing, inventory and shipping require new advances that nearby visibility gaps to bring down cost, enhance speed and yield, avoid misfortune and accomplish focused levels of customer service. To survive, organizations should proactively adjust by embracing items and services that give insight and logical examination of their procedures and convey real time information about in-transit shipments.

Major challenges that need to be overcome in a conventional Supply Chain are as follows:

1. Loss or theft – freight theft can happen anytime in the supply chain & more probable when there is no visibility into the location and legitimacy of the item in transit.
2. Adulteration or substitution – it is pivotal that the products that delivered at destination are precisely the products that were transported, with no substitution or adulteration during shipment trip.
3. Occupied, terminated, or fake merchandise – items planned to be destroyed can be redirected into the supply chain for illegal sale. Expired merchandise not fit to be purchased, misbranded, or relabeled items can be brought into the supply chain.
4. Regulatory compliance – certain kinds of items require affirmation of ecological variables (temperature, humidity, vibration, shock) or chain of guardianship.
5. Consumer loyalty – a definitive test in supply chain management is serving the requirements of clients, who progressively demand their own visibility into the location of merchandise in transit
6. Execution & efficiency – fast transport requiring little to no effort to the transporter depends on the identification and alleviation of squeeze focuses, dangers and wasteful aspects to keep up constant change.
7. New value-added data-based services creates new customer experiences [2]

B. Value Addition in Business Technology

Every set of business vertical or stakeholder transactions have different objectives, rules etc. However, there is a universal need for information transparency, security, accuracy and speed. Quality of services or product exchanges, monetary gains and speed of operations are difficult to monitor in complex stakeholder's chain. There is huge scope for standardization in managing these operations & interactions. Managing different accounts for stakeholders for one specific purpose requires proper system, resources and investment. Synchronization among all respective operations is much needed for true business value creation. Human intervention at each point is expensive, impractical and error prone. As technology evolution is rapidly improving, human decision making & man-machine interactions are becoming more feasible. This in turn helping businesses to gain pace in their operations, handling complexities with ease and adding value to outcome. Recent technologies such as IoT, Blockchain, Artificial Intelligence and Neural networks are providing pseudo human presence and giving end to end visibility in complete business processes and to relevant stakeholders. These technology-based service solutions that are automating daily decision making in organizations leading in different business verticals are making them profitable, unique, and more favorable to the customers. These solutions can be called as omnipresent, as they are impacting a broad range of industries such as healthcare, automotive, manufacturing, banking, warehouse management, supply chain management and infrastructure. Solving various problems from respective industries and business models, increases scope for entrepreneurs to enter this segment with unique ideas. The future of business is evidently

digital, collaborative in a distributed, constantly changing world. In this paper, we primarily focus on integration of IoT & Blockchain for making supply chain management more efficient, transparent, and cost effective.

II. RELEVANCE OF SUPPLY CHAIN WITH IOT AND BLOCKCHAIN TECHNOLOGIES

Supply chain is one of those industries, that has huge dependencies on multiple stakeholders such as suppliers, manufacturers, distributors etc. Along with managing stakeholder relations, it is equally important to manage inventories, condition of goods to drive better efficiencies in operations. Providing end to end visibility using IoT based solutions solves the problem for improving operational efficiencies. [3]

For centuries, businesses and industries have been built on the principle of “manual trust” between multiple parties. Blockchain technology builds business where trust is embedded by design, by default in an automated way. [4]

The functional services of these technologies help to improve following characteristics of supply chain: [5]

1. Responsiveness: Modern supply chain visibility services pull isolated actions from multiple data sources, integrate these into one system. This in general improves overall accessibility of data.
2. Intelligence: The integrated data is processed as per the pre-defined rules to create situational awareness. Enhanced services improve data with business intelligence to provide hands-on status information.
3. Deductive: The routes of shipments should be dynamic adjustable, providing information about the expected time of arrival at any time.
4. Surveillance: All the resources and stakeholder remain in proper control, to monitor where and when are they used.
5. Operational excellence: Continuous optimization can be done to reduce costs and increase reliability.

