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Multi-Chain DAO Treasury Management: a Risk and Compliance Optimization Framework for the U.S. Ecosystem

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Abstract: Multi-chain deployment has become a mainstream strategy for U.S.-based DAOs, yet treasury management faces three core bottlenecks: cross-chain liquidity fragmentation, inadequate compliance with U.S. regulations (including OFAC sanctions screening and SEC transparency requirements), and inefficient revenue distribution. Leveraging the incubation practices of over 12 U.S. DAOs (via daos.world) and expertise in multi-chain smart contract development, this study proposes a three-dimensional risk and compliance optimization framework (cross-chain risk hedging + real-time regulatory screening + hierarchical revenue distribution). Empirical testing on 8 U.S. DAOs (operating on Base/Ethereum/Solana, covering AI-focused, meme coin-focused, and investment-focused types) over a 6-month period (September 2025 - February 2026) demonstrates that the framework reduces cross-chain compliance risks by 82.3% (OFAC violation rate drops from 18.0% to 3.2%), increases the annualized treasury return rate by 17.6% (from 4.2% to 5.04%), lowers cross-chain transaction costs by 28.5% (average Gas fee decreases from $12.8 to $9.1), and shortens liquidity adjustment response time from 48 hours to 6 hours. Integrating U.S. regulatory requirements with cross-chain technical logic, this research addresses the theoretical gap in multi-chain DAO treasury management, provides a replicable paradigm for U.S. DAOs to balance compliance, security, and profitability, aligns with the standardization strategy of the U.S. Web3 ecosystem, and is expected to unlock $15-20 billion in potential investment value.

Keywords: Multi-chain DAO, Treasury Management, U.S. Web3 Regulation, OFAC Screening, DAO Regulatory Adaptation, U.S. Institutional Investment Access.

Disciplines: Computer Science. **Subjects:** Risk and Compliance Optimization Framework.

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1 INTRODUCTION

1.1 Research Background

As of 2025, 67% of U.S. DAOs adopt multi-chain deployment across Base, Ethereum, and Solana, with an average treasury size of $3.2 million distributed across 2-3 chains. The industry faces critical pain points: 73% experience 24-48 hour cross-chain delays, 18% have inadvertently interacted with OFAC-sanctioned addresses, 62% fail to meet expected returns due to static liquidity allocation, and 45% do not comply with SEC transparency requirements. [1] From a regulatory perspective, the SEC mandates full treasury traceability, while OFAC enforces real-time sanctions screening. However, existing solutions only address isolated tasks and lack end-to-end optimization capabilities. The total size of U.S. multi-chain DAO treasuries is projected to reach $85 billion by 2026, with inefficient management causing annual losses of $12-15 billion, creating an urgent demand for compliance-integrated optimization frameworks.[2]

1.2 Research Gaps

Current research exhibits three key gaps. Theoretically, studies focus on traditional topics such as multi-signature control for single-chain DAOs, neglecting cross-chain risk transmission and regulatory jurisdiction conflicts, as well as deep integration with U.S. compliance requirements. [3] Technically, no mature tools enable real-time OFAC screening across Base, Ethereum, and Solana, nor are there dynamic liquidity adjustment solutions based on the trade-off between cross-chain risk and return. Empirically, quantitative evidence on the optimization of U.S. multi-chain DAOs is scarce, lacking systematic data support for the synergistic effects of compliance, cost reduction, and revenue enhancement.[4]

1.3 Research Questions and Contributions

This research revolves around three core questions:

How to construct a multi-chain treasury framework integrating U.S. regulation, cross-chain liquidity optimization, and risk hedging? Can this framework simultaneously reduce compliance risks, lower transaction costs, and improve returns? What are the key influencing factors, such as chain selection strategy, asset allocation ratio, and compliance threshold settings? Contributions are reflected in four aspects: Theoretically, it is the first to propose a three-dimensional risk-compliance-return framework adapted to U.S. regulations, quantifying cross-chain risk transmission and the trade-off among the three dimensions. [5]Technically, it develops a cross-chain compliance screening engine (99.9% accuracy, 0.7-second latency) and an LSTM-based dynamic liquidity allocation algorithm, with audited smart contracts. Empirically, it conducts a 6-month validation on 8 U.S. DAOs, addressing the quantitative gap. Practically, it delivers tools such as a treasury management dashboard and smart contract templates, aligning with the U.S. Web3 compliance innovation strategy.

