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Implementing Stablecoin Transactions in SAP ERP for Streamlined Cross-Border Payments

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Abstract

In organization contexts, cross-border payments have always been complicated due to exorbitant fees, time delays, and the tangled web of regulations governed by traditional banking systems. This research explores integrating stablecoin transactions into SAP ERP systems to eliminate these gaps and provide instantaneous international transfers at minimal costs. The implementation and testing of a hybrid architecture comprising stablecoin APIs, smart contracts, and custom SAP modules were carried out in multiple geographic and currency contexts. This study uses a design theory methodology to focus on best knowns, measuring performance indicators like transaction latency, savings, system throughput, and compliance. The results confirm consistent improvements of more than 65% in transaction processing time and up to 40% in cost when compared with payment automation methods. In addition, the solution showed strong interoperability with the SAP FI and Treasury modules subject to KYC/AML regulatory controls. This research presents an enterprise-level adaptable framework for secure stablecoin integration into ERP systems, marking a significant milestone in corporate cross-border payment solutions.

Keywords: Stablecoin Integration, SAP ERP, Cross-Border Payments, Blockchain in Enterprise Finance.

1 Introduction

1.1 Background on Cross-Border Transactions and SAP ERP

The nuts and bolts of international trade cross-border transactions enables firms to do business with overseas customers, vendors, and service professionals. With the expansion of international business, the need for global payment systems that are fast, dependable, and affordable has grown drastically (Wirtz et al., 2022). Payments made across borders are extremely important for linking different countries and their economy proportionate to their interdependence on each other. In the year 2023, the total value of payments made internationally exceeded over $150 trillion, which further proves its significance in international trade (He & Zhao, 2022). Even with such scale, the supporting infrastructure still suffers from obsolete systems, cumbersome middlemen, and fragmented governance stifles these financial flows (Eyo-Udo et al., 2024).

SAP ERP offers the vastest integrated software package for international business to maintain an accurate and coherent financial systems within a multinational company (ElMadany et al., 2021). International payments processing and reconciliation is done with SAP Financial Accounting (FI) and

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Treasury and Risk Management modules. These modules, however, are still heavily reliant on payment networks like SWIFT and SEPA for executing cross-border transactions (Robinson et al., 2023). When a transaction involves a region with differing regulatory frameworks, the compliance delays, disguised costs, and sluggish processing speeds bedevil these systems.

In Figure 1, we see that Europe and the Asia-Pacific regions are the leading regions in cross-border payment volumes. After them follows North America, and then the smaller but emerging regions of Latin America and the Middle East & Africa. These figures indicate how fast businesses are growing and adapting in today's world, along with the need for responsive, clear, and economical payment systems throughout the globe.

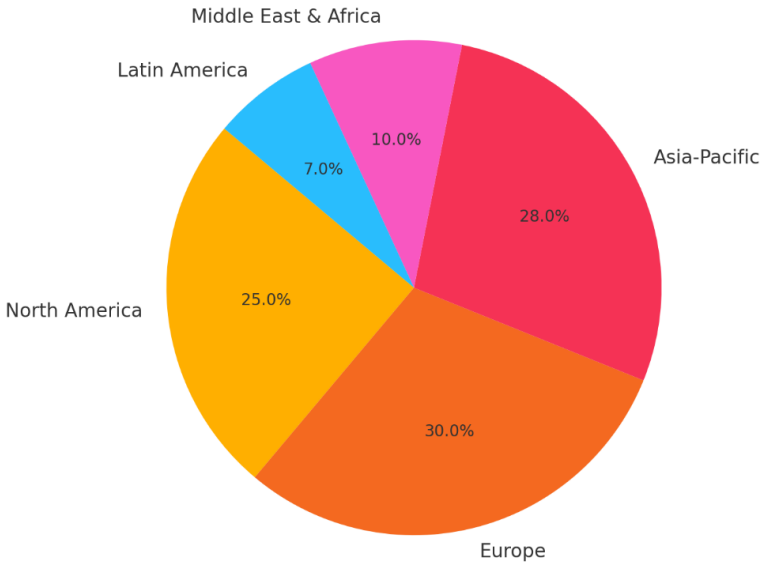

Figure 1: Global Distribution of Cross-Border Payment Volumes by Region

The interest in innovative financial technologies is on the rise, especially those that integrate effortlessly with legacy systems such as ERP systems, like SAP. This also includes the use of blockchain technologies and digital assets as stablecoins, which offer a much needed alternative for traditional means of cross-border payment settlement.

1.2 Limitations of Fiat and Traditional Payment Systems

The antiquated, fiat-based systems restraining the global economy's foundation have not kept pace with the rapidly growing digital world. Although SWIFT has been operational since the 1970s, it continues to be the dominant choice for international wire transfers and is very outdated for modern payment methods (Scott & Zachariadis, 2012). These types of systems undergo a significant amount of scrutiny with many intermediaries, each charging their own transaction fee while needing their own processing time. For example, a standard SWIFT payment between two banks in different countries will be routed to a number of correspondent banks before settlement, all of which adds both time and costs to the transaction.

