AUTOMATING HEALTHCARE SUPPLY CHAIN PROCUREMENT WITH BLOCKCHAIN SMART CONTRACTS

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ABSTRACT: Regular checks of the healthcare supply chain (HCSC) by doctors and nurses are essential during the COVID-19 pandemic. Healthcare personnel still confront challenges in areas such as ordering, forecasting, delivering, and purchasing despite advances in technology and a wider variety of treatment options. Group purchasing organizations (GPOs) provide savings and a wide range of options when shopping for healthcare services and consultancy (HCSC). Slow and inefficient is how the Government Printing Office (GPO) makes purchases. It has been proven that incorporating blockchain technology and decentralized storage systems can enhance several facets of how firms function. Increased transparency, enhanced communication with all relevant parties, streamlined procurement procedures, and more precise pricing are just a few examples. Distributors, wholesalers, retailers, and manufacturers may all communicate with one another thanks to blockchain technology. This research utilizes blockchain technology and smart contracts in an effort to streamline the GPO contracting procedure. Our organization provides HCSC with a comprehensive legal structure by employing cutting-edge stakeholder link tactics. The Remix IDE was used by the development team while they edited and tested the Github smart contract code. Within the scope of our study, we investigate the risks and costs associated with such transactions. Our research shows that blockchain technology is practical for the economy since members in the network incur low transaction costs.

INDEX TERMS: Blockchain, Ethereum, Security Analysis, Blockchain Applications, Group Purchasing Organizations, Healthcare Supply Chain

1. INTRODUCTION

Supply chain management is useful in many fields, including healthcare. Suppliers play a crucial role in improving care by ensuring patients are safe, ensuring treatments are effective, and keeping costs down. It's possible that healthcare providers will avoid using supply chain and logistics technologies. Supplying, transporting, and managing medications is an expensive process for the healthcare business. According to Healthcare Finance, the supply chain waste amounts to around $25.7 billion annually. Industry and retail supply networks are more streamlined and controlled than healthcare networks.

Lack of communication and outdated protocols and technology are just a few of the issues plaguing the HCSC. False information can damage commercial relationships. High transaction costs, fluctuating prices, inaccurate forecasting, and convoluted distribution structures all work against HCSC's expansion. Healthcare supply chain management (HCSC) is greatly aided by GPOs, or group purchasing organizations. The economic impact of the concept of collective purchasing power is broken down. Many businesses, particularly those in the retail and hotel sectors, cater to customers who prefer to shop in groups. Group Purchasing Organizations (GPOs) are similar to wholesalers in that they purchase things in bulk from manufacturers, but they negotiate pricing with hospitals.

Furthermore, neither suppliers nor producers get compensated, and their products are not widely distributed. Group purchasing organizations (GPOs) in the healthcare supply chain (HCSC) serve as intermediaries between healthcare providers, distributors, and suppliers [6]. GPOs play a significant role in the healthcare supply chain, as they are used by more than 90% of hospitals in the United States. The third annual value analysis by the Health Supply Chain Association (HSCA) found that GPOs saved healthcare providers $34 billion during the COVID-19 pandemic. Group purchasing organizations (GPOs) play a crucial role in healthcare supply chain management by selecting vendors, negotiating contracts, and providing statistical data. By taking these measures, proponents want to improve the healthcare supply chain's effectiveness and efficiency. Suppliers gain as GPOs lose out on business due to issues with contract management and drug shortages. Disputes, refunds, chargebacks, and legal processes are just some of the tactics pharmaceutical companies and Group Purchasing Organizations (GPOs) use to negotiate contracts. Negotiations for healthcare contracts are notoriously protracted. It's not a simple task to communicate pricing and contract modifications to all parties involved. We propose leveraging blockchain technology to automate GPO contracts in order to streamline HCSC operations and administrative responsibilities. Health care group purchasing organizations (HCSC GPOs) provide their knowledge to the effort to benefit healthcare providers and other participants. Smart contracts and distributed marketplaces on Ethereum enable the legalization of contracts. Sequence diagrams and complex algorithms both illustrate how several parties are interconnected for optimal GPO contract management.