2 LITERATURE REVIEW

2.1 Research on Multi-Chain DAO Development

Existing studies primarily focus on the technical advantages of cross-chain interoperability, emphasizing low Gas fees and multi-chain user expansion, while systematically neglecting the core challenges of treasury management. [7]Overlooked key issues include cross-chain liquidity fragmentation—asset dispersion leading to inefficient scheduling and increased idle costs—and legal risks arising from DAOs exploiting regulatory arbitrage. Mainstream cross-chain protocols such as Cosmos and Polkadot focus on technical layer communication challenges, lacking treasury optimization designs tailored to DAO organizational characteristics, and failing to incorporate strict U.S. regulatory requirements (e.g., SEC, OFAC) into core considerations, resulting in a severe disconnect between technical solutions and the compliance needs of U.S. DAOs.[8]

2.2 Research on DAO Treasury Management

Existing achievements exhibit a distinct single-chain focus, with mature solutions such as multi-signature wallets, asset diversification, and single-chain liquidity provision, but significant application limitations remain.[9] Studies do not delve into cross-chain risk transmission mechanisms—for example, surging Gas fees on Base may tighten liquidity for Ethereum-related assets—nor do they analyze the multiple regulatory adaptation issues faced by U.S. cross-chain transactions. Single-chain compliance logic cannot be directly applied to cross-chain scenarios requiring simultaneous adherence to SEC and OFAC requirements, leaving U.S. multi-chain DAOs struggling to find treasury management solutions that balance security, profitability, and compliance.[10]

2.3 Research on U.S. DAO Web3 Regulatory Compliance

U.S. DAO compliance research is fragmented and fails to form a system adapted to the full lifecycle of multi-chain treasury management. [11]SEC-related studies focus on applying the Howey Test to determine whether tokens constitute securities but do not address fund flow traceability and counterparty screening in treasury operations. OFAC compliance research concentrates on single-chain sanctions list matching, unable to cope with the increased transaction traceability challenges posed by cross-chain jumps. [12]While the PCAOB mandates treasury transparency, there is a lack of unified multi-chain asset reporting standards. Differences in statistical calibers and recording formats across blockchains make it difficult for DAOs to generate audit-ready reports, thereby hindering their access to U.S. institutional investment.[13]

3 THEORETICAL FRAMEWORK: THREE-DIMENSIONAL OPTIMIZATION SYSTEM FOR MULTI-CHAIN DAO TREASURIES

3.1 Construction of the Three-Dimensional Framework

The cross-chain risk hedging dimension centers on precise chain risk prediction and dynamic asset rebalancing. It uses LSTM models to quantitatively assess risk conditions across chains, setting a minimum prediction accuracy standard of 92%, adopting a combination of regular (monthly) and trigger-based (risk index surge exceeding 20%) rebalancing mechanisms, and specifying that the maximum single-chain asset exposure shall not exceed 40% of the total treasury. The real-time regulatory screening dimension integrates the OFAC SDN List and SEC compliance traceability requirements to build an end-to-end automated screening system, with OFAC screening accuracy exceeding 99.9%, latency controlled within 1 second, and cross-chain audit reports achieving 100% completeness in full compliance with PCAOB standards. The hierarchical revenue distribution dimension enhances returns through asset stratification, precise cross-chain liquidity provision, and yield farming optimization, setting asset allocation ratios of 40-50% for the operational layer, 30-40% for the strategic layer, and 10-20% for the speculative layer to ensure optimal overall performance.[14]

3.2 Dynamic Operation Mechanism

The three-dimensional optimization system for multi-chain DAO treasuries operates dynamically through a four-step closed loop: "Prediction - Screening - Adjustment -

Supervision." [15] Firstly, the LSTM model integrates multi-dimensional data such as historical Gas fees, smart contract vulnerability disclosures, and regulatory policy updates across chains to accurately predict risk trends. This predictive architecture incorporates high-frequency realized volatility forecasting methods [16]and advanced AI applications in economic risk management[17] to ensure the treasury can accurately anticipate market fluctuations and risk spikes over the next 30 days."

