

Impact of Blockchain Technology on a 'Relay Network'



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Original equipment manufacturers are dependent on the global supply chain system for material supply. They consistently strive for effective strategies to optimize cost especially when transported from the point of origin to the point of destination. A suggested technique the 'Driver-relay Model' allows delivery to be undertaken in a distinctive way. This case-based qualitative research identifies the major supply chain components and processes that can be made digital and while making all exchanges and transaction transparent to ascertain if a 'Driver-relay Model' is an efficient component of the blockchain.

Keywords: Blockchain Technology, BT, Transportation, Driver Relay Model, Relay Network, Traceability, Supply chain, Trucking Industry.

1. Introduction

In the current paradigm, the network grid underlying the supply chains of goods or services in any industry is complex and faces an exponential increase in numeral steps and parties involved in comparison to the early stages of the industrial revolution. However, for the continuous flow of material in the unforeseeable situations, supply chain still lacks visibility, and efficiency in transporting the product (K.L. Croxton, S.J.Gracia-Dastugue, D.M.Lambert and D.S. Rogers, 2001). With greater complexity, the requirement for greater input of both physical and human resources arise which have had a direct impact on the cost that the ultimate consumer is made to pay in order to avail such goods and services. Presently, the supply chain systems place reliance upon paper-based documentation. This in effect, means that any exchange of documents, for each of the processes, are required to be approved manually for completing a delivery, this model of trade practice is commonplace in various organizations. Further, the paper-based exchange process for every document is inefficient, slow and burdensome. Due to various bureaucratic challenges, which are the primary cause of delays and thereby increase the overall cost of the goods produced, adversely affecting the efficiency of the business ecosystem (Pierro, 2017).

All of the OEM's rely upon their supply chain systems for making effective decisions, and to optimize productivity by reducing costs resulting in an increase of profits. The industries need to address the problem of the lack of efficiency in the continuous flow of material due to a number of unforeseeable circumstances in the various steps of the supply chain system. The present-day system adopted by different industries such as shipping and transportation lacks essential capabilities of laying down real-time or even near time information that restricts both scalabilities as well as security to all stakeholders. The prevalent practice is lacking efficiency, to sufficiently integrate technology and leveraging its potential to induce sleeveless efficacy, the blockchain or the distributed ledger technology (DLT) enables the creation of a decentralized system, which can be used to access real-time information by permitted parties (K.Korpela, K.Mikkonen, J. Hallikas, M.pynnönen, 2016). Such information may include - ongoing operations and processes, information that is made available to all the processes, or any faults or errors that may have occurred during the duration of their business. This could significantly reduce the time delays, additionally or miscellaneous costs, or human error that plague a substantial foray of transactions today.

A typical supply chain has three different types of flows that move in a 'to and fro' direction from suppliers, buyers, warehouse, vendors, sales partners, customers, manufacturers. The first type is the information flow, is the documentation of the material that has been shipped. The second flow is the material flow, which includes the goods having to be transferred from its origin to the final destination. The third is the flow of capital, which includes the payments and transfers of assets. This type of financial data is necessary for critical decisions of the business that may affect the business's market share. With the current rise of the e-commerce industry, supply chain industry will need to adapt to the dynamic techniques to overcome novel problems, that are increasing the cost of the product, and to sustain and remain relevant in the industry; one needs to adapt to the evolving changes in the technology dynamically. The 'Relay Network' (RN), is an exceptional tool for the purpose of same day arrangement, which allows delivery to be undertaken in unprecedented transit time. Thereby ensuring that the personnel responsible for transporting the product such as truck drivers are able to return to the original destination on the same day. The blockchain linkages allow for the automation of all the tasks and even payment methods; hence nullifies fraud and payment errors. The results shall predict and ascertain through qualitative research, based on two distinct sectors, in the supply chain industry whether the 'driver-relay model' is an efficient component of the blockchain (Nakamoto, 2008). Therefore, the potential impact that Blockchain Technology (BT) may have in the near future upon the Relay Network (RN) through this research is highly relevant (Keane, 2017).

Relay networks are designed for making transportation of goods and materials faster, in a much smooth and systematic manner (Taylor, G. D., Meinert, T. S., Killian, R. C. and Whicker, G. L., 1999), as well as a healthy lifestyle for transporting personnel. An example to explain this is when travelling from Delhi to Maharashtra, there can be two routes, one from Delhi

to Kota, and Kota to Maharashtra, making the delivery faster and safer as the trucks/ cargos can be transported by two different drivers, and after completing their designated route, they can return to their point of origin. So, the goods that are carried by the driver coming from Maharashtra to Kota will be taken over by the driver coming from Delhi, so that he also returns to his point of origin, this relay network is designed for faster transportation of material. This design needs to be executed in the given time 'T', which is the maximum distance a driver is required to halt after reaching the designated relay point (Keller, S.B., Ozment J, 1999). The vehicles can then also be used for longer hours if they are maintained properly (Iqbal, 2016). The point-to-point (PTP) shipping method for Full Truck Load (FTL) has a high driver turnover these carriages that are utilized to fulfil and satisfy the demand of delivery and transit (Halit, 2011). A single driver is assigned a truckload holding him responsible for the transportation from origin to destination. According to (Vergara.Hector A., 2013) we shall be evaluating the alternate shipping methods as a means to decrease driver tour lengths, improve retention, and pick up times.