This essay concludes by discussing the ways in which HCSC GPO can take advantage of blockchain's advantages. The GPO's preliminary research is discussed in Section III of the publication. Section IV discusses GPO contract management, whereas Section V details the implementation of smart contracts; Section VI details testing and validation results; Section VII details cost and issues. The eighth part presents research project results.

2. BACKGROUND

In this section, we address the challenges presented by HCSC, the benefits of partnering with GPOs, and how blockchain technology may be able to circumvent the difficulties presented by GPOs.

BENEFITS OF WORKING WITH GPO

HCSC is making concerted efforts to adjust to the dynamic nature of healthcare business relationships. Every year, technology improves further, expanding the range of available therapies. Consequently, the adoption of a wide variety of new and repurposed medical practices is accelerating. The global ordering, purchasing, and shipping operations are negatively impacted by lack of preparation and unscrupulous conduct. Group purchasing organizations (GPOs) have been proved to be an effective way for healthcare providers to cut costs, boost supply chain efficiency, and streamline the purchasing process. Producers and GPOs have to negotiate sales pricing because of fluctuations in supply and demand caused by changing consumer tastes. Contract pricing makes purchasing simple for businesses of all sizes. Group buying organizations (GPOs) eliminate the need for individual contracts and extensive research into the supply chains, budgets, and consumption habits of competitors. Manufacturers and suppliers can have access to valuable data through GPOs. Group Purchasing Organizations (GPOs) also employ value analysis techniques to enhance the effectiveness of supply chains. Information collecting to monitor price and supply chain changes is essential to the project's success. Group Purchasing Organizations (GPOs) play a crucial role in the healthcare industry by alerting healthcare professionals to drug shortages and helping to locate alternative suppliers in the event of medical product recalls due to safety concerns. Because few other producers provide this special function.

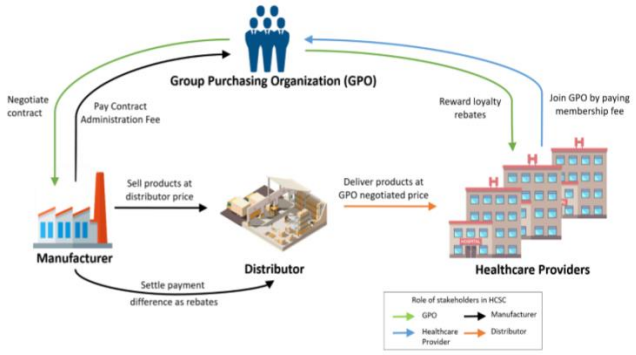

FIGURE 1: Custom contracting through the use of GPOs in HCSC

Group purchasing organizations (GPOs) play a crucial role in educating healthcare providers on topics such as new markets, internet shopping, inventory management, and the use of new technology. The goal of these training exercises is to raise the standard of healthcare delivery, particularly in times of shortage.

ENHANCING GPO CONTRACT PROCESS USINGBLOCKCHAIN TECHNOLOGY

There is need for improvement in the GPO's contract administration process in terms of automation, transparency between vendors and providers, and data management concerns. Stakeholders in the HCSC must take an active role, and GPOs must establish a system that streamlines communication between producers and retailers and permits the sharing of data in real time. This expedites the dissemination of information regarding GPO price changes, hence decreasing the likelihood of disputes and keeping projects on schedule. Blockchain technology allows for more efficient and lucrative transactions between healthcare providers of varying sizes and their suppliers and distributors. The functions are simplified by using a decentralized network, implementing smart contracts, obtaining consensus, and maintaining immutable data. Distributed networks are used to link supply chains.

To facilitate data exchange, every authorized transaction in the blockchain is made available to all participants in the network. Each new block automatically refreshes the whole transaction log. Each section has legitimate transactions. Miners create a global distributed ledger by connecting individual blocks together. In the process of creating blocks, miners band together to seek payment for the transactions they back. The miners' pick for the next block adder has been unanimously approved. On many platforms, protocols vary.

