OpenTrack

Efficient Supply Chain Management using Blockchain and Machine Learning

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Introduction

The automotive supply chain for manufacturing cars and other vehicles is one of the most complex in the world and thus has a lot of intermediary parties which carry the transactions in between.

Through our project, we have proposed an Efficient Supply Chain Management System for the Automotive Industry using Blockchain and Machine Learning Technology.

Problem Statement

- One of the biggest issues in the automotive supply chain industry is counterfeiting products, which is currently estimated at several billion dollars' worth of spare parts.
- Counterfeit spare parts often have poor quality, as they enter directly into the supply chain or through online channels, and have an impact on the original equipment manufacturer and spare parts suppliers.
- Effective planning of production capacity, tracking and tracing of individual parts across the supply chain, and accurate and real-time information can build a sustainable framework for the automotive industry.

Motivation

According to the PRS India Legislative Research , more than 2.3% of the accidents in India are caused due to the faults in the vehicle. (Link)

The National Highway Traffic Safety Administration (US) also stated that more than 43,000 of the accidents that took place in US were alone due to faulty Spare-Parts. (Link)

Table 3. Vehicle Related Critical Reasons

Critical Reason	Estimated (Based on 2% of the NMVCCS crashes)	
	Number	Percentage* ± 95% conf. limits
Tires /wheels-related	15,000	35% ± 11.4%
Brakes-related	10,000	22% ± 15.4%
Steering/suspension/transmission/ engine-related	2,000	3% ± 3.3%
Other/unknown vehicle-related problems	17,000	40% ± 24.0%
Total	44,000	100%

*Percentages are based on unrounded estimated frequencies
(Data Source: NMVCCS 2005–2007)

Literature Survey

- Through the Research paper,"**Blockchain's roles in meeting key supply chain management objectives**", we concluded that there are many startups in the world that are providing solutions with Supply Chain Management in the field of Pharmaceutical and food.
- The paper "**Blockchain-based Distributed Framework for Automotive Industry in a Smart City**", proposes a blockchain-based distributed framework for the automotive industry in the smart city. **through the shared distributed record keeping structure, collaboration in the supply chain life cycle can be greatly enhanced; thus realizing significant time and cost savings and enabling manufacturers and suppliers to protect their brands against counterfeit products.**
- The Paper "**A study of forecasting practices in supply chain management**" demonstrates forecasting in supply chain management at various areas

About Our Project

While analyzing these papers we concluded that the authors have approached Blockchain Technology as a distributed medium for maintaining data about all the transactions that take place in the Automotive Industry. Adding to this, Machine Learning has been used to forecast the sales & inventory with the help of supply chain management, thus improving the efficiency of the industry with respect to sales and demand prediction.

We have analysed the results and have combined both of these technologies in a single platform which offers a **Blockchain based Distributed and Transparent Supply Chain Management System as well as an Efficient Inventory Management with the help of Machine Learning for the Automotive Industry.**

What is Supply Chain Management ?

Supply chain management (SCM) is the broad range of activities required to plan, control and execute a product's flow, from acquiring raw materials and production through distribution to the final customer, in the most streamlined and cost-effective way possible.

SCM encompasses the integrated planning and execution of processes required to optimize the flow of materials, information and financial capital in the areas that broadly include ***tracking & tracing, demand planning, inventory management, transportation.***

Importance of Supply Chain Management System

Organizations need a SCM system to establish streamlined supply chain management processes in order to realize the very best value from their spending through supplier analysis of cost, risk and performance.

An effective SCM system helps accomplish the following:

1. Managing contractual obligations to assure a continuous supply and avoid a service company's delivery disruptions.
2. Strengthening supplier relations for systematic synergy with suppliers and different lines of business.
3. Enterprise spending management to assure procurement happens through the right suppliers and reduces costs.
4. Establishing a single comprehensive supplier view and deriving insightful procurement analytics.

Project Workflow

We are trying to solve the major challenges faced by the supply chain using Blockchain and Machine Learning.

For this, we will be building a platform which are keeping track of the parts till it reaches the manufacturer.