This study focuses on the advantages, disadvantages and impact on efficiency by the adoption of the BT and development of a distributed private ledger, which can update information on a real-time basis. This ledger can be made accessible to all the concerned trading partners by giving permission access to the network, without risking the confidential information of the participant and increasing the visibility of supply chain activities. By adopting these new technologies, the supply chain industry can receive the benefits in various different areas. Some of this area that will be impacted include premature identification for the scarcity of product and quality related concerns. Such visibility will help in efficient lead times and functioning, if the industry lacks, transparency and visibility there could be imprecise projecting of material, and unanticipated interruptions can lead to higher production cost. We also try to mitigate four major issues faced in the current supply chain industry, i.e., Traceability, compliance, flexibility and stakeholder management (Yli-Huumo J, Ko D, Choi S, Park S, Smolander K., 2016).

2. Literature Review

Multiple industry giants and start-ups are now looking to capitalize on this new opportunity. Further, it enables the logistics players to reassess their business model and plans for discovery growth (AT Kearney, 2018). The concept that 'A blockchain consists of the "chain" of data storage "blocks," wherein every block hosts information in regard to transactions processed, the values and the party(s) involved. Having the capability of making available access to all prior blocks, which are held together in this chain, permits retaining the complete history of previous assets and the required instructions brought about from the very beginning (Stephen Laaper, 2017), (Benjamin Leiding and William V. Vorobev, 2018). This definitive feature of such a chain is its ability to link together cryptographically authorised sequences of lists makes the entire process secure, transparent and immutable. The usage of complex mathematical functions allows the system to categorise a record of which assets are owned by whom. This can be verified by the cryptographic receipt of any transaction (Hackett, 2017).

As Ali (2002), observed through his research that the freight network of transport if optimised would enable a significant reduction in terms of the input costs resulting in an increase in savings. RN enables us to understand that, this system would consist of various relay points, which will be used for making the transportation of these goods, cost-effective, efficient and transparent. Reducing the risk of trust that needs to be accorded to individual transporting personnel. The various exchanges of trailers, trucks and even drivers occur at the many substations or Relay Points. Exchanging of trailers and trucks allows for an optimised method of the assignment of routes for deliveries. Also allowing the opportunity for the drivers to reduce strenuous work schedules and better management of their trailers/trucks (Zhao, J., Fan, S. and Yan, J., 2016). These Relay Points also enable drivers to pass over consignments to other drivers for furtherance along the route (Ali, 2002).

However, since we know that no single driver is solely responsible for the truckload, and it would complicate the imposition of liability as to where exactly the concern has arisen. Blockchain can also be encoded with inserted guidelines, which makes the execution of arrangements when undeniable circumstances arise. These instructions can be used to program "smart contracts," which link the information in a blockchain to automatically execute the agreement that was agreed upon. The BT will also enhance in clubbing a common carrier with a privatized fleet while ensuring the mandate of distance minimization and cost optimization (Ronen, 1997). The integration of smart contract with the Internet of Things (IoT) will allow machines to be able to input data at a designated point and to allow uninterrupted data tracking capability for various industries. In a case, where participants can access intelligence about the whereabouts of the unit, its conditions, the various government approvals required, that will become accessible at any point of time, allowing the complete audit of all belongings in the chain (Kehoe Lory, Gindner Kai, Dalal Darshini, Andrejewski Danielle, O'Connell Niamh , 2017).

This type of technology that plays a huge role in achieving the data like fuel, RPM, engine oil temperature, brake oil pressure from the vehicles on a real-time basis. Deepak Garg (Laha, 2017) informs that the data is then processed to aid with decision-making for predictive maintenance and mileage improvement. There are simple apps that help drivers leverage technology for further ease (Khedekar, Rivigo, A tech enabled logistics startup bets big on driver relay system for faster delivery, 2016). Further, the inclusion of a decentralised structure of ledger, as in Blockchain, would enable all parties to have equal access and claim ownership of, or possess, the ledger and thereby retain complete unadulterated partiality from a third party intermediary (Batra, 2018).

Implementation of such a system in a practical scenario, the driver can be equipped with a smartphone that can allow him to track his/her upcoming trips, vehicle details, travel reports, QR codes for trips, details of the handover driver, among other essential details. Each truck will possess sensors to allow for tracking and engine/vehicle management like any other IoT enabled ecosystem. Trucks and their drivers can be allotted trips based on their performance and availability/convenience of the trip. The RN, which may seem perfectly simple, is actually a complicated logistical exercise. It is backed by automated

processes, analytics, algorithms, and data science, which match vehicles and pilots, ensuring that there are no breakages in the process. If a breakage happens — whether because of a vehicle accident or breakdown or a driver not turning up — it is handled immediately; disruptions can affect the whole delivery chain (Chaudhary, 2018). This research is to explain how BT would create a huge difference and benefit for the RN application in various aspects by offering more efficiency and viability to this process by making it faster.