Proof of Work is the consensus process used by Bitcoin and Ethereum. Blockchain transactions are permanent, secret, and inherently unreliable, which is useful for supply chains. Many businesses, like HCSC, have expressed serious enthusiasm for blockchain. This technology has the potential to significantly enhance the GPO bidding process. Negotiating costs is an integral part of putting into practice healthcare contracts with many stages. Agreements may be communicated to the network. Plans for HCSC do not include any outside parties at this time. Blockchain technology use timestamps for storing and verifying network data as a solution to the issue of disconnected networks. The complexity of pricing, reimbursement, and administration is increased by the regular upheaval of GPO relationships. Contract modifications are stored and timestamped in a permanent public ledger using blockchain technology. Group purchasing organizations (GPOs) report that it is time-consuming to monitor supplier contracts. Group Purchasing Organizations (GPOs) can more easily monitor service providers and provide prompt feedback if they are not following the regulations when they implement smart contracts on the blockchain.

3. RELATED WORK

The literature on healthcare features extensive studies of GPOs. Burns and Lee conducted an exhaustive inquiry before contacting hospital personnel. The use of GPOs by business leaders has helped reduce healthcare and pharmaceutical market expenses for many (94% of those polled). Group purchasing organizations (GPOs) were helpful to hospitals over a 10 year period when healthcare prices increased significantly. Cooperating in order to reach an agreement. The production expenses of large buying groups are reduced. Buying food and supplies from the government. Group purchasing organizations (GPOs) assist hospitals share information and resources, make bulk purchases, and mitigate the

effects of demand fluctuations, as shown by analysis of actual hospital transactions. In order to increase the retention of healthcare providers, Group Purchasing Organizations (GPOs) have adopted a strategy of reducing registration fees for vendors and manufacturers. The GPO is conducting a market research, and as part of that study, statistical methodologies are being applied to data pertaining to healthcare services. Supply chain costs can be reduced by making fewer unneeded purchases. Companies that pool their resources and research into what customers want reap the benefits of both. According to research, GPOs can be beneficial for hospitals. In the United States, children of healthcare workers receive free immunizations. Vaccinations are available for adults from private vendors, consumers, and businesspeople. The Vaccine Procurement Group (VPG) works to negotiate bulk discounts from vaccine manufacturers. There's a published study that uses in-depth, qualitative phone interviews. The findings of the study imply that Vaccine Purchasing Groups (VPGs) have the potential to streamline and expedite the process of obtaining recommended vaccines in the United States. More than seventy healthcare professionals were reportedly polled by Nollet and Beaulie on the subject of the growth of purchasing cooperatives. All relevant factors, including as benefits, payer involvement, supplier relationship, procurement approach, organizational context, and available resources, must be considered. The power of mass purchasing cannot be overstated. The greater pool of potential buyers could cause a shift in pricing.

Group purchasing organizations (GPOs) in the healthcare industry continue to expand. HCSC is now much more effective. Sharing of resources among healthcare professionals, stockless systems, electronic commerce, and cooperative purchasing are all topics of discussion in academic settings. Collective purchasing is hampered by ineffective leadership, muddled communications, conflicting priorities, tight finances, and a general lack of trust and transparency among all parties involved. Group buying has been the subject of academic inquiry, but the challenges it presents remain unresolved. There isn't enough research on the matter, so we want to investigate the part blockchain technology plays in the contracting process at the Government Publishing Office (GPO). GPO healthcare contracting allows for verification of findings using smart contracts and autonomous networks.

4. PROPOSED BLOCKCHAIN-BASED GPO CONTRACT ADMINISTRATION SOLUTION

It is now known that blockchain-powered GPO contracts are readily available. Figure 2 depicts a decentralized network built on the Ethereum platform that facilitates participation from a wide variety of stakeholders, including healthcare providers, manufacturers, and distributors. Protecting immutability, provenance, and transparency by utilizing blockchain technology in our contracts system. Figure 2 demonstrates the interoperability of entities through the use of smart contracts.