- Building and Registering Parts
- Changing Ownership of Parts
- Building Car from the parts
- Changing Ownership of Car to Dealers
- Verifying the Authenticity of Car and its parts
- Sales and inventory forecasting through ML

“Main Features”

- **Continuity of Information :** Through the immutable and irrevocable properties of blockchain, sharing information effectively between the different stakeholders involved in global supply chain will be key to ensure traceability and reduce inherent risks.

- **Security of the Product (Fraud Detection):** Since we are keeping track of the product from the manufacturing till it reaches the customer through blockchain and verifying that the product is original i.e not a duplicate product, by scanning the QR code of the product every time it reaches to the seller till it reaches the final customer. This will be majorly enabled by the transparent and auditable features of blockchain.

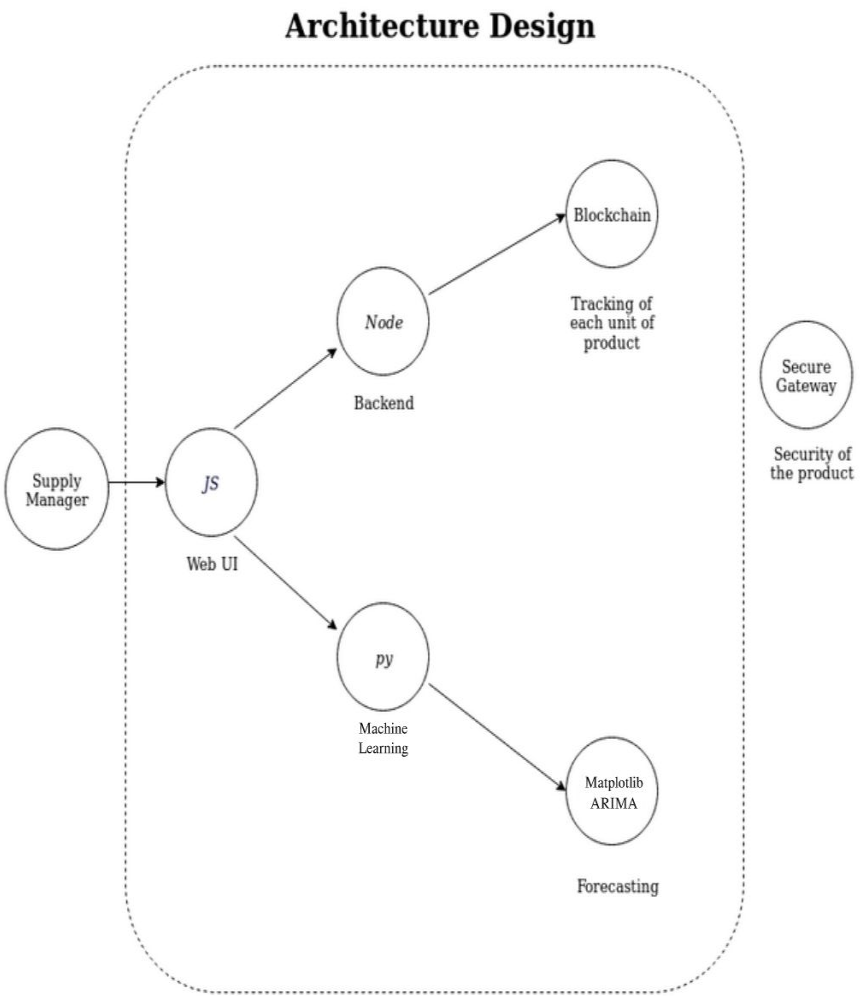
“Main Features”

- **Inventory Management:** through full fledged dashboards we will be providing complete inventory control to the manufacturer and to the vendors who will be receiving the goods.

