

Blockchain Design for Logistics & Supply Chain Management in Developing Regions



Neeraj Nautiyal, Sandeep Bisht, Bhavesh Joshi, Harshit Pandey, Narendra Bisht

Abstract: *Blockchain led technology is unlocking value to business by boosting supply chain authenticity and expediting the entire operational process for a large rally of projects that are underway in selective industries. The current paper attempt to observe a reality check on the different useful application of blockchain technology over various sectors to reshape the economy in general and over the supply chain and logistics system in particular. The study also validates the enthusiasm of blockchain's potential i.e., claim for revolutionising business and society over the virtual effect it is creating in the challenging environment of developing regions. Supply chain and entire logistic domain have evolved to be an active participant to took up and adapt to blockchain innovation. The current study adds to the existing literature by driving the subject matter from different studies results concerning blockchain technology along with author own outlook. An observation approach to reflect critics, supporters towards the adoption of technology led by blockchain also developed the foundation of the work.*

Keywords: *Blockchain, logistics & supply chain, developing country, transparency, security.*

I. INTRODUCTION

With every developing day, the world of technology seems to travel a new milestone. In the last four decades, the world has seen new aka disruptive computing paradigms such as mainframe in the 1970s, personal computers in the 1980s, internet in 1990s, mobile/social networking in the 2000s (Swan 2015). This time it's the improvements in the blockchain technology that is earning a buzz of being a panacea in the business world. Blockchain is poised to become a new frontier of venture capitals as it complements the internet with a faster network of resolving issues via network computing. It is been described as a way out for all networking problems (Mc Conaghy et al., 2017), trust concerns Wang et al., 2017; Weber et al., 2016), and validate traceability in the supply chain (O'Marah, 2017). Whether it is insurance, healthcare, telecom, financial markets, manufacturing, real estate or any other sector, blockchain technology is revolutionizing the way of entire operations.

The blockchain economy refers to the mobility of finance, operational information, optimal allocation of other financial and non-financial resources facilitated by money in the human and corporate level integration (Swan,2015). The fourth industrial revolution has brought many challenges to the business environment. Newly emerged blockchain technology remains as one of the mainstream to cope with business environmental challenges.

Indeed, the potential of blockchain technology is expected to suit and adjust with the modern business world challenges more easily and quickly than any other previous paradigm due to the better connectivity across the board (Crosby et al., 2016).

Beyond Bitcoin

The age of Blockchain is not too long since its controversial birth in 2008 by Satoshi Nakamoto as it remained more like a concealed story for eight years. The system was overlooked by the society and industry for several years despite many scientists and developers became interested in the technology after the breakthrough of Bitcoin in the market. It is in September 2015, when nine world largest financial institutions joined hands to set up a Blockchain led infrastructure (Underwood 2016). Since then, blockchain became as revolutionary as the internet, and hence many different applications start appearing in the market. Initially conceptualized to support transactions of digital currency; Bitcoin and other virtual currencies, blockchain is an open distributed digital ledger of a transaction, verified permanently (Nakamoto 2008) and duplicated across several computer networks. Simply it is the algorithms and the computational infrastructure that is generated and embedded using a chain of blocks. (Bereck 2017). Much more sophisticated implementation of blockchain is in use today. Besides its public usage which is permissionless, the system implementation is also centrally controlled (read and write) (Pilkington 2016).

Although the world is excited to adopt the next big change of network computing, logistics and supply chain management is slowly grasping the change that it can bring to the business model. The related research is still in its beginning stage (Zhao et al. 2016), hence, exploring the viable application of it (Yli-Huumo et al. 2016). Having said that, encashing the impact of blockchain on logistics and supply chain management would remain a tough improvement to achieve especially to maintain transparency amongst several parties of the process (Abeyratne & Monfared 2016). This study ought to look towards the visibility and potential of blockchain technology with its benefits emphasizing the applications of the technology in logistics and supply chain management.

Manuscript received on February 10, 2020.

Revised Manuscript received on February 20, 2020.

