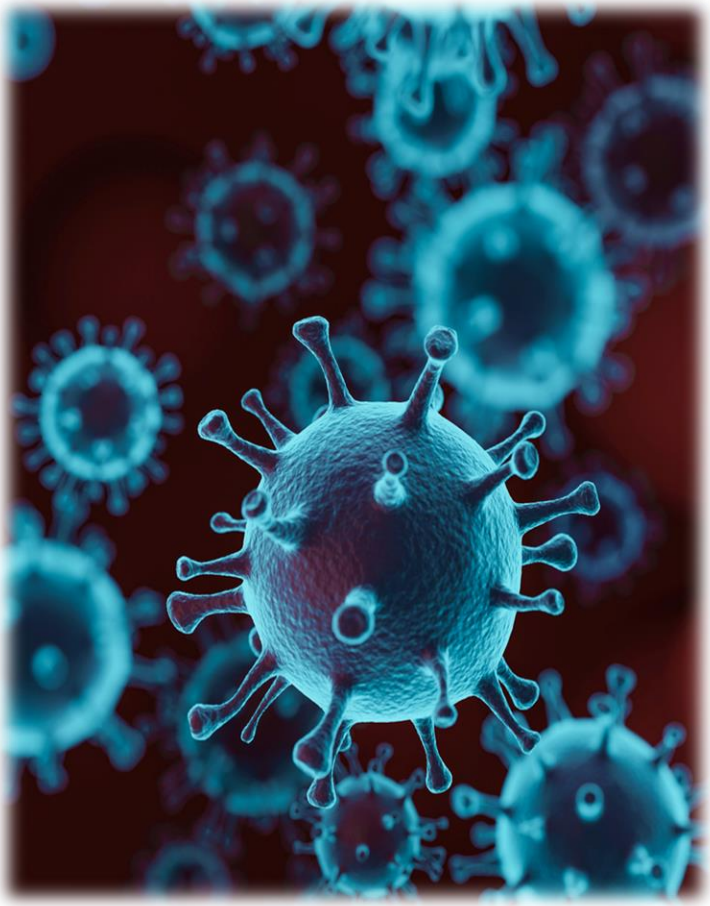


NEEDS ANALYSIS DOCUMENT

Team:

Pratik Patel -101339642

Priya Minhas -101339644

Natasha Rupani -101339597

Shivam Rattan -101339648

Vaibhav Madaan -101339653

Team – UnPerish

COVID-19 Vaccine Supply Chain solution

Design Patterns for Blockchain – BCDV 1011

Professor: Dave Mckay & Paul Chafe

Table of Contents

Introduction

Logistics companies are going through a revolution of new strategies and operational technologies implementation as an answer of the demand of the 21st century. The huge demand for fresh goods has stimulated lots of research on the perishable food supply chain. The characteristics of perishable food and the cross-regional transportation have brought many challenges to the operation models of perishable food supply chain.

However, there is an unprecedented perishable product has come into market, and that is vaccine. In the current pandemic time of COVID-19, many pharma companies have made vaccines with lots of research and development, but it has come with some complex logistics challenge. This vaccine transportation is a new challenge in current scenario as it has to be transported within specific temperatures range. Since it is naïve vaccine, tracing of every single dose or bath becomes essential as a part of supply chain in order to analyze any future patterns. This document provides substantial information on the need analysis of Vaccine supply chain of COVID-19.

Why blockchain?

Traditional solution of this problem is already there in a market which provides data from manufacture to buyer. However, that modes are not tampered proof and there is limited authorization shared between all parties for some of the transaction, which limits the true data of complete supply chain. A potential solution that can bring together different parties that have not directly established trust-relationships with one another, through the transparency it provides and its tamper-evident nature.

'You see what I see' from a data perspective, blockchain can help eliminate complex and costly data reconciliation required by most systems in the world today.

CHALLENGE 1: Coordinating across multiple, disbursed and often disconnected supply chain actors.

CHALLENGE 2: Misinformation injected by the actors involved in supply chain handshakes.

CHALLENGE 3: Lack of product traceability and data monitoring.