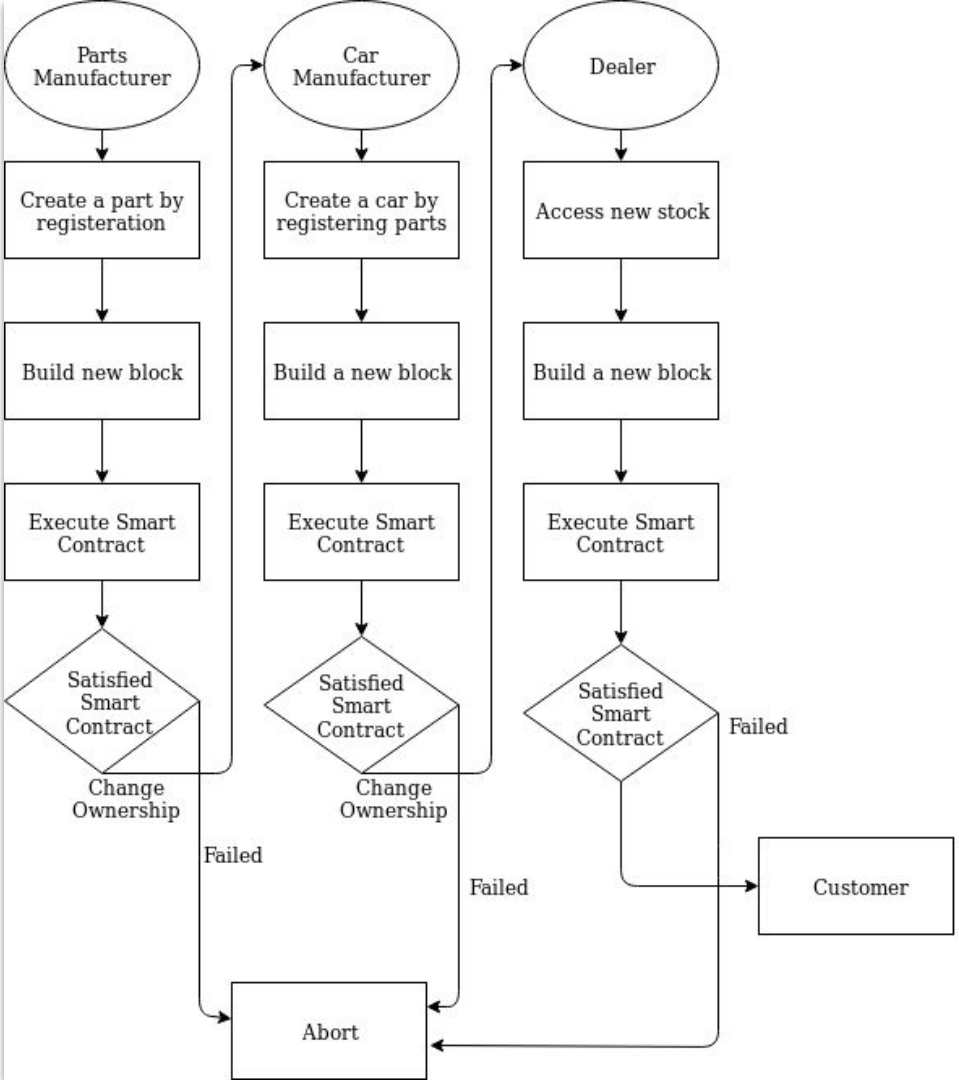
- **Inventory forecasting**: Inside our dashboards we will also provide the prediction for items in the inventory giving you a glimpse about what the rate of consumption will be in the coming weeks.

Architecture

Product Design



FLOWCHART


Parts Manufacturer
Car Manufacturer
Dealer
Create a part by registeration
Create a car by registering parts
Access new stock
Build new block
Build a new block
Build a new block
Execute Smart Contract
Execute Smart Contract
Execute Smart Contract
Satisfied Smart Contract
Satisfied Smart Contract
Satisfied Smart Contract
Change Ownership
Change Ownership
Failed
Failed
Failed
Customer
Abort

Tools and Technologies Used

Frontend Stack : Bootstrap

Backend Stack : Node.js

Blockchain: web3.js, ganache, truffle,ethereum

Machine Learning: statsmodel

Relevance

- **Improve Financial Position:**
  - **Increases Profit Leverage -** Firms value supply chain managers because they help control and reduce supply chain costs. This can result in dramatic increases in firm profits.
  - **Increases Cash Flow -** Firms value supply chain managers because they speed up product flows to customers.
  - **Decreases Fixed Assets -** Firms value supply chain managers because they decrease the use of large fixed assets such as plants, warehouses and transportation vehicles in the supply chain.

