Increasing the efficiency of decision-making in a decentralized autonomous organization in the warehousing sector

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Abstract

This paper presents a cost-efficient decision support system (DSS) architecture for warehouse operations, built around a decentralized autonomous organization (DAO). By fusing blockchain-based decentralization with advanced computation and data-processing techniques, the proposed design enhances data storage integrity, accelerates decision-making, and lowers operational overheads. Experimental evaluation shows measurable maintenance savings for DAO-driven warehouses, validating the approach. The study details core warehouse processes, decision algorithms, and optimization methods, and contrasts them with traditional centralized models. Principles distilled from this analysis – distributed data governance, modular algorithm selection, and scalable computational off-loading – collectively reduce service costs while raising accuracy and throughput. A novel DAO data-storage mechanism underpins the architecture, enabling tamper-resistant records and real-time analytics without heavy central servers. The findings demonstrate that integrating blockchain into warehouse DSSs can streamline management, improve resilience, and deliver sustainable cost reductions, marking a substantive advance in smart-logistics technology.

Keywords

Indexing, storing data in blockchain, DAO, DSS, warehouse management, warehouse management system, prioritization methods, supply chain

1. Introduction

The warehousing industry is a fundamental part of the global supply chain management system, which is a key link that ensures the smooth operation and rapid delivery of goods from one location to another. This complex network is inextricably intertwined with a DSS, a critical element that significantly increases the efficiency of warehouse operations. However, like any complex system, DSS is not perfect, and there is always room for improvement and scaling. This comprehensive article will take a closer look at potential improvements that can be made,

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discuss their implementation in detail, and evaluate the projected impact of these changes on the effectiveness of DSS in the warehousing industry.
To stay ahead of the competition and keep up with technological progress, a decision maker must be aware of what is happening. However, if there is a lot of information, it is impossible to quickly "see and understand" it, let alone make the right decision based on it. It is for such cases that DSS are developed. For example, these are solutions related to the management of organizational operations, production processes, resource management, etc.
WMSs are information systems designed to support managers in choosing the best solution from numerous alternatives [1]. These systems are a combination of organized models, procedures, software, databases, telecommunications, and other devices. They are aimed at solving unstructured or semi-structured business problems [2]. In organizations that have implemented SPMS, they are a key tool for operations management and planning, helping managers to effectively solve complex and dynamic problems.
Decision support system should meet following requirements:

- Processing large amounts of data [3];
- Receiving and processing data from various sources, including internal and external, stored in systems and on mainframes [4-6];
- Flexibility of reports and presentations to meet user needs;
- Supporting management judgment rather than replacing it;
- Conducting comprehensive analysis and comparisons using modern software packages;
- Increase the effectiveness of decisions;
- Availability of forecasting tools [1].
- Modern decision support systems have the following capabilities:
- Adaptation to different decision-making frequencies: from individual to regular;
- Support for the stages of problem solving: analysis, design, selection, implementation, monitoring;
- Work with different types of problems: from structured to unstructured;
- Support at different levels of decision-making: operational, tactical, strategic [2].

2. Related work

The article [3] focuses on exploring the field of warehousing and especially the role of decision support system. Utilizing a systematic approach, the article examines different aspects of research, such as problem subject, decision support goals, methodologies used, problems types, solution architectures, technologies to use best. The article proves the need for the development of more complex and smart decision support systems for supply chain process, especially in time of the growth of e-commerce and the demand for rapid business automation. It is examined that in the current conditions, the issues of actuality and responsivness of decision support systems are vitaly relevant for warehouse area to ensure the possibility to quickly respond to minding conditions and market requirements. Thus, the literature review in [7] emphasizes the importance of innovations in the field of decision support at warehouses and identifies key points for future researches aimed to improve the efficiency of warehouse automation.

The following studies describe implementations of blockchain-related systems in wareousing domain. Blockchain-assisted Supply Chain Management System for Secure Data

Management by Kandpal et al. (2022) showcases a framework utilizing technologies such as Ganache, Metamask, MySQL, PHP, NodeJS, Solidity, and JavaScript to enhance supply chain management with blockchain [7].