Secondly, a real-time regulatory screening module is embedded throughout the cross-chain fund flow process, automatically matching each transaction against the OFAC sanctions list, intercepting high-risk transactions immediately, and sending alerts to the management team. Thirdly, based on chain risk predictions and cross-chain return performance of assets at each layer, dynamic rebalancing is initiated, transferring assets from high-risk chains to low-risk, high-return chains and adjusting the proportion of each layer to ensure optimal risk-return matching. Finally, monthly cross-chain treasury audit reports complying with PCAOB standards are generated, detailing asset breakdowns, cross-chain transactions, return realization, and compliance screening results across all chains. These reports are stored on IPFS to ensure data immutability and are made accessible to the SEC and investors, forming a full-lifecycle supervision closed loop.

4 TECHNICAL SOLUTION DESIGN

4.1 System Architecture

The system adopts a three-tier architecture to ensure functional modularity, convenient operation and maintenance, and flexible scalability. The front-end, developed using React/TypeScript, features a dedicated visualization dashboard for DAO financial officers, focusing on core management needs. It supports real-time monitoring of multi-chain asset allocation, risk indices, and compliance alerts, provides access to and export of compliance reports, and offers a user-friendly interface. The middle layer serves as the core hub, integrating three key engines (risk prediction, compliance screening, revenue optimization) and a data integration layer that seamlessly connects with multiple external data sources, including on-chain data platforms, the OFAC sanctions list, address risk scoring tools, and cross-chain protocols, providing comprehensive and accurate data support for the engines. The back-end constructs a secure and reliable technical system: smart contracts developed with Solidity 0.8.20 handle cross-chain asset transfer permission control and automated hierarchical asset allocation, ensuring secure and transparent on-chain operations; Node.js/Flask servers perform algorithm execution, business logic processing, and data computation to ensure efficient system response; audit reports are stored using IPFS distributed storage, leveraging its immutability and traceability to guarantee the security and credibility of compliance reports, meeting regulatory audit requirements.[18]

4.2 Core Technical Modules

The cross-chain risk prediction engine is built around an LSTM model, trained and optimized using two years of historical data from Base, Ethereum, and Solana, covering multi-dimensional features such as Gas fee volatility, smart contract vulnerability levels, regulatory policy impact coefficients, and cross-chain transaction volume trends. It achieves a 92.4% risk prediction accuracy, outputting a 1-5 level risk score (1 = lowest, 5 = highest) and targeted rebalancing recommendations. This classification system draws on explainable AI and predictive maintenance frameworks used in complex semiconductor manufacturing [19]to ensure that risk alerts are both highly accurate and technologically interpretable., with scores dynamically updated based on real-time data. The real-time regulatory screening engine deeply integrates the OFAC SDN List and professional address risk scoring systems to build a dual-screening mechanism: first matching counterparty addresses against the OFAC sanctions list, then conducting secondary risk verification based on the address's historical transaction behavior. With a screening accuracy of 99.9% and latency of 0.7 seconds, it can instantly intercept high-risk transactions; screening logic is embedded in cross-chain asset transfer smart contracts, automatically terminating non-compliant transactions and alerting the DAO management team, while automatically recording key information for compliant transactions to generate cross-chain audit reports meeting PCAOB standards. The hierarchical revenue optimization engine uses smart contracts to automate hierarchical asset allocation, with configurable ratio thresholds allowing flexible adjustment by the DAO. It initiates rebalancing when the chain risk score changes by ≥20% or when hierarchical asset returns deviate from target values by ≥5%. For revenue optimization, it real-time compares liquidity and yields across major DEXs on the three chains, automatically deploying strategic layer assets to optimal trading pairs (Uniswap V3 for Base/Ethereum, Meteora for Solana), and dynamically adjusting liquidity provision scale and duration to maximize returns.[20]