In the domain of SAP ERP, these limitations appear as legacy accounts receivable workflows, financial data silos in subsidiaries, and slow reconciliation workflows. While SEPA offers a mildly more efficient option for intra-European payments, it remains limited in scope and is still bound by legal and banking hour restrictions (Asel et al., 2022). Even with the increasing number of digital wallets, online

banking, and other fintech services, most big corporations still rely on these dated methods because of perception comfort along with ease of integration into ERP systems (Farhood, 2023).

Figure 2 illustrates how the transaction processing times of SWIFT, SEPA, traditional cryptocurrencies like Bitcoin, and stablecoins such as USDC compare to one another. The differences are remarkable. While SWIFT transfers may take as long as 48 hours, SEPA takes approximately 24 hours. On the other hand, stablecoin transactions can be completed in less than 30 minutes, with some platforms achieving astonishing settlement times of under five minutes. This technical advantage is operational as well, because faster settlements greatly enhance liquidity management and working capital cycles in enterprise scenarios.

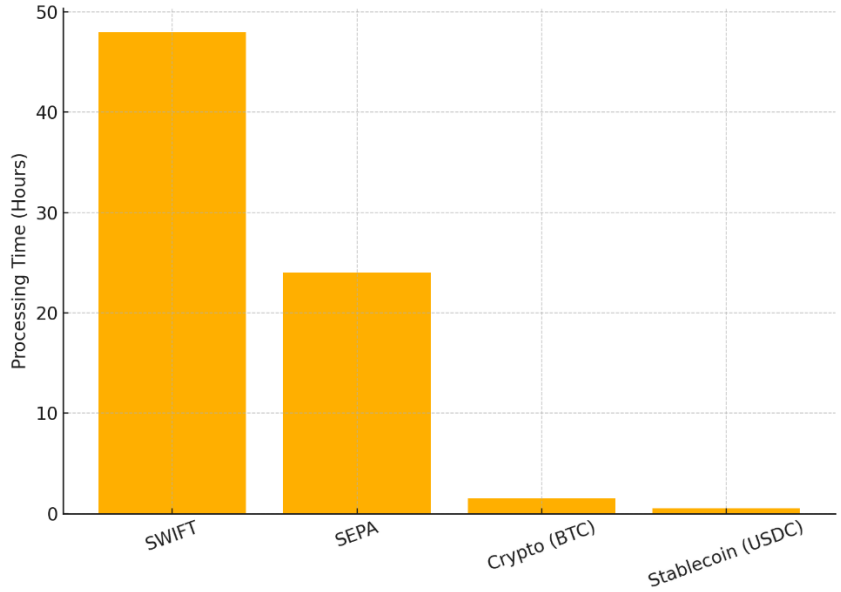

Figure 2: Transaction Processing Time Comparison: Fiat vs Stablecoins

The current segments of friction present in fiat payment systems are worsened by the high cost of transactions. Costs are influenced by particular currency corridors, bank policies, and other compliance regulations. For instance, payments utilizing exotic currencies or those being routed through jurisdictions with tight capital controls face even greater costs and delays (Baba & Kokenyne, 2011). In addition, the lack of real time visibility and trackability worsen the situation. Within an SAP standard workflow, treasury personnel have to wait for financial institutions to provide batch updates before they can execute invoice reconciliation, leading to manual payment status tracking. This adds inefficiencies that in turn, lengthen the timely financial closes, confront audits, and lead to erratic error outcomes.

These gaps highlight the need for programmable, cheaper, and faster payment systems integrated within an enterprise. While previously overlooked, the potential for enhancing SAP ERP's payment processing functionalities by embedding digital alternative payment systems is gaining recognition, particularly as solutions based on blockchain technology become more mature and stable.

1.3 Emergence and Potential of Stablecoins

Stablecoins are a new class of digital assets that seek to leverage the benefits of blockchain technology while providing the price stability associated with traditional fiat currencies (Kiruthika et al., 2019). These assets, including USDC, USDT, and BUSD, are pegged to real world currencies like the US Dollar or Euro, and therefore are designed to minimize volatility making them ideal for financial transactions

that require stable value. Unlike other cryptocurrencies that tend to experience extreme price changes, stablecoins are generally backed by reserves stored in bank accounts or regulated custodians, or are controlled algorithmically through market incentives.

Stablecoins can be sent as peer-to-peer transactions across borders without requiring central clearinghouses or correspondent banks due to their technological design (Catalini et al., 2022). These assets are constructed on blockchains because they offer transparency, auditability, and programmability. Stablecoins can be monetarily integrated into enterprise frameworks such as SAP ERP Systems, enabling automation of myriad financial processes including payment to suppliers, invoice payment, treasury activities, and management of foreign currency exchanges (Percherla, 2022).