Evaluation of Factors Affecting the Decision to Adopt Blockchain Technology by Maden and Alptekin (2020) highlights blockchain's potential beyond financial services, notably in supply chains, power, and food/agriculture, describing its role in reducing management costs [8].

Blockchain Technology Implementation in Logistics by Tijan et al. (2019) explores the applications of decentralized data storage in logistics including supply chain management, common logistics challenges are addressed [9].

Blockchain Performance in Supply Chain Management by Hong and Hales (2021) assesses performance in supply chain management by identifying various methodologies for analysis [10].

Decision Support for Blockchain Platform Selection: Three Industry Case Studies by Farshidi et al. (2020) claims usecases of a decision model for blockchain platform selection, reducing decision-making time and costs keeping traditional methods consistency [11].

Big Production Enterprise Supply Chain Endogenous Risk Management Based on Blockchain by Fu and Zhu (2019) applies blockchain to mitigate endogenous risks in enterprises' supply chains, prooving improvements in decision accuracy [12].

Blockchain-Driven Customer Order Management by Martinez et al. (2019) investigates blockchain's effects on supply chain management processes, showing efficiency improvements and better data tracking of operations [13].

Evaluating the Feasibility of Blockchain in Logistics Operations: A Decision Framework by Ar et al. (2020) designes a framework for assessing blockchain's feasibility in logistics, focusing on enhancing decision-making in this field [14].

These studies collectively highlight blockchain's security potential in the warehousing industry, ephasize advantages of providing decision support system on chain, demonstrating this technology can enhance traditional decision-making systems in domain specified.

The most impactful and defining drawbacks and challenges found during exploration of blockchain technology's application in warehouse field to enhance decision support systems are the following:

- Integration Complexity: implementing blockchain technology into existing warehouse management systems can be challenging due to differences in architecture and the need for high compatibility between systems [15].
- High Initial Costs: the development and deployment of blockchain solutions require significant initial investments, which can be prohibitive for some organizations, especially small and medium-sized enterprises [16].
- Scalability Issues: some blockchain platforms may face limitations in scalability, particularly in the context of large warehouse operations where high volumes of transactions need to be processed [17].
- Transaction Delays: due to blockchain's consensus algorithms, such as Proof of Work, transaction processing can experience delays, which may be critical for time-sensitive warehouse operations [17].
- Privacy and Security Concerns: despite blockchain's high level of security, there are concerns about data privacy, especially in permissioned networks where access to information can be limited [18].

- Technical Complexity: developing and managing blockchain systems require specialized knowledge and skills, which may not be available in some organizations, limiting their ability to effectively utilize this technology [18].
- Technology Dependence: a strong reliance on blockchain platforms can pose business risks, especially if the platform experiences technical issues or ceases to exist [19].

These challenges force engineers to switch between methodologies and approaches, create new ones when integrating blockchain technology in decision support systems into the warehousing sector to hide difficulties with great achievements.

3. Dao structure for decision support system

Each DAO consists of a number of necessary concepts that ensure its reliable operation. This is how a high-quality decision support system is built, including in warehousing processes (Fig. 1):