3. Research Methodology

In the current supply chain, of the automotive sector, there are over thirty thousand components procured by various different suppliers, assembling various parties together is not easy. To check whether the delivery of the product is on time, have the government regulations been attained; have the finances been cleared; whether every supplier has paid on time becomes essential. Delays are inescapable because of human errors; lengthy paperwork and multiple middlemen slow the flow of finances and increase the risk because various parties get involved. Since the flow of information takes place in layers, one after the other, each member on the supply chain manually sends the product and data to the next layer, and in every layer, there are various approvals that are mandated. (Roberto Casado- Vara, Javier Prieto, Fernando De La Prieta, Juan M. Corchado, 2018) Therefore, the BT has reinvented the entire business environment, by creating an environment of complete trust and transparency by automating the entire process and transactions helping us identify the reliable and good suppliers by providing the transparent record of the supplier's history. (IBM, 2018)

The research includes procurement, the process acquiring the best goods or services, at the best cost from different suppliers, then manufacturing the product and sending it to retail stores and outlets, and it will also show us how blockchain would help in making the procedure less complex, and efficient. There are different layers like finances, suppliers, quality control, inspection control to get approvals from all one after the other is a very lengthy process where chances of errors increase, and so many middlemen have involved that the cost of the product raises automatically. There is a disadvantage in the RN, that the data is centralized in every element and cannot be viewed by all parties, for verification of the product we are dependent on the paper-based document which we receive along with the goods, and we cannot nearly make a verification of the product after it undergoing various different stages which increases the chances of counterfeiting the product and the condition in which the product has reached us, if the material has been contaminated or has been coming from another source. Hence, we present a new type of storage ledger along with various features, that help in the smooth running of the RN.

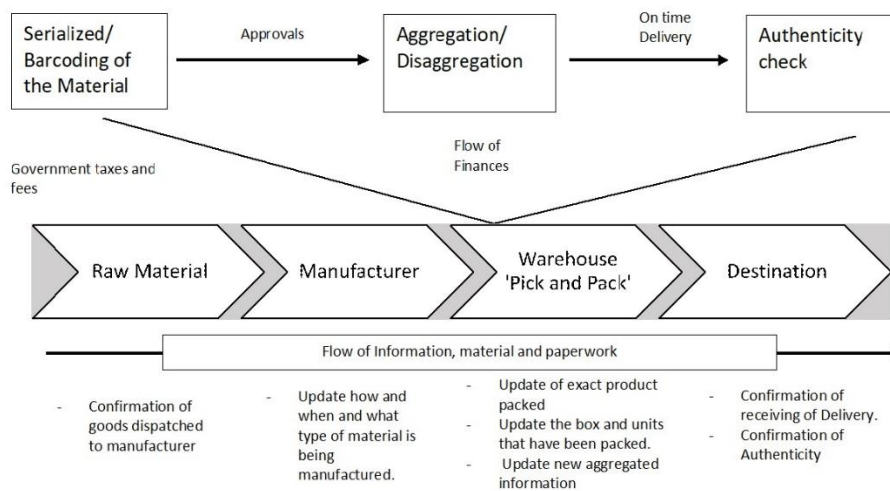


Figure.1 Supply chain along with Blockchain (Author's View)

The research involves the integration of different types of technologies, for a smooth and efficient flow of information, to successfully run the supply chain without any disruptions. Technologies like a smart contract, IoT devices, GPS enabled tracking software's for real-time tracking, RFID technology. Through the implementation of the new technologies in the already existing supply chain, involved parties would benefit as this technology aid's in increased visibility, traceability, security, access to information on a real-time basis in a decentralized manner, without any verification, and allow us to achieve a faster and smoother operational reliability.

However, the growing digitization of data online or on systems has increased the threats to theft of data, where a hacker may modify or delete or copy confidential data for his own use. (Cauê Cardoso R., Heitor Bordini R., 2017) (Tapia, 2013). In the RN, there are various haul points or relay points the exchange of drivers, or the shipment takes place, this is a designated area, where the second driver rides the vehicle or the shipment to drop till the destination, the destination may be the endpoint or may even be a relay-point from where another driver takes over. This method elaborates on bringing safety to goods, the driver, and is an effective time-saving method. The concept of having haul points is primarily built around safety to both goods and the drivers. This method is a pioneer in the sense that, it is safe, effective and helps the customer have a check on the place and condition of his products.

A cost-effective model is the ideal style of business that a customer and the service would warrant to be associated with. Taking that into consideration, this module of business is a win-win situation for both committed parties to the contract. To put emphasis on how this is not just cost-effective but also time effective, research and data have been accumulated through analysis and the outcome of that is that a long haul would take the single normal system of transportation 7-8 days. However, the same distance covered under the Driver Relay Model, within the RN would sum up to 3 days in totality for the same distance. While conserving the safety of the driver, the concern is not limited to accidents but also health reasons owing to fatigue, hygiene and other reasons that drivers exposed to long durations on the road suffer. This method will directly eliminate those health concerns that drivers are worried about.

There is a fixed route on which the drivers have to transport. Also, there is a fixed number of driving hours; this process removes various factors, and safety-related issues like fatigue, sleeplessness, etc. Currently, in the supply chain, there is a major concern troubling the industry which is the driver retaining which is one of the most significant problems in FTL carriers.