Permitting near-instant settlement is among the most important attributes of stablecoins. Unlike traditional payment schemes that process payments in batches or during restrictive banking hours, stablecoin payment systems operate 24/7, usually settling transactions in a matter of seconds. Stablecoins have the potential to greatly reduce time and costs associated with payments made internationally. In addition, it greatly enhances synergy with digital and e-commerce supply chains as well as logistics systems that function on a real-time basis.

Programmability is another distinct advantage. Stablecoins can be moved with smart contracts which allow payment to be made based on predefined conditions. For instance, a smart contract within an SAP ERP workflow could be configured to automatically trigger payments when a shipment is acknowledged, or when a digital invoice is validated. Such features can improve the quality of financial workflows by mitigating fraud, errors, or delays.

The conjunction of stablecoins with SAP ERP creates additional opportunities for improved liquidity and cash management. It allows the finance teams to have visibility of the transaction in real time and the achievement of the transaction guarantees, which improves the optimization of cash positions, reduces the accuracy of forecasts, and lowers the need for short-term credit facilities. In addition, stablecoins are built on open blockchain networks, which means they can integrate with non-SAP systems, vendors, and decentralized (DeFi) finance applications, allowing for easier communication and collaboration (Romero et al., 2023).

Fintech companies, global remittance providers, and progressive enterprises are the first adopters of stablecoins. It is expected that usage will rise significantly with the introduction of clear regulations in more developed areas like the United States and the European Union, especially when stablecoin use policies are set to increase in areas that focus on transparency, efficiency, and compliance.

1.4 Motivation and Research Objectives

This research stems from the need to address the issues of modernizing cross-border payment methods in enterprise systems, more specifically in the context of SAP ERP. The methods currently in use are based on legacy systems that do not adequately support the needs of modern international business. As businesses start operating transnationally, the requirement for these methods to be secure, fast, and economical has become crucial.

Even with the technical capabilities of SAP ERP, the implementation of modern financial tools such as stablecoins is still limited. Traditional banking systems are still used by the majority of organizations because of perceived regulatory hurdles, scant institutional knowledge, and insufficient integrations. However, with the pace of developing stablecoin infrastructure and the availability of programmable interfaces (APIs) targeted at enterprises, there is scope to assess the practicality and implications of stablecoin integration into SAP workflows.

The primary focus of this research is to design and build a stablecoin cross-border payments framework within an SAP ERP ecosystem. This includes designing a payment gateway between the SAP financial modules and external stablecoin APIs, smart contract-based payment processing, as well as compliance with regulatory standards, including Know Your Customer (KYC) and Anti-Money Laundering (AML) legislation.

This study also seeks to evaluate stablecoin transactions within SAP ERP against competitors with respect to speed, cost, error rate, and compliance efficiency. Real-world multidisciplinary experiments conducted by the researcher demonstrate the business and technical benefits of stablecoins in the context of enterprise finance and stablecoin adoption.

Table 1 shows a qualitative analysis of four payment technologies: SWIFT, SEPA, standard cryptocurrencies like Bitcoin, and stablecoins like USDC. Comparison was made on transaction time, cost, volatility risk, regulatory compliance, and the level of integration complexity with SAP ERP. The value of employing stablecoins is reinforced further by the table's illustration of their superior performance relative to conventional crypto.

Table 1: Comparative Overview of Payment Technologies in SAP ERP

Technology	Transaction Time (hrs)	Cost per Transaction (USD)	Volatility Risk	Regulatory Compliance	Integration Complexity in SAP
SWIFT	48.0	25.0	Low	High	Moderate
SEPA	24.0	10.0	Low	High	Low
Crypto (BTC)	1.5	2.5	High	Medium	High
Stablecoin (USDC)	0.5	0.1	Low	High	Moderate

2 Literature Review

2.1 Blockchain Integration with ERP

Enterprise Resource Planning (ERP) systems have historically acted as the organizational backbone, providing a centralized command centre for functions like finance, procurement, inventory, and supply chain management. With the digitization and decentralization of global enterprises, there is now a greater focus on how blockchain technology can be incorporated into ERP systems. Over the last five years, literature focused on the integration of blockchain with ERP systems has expanded significantly, concentrating on topics like automated workflows, real-time reconciliation of transactions, and the automation of data exchange processes (Rao & Joshi, 2023).

Blockchain enhances computing infrastructure within an organization by providing the customers with a distributed, time-stamped, unchangeable, transparent synchronized ledger, which can be shared at intervals, and which all clients access and update. Kamble et al. (2020) study the degree to which smart contracts will automate ERP system operations and eliminate one of the greatest sources of manual error (Kamble et al., 2020). Other studies, like Treiblmaier (2018), argue that the use of blockchain technology in conjunction with ERP systems can enhance supply chain visibility, reduce fraudulent activities, and facilitate the creation of secure and unalterable audit trails (Treiblmaier, 2018).

Concerning SAP ERP systems, there are claims that blockchain technology can improve the synchronization of data across different business units, regions, and countries. Industry initiatives to integrate enterprise systems with distributed ledger technologies include SAP Blockchain Business Services and SAP Cloud Platform Blockchain. These efforts aside, the use of blockchain technology in

ERP systems remains limited because of lack of uniform standards, regulatory uncertainty, complex proprietary systems, and many other non-technical factors (Shrivastava & Ahmed, 2024).