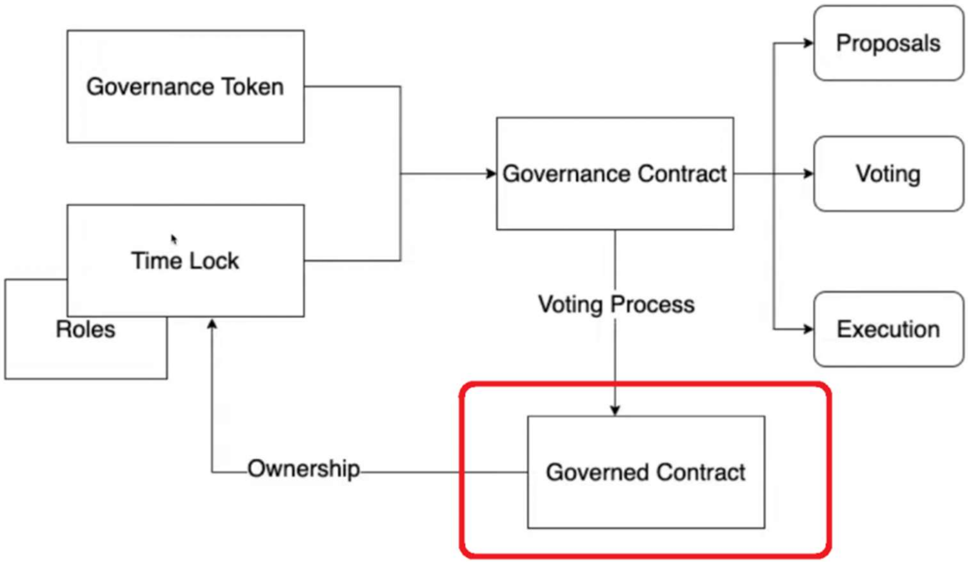

Figure 1: DAO structure

Sysetm is based on smart contracts. These applications, stored and executed on an Ethereum virtual machine, define unchanging rules of interaction between system participants, assigning them roles, ensuring transparency and data integrity [20]. Its administration through token voting. System participants act as holders of the system's internal ERC-20 token, which gives them voting rights. The more tokens a participant has, the more weighty his or her vote is. Participants' actions that benefit the system itself allow them to earn tokens. The actions of a participant that harm the system penalize the participant by imposing a fine in tokens. Since the system is closed, each participant is interested in actions that will have the most positive impact on the system, often ignoring personal beliefs. In this way, competitors gathered in one system create the most honest marketplace for interaction, which forces them all to improve their performance only by fair means. Voting is usually done using a proposal and vote mechanism.

All the business is implemented through the proposal system. Each DAO participant has the ability to propose a transaction. It can, in turn, define an action on DAO values, or add new or remove existing DAO values. It can also indicate interaction between system participants (imposing a fine, rewarding with a prize, removing from the system, adding to the system). This approach is highly customizable and ensures that participants are forced to remain loyal to the system. The number of successful proposed transactions determines the participant's voting power [21, 22].

A transaction in a DAO network is the only mechanism that involves changing data [23]. All processes in the system are carried out with the help of transactions. There are 10 types of transactions, which together make it possible to create a DAO with any set of rules that can solve real problems in an infinite number of aspects of human life.

Proposal making transaction (Fig. 2). Contains data about the proposal to be executed. It determines the time during which the proposal must be accepted. If this time expires, the offer becomes rejected. A proposal has several states of its life cycle: Draft, Confirmed, Active, Validated, Rejected, Completed, Expired, Canceled.

Token voting transaction (Fig. 2). This is a typical ERC-20 token transfer transaction, but with additional data. It denotes the voting process. Thus, system participants can support or reject existing proposals. The creation and burning of internal system tokens must be precisely prescribed so that it defines the balance of the system and the integrity of the vote. Incorrectly defined rules for token interaction can lead to inflation or shortages, which will tilt the levers that ensure the equality of the system in someone’s favor. Knowledge of the mechanisms and approaches to creating tokenomics is an integral part of building a reliable DAO system.

Proposal execution transaction (Fig. 2). Can be executed by any participant in the system if all prerequisites for the proposal execution have been met. At the time of execution, the proposal must be confirmed. Usually this is an expensive transaction, because it involves the execution of business tasks, as well as all processes within the DAO that arise from this proposal: accrual of reward, imposition of a penalty, updating the history of system activity, etc.

Fund transfer transaction. Can be performed separately from the main business proposals. In case the system tokens have been credited to one of its participants, they can still be blocked at the system level. Then the participant himself initiates a transaction to withdraw them. Or the participant can additionally block some assets within the system to obtain additional system tokens.

Transaction of changes to the administration parameters and collective adjustment of administration. Can be marked with separate attributes so that separate rules apply to them. The transactions themselves do not issue the common resources themselves for which the DAO system has united, but rather the rules and principles of operation of this system itself.

Transaction of registration of a new or removal of an existing participant. For most closed DAO systems, this type of transaction is replaced by a transaction of system token transfers. Thus, a system participant is any person who has system tokens in his wallet.

Other types, such as staking/unstaking transactions, dividend distribution transactions, emergency acting transactions, are used extremely rarely, or are not used at all, depending on the construction of a DAO system with a finite set of users.