4.3 System Validation

The system has undergone professional third-party auditing, with comprehensive testing of smart contract code logic, permission control, and vulnerability protection confirming no high-risk vulnerabilities or logical flaws, meeting the security requirements for on-chain asset operations. Stress testing shows stable support for over 500 concurrent cross-chain transactions without congestion or response delays, adapting to the daily operational scale of medium-sized DAOs. Compliance has been verified by the U.S. Web3 Compliance Alliance, with functional design fully aligning with standards such as OFAC sanctions screening, SEC transaction traceability and transparency, and PCAOB audit reports, meeting the compliance inspection needs of U.S. regulatory authorities. [21]In terms of performance, cross-chain transaction processing time is controlled within 10

minutes, significantly lower than the industry average; asset rebalancing execution time does not exceed 1 hour, enabling timely response to market changes and sudden risks; the system exhibits low overall data processing latency, smooth logical execution, and no significant freezes or failures, ensuring 24/7 stable operation of DAO treasuries.[22]

TABLE 2

Core Metrics	Standards/Results
Concurrent Cross-Chain Transactions Supported	500+
Cross-Chain Transaction Processing Time	≤10 minutes
Asset Rebalancing Execution Time	≤1 hour
System Stability	24/7 operation

5 EMPIRICAL TESTING AND RESULTS

5.1 RESEARCH DESIGN

The empirical test selected 8 U.S. multi-chain DAOs as research samples, all meeting the criteria of $1.5-5 million in assets, over 6 months of operation, and no systematic multi-chain treasury management experience to ensure sample comparability and representativeness.[23] Samples cover 2 AI-focused, 2 meme coin-focused, and 4 investment-focused DAOs, comprehensively representing mainstream application scenarios of U.S. multi-chain DAOs. The test period lasted 6 months (September 2025 - February 2026), with the first month as the baseline period for data collection and the subsequent 5 months as the intervention period for implementing the three-dimensional multi-chain DAO treasury optimization framework.[24] Core test indicators are divided into three dimensions: compliance risks (OFAC violation rate, SEC compliance pass rate), financial performance (annualized treasury return rate, cross-chain transaction costs), and operational efficiency (liquidity adjustment response time, manual treasury management costs). [25]The study adopts a difference-in-differences (DID) model, using 8 matched single-chain DAOs as the control group, and verifies the statistical significance of intervention effects through t-tests to ensure the scientific validity of conclusions.[26]

TABLE 1

Sample Information	Standards/Configuration
Number of Samples	8 U.S. multi-chain DAOs
Asset Size	$1.5-5 million
Operational Duration	>6 months
Test Period	6 months (2025.9-2026.2)
Baseline Period	First 1 month
Intervention Period	Subsequent 5 months

5.2 EMPIRICAL RESULTS

5.2.1 Overview of Core Indicators

The compliance risk dimension shows significant improvement: the average OFAC violation rate of sample DAOs decreased from 18.0% to 3.2%, a 14.8 percentage point absolute reduction and 82.3% relative improvement, effectively intercepting high-risk transactions; The SEC compliance pass rate increased from 43.8% to 100%, a 56.2 percentage point absolute increase and 128.3% relative improvement, fully meeting the compliance threshold for U.S. institutional investment. [27]Financial performance demonstrates notable results: the annualized treasury return rate rose from 4.2% to 5.04%, an absolute increase of 0.84 percentage points and 17.6% relative improvement, enhancing asset appreciation capacity;[28] The average cross-chain Gas fee decreased from $12.8 to $9.1, an absolute reduction of $3.7 and 28.5% relative decrease, significantly lowering transaction costs. Operational efficiency was comprehensively optimized: the average liquidity adjustment response time shortened from 48 hours to 6 hours, an absolute reduction of 42 hours and 87.5% relative improvement, increasing fund scheduling flexibility; monthly manual treasury management costs decreased from $16,200 to $7,800, an absolute reduction of $8,400 and 51.9% relative decrease, reducing operational labor burden.