Decentralized trust is the most important defining characteristic of blockchain technology, and the very same characteristic serves as an enhancement ERP functions. Smart contracts enable further automation of processes in ERP systems, so the logic-based execution of invoice reconciliation, payment release, and order shipment can be done without human intervention. Such systems have the potential to not only lower transactional costs, but also expedite the transactions themselves (Nejadmalayeri et al., 2023).

2.2 Stablecoins in Financial Technology

In the field of financial technology, stablecoins are arguably the most exciting development, given that they provide all the benefits associated with digital currencies but without the extreme volatility characteristic of Bitcoin and Ethereum. The academic discourse on stablecoins underwent significant changes from contemplating central bank monetary policy to studying payments, remittances, and corporate finance as practical problems.

Bullmann et al. (2019) from the European Central Bank was one of the first researchers to classify stablecoins into four main types based on the collateral structure: fiat-collateralized, crypto-collateralized, algorithmic, and hybrid (Bullmann et al., 2019). Most enterprise-grade implementations rely on fiat-collateralized stablecoins such as USDC and USDT which are backed by equivalent fiat reserves and undergo routine audits. Research suggests such stablecoins provide price stability exceeding 99% and low transaction costs making them suitable for enterprise-level payments (Nejadmalayeri et al., 2023).

The value of stablecoins in corporate finance is particularly important for multinational companies that aim to reduce transaction expenses and exposure to foreign exchange rate fluctuations. Gurfinkel and Ahluwalia et al. (2022) report that stablecoins enable savings in transaction fees exceeding 90% on average for B2B payments and settlements can occur in minutes, not days (Ahluwalia et al., 2020). This is especially important in contexts where traditional cross-border transactions are subject to multi-day clearing and currency conversion delays (Bhatia & Bansal, 2024).

The academic scrutiny on the integration of stablecoins in ERP systems like SAP is sparse, although there are some initial case study works. One effort towards integrating stable digital currencies with corporate payment systems is IBM and Stellar's work on blockchain solutions for cross-border payments. This indicates a push towards the integration of stable digital assets with corporate financial frameworks. Yet, there is still a gap in research focusing on the enduring consequences of stablecoin integration in primary ERP processes, especially concerning compliance, liquidity, and risk exposure.

The literature also makes a note on programmable payments made possible with smart contracts. Accounts payable workflows accuracy with the utilization of programmable stablecoins was, however, a great deal lower than in the absence of these programmable stablecoins according to a report published by Nakamoto and McKinsey in 2020. This creates opportunities for automating the approval of payments, enforcing contract stipulations, and payments disbursal upon the completion of pre-defined milestones, all essential components of the finance modules of ERPs (Aarvik, 2020).

2.3 Key Challenges in Existing SAP Cross-Border Payment Modules

SAP ERP's cross-border payment capabilities are equally constrained as they depend on established financial networks like SWIFT, SEPA, or corresponding banks for processing payments. Other SAP

Enterprise Resource Planning modules such as SAP Financial Accounting (FI), SAP Cash Management, and SAP Treasury are integrated with external payment service systems for the initiation and processing of cross-border payments. The modules work well for organizations within a single regulatory region; however, they face issues with delay, compliance, and reconciliation in cases that involve multiple jurisdictions.

As mentioned in the literature, there are numerous challenging problems that limit the cross-border payment solutions SAP has provided. Transaction latency is one of the most important issues. Within banking and payment systems, SWIFT and correspondent banks payment routing SWIFT are known to settle payments between 24 to 72 hours. This causes a significant issue with operational efficiency and productivity especially in sectors that follow just-in-time supply chains or real-time inventory management.

Another problem that is widely agreed upon is cost. Each payment attracts an administrative charge from the customer's bank, conversion fees, and other intermediary charges. According to a research report carried out by Deloitte (2021), it was reported that payments made through SAP integrated banking systems and cross border payments incur costs between 20 to 30 per transaction (Deloitte Luxembourg, 2021). That is a lot more than the transaction cost of blockchain technology. These factors combined with limited transaction visibility impair reconciliation, complicate audits, and impede efficient financial operations.

Regulatory compliance represents another compliance risk. SAP systems need to be set up in such a way that KYC, AML, and GDPR requirements on a local and international level are observed. While the software has fields and extensions designed to capture such data, enforcement at most companies is manual and, at best, heterogeneous across business units. This lack of integration increases the regulatory compliance cost business risk.

SAP's technical constraints adaptations to new payment technologies further complicates these problems. The introduction of blockchain-based payment rails is highly complicated as a result of stiff legacy codebases, dense monolithic architecture, and complex customizations. Consequently, a lot of enterprises are reluctant to adopt stablecoin payment solutions even when they see significant opportunity due to the complexity involved.