Manufacturer: Manufacturer of pharmaceuticals and medical supplies for healthcare professionals.

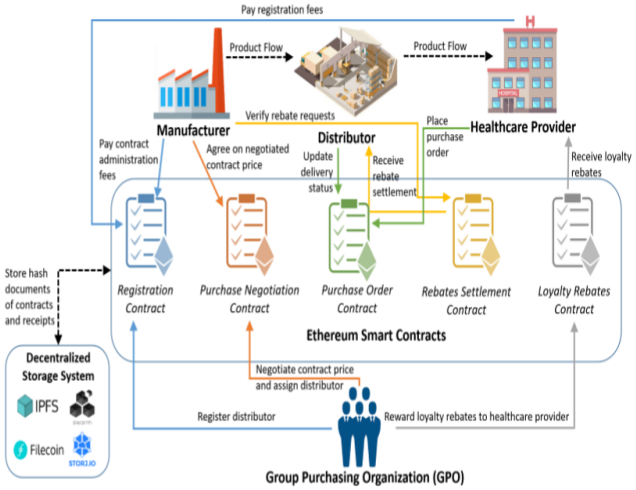

FIGURE 2: A high-level overview of Ethereum's decentralized GPO and smart contract storage.

Group Purchasing Organization (GPO):

The organization in question does more than just hospital treatment; they also offer home health care, assistance with ambulatory care, and nursing home care. Businesses can make more money from larger orders, so the more you buy, the

cheaper each item gets. Suppliers place a premium on GPOs due to the fact that they enable customers to save money and receive preferential pricing. Healthcare providers sign contracts with GPOs after GPOs and suppliers have negotiated minimum purchase requirements. Contract management expenses are covered by the manufacturers, while the GPO membership fees are covered by the service providers. The total value of the goods is calculated by adding the CAF costs (Cost + Insurance + Freight). The Government Publishing Office (GPO) operates through a combination of CAF grants and provider membership fees. Suppliers are incentivized to increase sales and develop customer confidence with the use of small cash assistance programs (CAFs).

Distributor:

Distributors are often the intermediary between manufacturers and hospitals or clinics. Distributors can save on GPO contract fees by directly purchasing from manufacturers at distributor-preferred prices. Distributors can seek for manufacturer rebates through their GPO contracts by calculating the gap between their actual spending and their agreed-upon spending. Distributors no longer have to track sales to ensure rebates since blockchain technology securely records all transaction data. Sadly, manufacturers are not obligated to verify distributor assertions that service providers were paid in accordance with agreed-upon terms. Shipping costs and manufacturer rebates are typically distributed to the distribution company's advantage.

Healthcare Provider:

GPO contracts streamline the purchasing process for healthcare organizations like hospitals and nursing homes by allowing them to buy directly from manufacturers and distributors. We advocate for the widespread use of standard procurement practices. Once the manufacturer has negotiated an agreement, all of the suppliers will be able to purchase the essential components at the negotiated price. Group purchasing organizations (GPOs) hire distribution companies to function as a bridge between manufacturers and suppliers. The capacity to send out a provider