Manuscript published on March 30, 2020.

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The paper marks the insight of various challenges and global perspective of blockchain technology in logistics and SCM and the key features of the innovative technology that can crack the difficulties intricacies of this sphere. The content of the paper is derived from different past studies results concerning blockchain technology together with the author's own point of view. The observation method to consider critics, supporters and adoption of blockchain technology also became the basis of the study.

II. EXISTING PROBLEMS IN LOGISTICS & SUPPLY CHAIN

The substandard and poor enthusiasm for sharing information is a common issue in small companies. This leads to incompetence in the logistics processes (Mittwoch, 2017). To entertain such concern companies use ERP and other software which brings more cost to the projects (Dickson, 2016). The more complex and expanded a business, the more intricate its supply chain and logistics processes and so it's operational functionality. To handle a substantial volume of supply chains, large companies find challenging to look for independent contractors to cover long distances. Due to the use of traditional operating systems, the flow of data related to cargo travel also becomes slower than its actual movements increasing the behavioral cost of the supply chain. Careful assessment and evaluation of risk to ensure better control of such undue losses can set the basis for a successful blockchain journey. Blockchain implementation may mitigate concern and many others which the logistics & SCM faces. For instance, blockchain applications host a big data corpus to present cargo status information that ultimately helps in the fast accumulation of information. Analyzing such big data and subsequently transmitting meaningful information is only possible through such breakthrough technology. Transparency, security, etc in transportation or any other point of events during the supply chain surely makes blockchain technology a true game-changer.

III. BLOCKCHAIN TECHNOLOGY INFLUENCE ON THE LOGISTICS INDUSTRY AND SUPPLY CHAIN

As mentioned in the previous sections, the blockchain technology is considered to offer a large umbrella of benefits to boost the potential of established processes and business models. The digital era is leveraging the new governance models through the complete supply chain system. Today's supply chain system consists of various stages and points engaged in a flow of activities from manufacturing to delivering goods to the end customer. This complex structure makes difficult to trace developments like environmental incidents in the entire process. Since the adoption of digital tools to exchange data transfer in supply chain blockchain technology has emerged as a tool to transform the mechanism of supply chain and logistics system for any business enterprise. Suitability and benefits of blockchain application concerning the logistics and supply chain are discussed below:

In the words of Iansiti and Lakhani (2017) "Blockchain could dramatically reduce the cost of transactions and, if adopted widely, reshape the economy". They further explained that the technology has enormous potential to influence the economic and social systems which are

foundational rather than disruptive. Integrating this technology in supply chain and logistics process is likely to offer absolute, transparent, and decentralized way of doing business. Since the information is duplicated in several computers, giving a safer and synchronized way of recording transactions such as while shipping goods, the bill of lading cannot be altered as the original one is always visible through many sources (Morley H.R. 2017). The exponential increase of shipping goods with a volume of \$4 trillion worth of shipping goods across of world annually (80% of it by ocean freight) has reduced the cost of transportation to one-fifth of physical form. Realizing the value of blockchain technology, Maersk, the world's largest container shipping player along with IBM aims to simplify its global supply chain functions by developing a digitally secured platform to share and exchange information regarding their goods and products across global borders and trading zones.

Identifying the Opportunity

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Improve workflow and Compatability

It's not difficult to imagine the unprecedented regulatory and technological complexity that is required to run supply chain management especially when an estimated 90% of world trade being carried out by the international shipping industry every year. Since the process involves multiple actors with different levels of priority and conflicting interests and thus may face the risk of forgery, theft, and alteration. Blockchain, as a panacea possibly eliminates the vulnerability of any such manipulation, etc. Report by World Economic Forum (2013) estimates that trimming down such frictions to operate could boost world GDP by approximate 5% and worldwide trade volume by 15%. Blockchain technology also facilitates optimizing cost, and time that relates to administration and paperwork processes for the movement of goods through digitizing trade workflows and end-to-end shipment tracking.