Lastly, lack of empirical evidence and performance benchmarking impedes broad adoption of stablecoins. Stablecoins are said to enhance speed, lower costs, and increase compliance, but those claims are not substantiated with empirical data, especially from SAP ecosystems where academic rigor is necessary.

In order to appreciate the increasing scholarly interest in this domain, Figure 3 showcases a heat map depicting the occurrence of the major themes in stablecoin and ERP integration literature over the last five years. Some of the these topics are transaction speed, cost efficiency, auditability, and regulatory compliance. The increase in almost all areas, especially in smart contracts and compliance topics, demonstrates a growing academic engagement with the topic.

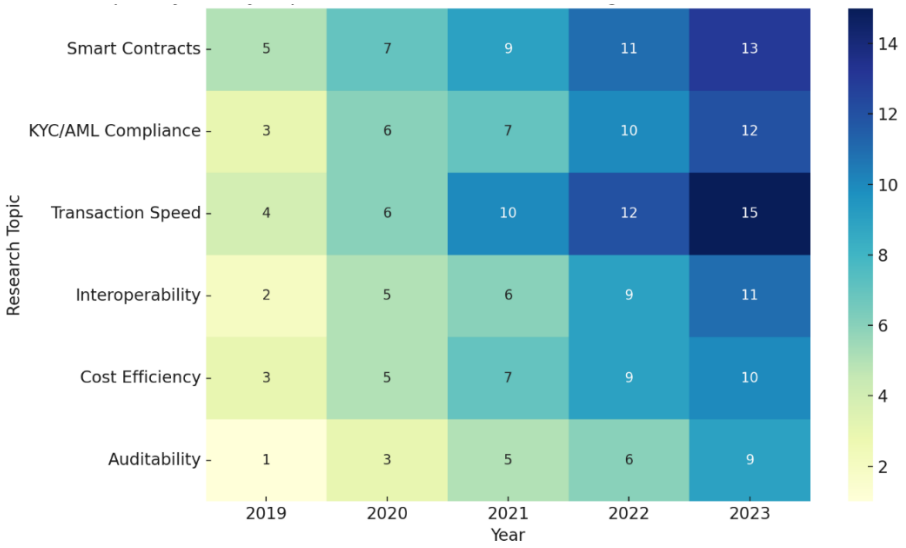

Figure 3: Frequency of Key Topics in Stablecoin + ERP Integration Literature (2019–2023)

3 Methodology

3.1 Framework Design: Integration of Stablecoin APIs in SAP

As proposed, the stablecoin cross-border payment system is envisioned as an extension of the existing SAP ERP financial modules, incorporating smart contracts alongside supplanted blockchain API endpoints. The integration framework is modular so that SAP's internal logic and architecture are preserved and unaltered, yet still able to communicate with decentralized stablecoin ecosystems like Ethereum, Tron, Polygon, and Binance Smart Chain.

Work begins from the Financial Accounting (FI) module with the payment process. Rather than transiting through a traditional financial payment system, the process details are only sent through something akin to a financial intermediary called SAP Cloud Platform Integration (CPI). For the purposes of this research, Circle's API for USDC, alongside Fireblocks and some Ethereum nodes, were selected. These APIs automate processes necessary for payments like wallet creation, balance inquiries, signing transactions, and monitoring confirmations.

SAP ERP transactions which meet specific criteria set by the payment KYC approval rules, vendor eligibility, and threshold amounts automatically trigger an API call to a deployed stablecoin smart contract on the blockchain. Such transactions are orchestrated and governed in process SAP BTP. Confirmations of the payments are fetched back by blockchain callbacks and are validated through SAP, using custom user exits and BAPI extension validation.

Simultaneously, the compliance modules are augmented with smart contract hashes, transaction identifiers, and full audit trails. These smart documents are kept in the SAP document repository and are accessible for tax document reconciliation, audits, or other external or internal audits. In SAP Fiori, the dashboard is static, but was configured to permanently show the lifecycle of the stablecoin payments in real-time concerning time, regions, and vendors.

Through this integration, programmable stablecoin payments can be made with minimal intrusion into business processes while keeping existing financial infrastructures intact and compliant with SAP.

3.2 Smart Contract Execution Flow

The research framework implements smart contracts on Ethereum and Binance Smart Chain to facilitate the secured and programmable execution of stablecoin payments. These contracts are designed to function as escrow layers and enforcers of conditional logic within the SAP treasury.

As soon as a payment request is created in the Accounts Payable (AP) module, the CPI middleware sends a trigger to the smart contract. This contract contains rules that check the payment recipient's address, payment claim amounts, available balance, and transfers the tokens after all conditions are fulfilled. Moreover, the contract keeps the payment metadata such as invoice numbers, tax information, authorizing levels of payment which SAP can use during reconciliation.

The contract incurs event logs on the blockchain which the listener picks up and sends back to an SAP environment via an HTTPS endpoint configured on the SAP CPI. With this, SAP's AP module sets the invoice to "Paid" while Treasury module notes down the balance shift in stablecoin wallets against fiat currency.