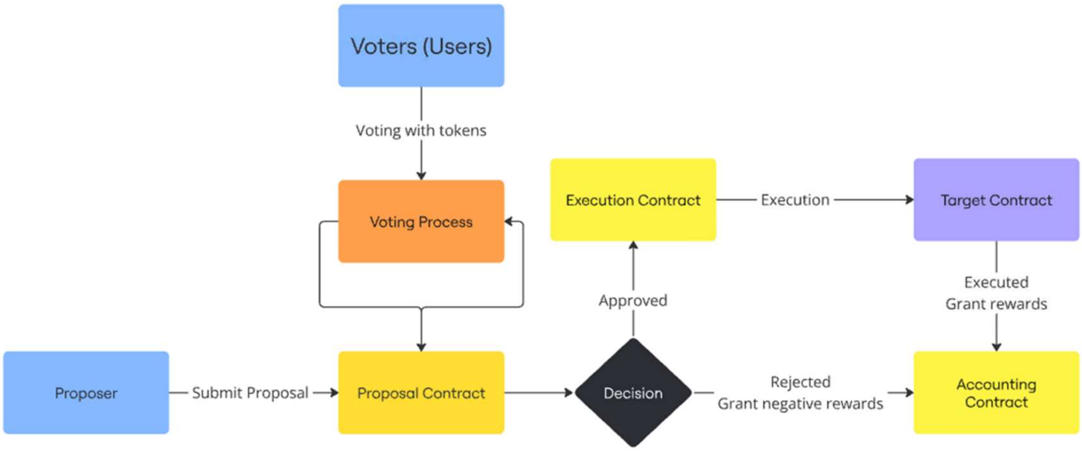

Figure 2: Proposal flow

These transactions differ by the following characteristics: the amount of data they write to the blockchain, the amount of data they read from the blockchain, the amount of work that a transaction can lead to (measured in gas), the number of internal transactions that are called. A feature of the DAO system, which works to support decision-making in the field of warehousing, is that the data that the participants of the system operate on are only identifiers of existing objects (product code, warehouse code, order number, route index, key operation code, etc.). The absence of big data significantly reduces the cost of blockchain transactions [24].

Proposed flow has its main advantage as decoupling responsibilities over entities for potential scaling of the solution. Also since every unit is separated it means that its integration with other systems can be implemented independently. In addition to that having Voting Process as a standalone smart contract provides ability to build it on top of any existing platforms such as DEXes to have rich functionality to support more complex token transfer scenarios.

Table 1 lists the estimated cost (in gas) of each type of transaction, used for the decision support system in the field of warehousing.

Table 1
DAO transaction types and their cost

Transaction type	Usage %	Cost (gas)	Cost (USD @ $3000/ETH
Token voting	50-70%	40-100k	$2.40-$6
Proposal submission	10-15%	100-300k	$6-$18
Proposal execution	5-10%	200-600k	$12-$36
Governance parameters update	2-5%	180-500k	$10.8-$30

Governance structure changes	2-5%	150-400k	$9-$24
Fund transfer	1-2%	21-50k	$1.26-$3
Member management	<1%	80-250k	$4.8-$15
Dividend distribution	<1%	30-70k	$1.8-$4.2
Staking Unstaking tokens	<1%	60-150k	$3.6-$9
Emergency actions	<1%	250-700k	$15-$42

Average DAO system for supporting daily decision making consisting of 50 participants performs about 400 transactions per month. Thus, the estimated cost of maintaining the system (transaction fees) is 46,800 gas, or $2,800 at a price of $3,000/ETH. The growth in the number of transactions is exponential in the growth in the cost of maintaining the system. Thus, a DAO for supporting daily decision-making, consisting of 100 participants, will require about $9,000 per month to pay for transactions.

4. Experimenting with data indexing to improve DAO performance

Each access to the blockchain requires payment for computing power. Each transaction must be paid for depending on the amount of gas that was burned to execute it. Since access to data in the blockchain is not competitive, both reading and writing can only be done in turn. Therefore, each reading and each writing is a paid operation. It is important to note that writing is more expensive than reading.