CHALLENGE 4: Lack of immutability of the original data and data tampering.

How this solution can add value to entire supply chain and to various stake holders.

VALUE 1: Transparency and auditability

VALUE 2: Security and trust

VALUE 3: Trade finance, insurance premiums and liquidity

Problem statement

- Tracking and tracing of perishable products like Covid-19 vaccines directly from manufacturing facility to the end consumers as hospitals or pharmacies.

- Providing and monitoring special conditions, like temperature regulations of up to -70^{o}C for vaccines such as for Pfizer and -20^{o}C for Moderna, and even so, which is only viable for 10 days after manufacture.

Goals

What are we trying to achieve?

- Lack of product traceability
- Coordination across multiple, disbursed and often disconnected supply chain actors
- Transparency and auditability

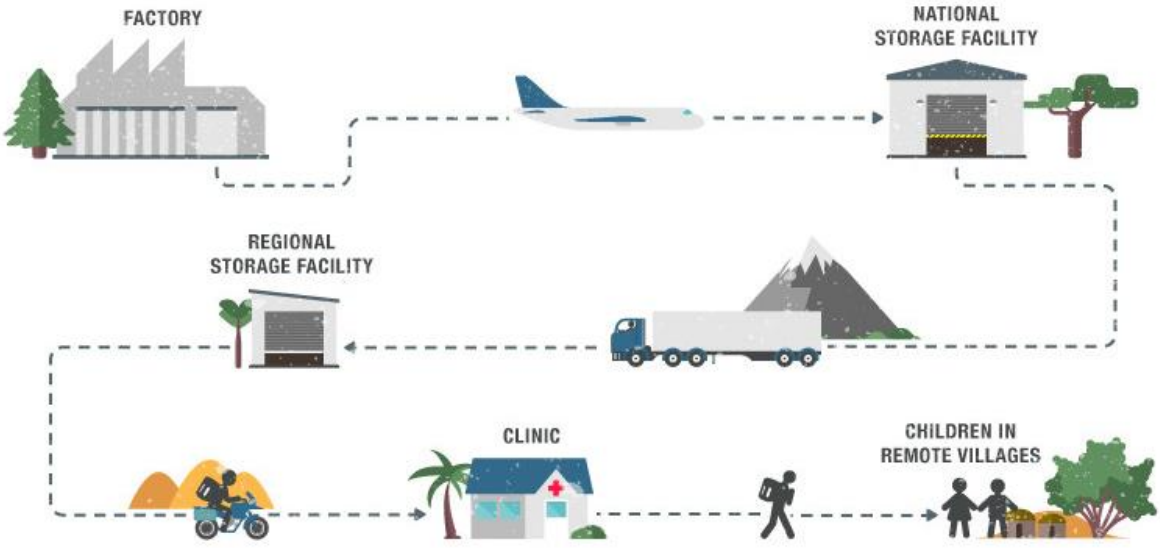
How do we measure that?

Measure the temperature of product since manufacturing to all logistics channel via IOT devices and all hand offs.

Stakeholders

Manufacturer: Manufacturer would be entities like Pfizer Inc or Moderna Inc which would sell the product to hospitals or pharmacies as per their requirement.

Seller/Trader**:** Seller/Trader would be the middlemen who collect the requirement from the hospitals and pharmacies and place the order with the manufacturer for the requirement on case-to-case basis.



Source: MSF

Logistics partners**:** This is essential part of the use case which comes in various phases starting from manufacturer, shipper, freight operator to buyer with multiple entities in between. It can be with various medium such as rail, road, sea and flight.

Buyer**:** This is the independent entity, mostly clinics and pharmacies or end consumer who is likely to buy certain amount of goods from pharmacies.

What are the roles that they play?

Manufacturers:

- Create quality vaccines that are safe and free from defects.

Logistics partners**:**

- Transport goods safely and maintain all required in-transit storage conditions.
- Ensure best practices of only properly handled vaccines enter the system.

Distributers:

- Ensure the vaccines are in handled appropriately during warehousing.

Authorities (varies from country to country):

- Audit, regulate and ensure all rules and regulations are met accurately by all parties.