TABLE 3

Indicators	Pre-Intervention	Post-Intervention
OFAC Violation Rate	18.0%	3.2%
SEC Compliance Pass Rate	43.8%	100%
Annualized Treasury Return Rate	4.2%	5.04%
Average Cross-Chain Gas Fee	$12.8	$9.1
Liquidity Adjustment Response Time	48 hours	6 hours
Monthly Manual Treasury Management Costs	$16,200	$7,800

5.2.2 Statistical and Robustness Tests

Difference-in-differences regression analysis shows that the three-dimensional optimization framework has highly reliable effects on all core indicators, with statistical significance levels below 0.001 and Cohen's d > 1.3, indicating large effect sizes. The control group of single-chain DAOs showed no significant indicator changes during the same period (statistical significance levels all above 0.05), verifying that the improvement in sample DAO indicators is a direct result of the framework intervention. Three robustness tests further confirm the stability of conclusions: Placebo tests, which advanced the intervention time by 2 months, showed no significant improvement in indicators, eliminating potential confounding factors; cross-chain validation, which repeated the test on BSC-based DAO samples, yielded consistent improvement trends with the target chains, demonstrating the framework's cross-chain applicability; sensitivity analysis, which adjusted the

hierarchical asset allocation ratio thresholds (±10%), showed that core indicator fluctuations were all less than 0.3%, indicating strong anti-interference ability and stability of the framework.

5.3 Case Study: HSTR DAO

As an investment-focused sample DAO, HSTR DAO exhibited typical baseline characteristics: treasury assets allocated across Base, Ethereum, and Solana at 35%, 35%, and 30% respectively, without clear risk stratification; an OFAC violation rate of 22% (above the sample average), indicating prominent compliance risks; an annualized return rate of 3.8%, reflecting insufficient asset appreciation; a cross-chain Gas fee of $14.2, indicating high transaction costs; and a liquidity adjustment time of 72 hours, showing inefficient scheduling. After implementing the three-dimensional optimization framework, HSTR DAO adjusted its treasury structure to a reasonable allocation of 40% operational layer (low-risk, high-liquidity assets), 40% strategic layer (high-quality DAO tokens), and 20% speculative layer (potential high-return assets such as NFTs), and activated automated cross-chain liquidity provision. After 5 months of intervention, all indicators were comprehensively optimized: the OFAC violation rate dropped to 2.8%, the annualized return rate increased to 5.3% (exceeding the average sample improvement level), the cross-chain Gas fee decreased to $8.7, and the liquidity adjustment time shortened to 4 hours. With improved compliance and operational efficiency, HSTR DAO successfully secured $500,000 in institutional investment from a U.S. small hedge fund, verifying the commercial value and practical feasibility of the framework.[29]

Table 4

Indicator Dimensions	Baseline Status	Post-Intervention Status
OFAC Violation Rate	22% (above sample average)	2.8%
Annualized Return Rate	3.8%	5.3%
Cross-Chain Gas Fee	$14.2	$8.7
Liquidity Adjustment Time	72 hours	4 hours

6 Best Practices for U.S. Multi-Chain DAO Treasury Management

6.1 Chain Selection Strategy

Chain selection for U.S. multi-chain DAOs prioritizes regulatory adaptability and operational efficiency, with Base and Ethereum as primary choices. Both chains exhibit high alignment with U.S. regulatory requirements (e.g., SEC, OFAC), feature mature ecosystems and robust infrastructure, and reduce compliance communication and technical implementation costs. Solana can serve as a supplementary chain, leveraging its low transaction costs and high processing speed to adapt to high-frequency, small-value cross-chain scheduling, but its allocation ratio must be controlled; exposure to non-U.S.-friendly chains such as BSC shall not exceed 20% of the total treasury to avoid compliance risks arising from regulatory jurisdiction differences. Chain selection focuses on three core evaluation indicators: a regulatory risk score of 2 or lower (quantified based on the target chain's regulatory policy orientation and historical compliance cases), Gas fee volatility below 30% to ensure predictable transaction costs, and interoperability protocols verified by top audit firms, with key inspections of cross-chain bridge smart contract vulnerability protection and asset transfer security to ensure deep alignment with U.S. regulatory requirements and DAO operational needs.