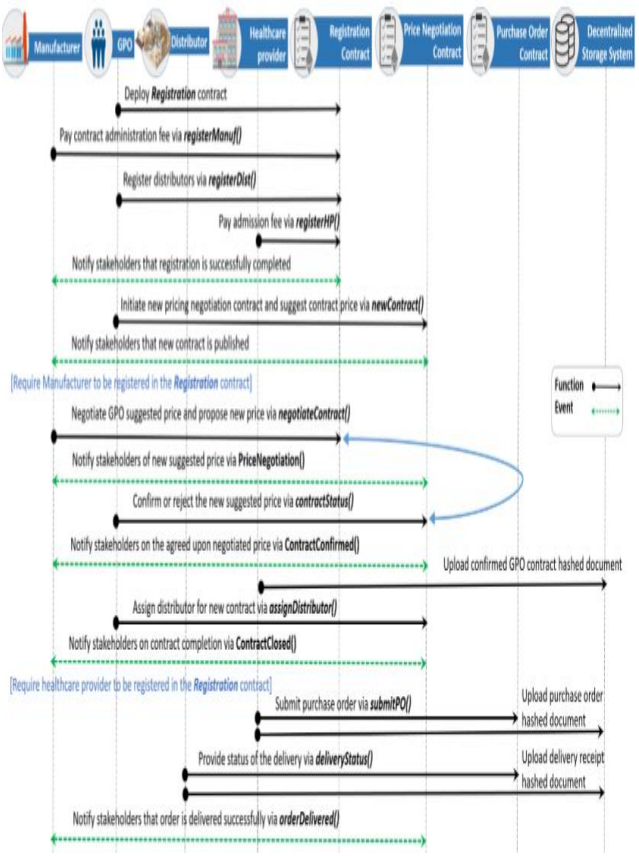

FIGURE 3:

When a purchase order is placed through a Group Purchasing Organization (GPO) contract and sent directly to the distributor at the agreed upon price, a graphical representation of the sequence of function calls and events involving the various stakeholders is generated.

Decentralized Storage Technology:

A distributed file system that links all nodes in the network is used for this purpose. IPFS and Filecoin are just two of several file-sharing networks out now. The InterPlanetary File System (IPFS) allows authorized users to securely store massive volumes of information. IPFS (InterPlanetary File System) links are immutable since they are recorded in blockchain transactions with timestamps. Stakeholders only need to save a minimal amount of information in the blockchain, making this a crucial component. GPO contract solutions can make use of distributed ledgers and storage systems by storing just IPFS data that has been indexed

Ethereum Smart Contracts:

Ethereum can be used to implement smart contracts. The procedure of electronically signing contracts accomplishes a number of goals. Their role as software agents is to monitor the network

for compliance with the agreements made by its constituents. The system is described visually with examples of its functions, events, and connections. The formal relationships between the parties are depicted in Fig. 3. The Government Publishing Office (GPO) can help you with any contract registration needs you may have. Support for registration contracts makes acquiring an Ethereum name simpler for those with a stake in the network.

The Manuf() and HP() services collect both the administrative and annual membership fees from manufacturers and sellers. The GPO has established a new price negotiation agreement for a specific product or set of items. Manufacturers might use pricing negotiation tactics to reduce the prices they pay to the Government Publishing Office (GPO). The GPO's ability to accept or reject pricing offers is contingent on the GPO's contract status. being handed over the ContractConfirmed() method. When a contract is executed successfully, it is added to the distributed storage system at a predetermined price and can be purchased by authorized parties. Distributors manage Group Purchasing Organization (GPO) contracts with manufacturers and suppliers. Invoking the "Closed()" function signifies the conclusion of a deal. The PO() method makes it simple for services to distribute and transmit orders. Order statuses are updated by Distribution once work is complete. When an order is received, processing begins.

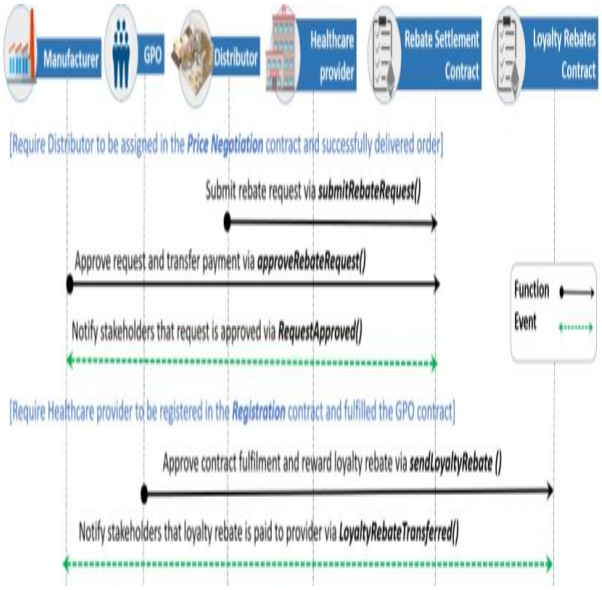

FIGURE 4:

Make a flowchart outlining the steps required to provide a refund.