Driver turnover rate is one of the key expenses in the trucking industry, due to the extremely high hiring and retention costs, that have to be borne by the industry. As the effects of a driver leaving his job have an impact on various different variables, such as the loss in income for not fulfilling the demand. (Sarah Root, 2013) There are overheads that have to be bared by the shipping company, in order to avoid losses these expenses are then shifted to the customers, and hence the increase in the price of the product because of delays, improper delivery as well as damaged delivery. The driver turnover rate is high, because of various reasons, as per research the most important reason that was listed as the driver scheduling, there were no fixed schedules for the drivers, as they were responsible for point to point (PTP) dispatching and had to satisfy demand. So, drivers were out on long-haul trips and away from home for 15-20 days (industry average). This led to poor quality of life for drivers and fatigue throughout the delivery.

To conclude, the BT is a fast-moving aspired addition to many industries to help block the loopholes and enhance productivity in the most effective manner. The BT can be used in various industries and have been prominent in the automobile and the pharmaceutical industries. With the combined help of blockchain and IOT devices, in the automobile industries, the defective parts in the product can be identified and intimidated for repair during product delivery, service etc. In the aspect of the pharmaceutical industry, certain chemicals have a stipulated condition and temperature that they have to be maintained in. The failure of the same could lead fatal to the process of producing the product. The above-mentioned technologies can identify these glitches and fix them before any complications could arise.

A concept like RN thrives on BT to enhance the efficiency that such a system could have. The assertive point being made at this juncture is that the BT enhances it but not to deny that the RN would not work without the BT. However, as it can be understood from above, the additions that blockchain brings with itself to a model such as the RN makes it time and cost efficient. Therefore, and smart contracts would allow seamless integration of new technologies in business scenario Blockchain brings with itself, error-free technology, scheduled process, is time effective, cost-effective and transparency. The BT is the best way forward in terms of efficiency and growth.

The change that I propose to the industry at this juncture is, with the use of BT, the RN will be a surety in terms that it will be safer, smoother and transparent as far as information and the necessary records that are essential to the parties of the business/contract, hence the process is recorded and stored online which is irreversible allowing people to understand if any product that the customer purchases are authentic.

4. Data Analysis and Methodology Adopted

From the earlier discussion, it has been found that the introduction of IoT and BT as an additional layer over the RN adopted by truck delivery services, is not introduced as a totally new archetype. However, it does improve the old method by eliminating key inefficiencies. In the following section, for analyzing the existing inefficiencies and bottlenecks, sample data from two different industries are utilized, to develop new efficiencies and fill-up the gaps that were previously unnoticed. As Blockchain is a shared, distributed ledger in a grid of stakeholders which do not have a centralized administrator. Instead, it is capable of being updated and managed with the consent of network participants, and due to the distributed ledger's immutability, it can be audited properly, so the immense amount of documentation in the RN occurs automatically through blockchain.

To have a deeper knowledge about the problems that are observed within the automation industry, interviews with executives and managers from Honda Cars India Ltd. was conducted. The information gathered indicates as to how they are struggling and lacking efficiency in bringing output for the company. As per conversation with Mr Anand, Assistant Manager HCIL Tapukara, "The senior management is not able to identify where the problem arises and where is the process at hold, due to the manual work and regular order punching, our decisions are delayed as suppliers are not informed on time as to what is the capacity requirement. There is no live tracking, and if the system is not working they have to manually do all the work till the time portals issues are resolved, and the work in between the server downtime is not recorded, so if any problem arises from the batch that is not recorded, no one can be held liable, and generally an MNC will shift the blame to the supplier, and they have to bear the cost of the improper material". The system that is operating has a lot of limitations which decreases the flow of work.

In another interview, global sourcing was spoken about, in this we spoke to Mr a Pathak, 'Sourcing material from various countries, is a problem as the process consumes a lot of time, and you need to prepare well in advance for a new product to be put on the line'. In another interview at HCIL from Mr Yadav stated that, 'Due to various parties involved in design change

procedure various steps need to be followed, a design change form needs to be filled, including all details of the process that needs to be executed on the line, has to be verified from various different authorities within the organization, and takes weeks and sometimes months, to complete the documentation of a very small change'. Also, as spoken to Mr Saini, "if some executive forgets to punch orders on time, it may lead to line stoppage, causing huge losses."

From the above interviews conducted we could identify the key areas that were impacted and therefore to mitigate these problems and attempt of using the relay model through the BT.

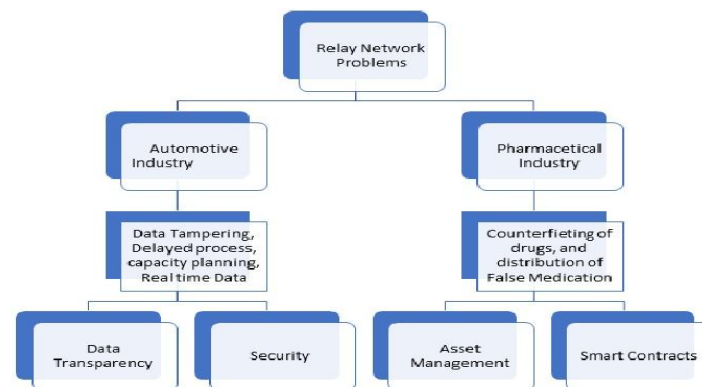


Figure. 2 Problems in a relay Network of Automotive and Pharmaceutical Industry (Author's View)