State Data

What is the system tracking?

- Cryptographic Signature

What needs to be captured?

- Temperature, humidity of the entire shipment
- Location of the vaccine batches
- Orientation of the vaccine
- Sudden movements/G-sensors while in transport

What are their restrictions?

Manufacturers:

- Maintain compliance with drug authorities when manufacturing of product under specific conditions.
- Ensuring that the hand-off time between manufacturing and logistics is minimum.
- Ensuring the IOT devices are synchronized properly and are correctly transmitting the data.

Logistics:

- Maintain compliance with authorities when transporting COVID-19 vaccine.
- Ensure they implement the required equipment to monitor environmental conditions (temperature)
- Ensuring all the IOT devices are calibrated and integrated perfectly on the chain and providing live data.
- Pitfall due to the unknown factors that may happen during the transportation process.

Distribution:

- Lack of sufficient storage facilities due to the compliance with legal authorities required when storing and selling vaccine.
- Ensuring the IOT devices are transmitting the data correctly while receiving and handing off the vaccines.

Authorities:

Laws change with new governments and varies from country to country or sometimes from province to province. The new regulations must be communicated and held up effectively

- Current holder of the product.
- Clear visibility of product transfers and handshakes with respect to date and time.
- Ensuring the correct data goes on the Blockchain.

Restrictions

Are there restrictions by roles/users?

- Ensuring right temperature of vaccine by transporter all the time till it reaches to consumer.
- Hospitals meet storage requirements for their vaccine.

Are there date/time restrictions?

- Vaccine's expiry date.
- Time required to transport the vaccine in batches.

Limitations by rules?

- Airline rules may be applicable but would be negotiated based on current pandemic situation.
- Required Ontario freight rules while transporting within towns or states.

Exceptions

Can any of the rules be broken under certain circumstances?

- Temperature can vary between -80 °C to -60°C prior to stocking vaccine but should not breach this limit.
- Should any new rules be added in certain circumstances?
- If authorities change rules of transportation, we must abide.

What about edge conditions?

- If our driver is an accident that damages the products, insurance may come into picture as product is precious based on current pandemic situation.

References

TRACING THE SUPPLY CHAIN, how blockchain can enable traceability in the food industry. Retrieved 12nd February 2020, from **https://www.accenture.com/_acnmedia/PDF-93/Accenture-Tracing-Supply-Chain-Blockchain-Study-PoV.pdf**

How blockchain can enable traceability in the food industry. Retrieved 10th February 2020, from **https://www.intel.com/content/dam/www/public/us/en/documents/pdf/connected-logistics-platform-study.pdf**

Martin Westerkamp, Friedhelm Victor, Axel Küpper (2019), Tracing manufacturing processes using blockchain-based token compositions. Retrieved 13th February 2020, from **https://www.sciencedirect.com/science/article/pii/S235286481830244X**

Daniel Bukszpan, The challenges Pfizer faces distributing its Covid-19 vaccine to the masses(2020). Retrieved 15th February 2020, from **https://www.cnbc.com/2020/11/25/challenges-pfizer-faces-distributing-covid-19-vaccine-to-the-masses-.html**

STEPHEN GANDEL, Pfizer's COVID-19 vaccine distribution will be a "logistical nightmare" (2020), Retrieved 16th February 2020, from **https://www.cbsnews.com/news/covid-vaccine-pfizer-distribution-logistical-nightmare/**

Sarah K. Rathke, Addressing COVID-19 Vaccine Supply Chain Challenges (2020). Retrieved 11th February 2020, from **https://www.natlawreview.com/article/addressing-covid-19-vaccine-supply-chain-challenges**

Adam Robinson, The Hurdles & Current Challenges of Using Blockchain in Supply Chain & Logistics (2020). Retrieved 15th February 2020, from **https://cerasis.com/using-blockchain-in-supply-chain-logistics/**

Over half of vaccines are wasted globally for these simple reasons. Retrieved 17th February 2020, from **https://www.weforum.org/agenda/2018/07/the-biggest-hurdle-to-universal-vaccination-might-just-be-a-fridge**