Requesting the delivery of a good or service. Figure 4 depicts the manufacturer and distributor reconciling their refunds after shipments have been made. The Rebate seek() procedure helps wholesalers locate and claim available rebates. When a rebate is valid, the manufacturer sends the customer a payment. The distributor has acknowledged receiving the refund, which will be known to everyone reading this message. Companies that deliver as promised receive financial incentives through the Loyalty Rebate program. The Loyalty Alert service providers are being compensated in other ways now.

5. IMPLEMENTATION

Here is a sample of the automated purchasing contracts we can create with smart contracts and a blockchain platform. The proposed strategy was validated on the Ethereum network. Please provide an explanation for your request. The Remix IDE simplifies the process of developing, deploying, and testing Ethereum smart contracts written in the Solidity programming language. The proposed Remix IDE solution incorporates a comprehensive system overview, and subsequent experiments with smart contracts. Remix is an IDE for the Ethereum platform that is compatible with the Solidity programming language. Rebates, Purchase Orders, Rebate Settlement, Price Negotiation, and Registration are just few of the many scenarios where smart contracts are used. All contracts have the following obligations::

Registration contract:

Figure 2 depicts the extent to which this agreement covers the registration procedure. According to the terms of the agreement, registration is required of anybody involved in the healthcare industry in any capacity. The annual membership costs for smart contracts must be paid by both the offerors and the producers.

Purchase Negotiation contract:

This method involves price negotiations between GPOs and publicly listed producers. The GPO's guaranteed minimum price is contingent on the supplier's ability to meet that target. The GPO will authorize a distributor once a manufacturer has approved the provider contract pricing

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Purchase Order contract:

The modern smart contract streamlines the buying process for sanctioned businesses by allowing instantaneous price comparisons. Suppliers issue purchase orders to distributors to ensure delivery of goods at the agreed-upon price. Once the materials have been delivered to the designated distribution facility, the service provider can begin processing the order.

Rebates Settlement contract:

The primary function of this smart contract is to handle refunds to manufacturers once distributors have finished fulfilling orders. The manufacturer may, at the distributor's request, reimburse the difference between the distributor's requested price and the agreed upon contract price.

Loyalty Rebates contract:

In exchange for the GPO's assurance that they would continue to do business with the government after the contract has ended, registered suppliers pay a portion of the CAF to the GPO. The algorithms require a two-way conversation consisting of requests and responses in the context of purchase agreements and shipments. Registration is a pre-requisite for using the smart contract. Personally

Algorithm 1: Issuing New Contract

Input: product ID, quantity ordered, manufacturer address

```
if sender is the GPO then
    if Manufacturer address is registered in the Registration smart contract then
        Generate a new contract number.
        Link new contract number to manufacturer address, product ID, and quantity.
        Set contract status to NewContract.
        Set the contract price to zero.
        No distributor assigned yet.
        Announce the availability of a new contract for negotiation.
    end
else
    Revert transaction.
end
```

Suppliers and billing services have to pay more thanks to intelligent contracts. The price of using smart contracts is consistent regardless of the nature of the business or the desired outcome. GPO products are frequently ordered by qualified medical personnel. The first equation represents the GPO's preliminary stages of purchasing a product from the manufacturer. This is done once a smart contract has been used to determine the appropriate amount. All future references to smart contracts will use the 64-byte order number that is included in the request data. Each bit of Algorithm 2 is priced by the manufacturer. The Government Publishing Office (GPO) has the discretion to approve or reject requests for quotations. If the maker's initial offer is rejected, they can try again with a better one. It usually takes some time to determine costs. After comparing prices, the GPO chooses a vendor from its approved vendor list to finalize the transaction. The purchase order and subsequent shipping process is managed by the third algorithm. How orders are placed impacts the allocation of resources. Medical service providers negotiate with manufacturers in order to secure supplies. The manufacturer ships the goods to the retailer. The fourth formula takes into account feedback from both healthcare providers and distributors. The Government Printing Office (GPO) may cover the spread once the order has been delivered. There are return provisions written into intelligence contracts. Smart contracts can be used to verify deliveries for purchase orders. The manufacturer reimburses the retailer by means of a smart contract. The Group Policy Object (GPO) protocol can be used to transmit values.