Relevance

- **Boost Customer Service:**
  - *Quality of the product delivered* - Customer expect the quality of the product to de delivered to be as good as when it was manufactured.
  - *RIght Delivery Place* - Customers expect products to be available at the right location.
  - *Right Delivery Time* – Customers expect products to be delivered on time.
  - *Right After Sale Support* - Customer expect a good sales support after receiving the product in case of replacement and other queries.
- **Reduce Operating Costs:**
  - *Decreases Purchasing Cost* - Retailers depend on supply chains to quickly deliver expensive products to avoid holding costly inventories in stores any longer than necessary.
  - *Decreases Production Cost* - Manufacturers depend on supply chains to reliably deliver materials to assembly plants to avoid material shortages that would shutdown production.
  - *Decreases Total Supply Chain Cost* - Manufacturers and retailers depend on supply chain managers to design networks that meet customer service goals at the least total cost.

“COMPREHENSION & AWARENESS”

Supporting Research Papers:

- Blockchain’s roles in meeting key supply chain management objectives: https://www.researchgate.net/publication/324139564_1_Blockchain'sroles_in_meeting_key_supply_chain_management_objectives
- Blockchain-Based Distributed Framework for the Automotive Industry in a Smart City: https://ieeexplore.ieee.org/document/857918
- A study of forecasting practices in supply chain management: https://www.researchgate.net/publication/288228334_A_study_of_forecasting_practices_in_supply_chain_management
- Blockchain’s roles in meeting key supply chain management objectives : https://www.sciencedirect.com/science/article/pii/S026840121730524
- SUPPLY CHAIN MANAGEMENT IN INDIAN AUTOMOTIVE INDUSTRY : COMPLEXITIES, CHALLENGES AND WAY AHEAD : http://airccse.org/journal/mvsc/papers/5214ijmvsc06.pdf

“COMPREHENSION & AWARENESS”

Top 10 Leading Supply Chain Companies

- Unilever Ltd.
- Inditex
- Cisco Systems
- Colgate-Palmolive
- Intel
- Nike
- Nestle SA
- PepsiCo
- H&M
- StarBucks

“COMPREHENSION & AWARENESS”

Top Startups working on Supply Chain Management

- Blockverify – A startup focusing on improving anti-counterfeit measures. Currently, the company verifies products, goods, merchandise, and transactions.
- Everledger – A blockchain startup that helps track the provenance of luxury items (like diamonds). Additionally, the startup assists in fraud and risk reduction.
- Origintrail – A blockchain-powered data exchange protocol for interconnected supply chains.
- Provenance – An emerging blockchain company making information open and accessible all along the supply chain and at the point of sale.
- Shipchain – Blockchain-powered logistics and freight platform pursuing smart contract applications in the logistics industry.
- Skuchain – Applies the cryptographic principles developed in the Bitcoin network to security and visibility for the global supply chain.
- SyncFab: Available capacity, transparent order tracking, and purchase order management secured by blockchain.

“FUTURE WORK

Blockchain is a technology that is ready to be explored by the automotive industry. As an emerging technology, the blockchain will continue to evolve due to its ability to disrupt industries and areas of research in various sectors. The blockchain works as a distributed value of the system, it depends heavily on collaboration with stakeholders, suppliers and competitors, etc. For the realization of a sustainable IoT network of smart cities, blockchain technology can wield positive impacts.

- **Co-integration with IoT platform** : Co-integration of platform with IOT to scan the QR/Serial No. of parts with the help of a scanner.
- **Standardization** : Currently, due to the lack of common standards, different organizations are developing their own blockchain and standards. In the public domain, blockchain-based applications are supposed to work within the regulatory framework.
- **Structurally adaptable**: The structural design of smart contracts directly affects the adaptability of the entire framework as an attribute of quality needed by many industries.

Thanks!