It also allows viewing the status and movement of goods in progress, and other related documentation. However, the progress in the blockchain based system for the supply chain is still in the primary phase, it could lead to smooth and fast error-free functioning of the supply chain system.

Improving Transparency and Traceability

The blockchain-based system enables to track the goods origin, movements, management, etc. and store the data permanently that is further shared facilitating stakeholders a comprehensive capability to trace and monitor the movement of shipped goods.

Companies are already applying blockchain in the diamond industry, where diamonds are traced from mines to final consumers. Such headway can tender huge customer benefits and can change the level of competition altogether, as potential buyers can source the proof of authenticity especially in luxurious and healthcare items. In the food supply chain, retailers normally face challenges of tracking the supplier and replacement of existing food items that might be affected by the new entrant of food supply from the stores. Companies like Wal-Mart, Dole, Nestle, and Unilever are already experimenting with blockchain-based supply chains to develop transparency, providing a single point of trust (Tapscott & Tapscott 2016) and safety in their transaction. Leading the way Wal-Mart jointly with other partners created blockchain food safety Alliance to monitor its food supply chains like pork from China and mangoes from Mexico. To reduce the illegal fishing application of blockchain to track tuna from habitat to market is yet another recent development in the seafood sector.

Automating with smart contract

Likely threat of loss due to mismanagement in the supply chain for industries with heavy transportation spend is always a concern. Discrepancies in invoicing and movement of material via land, air or water against services discharged with legitimate remittance are painstaking and costly. According to Intra (world largest ocean shipping network company), inaccurate data of all freight invoices accounts for 10% of conflicts and inefficiencies that arise in the logistics industry. Accenture reports that in the oil and energy industry alone, nearly 5% in annual freight spend could be saved through improved invoice accuracy, cutting overpayments and removing the intervention of intermediaries. Accuracy and fastening the settlement process through enabling smart contracts is yet another secret that blockchain technology brings to the entire logistics process. Smart contracts are reported as one of the most noticeable explanations for such hindrance in supply chains (Bocek et al., 2017). The smart contract is a digital and independent agreement in a coded language between two counterparts without liaisons (Bocek et al., 2017). Such facilitation has made the involvement of intermediaries like lawyers and bankers outdated (Fairfield, 2014). Due to the application sovereignty and decentralization function, these digital contract helps in meeting the biggest challenge for parties concerned that is building trust in shared information. Through these smart contracts, the conditions of the transaction are mentioned as a code into a blockchain, so as a contract is a part of the blockchain hence, it is distributed across the network. This smart contract works automatically no sooner had the term and conditions of counterparties are met.

Therefore, a huge chunk of benefits is offered by the blockchain to the logistics and supply chain system. The next step is to set up a plan of action for application. However, management is leaving no stone unturned to manage today's supply chain system as creating and distributing goods has become tremendously complex. It is yet to make its remarkable mark in logistics and supply chain management (Zhao et al. 2016). Especially, many SMEs are less familiar with blockchain (Kersten et al. 2017) and remain a technology to pursue and sought after. For the rest, it appears to be a skeptical emergent as they are hesitant to contribute capital to build the required infrastructure to blockchain applications (Hackius, N. & Peterson, M.).

IV. BLOCKCHAIN IN ACTION FOR DEVELOPING COUNTRIES

The advantage that blockchain technology can bring to developing economies due to the fundamental obstacles like underdeveloped infrastructure, transparency, corruption, security, accountability, etc. in the process of logistics and supply chain process is much more than in any developed country. Due to the infrastructural perfection, developed economies especially the western part is leading the race as far as the attention, furor, improvement around Blockchain is concerned. These countries are focusing on a bundle of novel applications. Developing countries; where the legal structure is expensive, sluggish or irresponsible, smart contracts can provide value to the system so that the obstacles can be reduced (David Crosbie). Blockchain's suppleness and balanced approach make it perfect for acceptance for developing economies to fill the gaps in the governmental official documentation process and for other developments. Since all the issues with the underdeveloped world will not be removed overnight, a kick start can be made in the area of property registry, over basic legal documentation digitally, to trace government and institutional spending and financial exclusion Schmidt and Sandner (2017).