Data stored in the blockchain does not have the proper level of structuring that users and developers of traditional databases are used to. Also, the blockchain does not offer standard querying, filtering, or data indexing functions [25]. The user only gains access to a memory segment and reads it in full or in part, operating with bytewise indentations. Working with memory is also complicated by the lack of complex data structures that are supported natively. Only primitives, as well as arrays, mappings (dictionaries), and structures can be operated on.

Indexing data to create a copy of it outside the blockchain is a method that can significantly reduce the cost of maintaining a DAO system [26]. This is achieved by building a database outside the blockchain, exposing an event listener from the blockchain, and creating a user interface for searching and processing the data [27].

Every transaction that is executed in a decentralized system can trigger events. An event is a kind of log record that transmits data from the blockchain in a simple form back to the client, or blockchain explorer. Each event can contain up to 6 fields, some of which are indexed. A transaction can trigger as many events as there is gas for execution. An event does not take up space in the smart contract storage, so it is efficient to transfer large amounts of data with it.

Events are typed and are used to indicate important changes that occurred during the execution of a transaction [28]. This can be a token transfer, a change in the owner of any artifact, the creation of new tokens or contracts, a vote, etc. In this case, the event not only reports that changes have occurred, it also supports data that directly relates to these changes (participants, volumes, prerequisites, results).

The main purpose of events is to optimize gas consumption, since data that should not be directly protected by the blockchain can be stored in the events themselves outside the blockchain. They can be searched, their fields can even be indexed. At the same time, this is a search outside the blockchain, that is, it does not require payment for computing power to work.

Data indexing is achieved by hashing the key field, and sorting by the hash found. Thus, searching for an element in an array can have either logarithmic complexity, if it is a sorted array, or unit complexity, if it is an array of buckets with indexed access to elements. Let's consider 2 hashing methods that can be used to index data stored on a blockchain: Keccak-256 and SHA-256. Their use depends on the data access mechanism.

Keccak-256 follows a sponge construction, consisting of two phases: Absorbing and Squeezing. Following formula is being used:

$$Keccak - 256(M) = Sponge(M, r, c),$$

where:

- M – Input message
- r = Bitrate (1088 bits for Keccak-256)
- c = Capacity (512 bits for Keccak-256)
- Sponge function consists of two operations: Absorbing - Message is XORed into the state and permuted and Squeezing - Output is extracted from the state.

Permutation Step f. Keccak uses a permutation function f applied 24 times to a 5×5×64-bit state matrix. The transformation consists of:

- Theta (θ): XORing columns;
- Rho (ρ): Bitwise rotations;
- Pi (π): Shuffling state matrix positions;
- Chi (χ): Non-linear transformation (XOR with AND);
- Iota (ι): XOR with a round constant;

$$S' = \iota\left(\chi\left(\pi\left(\rho\left(\theta(S)\right)\right)\right)\right),$$

Where S is the state matrix.

For a closed DAO system that will operate within an automated warehouse or a network of warehouses, it is proposed to set up a listener for events from the blockchain. Data indexing will be done using the keccak-256 method. This is a service whose backend connects directly to the blockchain node and listens to events from the smart contracts of its own DAO. The data stream can be filtered, transformed, systematized, and recorded in a traditional database. A relational database is better suited for individual entities and their dependencies, while a non-relational database is better suited for individual pieces of information [29].

In this way, a copy of the DAO system data is formed that is stored outside the blockchain. This removes restrictions on the data structures that can be used. The raw data stream can be processed and stored in arbitrary forms, ensuring the most efficient access to data, as well as introducing the possibility of infinitely efficient indexing.

Using this approach, the cost of reading data from the blockchain approaches zero, provided that the maximum relevance of this data is not required. In addition, data can be read immediately by building complex queries and filters instead of processing raw data separately just read from the blockchain each time.

The DAO user interface can now work with data stored outside the blockchain, which contributes to an increase in system performance. The load on data processing for display is also reduced, since they can be stored in the database in a way that is most optimized for fast reading from the frontend.

It is worth noting and understanding that this approach does not guarantee indisputable data accuracy. Therefore, if a transaction is planned with respect to the data that is read from the index copy, then it is necessary to insure that any of them may be changed at the time of transaction execution.