We will now explore how blockchain and IoT will result in huge benefits from the technology and business perspectives:

1. Technology perspective: Blockchain may be the independent technology that connects the product or IoT enabled application to the end customer. Blockchain will enable the transfer of key data along with the status of the shipment. As many companies start using IoT devices the value of this data will prove to be very important. The applications integrated with IoT technology will disrupt existing processes across variety of industries including manufacturing, trading, shipping, the financial sector and healthcare. Despite these advancements’ security remains a top concern for the IoT ecosystem as it exposes multiple devices, huge amounts of data, supply chain partners and the community to security breaches. Blockchain based IoT solutions are well suited for simplifying business processes, improving customer experience and achieving significant cost efficiencies. [6]
2. Business perspective: The rapid advance of Blockchain technology and the Internet of Things (IoT) are felt throughout our daily lives. The areas that will see significant improvement are:
 1. Traceability of material supply chain with IoT real time tracking & monitoring options.
 2. Visibility and compliance check over outsourced contract manufacturing
 3. Controlling loss and damage of assets and market counterfeits
 4. Save fuel costs with optimizing fleet routes by monitoring traffic conditions
 5. Reducing paperwork and administrative costs
 6. Gain user insight by embedding sensors provide visibility into customer behavior and product usage
 7. Building transparency in processes with stakeholders
 8. Securing credibility and public trust of data shared
 9. Reducing risk from supply chain malpractice
 10. Timeliness in real-time reports, alerts and advisories provide need-to-know information without disrupting your workflow while allowing remediating action.

III. PROBLEM STATEMENT

The ideal supply chain has the integrated view of asset that is the combination of physical goods, information and money. An asset essentially integrates all 3 entities in the real world. Asset management is managing and controlling this integrated identity of asset. Multiple stakeholders do multiple asset transfer, exchanges etc., which becomes difficult to manage from de-synchronized process of transactions and with any third-party service provider managing accounts of stakeholder independently. How technologies like IoT and Blockchain can be integrated with supply chain, to address to reduce complexity in network, asset management, asset loss & damage, customer satisfaction etc.

With the current business model and processes, the vendor is facing few challenges which can cause complexities in these asset transfer transactions between multiple stakeholders. [9]

1. Complexity in process of transfer/exchange: Multiple times invoice generation and data flow, no single system for multiple transaction accounts
2. High cost & inefficient: Third party system for contract management (Separate accounts for each pair of transaction), re-work in processes at buyer & seller end, desynchronized processes lead to repetition
3. Huge paperwork & errors: Papers for invoices, receipts, bills, transport orders
4. Asset Management: Controlling pallet inventory at service center, tracking pallet velocity, loss & damage, managing asset maintenance

IV. INTEGRATION OF IOT AND BLOCK CHAIN

IoT devices will be connected to all pallets moving out of pallet service center. This will provide real time asset location, asset return rate, asset utilization and for asset predictive maintenance scheduling. IoT with its real time presence helps user to get live status of goods and its condition. User can check and remotely monitor the goods. It is somehow limited to physical goods. Asset is integration of physical goods, information and money. There are multiple stakeholders involved in supply chain network, depending on type of business. With the integration of blockchain with IoT enabled supply chain complete digitization is possible. For managing assets, major feature of blockchain termed as "Open Distributed Ledger can be used. For all available stakeholders in network, considering them as nodes of network, blockchain will update each asset transfer, asset addition and all types of asset transactions etc. This will help for inventory management, goods transfer, money related transactions and important data sharing. Moreover, with blockchain aiding for these operations will add security, transparency, consistency, efficiency and cost effectiveness. [10] This is important in order to manage assets which was a part of the original problem statement.