A smart contract could turn up a boon for developing countries for improving efficiencies, Blow, N. (2018). The world food Program (WFP) started a project called 'Building Blocks', in Pakistan and Jordan to provide financial help and food which was based on Blockchain through smartphone articulation for recording and authentication purpose. The WTF would show an improved result once Blockchain technology is implemented in other developing countries (Gautham, A., Programme, W. F. (2017). For instance; In the initial year of launching BitPesa in 2014, 6000 users in Kenya, Nigeria, Tanzania and Uganda made international transactions and operated their business faster using BitPesa. In Latin America Ripio (a financial company) also facilitates cross border transactions with bitcoin and credit cards using blockchain technology. This eases the usage of bitcoin with cash in countries such as Brazil, Argentina, Ecuador, and Chile. The Noah Project by Japan is currently running intending to benefit developing countries like the Philippines to provide smart tools and large-scale solutions. Driven by blockchain this project has also created a remittance system known as a Noah Coin that can reduce the remittance fees by 2-3%.

Another feature of the project is supportive to store, send, and receive Noah Coins and other cryptocurrencies with the help of user-friendly App 'Noah Wallet'. Realizing the significance of cutting edge technology applications Africa has also joined the bandwagon to sensitize and integrate different governmental and institutional activities. Uganda is enhancing greater transparency and accountability in corporate and various governance systems through blockchain since May 2018.

Status quo in India

Upholding the prominence of being a frontrunner to recognize the immense potential of IT, Karnataka has become the first in the country to adopt the blockchain system. The state identified e-governance, cybersecurity, agriculture, land registration records, incubation and hand-holding of start-ups, etc to implement blockchain technology. Indeed, other south Indian states such as Andhra Pradesh, Kerala, Maharashtra, Telangana have also started exploring the technology for e-governance purposes. Telangana and Andhra Pradesh have started executing the technology for integrated land records management systems through an RFP (request for proposal); a System Integrator and numerous blockchain-based POCs (proof of concept) respectively. The government of Kerala is also working on streamlining the operation in the Agriculture sector through food distribution and crop insurance schemes with the help of radio frequency identification (RFID) tags to track food distribution items, particularly of milk, vegetables and fish. Government of Maharashtra and Rajasthan in association with various agencies aggressively pushing blockchain agenda to enable the digital transformation (especially data security in various departments) through organizing conferences, hackathon etc. In addition to this, other Indian states like Gujarat and West Bengal have also shown interest to use the blockchain system for cybersecurity reasons.

Implementation of Blockchain Solutions in India

What is true for cryptocurrencies in India (stern action by the government), is not true for blockchain technology. Realizing the importance of blockchain, few Indian companies have started unlocking the use of the digital platform. Bajaj Finserv, have started settling claims in services such as travel insurance. For instance, in case of flight delay the company's system is so automated that it generates and settles the claim amount before any complaint is registered by the customer. Another entity of the Bajaj group, Bajaj electrical in collaboration with Yes Bank is also using the technology to manage its bill discounting process to reduce conflicting interest and manual efforts. Indeed, we also see an aggressive acceptance by banking financial services and Insurance (BFSI) sectors. In February 2017, BankChain, a consortium of 27 banks, partnering with Primechain Technologies was set up to explore and find solutions for the banking system in India. Few other banks such as; ICICI bank has the highest number of participants on any blockchain platform in the country i.e., 250, that are undertaking domestic/international trade finance transactions on the network. Axis bank has also partnered with fintech company Ripple Enterprise in 2017 to settle financial transactions for paperless and timely cross-border remittance. Axis bank has initiated a service for its Indian retail customers to receive payments from Rakbank in UAE and from Standard Chartered Bank in Singapore. State bank