Algorithm 2: Contract Price Negotiation

Input: Contract number, requested price

if *Contract is already initiated by the GPO ∧ sender is a registered manufacturer* **then**
  if *The contract is newly created ∨ previous price was rejected by the GPO* **then**
    if *the requested price is by the manufacturer that is assigned for this contract* **then**
      The manufacturer proposes a price for the requested product and quantity.
      The status of the contract is changed accordingly.
      The new price is sent as a broadcast to the GPO.
      The GPO reviews the price and approves or rejects it.
      if *the GPO accepts the price* **then**
        Change the contract status to confirm the price.
        Trigger price confirmation event.
        The GPO assigns a distributor via the smart contract.
        if *distributor address is registered ∧ price is confirmed* **then**
          The distributor is assigned to the contract.
          Close the contract.
        else
          Reject assignment of a new distributor.
        end
      else
        Change the contract status to reject the price.
      end
    else
      Reject price negotiation.
    end
  else
    /* Pending reply from the GPO */
    Revert.
  end
else
  Revert transaction.
end

6. TESTING AND VALIDATION

The testing section, like the introduction, outlines the procedure. As advised, the Remix IDE went ahead and did it.

Algorithm 3: Purchase Order (PO) request and delivery

Input: PO number, distributor address

The healthcare provider submits Purchase Order request
Smart contract triggers an event to inform the the distributor.
The distributor validates the PO.
The distributor delivers the order and updates the smart contract.
if *the sender is the distributor assigned to the PO request* **then**
else
  Delivery confirmation registered by the smart contract.
end

Algorithm 4: Rebates settlement

Input: contract number, amount, manufacturer address

The distributor submits a rebate request to the manufacturer.
if *manufacturer address is valid* **then**
  Request registered.
  Broadcast message to the manufacturer via the smart contract with the requested amount.
  Manufacturer reviews the rebate request.
  if *orders were delivered successfully* **then**
    Transfer the required amount to the smart contract.
    Smart contract transfers the amount to the entitled distributor.
    Request closed.
  end
end
GPO transfers loyalty rebates to healthcare providers if appropriate.

Various cost estimates were considered for upcoming procurement contracts. The Remix IDE provides feedback on how to manage transactions and problems when smart contracts are being developed, tested, and evaluated. The IDE displays information on the sender address, arguments, outputs, processing, and transaction fees for each Ethereum transaction. Exception warnings in an IDE can be triggered by a number of different events, including runtime failures, gas limit breaches, and smart contract constraints.

The GPO use the Registration smart contract to record and manage all relevant events and participants. As a result, the GPO retains title to and control over this smart contract. Distributors operating independently can join a GPO at no cost to themselves.