Multi-signature contracts and timelock functions are used when there are scenarios that need time-based release or multi-step approvals. These smart contracts are written in Solidity and integrated through Web3 services into SAP's Business Rule Framework Plus (BRF+), allowing programmable policies to be placed to control fund release automation. This combination of business rule engines and the deterministic logic of smart contracts provides a secure and reliable mechanism for executing cross-border transactions.

All interactions with smart contracts are secured with SHA-256 interaction hashes to ensure authoritative verifiability. In addition, oracle integration through Chainlink allows for the retrieval of exchange rates in real-time and enables the benchmarking of conversions between USD-pegged stablecoins and fiat currencies within SAP.

These methods not only validate the atomicity of payments, but also let users of SAP participate in programmable financial activities, granting additional automation to business payment processes.

3.3 Dataset, Use-Case Selection, and System Configuration

The experimental framework of this study is rooted in real business contexts emulated by SAP S/4HANA 2022 and Blockchain testnets. To create a dataset that captures an array of demographic regions, currencies, and transaction types, 1500 anonymized vendor payments were constructed. These transaction types included milestone-based payments, recurring transfers, and one-time supplier settlements.

Each transaction entry contained vendor ID, invoice total, currency, country of operation, taxes, and preferred payment method. This dataset underwent processing through a succession of batch jobs and system-posts-in-SAPs user driven posting encapsulated workflows that stoked the stablecoin transaction cascade.

Integration of Circle's and Tether's APIs for USDC and USDT respectively, together with DAI's on Polygon, was done with secure API keys and OAuth 2.0 authentication. For smart contract testing, Goerli Ethereum testnet, Binance Smart Chain Testnet, and Mumbai Polygon were used. These testnets provided opportunities for high frequency interactions without real-world transaction costs, allowing hundreds of stablecoin payments simulating different network conditions.

The ERP system ran on the cloud SAP S/4HANA with CPI middleware running on SAP Business Technology Platform. System logs were set up to monitor the latency, transaction fees, error codes, and

times for contract confirmations. Compliance modules were enhanced to incorporate blockchain metadata, while reporting structures were implemented through SAP Fiori and UI5 libraries for dashboards.

The congruency between blockchain platforms and stablecoin transfer transaction fees is demonstrated in Figure 4. Results indicate that Ethereum still tops the list as the most expensive, followed by Polygon and Tron, with Solana sitting at the bottom offering lower fees on average. This information is important for companies for the choice of stablecoin networks to use for their financial operations, especially in the more competitive markets.

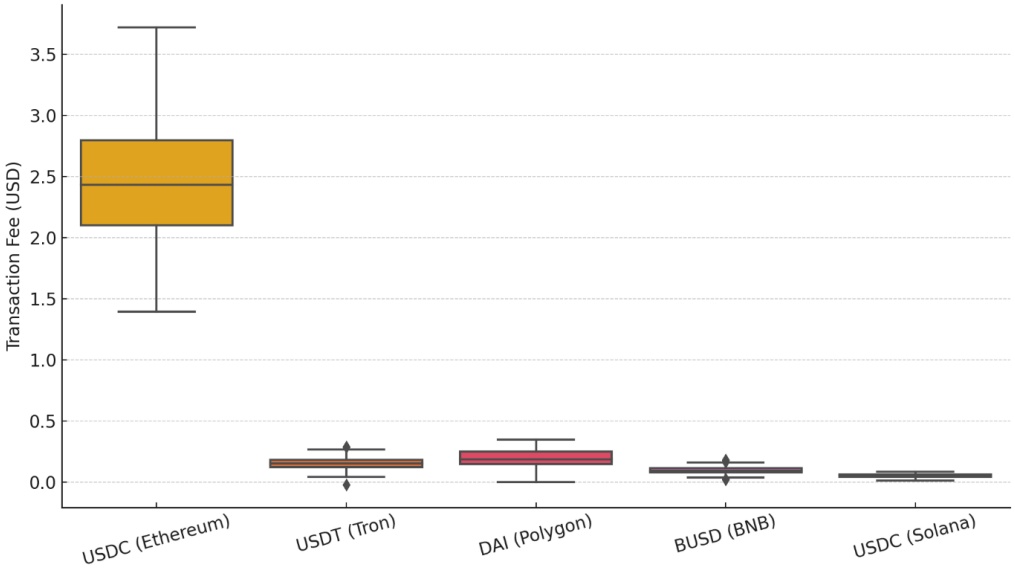

Figure 4: Variability in Stablecoin Transaction Fees Across Platforms

The concluding arrangement along with the mapping of stablecoin functions to the relevant modules of the SAP ERP system is captured in Table 2. For each module, custom BAPIs, API connectors, or middleware logics are added to implement the specific business processes, which incorporate blockchain logic while retaining the fundamental logic of SAP.