of India together with other paperless documentation for various national and international services is designing India's largest innovation center in Navi Mumbai to explore next-level technologies for various business analytical processes that may ease and provide a solution for different banking complexities. Other players like HDFC bank are also adopting new-age technology like Artificial Intelligence and the Internet of things to come with fasten and conflict-free transactions. RBI wing IIDRBT (India's Institute for Development and Research in Banking Technology) has indeed shown interest in the blockchain-based system for banking solutions. Blockchain is vigorously adopted by the food industry across the world to smoothen and bring efficiency to their supply chain. A very recent announcement was made by the Ministry of Commerce and Industry (MCI) in March 2019 on the development of the pilot project on e-marketplace based on blockchain technology rolled out by the Coffee Board of India to integrate Coffee producers with markets. This project is undertaken to build the brand of Indian Coffee to be more premium, luxurious, and remove the barriers (intermediaries) in the stage of the supply chain. All these leading innovations are based on blockchain systems. Although, in the absence of clear policies and regulations the blockchain technology in banking and NBFCs is still in its initial phase, a lot is yet to be explored to establish a safer network.

V. WHAT CRITICS SAY

With the widespread acceptability of the new paradigm, blockchain has proved its mark and became the spearhead universal remedy for all technological problems in different sectors. In a short period, every industry has adopted or wants to use blockchain to earn a competitive edge in their operations. However, it is very hard to use blockchain practically in supply chain management as it may not be easy to integrate the entire chain (Mougayar, 2016, 123). While handling a large number of suppliers, financial risk and ascertaining legal department expertise remains a challenging area (Venegas, 2016). There is a substantial need of interrelationship harmony and cooperation between the counterparties, as technology cannot resolve and fix the complicated end to end processes and weak relation in a supply chain (Earls, 2016). Nevertheless, a lot of positive buzzes that are created around blockchain technology yet the vulnerability of attack cannot be denied. It has been identified that 51% attack is unique to blockchain. Many security breaches have happened in the past such as the collapse of a bitcoin exchange in 2014, DDoS attacks and private account hacking (Lim et al. 2014) an extra burden of strong cyber defense strategies needs to be placed to deal with it. Atzori, 2016 revealed that independence and confidentiality remain a concern since all the nodes of blockchain have access to the database. Hence, the grass might not be as green as we see on one side and might be overhyped as another IT development praised as the largest silver bullet in Fintech comes with few but serious perils as well.

Challenges for the new Architect and framework for Blockchain adoption

The blockchain-based system is making huge headway in every sector of society and may continue to do so for the next decade. After grabbing the attention in financial services through cryptocurrencies, blockchain technology is aggressively exploring new areas such as art, energy, telecommunication, supply chain, insurance, etc. But to attain its full potentials and improve supply chain collaborations it needs to overcome few bottlenecks (Casey & Wong, 2017).

Due to its immense contribution to the supply chain system in various industries, it stands as a gatekeeper for its reliable mechanism. Indeed, provides a radical solution to product provenance (Kim and Laskowski 2016). Although, blockchain technology not only comes with all benefits but also raises alarm especially those that result from the infancy stage of it (Petersen et al. 2016; Yli-Huumo et al. 2016; Xu 2016). The dubious approach of regulators and policymakers together with trustworthiness among users and an absence of a single but large system that can bring a network together remains the biggest roadblock (Clancy (2017). A technical limitation of dealing with a large volume of transactions together with a high level of security within a short period and hence, maintaining a trade-off between scalability and degree of security remains another dispute Zheng, Xie, Dai, Chen and Wang (2017). The skeptical behavior of bureaucracies that are formed to manage the economy's digital transformation is yet another barrier that we need to handle. To maintain a pace with digital revolution the present regulatory, technological (cloud infrastructure), administrative and even societal control has to change. Another sensitive distress supply chain is suffering from is the inherent risks in suppliers' operations due to visibility shortage. However, progressive steps are indeed been taken by companies to reduce asymmetric information flow within their levels, yet the traditional methods leave with no choice but to trust the internal and external vendors. Any breach in traceability may result in fraud and data manipulation. According to one estimate, food and automobile industry bear an extra burden due to recall and sales losses in their entire operations. Preventing such losses and creating a fraud-proof solution for a reliable supply chain process always remained key challenges for the industry. The intrinsic properties of blockchain technology offer an IoT enabled a system that can provide a resilient way to prevent such visibility and traceability breaches. For example, logistics articles are operated with sensors that produce data along the supply chain. Other functions could also be automated like the outsourced transportation system, route planning, delivery program, fleet management, networking with partners. Having said that, a holistic blockchain that can redefine the economy is a distant thing without the participation of industry and government. There lies a risk of experimenting with blockchain given the barriers to adoption. The technology is complex due to the expertise it needs to implement hence; adopting the perfection of blockchain theory in real life is yet to take off. However, banking and the financial sector have well proven itself to bandwagon with the blockchain transformation. Other sectors such as manufacturing, retail, healthcare, telecom, etc. are still away. Nevertheless, a report of PwC mentions that integrated participation of different concerned parties (industry,