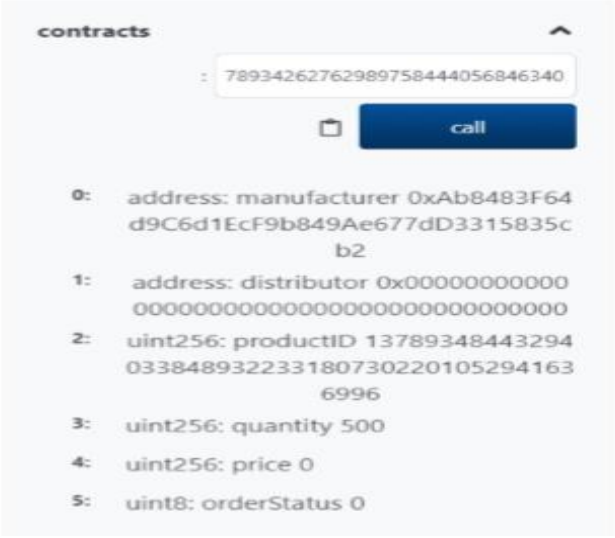

FIGURE 5: Newly created contract details

The freshly drafted agreement particulars. driven only by their own internal desires. Using the integrated development environment's given virtual Ethereum addresses, we sign up a sizable group of producers, distributors, and healthcare providers for experimental use. It is always the GPO's responsibility to initiate contact with the buy negotiation smart contract function, providing details such as the quantity needed and the location of the manufacturer, in order to negotiate a price reduction. The recently finalized GPO contract is depicted in Figure 1. There isn't enough material here to warrant a serious rewrite by this author. The Distributor's location is kept hidden due to a stipulation in the contract that mandates unanimous agreement on the price. Since this is a brand-new contract and the maker has not yet disclosed pricing details, we can safely assume that it will cost nothing. A new agreement has been initiated per the new state of 1. The service supplier then provides an estimate for that sum. When the manufacturer proposes a lower price, this is called "negotiation" (Figure 6). The GPO's acceptance or rejection of a proposed pricing is crucial to the next stage of negotiations. Negotiations will continue until a compromise is reached. Group Purchasing Organizations (GPOs) select wholesalers and ensure that the agreements made with them are carried out. The smart contract stipulates that all prior negotiations must be finalized before going on to the next stage. Before any agreement can be finalized, the proposed rates must be reviewed and accepted by the Government Publishing Office (GPO). In this case, the smart contract throws an exception and displays a comprehensive error message.


```
[ { "from":
"0x9D7f74d0C41E726EC95884E0e97Fa6129e3b5E99",
"topic":
"0xc382ef700bf5db62b7270b2a6d0029b93c53f5fdd928b9e816
15c604b9c451e0", "event": "PriceNegotiation", "args":
{ "0":
"789342627629897584440568463405971177127589281640262 9
827003995138588361821872 0", "1": "1200",
"contractAddress":
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827003995138588361821872 0", "newPrice": "1200" } } ]
```


FIGURE 6: Manufacturer event new contract pricing proposal

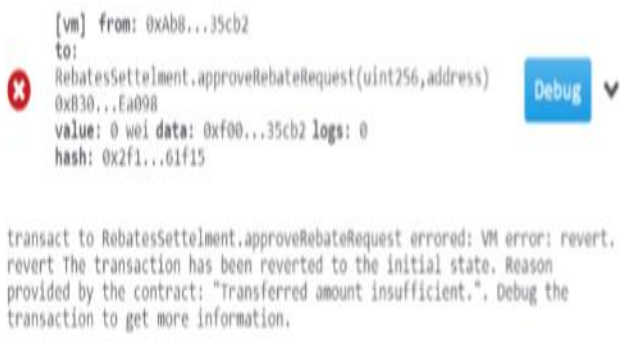

FIGURE 7: According to the notice of exception, the manufacturer rebate is insufficient.

7. CONCLUSION

The purpose of this research was to examine HCSC's management of its suppliers, buyers, and distributors. By employing effective purchasing strategies and favorable volume rates, Group Purchasing Organizations (GPOs) can save HCSC stakeholders, notably providers, money. This point was driven home. Manager support and vendor vetting are only two of GPO's many offerings. They are responsible for ensuring that hospital contracts are upheld and for assisting manufacturers in reducing expenses and increasing profits. The Government Publishing Office (GPO) contracting process is notoriously difficult, resulting in substantial lost time and resources. The goal of HCSC's use of blockchain and distributed storage is to enhance stakeholder participation, transparency, data quality, and data provenance. Maintain uniform pricing and strengthen communication with key players. HCSC classifies products based on features such as system architecture, algorithms, sequence maps, and testing procedures. Smart contracts encourage transparency and honesty by restricting registration and communication to verified users. The smart contract source code is available on Git Hub for research and practical use. Concerns about the reliability of the proposed approach's data, as well as its non-repudiation and security, were thoroughly examined. Costs associated with partnerships were calculated. Our method will be useful to HCSC's constituents. The integration of DApps is a future priority with the aim of simplifying and automating as many HCSC operations as possible for all stakeholders.

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