Smart Contract-based Secured Manufacturer-to-Customer Supply Chain Systems

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***Abstract*—Blockchain has become an important tool in digitized supply chain systems. Traditional supply chain management designs lack the ability to cost-effectively relay near real-time ground information to all stakeholders, and most importantly suppliers and customers, while cargo is in transit. We propose an application that demonstrates how to solve the current state of inefficiency and inaccuracy that is common in processing order requests in online retail stores.**

I. Introduction

The main purpose of this project work is to develop Smart contract for a transparent and traceable supply chain. This work aims to study the customization of smart contracts for developing a supply chain model that facilitates digitization, review and conduct contract negotiations. Supply chain includes several processes from procurement of raw materials, to processing and manufacturing at the manufacturer,delivery of final products to end users and after-sales support. These steps should be integrated together to form a stable supply chain.

II. Background

A. Smart Contracts

By Definition on wikipedia, "A smart contract is a computer program or a transaction protocol that is intended to automatically execute, control or document legally-relevant events and actions according to the terms of a contract or an agreement." These smart contracts are the building blocks of blockchain network like ethereum. A smart contract can include a group of functions and rules written in Solidity programming language to process resource exchange when certain events take place in a peer-to-peer network.

B. Supply Chain Systems

Blockchains and related applications can used to develop blockchain-enabled composite supply chains. Raw materials, semi-finished products, components, structures, and original equipment manufacturers (OEMs) can create multiple smart contracts based on block-chain. Once a specific process is completed, the next process will automatically start based on the previous result. Goods transfers will be more efficient and traceable for all owners in the block-chain without the need of third party or a centralised authority to control every process.

**CS579 Term Project*

III. State of the art

The current state of art uses following steps : a. Define Seller, Carrier, and customers. b. Validation function: to validate product information from customers to Seller and from Seller to Carrier. c. Tracking function: only Carrier has access to update status of package shipment. d. Confirm/Notify function: Seller uses this function to confirm the order request and notify the carrier for shipping. The carrier uses this function to confirm the order request and shipping request, and to notify the customer about package status.

IV. Methodology

In this project we have created a smart contract to handle whole supply chain process from manufacturer to customer. It registers various users in the contract according to their role. The manufacturer can create new products and set some price for it. The unique id's are automatically generated for each new product created. The customers can order the products and once the order request is approved by manufacturer, the product is given to some supplier and going through a number of suppliers, it finally reaches customer who pays for the quantity of product and then only he can receive the product. Each step of this process takes place through smart contract and hence is consistent.

V. Implementation

A. Registration of Users

We have created a function createParticipant which takes the name of a user and role and then generated a User account according to that on smart contract. User is only allowed to perform the task assigned to him and he cannot go out of his allotted roles. A manufacturer can create and ship a product. A customer can order, cancel a order. track order, get product details and in the end of it all, it can pay and receive the delivery of the product. A supplier is just a middleman which can take products from manufacturer or another supplier and transfer the product to another supplier or customer.

B. Creation of Products

Manufacturer accounts can create the product by providing product name, cost, specs and other necessary details. After the product has been created, it can be ordered by the customer.

C. Placing and Cancellation of Orders

customer accounts can order the products with the quantity specified. They are shipped once the manufacturer acknowledge the order.The customers can cancel the order as long as it is not shipped.The order once shipped cannot be canceled.

D. Shipping of orders

Manufacturer when receive the request of an order, it can confirm and send to shipping and the product ownership changed from manufacturer to supplier and then it propagates in our supply chain.

E. Tracking of the orders

customers can track their orders at any time, they need to provide the order id and then receive the whole tracking status as well as order details if they want.

F. Transfer of Ownership

Transfer of ownership is a function which help the transfer of order shipment from one user to another user. It logs all the all the transfer happening in the associated order and creates a tracking log which is later used by the tracking status function.

G. Payment and receiving of the products

The customer can pay the payment when he gets the order.After the payment to the manufacturer, customer is made the owner of the product and the related money is transferred to the manufacturer.

VI. Discussion

Our implementation can be used to perform supply chain related tasks like registration of users and products, ordering and supply of the products, maintaining status and tracking features as well as payment and delivery of product to customer by the supplier. This implementation still needs some work on it for it be useful in real life supply chain applications, as it does not yet support cancellation of order at any step of supply chain. It also needs the feature of advance payment as well as on-chain payment for the supplier during each shipment it does.

VII. Conclusion

This simplified version of the smart contract based supply chain management can be used in the simple model. It does not need any centralised party to settle all the processes. It fully utilises blockchain based transfer of data and assets to transfer the product and payment. It can be easily extended to implement more advanced features in the future to satisfy complex needs of the businesses.

VIII. Individual Contributions

A. Siddharth Sankritayan

Siddharth has worked on following features in the smart contract:

1) *Participants registration:*
2) *New products registration:*
3) *Placing orders by customer to manufacturer:*
4) *Confirmation of order:*
5) *Cancellation of order:*

B. Abhay Rathour

Abhay has worked on following features in the smart contract:

1) *Transfer of ownership of products:*
2) *Getting products details:*
3) *Tracking of Orders:*
4) *Payment and Acceptance of delivery by the customer:*

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