government) may lead India to be in a leadership position in the next five years. The foundation of this estimation is the fact that India has the second-largest base of blockchain developers (roughly 19,627) after the US that has 44,979 till Oct. 2018.

VI. FINAL OUTCOME

Research findings showed that greater transparency of details and improved smart contract applicability lead to greater productivity and development of the partnership. Data openness is a feature of the Blockchain technology, demonstrating how easily and safely all users in the blockchain technology network receive information. If relevant to the whole Supply chain of an end item the blockchain technology will forward details to all approved members in that supply chain, including vendors of the components of the item, immediately where appropriate. Despite growing private-sector investment in blockchain network, few efforts were made to integrate government agencies' needs and requirements. There's a lack of understanding on the role of public authorities around the globe active and how these projects under the guidance of the private sector can be leveled. While cultivating emerging technology and business that draw upon blockchain network, research universities and businesses should collaborate with policymakers to further promote world trade and ensuring confirming trade legislation and regulation are complied with. The unique features of blockchain and smart contracts enable this to be done.

The creation of a single export Windows, in which all necessary export formalities are listed often, focuses on trade facilitation programs in developing countries. Such Single Windows should hopefully be compliant with the information needed to import into the country of destination. When documents regarding the source and content are already held on a blockchain, accessibility for border officials is eased and thereby reduces the required formalities for exporting companies. Blockchain technology would lead to fundamental international trade transitions. It can contribute more effective integration of developing countries in international trade since BT encourages global value chains and lower trading costs, thus limits hassles for small and medium scale enterprises. In a poor institutional ecosystem, it could be especially effective as the surveillance it offers will replace operational functions and significantly improve administrative processes significantly

VII. CONCLUSION AND OUTLOOK

Indisputably, blockchain is one of the remarkable development in the history of computer application and truly has unlimited benefits for the business world. It will be a way of enhancing and connecting the Internet of Things and other industries (Robinson, 2016). But the economic literature is still in an introductory stage, even the basic scientific knowledge and terminology is missing among the concerned stakeholders. Entrepreneurs could evidence the profitability of the business models using blockchain to make better investment decisions. The supply chain and the entire logistic domain have evolved to be an active participant to took up and adapt to blockchain innovation.

Blockchain led technology is unlocking the value to business by boosting supply chain authenticity and expediting the entire operational process for a large rally of projects that are underway in selective industries. As it enables to create and maintain embedded contracts that can be stored permanently in transparent and decentralized databases, where the originality cannot be tampered or revised (Pilkington 2016). The system records every necessary action (every time the product changes hand) in the business transaction from manufacture to sale that could be identified, validated and shared.

Overall, blockchain can potentially overcome frictions that are attached to the traditional practice of business models. Although, a radical change in the operation of the supply chain will not occur overnight. With the right amount of willingness, investment and participation from both industry and government can open the new landscape of a digital world. In the Indian context, the use of blockchain in logistics and supply chain processes remains an unexplored domain due to its conservative nature (logistics). In the presence of infrastructural immaturity the area might take off only once the policy's guidelines and benefits would be clear together with the participation of other stakeholders.

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