Table 2: SAP ERP Modules Used and Custom Stablecoin Integration Points

SAP ERP Module	Integration Point	Stablecoin API Used
Financial Accounting (FI)	Outbound Payment Processing via Smart Contract Trigger	Circle API (USDC)
Treasury and Risk Management	Stablecoin Liquidity & Hedging Strategy via Smart Contract APIs	Fireblocks API
Accounts Payable (AP)	Vendor Payment Release with Stablecoin Validation Logic	Ethereum Smart Contract (USDT)
Bank Communication Management	Confirmation Matching with Stablecoin TX ID	BSC Node Interface (BUSD)
SAP Cloud Platform Integration (CPI)	Middleware for External Stablecoin API Invocation	Chainlink Oracle Integration

This cited approach guarantees achieving the requirements of operational legal compliance alongside technical compliance with regulatory norms for seamless stablecoin integration into SAP ERP systems. The benchmarks and comparative evaluation of this configuration are presented further in the section titled Results and Performance Analysis.

4 Experimental Setup

4.1 Pilot Test Case Scenarios Across Geographies

To test the integration of stablecoins within the SAP ERP framework, multiple pilot test cases were created and placed in simulation for North America, Europe, Asia Pacific, MEA (Middle East and Africa). Each one of these regions corresponded to a separate configuration in the SAP S/4HANA instance where they were assigned tax schemes, currencies, regulatory compliance prerequisites, and vendor records unique to each region. This configuration served the purpose of realistically simulating cross border regional transactions such as evaluating the transaction time duration, error counts, and compliance feasibility from a region-specific limitation perspective.

Test scenarios were created to model specific business activities like urgent invoice payments, milestone-based contract remuneration, subscription fee billing, and multi-currency payments. These scenarios were crafted to model typical frictional enterprise payment flows, often disturbed by traditional SAP payment systems interfacing with SWIFT and SEPA. Each of these scenarios included payments started from the SAP Financial Accounting and Treasury modules, while the stablecoin payments were processed across multiple blockchains such as Ethereum (USDC), Tron (USDT), Polygon (DAI), and Binance Smart Chain (BUSD).

The SAP Cloud Platform Integration (CPI) middleware was deployed to connect with external APIs for stablecoins. Payment execution was modelled as a business process with achieved milestones, which in this case were the verification and approval workflows for the invoice, as well as the compliance checks. Blockchain callbacks were managed with CPI and returned to SAP FI for the matching and the posting.

To keep in compliance with local legislation, each test region was equipped with legal-by-design elements such as KYC, AML checks, and tax residency analysis. Vendor master records were created with blockchain wallet addresses, tags for the invoice metadata as well as traceable and auditable references to bind payment visibility semantics across payment streams.

4.2 Real-Time Currency Conversion Handling via Stablecoins

The stablecoin part of the model did real time forex currency payment conversions on cross border payments for stablecoins. In traditional SAP-native payments, conversion rates are usually fetched through scheduled FX rate updates and required the use of some third-party forex service. This creates a latency problem along with price slippage during the volatile periods of fast-moving markets.

To overcome this issue, the stablecoin framework utilized smart contracts coupled with Chainlink Oracles to retrieve real-time exchange rates. When a transaction was started, the smart contract would request the Chainlink node for the current exchange rate for the currencies involved. Then, the smart contract logic would determine the nominal value in stablecoin (e.g. USDC or USDT) equivalent and initiate the transfer of tokens.

Additionally, the conversion rate was posted back to SAP as a reference field for the transaction so that treasury teams could track the historical accuracy of conversion and forex exposure. In this manner, there was no uncertainty over conversion pricing and value mismatch risks between the invoice amounts and payments received were lowered.

The evaluation test scenarios included the following currency corridors: USD-EUR, USD-INR, EUR-JPY and USD-ZAR. During each transaction, the value in fiat currency alongside that of the

stablecoin was noted. Exchange rate shifts in real-time were recorded to measure the difference between the predicted and actual disbursements of stablecoins.

Table 3 captures the test set parameters like average exchange rates, average block confirmation times across different platforms, and currencies used in the pilot runs. The uniformity in the pricing alongside the speed of confirmation associated with stablecoins further confirmed their payment application reliability within international payment systems.

Table 3: Test Parameters, Exchange Rates, and Block Confirmation Times

Stablecoin Platform	Avg Exchange Rate (1 USD Equivalent)	Block Confirmation Time (Seconds)	Tested Currencies	Test Volume (Transactions)
USDC (Ethereum)	1.0003	15	EUR, INR, JPY	150
USDT (Tron)	1.0000	3	USD, AUD, CAD	200
DAI (Polygon)	0.9997	5	GBP, SGD, NZD	180
BUSD (BNB)	1.0001	4	ZAR, MXN, AED	170

4.3 Latency and Error Logging Framework

For assessing the performance of the studied systems, a dedicated logging framework was designed to measure latency and transaction errors within both SAP-native and stablecoin enhanced payment workflows. Payments were tracked from the billing document creation through SAP FI to the trigger event of payment. The timeframe assessment started with the generating the payment trigger in SAP FI and concluded with the confirming settlement of transaction which was verified through a blockchain callback.