We had conducted a survey trying to identify the impacted areas in the pharmaceutical industry and how the industry faces various lawsuits, because of counterfeiting and sales of false medications, after our conversation with Mr Bhatia from the Vidit Healthcare Pvt. Ltd, we were able to list down a few problems that were arising in the industry, "we are dealing in chemicals, and drugs, that have to be properly maintained in a controlled environment, we are not so sure about the mixing within the material, have there been any forgery in the process, where was the material taken to, in what condition was it stored, what is the source of the material", were unanswered questions, and led them to always be in doubt about the quality of the material that they are going to use for the product. Also, in another, an interview with Mr Bhatia from Laborate Pharmaceuticals stated, "There is no method in which we can identify the step or the process at which the problem arises, this may lead to serious health related problems to various patients, there are side effects of improper material especially in the medications". Therefore we are trying to prevent these problems with the help of the BT and IoT devices, to eliminate the counterfeiting of drugs and false medications.

We have identified key areas that will be impacted and showcased data on how they are being used, and whether this technology is cost-effective, and thereby yielding greater efficiency to the system (Matthias Heutger, Dr. Markus Kückelhaus, 2018). The following sub-headings showcase, the key area of improvement:

1. **Data transparency** –The most important aspect that BT provides to a transaction is safety and accuracy of records while the parties can ascertain changes in case of any mismanagement of the goods through a reliable source. This in return, however, creates transparency and truth which entails confidence to the people concerned.
2. **Security**- A blockchain used system is preferred in the current context because of the safety that it brings with it. While we compare it with the traditional ledger system, the room for loopholes was high in the system. When one breach is committed, it gives room to access all the data. However, with blockchain, all details, messages and transactions are cryptographically saved in order to beat any security and safety breach.
3. **Asset management** – The Blockchain technology helps ascertain details of digital assets with respect to ownership and the transfers with regard to the asset in question. The system also helps in ascertaining the intricate details and help in managing a digital outlook of the said asset.
4. **Smart contracts** – A self – executing computer program is called a smart contract. It is understood to be a component layer of the blockchain technology. Contracts that are bound legally with all details the transactions generally are manual processes. However, with the help of smart contracts, the system can automatically enforce the stakeholder rules and agreements that were agreed upon or penned down. When the system is launched, it is understood to be a very autonomous system that indicates on every occasion a breach of the contract occurs. To explicate further the system is not only designed to identify the breach but provide for checks and balances of the transaction regularly. This also has two dimensions through which they may be viewed. One is when it is open for public participation similar to that of a bitcoin network, whereas on the other hand, in a private system only the selected and permitted may participate.

After looking at these key problems, we are trying to identify the limitations that are involved in the current distribution system and the supply chain, due to which the maximum efficiency has not been attained.

5. Limitations

Even though empirical data pertaining to the amount of efficiency that will be introduced or the cost-savings incurred is not available - the market for such technological up-gradation still being its nascent stage. However, the network effect can be triggered when stakeholder adoption within the supply chain increases. As the number of supply chain stakeholders participate, evolving into industry practice, the larger benefits will be observed. However, it may be difficult at first to acquire stakeholder assurance because of contradictory levels of digital readiness and the initial cost requirements. An added challenge is the development of standards and governance of such technology in every industry. Even Organization and culture will play a role in the digital transformation in any industry.

Key industries identified to serve the purpose of identifying key issues and revealing inefficiencies that can be a target subject for these technological inputs in the supply chain management system. The two industries, Automotive industry and the pharmaceutical industry, provide the requisite foresight, in terms of the net effect that can be observed in the global market. Thereby, setting the basis of my proposition that such technological inclusion is necessary.

5.1 Automotive Industry

The Automotive industry should be prepared for the potential disruptions that will strike the dynamic automobile landscape. At the current pace of growth in the demand for personal automobile ownership, India is expected to soon become the largest market of personally owned automated passenger vehicles in the world. The penetration of global player and the introduction of innovative technologies that they bring along is forcing both domestic and international players in the relevant market to streamline their supply chain process, by creating shorter lifecycles, new model meets demand preference and develops different types and designs of automobile vehicles.

Automotive industry undertakes a very complex yet connected process to develop its final product. It involves various parties that are responsible for different types of activities. In a singular automobile vehicle, there are about 35,000 different parts that are assembled, and most automobile companies that engage in manufacturing have outsourced the activity of procuring their material for this purpose. This is done to lower costs and to improve efficiency and to gain maximum profit out of the strategies which are deployed; such outsourcing may be undertaken in the form of 'Just in time' inventory or Vendor Managed Inventory, etc. However, the maintenance and the cost associated with those 35000 distinct parts, throughout the time-period of the production becomes a laborious and difficult task. The complete scale and complexity of supply chains create numerous challenges in tracking the complete lifecycle of a product, and many companies consistently face losses due to a variety of reason. These reasons include quality-related concern, mismanagement of schedules leading to a situation of delayed delivery, lack of proliferation or dissemination of proper information and a ripple effect due to errors in a single point of the process. Limitations also include no tracking mechanism, high chances of human error, unreliable supply due to lack of control by the supplier over transit activities, increased cost for the end consumer, ease of logistics data being tampered with, along with lack of trust when sharing data and no proof of loss. Hence, to avoid such inefficiencies in this complex yet connected procedures, we endeavour to explain how the Internet of Things along with BT can result in previously unseen efficiencies. The automobile manufacturers supply chain beyond the supplier, OEM and customers, there are various other parties that are involved. These parties are classified as a Tier-1 supplier, Tier-2 supplier, etc. as per the quality and quantity of material that they deal in, along with various dealerships and middlemen within this, that may also be required at the supply chain. These intermediaries also enable the supply in relation to the demand for the spare parts are required at other junctions such as car retailer and service repair workshops.