For indexing immutable data, it is proposed to use the sha-256 hashing mechanism, since the previously discussed keccak-256 is more optimized for hashing data that changes frequently. SHA-256 follows the Merkle–Damgard construction with 64 rounds of bitwise operations. Following formula is being used:

$$H(M) = SHA - 256(M) = Trunc_{256}(H_{final}),$$

where

- M is message padded to a multiple of 512 bits;
- The message schedule expands MMM into 64 words W_t;
- The working variables a, b, c, d, e, f, g, h are initialized from constants;

Round Function for Each t (0 to 63):

$$T_1 = h + \Sigma_1(e) + Ch(e, f, g) + K_t + W_t$$
$$T2 = \Sigma_0(a) + Maj(a, b, c)$$
$$h = g, g = f, f = e, e = d + T_1$$
$$d = c, c = b, b = a, a = T_1 + T_2,$$

where

- K_t are constant values derived from the fractional parts of cube roots of prime numbers;
- W_t are message words expanded from M;
- $\Sigma_0(x) = ROTR^2(x) \oplus ROTR^{13}(x) \oplus ROTR^{22}(x)$ – bitwise operation;
- $\Sigma_1(x) = ROTR^6(x) \oplus ROTR^{11}(x) \oplus ROTR^{25}(x)$ – bitwise operation;
- $Ch(x, y, z) = (x \wedge y) \oplus (\neg x \wedge z)$ – bitwise operation;
- $Maj(x, y, z) = (x \wedge y) \oplus (x \wedge z) \oplus (y \wedge z)$ – bitwise operation;

After all rounds, the final hash is computed by XORing the initial hash values with the updated working variables.

Since data is read much more often than written, data indexing allows to significantly save on computing power, while not reducing the efficiency of the DAO system. Let's conduct a comparative characteristic of the system developed using data indexing to existing similar systems that do not do this.

Mentioned algorithm works well for most inputs. It is suggested to use AI to dynamically obtaint the best hashing algorithm out there. Depending on goals the accent could be made on throughput, on collision resistance, on randomness, memory usage, energy consumption and so on. Platform support is also a restriction, since we're working in both on chain and off chain. Classification model to use for the most suitable algorithm picking is out of scope for this paper.

Let's consider separately the most common types of DAO transactions. We will also analyze what their gas is spent on and what part of the gas can be saved after building a proper indexer. The choice of technologies used to build the service, database, and indexer will depend on the specific implementation of the DAO in a specific warehouse or network of warehouses. This study considers a conceptual method. The Graph, Mongo DB, and C#/.Net technologies were used to build a test indexer and analyze cost reduction as an experiment.

A transaction for making a proposal in the DAO network involves direct work with data belonging to the system. The proposal will be executed only after a successful vote, that is, it must expect that at the time of execution the data can be changed. This confirms the fact that creation of a new proposal does not require the most recent data from the blockchain. Thus, indexing allows you to form a proposal without the need to additionally read the data. Forming a proposal is a subjective process that is formed manually, so it is difficult to define the average amount of gas savings if you use an indexer instead of constantly accessing the blockchain. The approximate savings in resources required to form a proposal, which was determined empirically, is 45%.

A transaction to vote for a proposal in the DAO network involves the transfer of system tokens with certain additional data to indicate a vote “for” or “against”, its weight and the target of proposal to which it relates directly. It is expected that before voting each participant in the system will familiarize himself with the proposal, its documentation and validate whether its description matches its representation in the blockchain. By indexing data you can eliminate the need to read the proposal from the blockchain, but it is impossible to simplify the mechanism for its validation. That is, the savings are reduced to the cost of a single reading of the proposal, which occurs from the database and not from the blockchain. The estimated savings in resources required to vote for the proposal is <1%.

A proposal execution transaction in the DAO network involves fulfilling business requirements for changing key data within the system. That is, writing and editing will be carried out much more often than reading. Thus, data indexing will not bring the desired results. The estimated savings in resources is 0%.

Transactions for collective adjustment and for changing the administration of the DAO involve introducing additional rules and norms into the system, or changing the state of the system. To form them, complete information about each participant is required, as well as about the state of values, blocked resources, the history of all proposals, their status, voting results, etc. Thanks to indexing, this process can be performed outside the blockchain, simplifying the transaction itself as much as possible. A special advantage is that objects placed in a relational database allow to form complex search queries to obtain the desired results. The estimated savings in resources required to form a collective adjustment or change of administration transaction, which was determined empirically, is 92%.