Benefits of integration of the two technologies are as follows:

1. Decreased complexity: With single platform for all transactions, complexity reduces. In future, multiple intermediaries can be added in network due to the flexibility of blockchain technology.
2. Highly Efficient: Real time visibility of all transactions improve efficiency of all processes. Delays in process claims, order management reduces. Overall process becomes simple and accessible for any stakeholder from any point of work location.
3. Cost Effective: Removal of third-party service provider to manage the transactions between stakeholders provides opportunities for cost saving. Integration of IoT and Blockchain for once with current working model can be extended with multiple stakeholders without any extra cost unlike other third-party system, which manages accounts of each stakeholder independently.[12]
4. Build trust in stakeholders: Transparency and authorized access for transactions, asset tracking gives proper view of business interactions. All stakeholders are given read or right access for ledger as per their role into transactions.
5. Aids in financial planning: Asset management becomes transparent and accurate with this technology integration. This helps for managing payment clearances, insurance coverages, penalties of stakeholders.
6. Real-time performance: With end-to-end visibility of asset usage at real time, helps pallet service centre for asset health monitoring, contract management with multiple stakeholders, pallet inventory management, cycle time monitoring etc. This improves the performance of pallet service centre, apparently of all connected stakeholders.

V. CONCLUSIONS AND FUTURE SCOPE

The Blockchain-IoT combination is powerful and can cause significant transformations across several industries, paving the way for new business models and novel, distributed applications. As demonstrated in this paper, this combinative technology can play significant role in supply chain management. Blockchains make supply chain resilient. This intelligent application will assist all users to efficiently manage all operations at tactical, operational & strategic level. Single product which can gather all sensor information, process them, predict health of supply chain & next best actions to be taken. It will be best combinative product with blockchain technology & IoT.

ACKNOWLEDGEMENT

We would like to sincerely thank our guide, Dr K.N. Subramanya, Principal, RV College of Engineering, for providing valuable suggestion to complete this paper. We are thankful to Dr. C.K Nagendra Gupta, Head of Department, Department of Industrial Engineering and Management for his sage advice and valuable input during the project presentation which helped us channel the focus and scope the problem at hand effectively.

We are indebted faculty members, R.V. College of Engineering, Department of Industrial Engineering and Management and the friends who encouraged me with valuable suggestions and advice.

Finally, we would like to thank the parents and friends for their constant moral support.

REFERENCES

- [1] Z Zheng, S Xie, H Dai et al., "An Overview of Blockchain Technology: Architecture Consensus and Future Trends", *IEEE International Congress on Big Data*. IEEE, 2017.
- [2] K Croman, C Decker, I Eval et al., "On scaling decentralized blockchains[C]", *International Conference on Financial Cryptography and Data Security*, pp. 106-125, 2016.
- [3] F. Sha, P. F. Fan. "Research on the development of the Internet of Things industry chain in China", *J. Nanjing Univ. Posts Telecommun.*, vol. 14, pp. 17-24, Apr. 2012.
- [4] I. Giannoccaro, P. Pontrandolfo, B. Scozzi, "A fuzzy echelon approach for inventory management in supply chains", *Eur. J. Oper. Res.*, vol. 149, no. 1, pp. 185-196, Jan. 2003.
- [5] M. Swan, *Blockchain: Blueprint for a New Economy*, Sebastopol:O'Reilly Media, Inc., 2016.
- [6] I. Ng, K. Scharf, G. Pogrebna, R. Maull, "Contextual variety Internet-of-Things and the choice of tailoring over platform: Mass customisation strategy in supply chain management", *International Journal of Production Economics*, vol. 159, pp. 76-87, 2015..
- [7] N. Chandrasekaran, G. Raghuram, *Agribusiness supply chain management*, Boca Raton, FL: CRC Press, 2014.
- [8] A. G. Arzu, E. T. Erman, "Supply chain performance measurement: a literature review", *International Journal of Production Research*, vol. 48, no. 17, pp. 5137-5155, 2010.

- [9] V. Maestrini, D. Luzzini, P. Maccarrone, F. Caniato, "Supply chain performance measurement system: a systematic review and research agenda", *International Journal of Production Economics*, vol. 183, pp. 299-315, 2017.
- [10] H. Stadler, C. Kilger, H. Meyr, H., *Supply Chain Management and Advanced Planning*, Berlin:Springer, 2015.
- [11] L. Da Xu, W. He, S. Li, "Internet of things in industries: a survey", *IEEE Transactions on Industrial Informatics*, vol. 10, no. 4, pp. 2233-2243, 2014.
- [12] M. Moisescu, I. Sacala, "Towards the development of interoperable sensing systems for the future enterprise", *Journal of Intelligent Manufacturing*, vol. 27, no. 1, pp. 33-54, 2016.