The excitement surrounding BT in the logistical sector, and the automotive sector, is to do with the relay model and enable them with IoT devices. This technology is a dynamic, digital representation of information and simulations of the erstwhile tasks which were previously undertaken physically will now enable companies to track its past, present and present-continuous performance throughout the asset's lifecycle. Additionally, the analysis of such data will enable companies to improve on their inefficiencies and replicate the efficiencies to enable guidelines for best practices. As we can now easily identify the quality related concerns at a very beginning of the process, we can easily recall the products and quickly shift the problem back to the source with the help of the open information source that is both decontrolled and tamper-proof because of BT. Companies can focus on bringing an intelligent IoT supply chain solution that can enhance the visibility of a product's complete lifecycle by providing real-time, tamper-proof, end-to-end tracking, to solve the inefficiencies in Supply Chains. Hence, issues of corporate governance such as underwriting or misreporting would also be curbed.

RN integrated with Blockchain can furthermore help us in cost savings, by running an error-free, leaner, automated and process, allowing visibility and predictability to multiple players that simultaneously involved in the process, so that it can quicken the physical flow of goods. However, small suppliers, providing less than truckload of goods, can also take advantage of such type of technology, because they can drop their material at the nearest relay point, and drivers with the help of the mobile application, or vehicle connector can pick up the material for them, which may help them optimize costs of the material. Source tracking of goods can permit responsible and sustainable supply chains and help everyone tackle product counterfeiting.

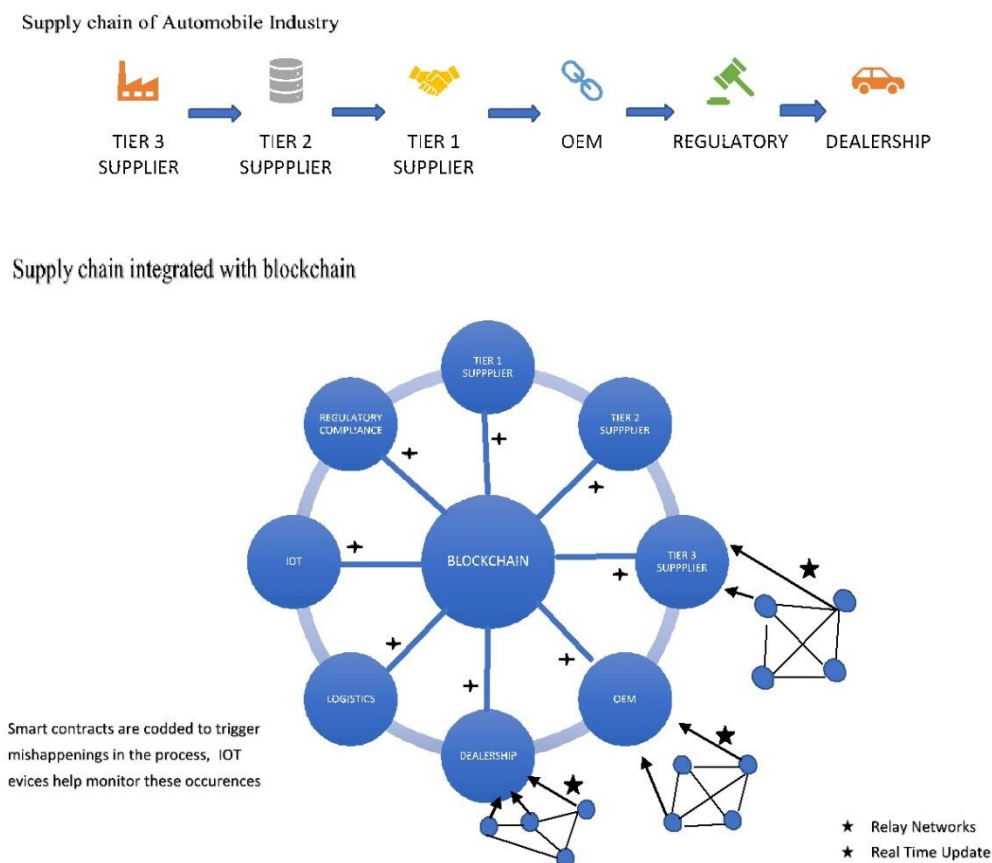


Figure 3. Blockchain integrated supply chain of Automotive Industry (Author's View)

To solve this challenge, we are trying to develop a blockchain based system with IOT device, which connects to the car to recurrently record the distances moved by each vehicle which acts as a continuing, tamper-evident record of events and temperature analyses. Here, the documented data on a distributed blockchain network makes it evident if an odometer or temperature is manipulated. This case explains to us how manufacturers can increase data credibility and protect public safety; it also has value for regulators, fleet owners and drivers who need access to trusted data on used vehicles. In the RN the material is transported from one destination to another, it is transported through relay points or by various drivers, the material can tamper as various parties get involved, so to avoid such tampering of material and data, smart contracts, IoT devices and blockchain can prevent these things from happening as everything stays online and can be tracked. The environment in which the material has been delivered is also recorded. So, the quality of the product also never depletes, because of lack of data, as we are always aware of how the raw material has been before becoming a final product. The availability of the data can also allow us to reuse the products in the future, as we can verify the product. A legal aspect that comes with this model is about the contract between the parties. In a situation of misrepresentation, fraud, counterfeiting of goods by one party essentially makes the contract void.