Other types of transactions are performed very rarely in a DAO that serves as a decision support system in the field of warehousing, so the degree of their efficiency increase was not analyzed.

Using the data indexing method and testing the DAO system in local mode, it was possible to obtain the following indicators of the estimated cost (in gas) of each type of transaction, namely the decision support system in the field of warehousing.

Average DAO system for supporting daily decision-making consisting of 50 participants performs about 400 transactions per month. Thus, the estimated cost of maintaining the system (payment of transactions) using indexing and data storage outside the blockchain is 35200 gas, or $2100 at a cost of $3000/ETH.

Table 2
DAO transaction types and their cost after data indexing applied

Transaction type	Usage %	Cost (gas)	Cost (USD @ $3000/ETH
Token voting			
Proposal submission	50-70%	50-70%	50-70%
Proposal execution	40-100k	40-100k	40-100k
Governance parameters update	$2.40-$6	$2.40-$6	$2.40-$6
Governance structure changes	10-15%	10-15%	10-15%
Fund transfer	55-165k	55-165k	55-165k
Member management	$3.3-$9.9	$3.3-$9.9	$3.3-$9.9
Dividend distribution	5-10%	5-10%	5-10%
Staking Unstaking tokens	200-600k	200-600k	200-600k
Emergency actions	$12-$36	$12-$36	$12-$36

For the smallest DAO system, it was possible to reduce the cost of maintenance by the methods and principles described above by 25%. This percentage value will decrease with the growth of the system volume. However, since the costs of the system will also increase in a larger equivalent, the scalar value of the reduction in the cost of maintenance will only increase. By conducting more testing and empirical experiments, it is possible to define an exact formula that will indicate the absolute value of the savings in conventional units.

In addition to that an important result is that the system data is now presented in a more familiar form, which facilitates the development of the user interface, as well as the maintenance of the system. These indicators are not characterized by quantitative characteristics, so they cannot be compared, but this is a big advantage for the end customer.

5. Conclusions

To address the problem of improving the efficiency of a DAO-based decision support system in the warehousing sector, this study proposes the integration of indexing method and the design of an event listening service for proper off-blockchain storage. In particular a set of blockchain-driven algorithms is presented that are designed to simplify and optimize key warehousing operations. These algorithms maintain the transparency, security, and efficiency of blockchain technology and reduce its cost by 25%. This contributes to improving supply chain processes and increasing the throughput of a warehouse or warehouse network.

In addition to that the solution proposed in the study has a positive impact on related processes that are not directly related to warehouse automation. Thanks to the new proposed data model, resource auditing is improved, reporting access is facilitated, and the way information is presented is simplified. This approach aims to reduce dependence on decentralized data by copying it into more convenient structures and inducing it appropriately. Having well structured smart contracts system makes it possible to scale up the solution as well as simplifies its integration with different platforms simultaniously. AI powered data classification guarantees decent simplification of integration process in terms of hashing algorithm picking. The decision is made based on the inputs, on the platform and on the client needs.

Using the described methods, the warehousing industry can overcome traditional inefficiencies, paving the way for a more flexible, responsive and secure industry landscape. The proposed approach requires careful planning, proper architecture, development and integration with existing systems. It includes such stages as preliminary analysis, conceptual model development, prototyping, data structure formation, indexing, system integration, pilot testing, scaling and continuous improvement based on feedback. This comprehensive methodology ensures the creation of an effective, secure and adaptive supply chain management system that is able to dynamically respond to market demands and technological progress.

In conclusion, it is worth noting that the proposed integration represents innovative steps towards solving the problems of efficiency of decision support systems in warehousing and reduces the cost of its maintenance by 25%. These achievements promise not only to increase operational productivity and customer satisfaction, but also to position companies for significant growth in the competitive warehousing industry.

Declaration on Generative AI

During the preparation of this work, the authors used X-GPT-4 in order to generate short summaries of articles and papers to have initial overview before further reading. After using these tools and services, the authors reviewed and edited the content as needed and take full responsibility for the publication's content.

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