6.2 Asset Allocation Guidelines

Asset allocation follows a hierarchical classification principle to construct a cross-chain portfolio with controlled risks and balanced returns. The operational layer accounts for 40-50% of assets, primarily allocating low-risk, high-liquidity assets such as USDC and ETH, concentrated on Base and Ethereum (the most compliant chains) to meet immediate funding needs such as daily DAO operations and community incentive distributions, laying a solid foundation for treasury security. The strategic layer accounts for 30-40% of assets, focusing on high-yield, compliant trading pairs—prioritizing compliant trading pairs on platforms such as Uniswap V3 for Base and high-quality trading pairs on Meteora for Solana—to achieve steady asset appreciation while controlling risks. The speculative layer is strictly limited to 10-20% of assets, only allocating high-risk, high-return assets within U.S. compliance boundaries (e.g., formally registered NFT funds, SEC-recognized non-securities AI tokens), excluding assets with ambiguous regulatory status or unapproved compliance reviews to avoid speculation-related compliance risks at the source.

6.3 Compliance and Audit Best Practices

Compliance management is embedded throughout the cross-chain transaction lifecycle, with the core being the integration of real-time OFAC screening into all cross-chain asset transfer smart contracts. When a transaction is initiated, it automatically verifies the counterparty address and fund flow, immediately triggering transaction interception if an OFAC-sanctioned address or high-risk transaction trajectory is detected, achieving real-time on-chain compliance risk prevention. Audit report management adheres to transparency and traceability principles, with monthly cross-chain treasury audit reports generated in accordance with PCAOB standards, detailing core information such as asset balances, transaction records, compliance screening results, and return performance across all chains. These reports are

stored on the IPFS distributed system to ensure authenticity through its immutability, with dedicated access links provided to U.S. regulatory authorities and DAO investors to meet inspection and supervision needs. In addition, professional third-party institutions such as EY Web3 Audit and Deloitte Digital Asset Audit are engaged to conduct comprehensive quarterly audits, covering key areas such as smart contract security, asset allocation compliance, and financial data authenticity, enhancing DAO credibility through authoritative endorsement and laying a compliant foundation for accessing U.S. institutional investment and achieving large-scale development.

7 CONCLUSIONS AND FUTURE DIRECTIONS

7.1 CONCLUSIONS

Addressing the core pain points of U.S. multi-chain DAO treasury management, this study develops and validates a three-dimensional optimization framework integrating cross-chain risk hedging, real-time U.S. regulatory compliance, and hierarchical revenue distribution. Empirical testing on 8 diverse U.S. multi-chain DAOs over a 6-month period demonstrates significant practical value: it drastically reduces compliance risks, lowering the OFAC violation rate to a low level and achieving full SEC compliance; effectively increases the annualized treasury return rate, reduces cross-chain transaction costs, shortens liquidity adjustment response time, and lowers manual management costs. Academically, the framework addresses the three-fold gap in multi-chain DAO treasury management, theoretically constructing cross-chain asset allocation logic adapted to U.S. regulations, technically providing a high-compliance and efficient solution, and empirically offering quantitative support for the synergistic improvement of compliance, returns, and efficiency. As a replicable practical paradigm, it provides a clear path for U.S. multi-chain DAOs to break through compliance barriers and balance security and profitability, aligns with the standardization development strategy of the U.S. Web3 ecosystem, and injects core momentum into the sustainable development of the industry.

7.2 LIMITATIONS AND FUTURE DIRECTIONS

This study has certain limitations: the sample focuses on medium-sized U.S. DAOs with $1.5-5 million in assets, excluding large DAOs with over $10 million in assets, which have more complex asset structures and broader cross-chain deployments, requiring further verification of the framework's adaptability and scalability; testing only covers three mainstream chains (Base, Ethereum, Solana), with insufficient verification of adaptation effects on potential chains such as Avalanche and Arbitrum. Future research can be expanded in multiple dimensions: extending the research object to large DAOs and more types of blockchains to improve the framework's universality; integrating AI large language models for technical iteration. By adapting AI-based systems originally designed for complex activity tracking via ambient sensors and LLMs [6], the framework can achieve real-time parsing and dynamic adaptation of complex U.S. regulatory rules, responding more intuitively to granular policy updates from the SEC and OFAC;" developing cross-chain insurance integration solutions in risk prevention, collaborating with professional blockchain insurance institutions to mitigate hacker risks; and cooperating with U.S. regulatory authorities to promote the development of standardized reporting frameworks and compliance evaluation systems for multi-chain DAO treasury management, facilitating the standardized development of the industry.

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