However, the smart contract plays as a catalyst and identifies the void that is taking place in the contract if at all any, at different relay points. This further identifies and holds the party liable for the act and blocks the payment process. Therefore, the integration of blockchain, smart contracts, IoT Devices, have a positive impact on the driver relay model as due to the various windows of counterfeiting the goods, this technology will help us lay down the origin of the problem.

5.2 Pharmaceutical Industry

In the Pharmaceutical Industry, lack of adequate audit and transparency regarding the original source of medicines is unclear. Patients rely on the pharmacists to sell and supply medicines which may or may not be procured from reputable sources. The pharmacists must subsequently ensure the medicines procured from suppliers are fit for use/consumption and have been stored and transported, in a secure way. Due to this, therefore, the counterfeiting of drugs and false medication is one of the biggest problems. Currently, there are various reasons and problems that we are not able to identify because of the diverse and complex nature of the business. In this industry usually, the counterfeiting of drugs arises at the manufacturing source as, the manufacturer may distribute the original drugs or medications and drain them in the black market, here BT helps our contest in the challenging and dynamic environment. According to Interpol, around 1 million people each year die from counterfeit drugs (Bagozz, 2006), 50% of pharmaceutical products sold through rogue websites are considered fake, and up to 30% of

pharmaceutical products sold in emerging markets are counterfeit (Southwick, 2013). The World Health Organization (WHO) estimates counterfeit pharmaceuticals lead to more than 1 million deaths annually and can cause severe adverse reactions. Given the potential for falsified pharmaceuticals to enter the supply chain, it's imperative pharmacists, and patients gain transparency into where medicines originate and if they've been tampered with, replaced, modified, or stolen. Inherent health risks Along with the lack of visibility may cause patients to distrust medicines, and instead switch to unscientific means of treatment, which may also result in detrimental health effects. New safety measures for medicines, such as the Falsified Medicines Directive (FMD) have been introduced in the European Union. However, security and fidelity of data remain a concern.

A blockchain-based serialization project providing sophisticated track-and-trace capabilities to the pharmaceutical industry will allow us to fight with the counterfeiting of medication and create a more transparent data flow paradigm. Serialization is the process of assigning a unique identity (e.g., a serial number) to each sealable unit, which is then linked to critical information about the product's origin, batch number, and expiration date. Which is stored on the distributed ledger, and only allows permitted parties to view the details? Serialization effectively enables a unit to be tracked at virtually in real time and traced to its location at any stage of its lifecycle with the help of IOT. A key serialization challenge is maintaining traceability and transparency especially when these units are repackaged or aggregated from unit to case to the pallet. In RN we have various different parties that are involved in transportation of the goods, and at each step if there is no transparency of information, there are several steps that can go wrong and if any type of error occurs, and information is not passed on to the next level it may lead to making of a false medication which is improper for consumption. Problems, like improper conditions, excess movement in the chemical, contamination in the material, may lead to fatal problems, blockchain will prevent these types of errors, to happen as the smart contracts would not permit the transaction to occur, and would help identify the problem, and point of origin. Smart contracts will not allow the transfer of ownership of material from one party to another if the contract is void. And in this case, till now there is no possible way of identifying in which temperature has the material been transported was it kept in proper conditions, etc. Hence, we suggest Blockchain will allow improving efficiency would be a drastic change in this industry.

BT allows proving product manufactured is from a legitimate supplier and has been handled properly throughout the supply chain. Thus this initiative allows the consumer to reassure that the medication that they are consuming is genuine and proper. This feature is available with CCTV footage and statistics explaining the temperature conditions of the travel in real-time basis as well as access all throughout to the permitted parties to prove compliance; The BT is going to support the drug recall management and also help in identifying the facilitation and counterfeiting of false medication.

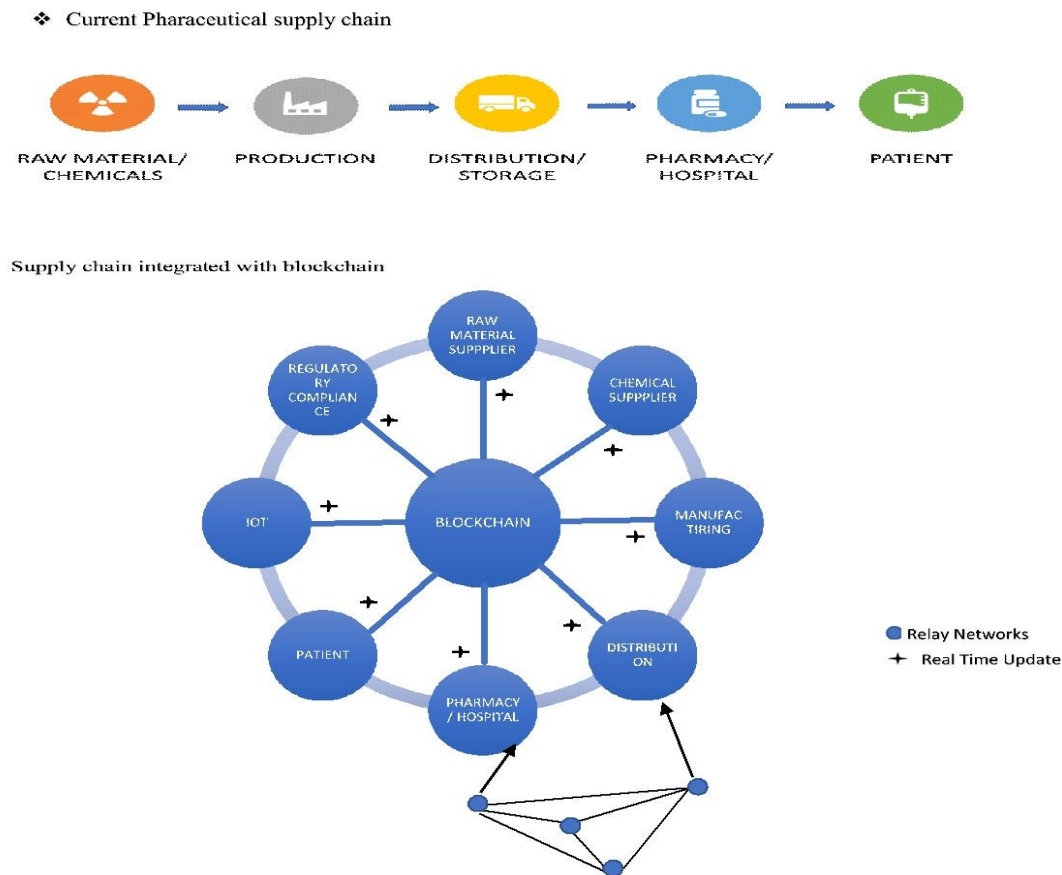


Figure 4. Blockchain integrated supply chain of a Pharmaceutical Industry (Author's View)

Smart contract will allow us to code decisions in the required manner and they would trigger disruptions in the supply as everything is being monitored, and will then allow organisations to perform required task automatically and accomplish as per the occurrence (Kehoe Lory, Gindner Kai, Dalal Darshini, Andrejewski Danielle, O'Connell Niamh , 2017). By developing an end to end supply chain (Brar, 2018), pharmaceutical companies can take advantage of implementing an independent software vendor (ISV) solutions. Through its immutability, transparency and traceability tracking a drug through its entire lifecycle, while providing all parties assurances of its safety and authenticity becomes possible. At every stage of the process, barcodes or smart tags could be scanned and recorded onto a blockchain ledger system with the help of IOT enabling. This to record and create an audit trail of the medicine's journey. Sensors can also be incorporated into the cold-storage supply chain system, with temperature or humidity being recorded onto the ledger system.

Even enabling the pharmacist to access the audit trail of the medicine and to pinpoint an instance of the medicine being compromised during the transportation journey can enable various positive results such as a reduction in the **complexity and costs**. The supply chain becomes less costly to track with **reducing errors**. Further, the immutable nature of the data on the distributed ledger can prevent malicious parties from altering drug information and **create shared and trusted transactions**. All parties including regulators can observe every stage of the drug journey to ensure the drug authenticity. Pharmacists can trust that a drug given to a patient is of the highest quality and has not been damaged or denatured. Patients can take comfort in the knowledge that the supply chain has been recorded at every stage and the drug is authentic. (*Ailis Mone, Chris Clements, 2018*)

CalQLogic is an Indian company that has launched a pilot to tried to address implementation and customization with blockchain to provide efficiency in the biopharma supply chain system. This organization harnesses a company's data from its different connected data sources and helps the company customize alerts when something is off in a supply chain.

6. Conclusion

Through this paper, an attempt has been made to list down various contributions being observed by the industry as the benefits of the BT, and secondly how RN works efficiently and effectively if commands are introduced to mitigate and operate the working and functioning on the blockchain network.

This has been done by conducted a comprehensive review and assessment of the supply chain of two different industries, namely, Automotive and the Pharmaceutical industry. The analysis point towards several processes that are involved in delivering the end-product and how the BT can minimize efforts and maximize the output, by removing the unnecessary middlemen which are increasing the costs.

Further, the system allows to view real-time information, such as temperature monitoring, route monitoring, CCTV footages, government regulations, documentation, approvals and other vital activities being performed on the blockchain network, smoothly and very quickly by making use of a digital copy which is updated all throughout the distributed ledger at any moment information is changed. Paper-based exchange of documents has been eradicated from the proposed scenario, with which the altercation and counterfeiting have also been eliminated, along with the advantages like timely deliveries, reduced costs, etc. The lack of continuous flow of material due to the unforeseeable situations like strikes, holidays, festivals, natural calamities etc. are also avoided as real-time information on the quantity of and quality of the product and when is the scarcity going to occur, which allows an organization to take effective and timely decisions, is available.

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