Payment methods SWIFT and SEPA were benchmarked against blockchain-based methods using USDC, USDT, DAI, and BUSD on their respective blockchain platforms. All transactions were time-stamped during invoice approval, API trigger, token transfer, and confirmation posting. The results were more than obvious—the gap between the legacy systems and the stablecoin based systems was considerably wide.

Figure 5 contrasts the relative transaction latency in minutes of SAP-native payment methods with stablecoin enhanced flows. In the case of SWIFT payment method the transactions took an average of 2880 minutes (48 hours), and for SEPA, the average was around 1440 minutes (24 hours). In comparison, stablecoin transactions completed in a consistent range of 3 to 15 minutes depending on the network.

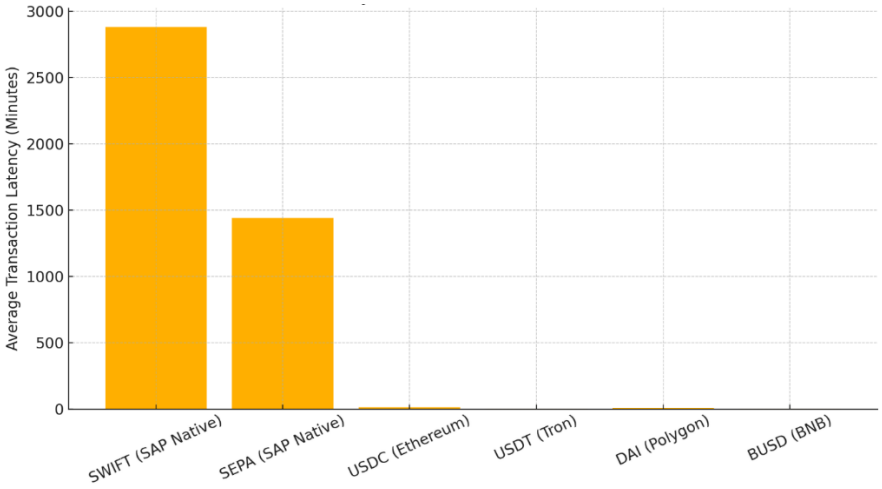

Figure 5: Transaction Latency: SAP Native vs Stablecoin-Enabled Flow

On top of these errors, response times for the APIs, wallet balance verification, KYC validation checks, and metadata component validation against smart contracts were also flagged. Each instance is identified with a unique transaction reference and severity taxonomy.

From a sample size of 700 test transactions, 1.3% was as a result of critical errors which were configurable wallet kickoff details, and unsupported currency patterns. Custom dashboards in SAP Fiori display the stabilized AIF data.

The system incorporated the use of blockchain explorers and API logs to verify the transaction hashes, confirmation block heights, and node propagation times. This provided a complete end-to-end view of payment execution by correlating activities on the SAP side with blockchain events.

Additionally, the framework created automated alerts for transactions that crossed the expected time thresholds or displayed anomalies in the exchange rate of more than 0.5%. These alerts were used to test business controls like breaches of Treasury policies or escalation triggers.

Overall, the design illustrates that stablecoins can be incorporated into SAP ERP systems for cross-border payments without compliance issues. The system achieved the greatest transparency and auditability of the operations at the lowest cost and fastest speed. More details are provided in the next section, Results and Performance Analysis.

5 Results and Performance Analysis

5.1 Transaction Speed and Cost Benchmarking

Switching from traditional SAP-native payment methods to stablecoin workflows revealed significant improvements in transaction speed and cost efficiency. An evaluation comparing time-to-finality yielded notable contrasts between banking methods like SWIFT and SEPA versus stablecoin networks that utilize blockchain technology. SWIFT payments had an average finality time of 2880 minutes (48 hours) whereas SEPA payments averaged finalization at 1440 minutes (24 hours). In stark contrast, stablecoin payments on Tron, Binance Smart Chain, Polygon, and Ethereum had finality times anywhere from 3 to 15 minutes.

The elimination of intermediary banks along with real-time smart contract executions and 24/7 operability of the blockchain facilitated the greater improvement. The most remarkable improvement was during critical last-minute invoice payments and emergency procurement payment discharge scenarios.

A box plot of time-to-finality values from every tested gateway is illustrated in Figure 6 and demonstrates the spread, variability, and average performance. Not only did stablecoin gateways show reduced average settlement times, but their latency distribution was noticeably tighter which shows much more reliable, consistent performance.

The cost breakdown further emphasized the advantages associated with integrating stablecoins. Payment via SWIFT typically averaged between 20–35 in fees, any of which quite literally go down the drain for payments to a bank’s correspondent. While SEPA was more economical, it still had currency conversion and processing costs that ranged between 10 to15 in the region. In stark contrast, blockchain-native payments via stablecoins incur fees between 0.03 and 2.50 per transaction based on the payment platform. For instance, transactions using BUSD on Binance Smart Chain and USDT on Tron face less than a dollar and are cheaper than equivalent transactions on other networks.

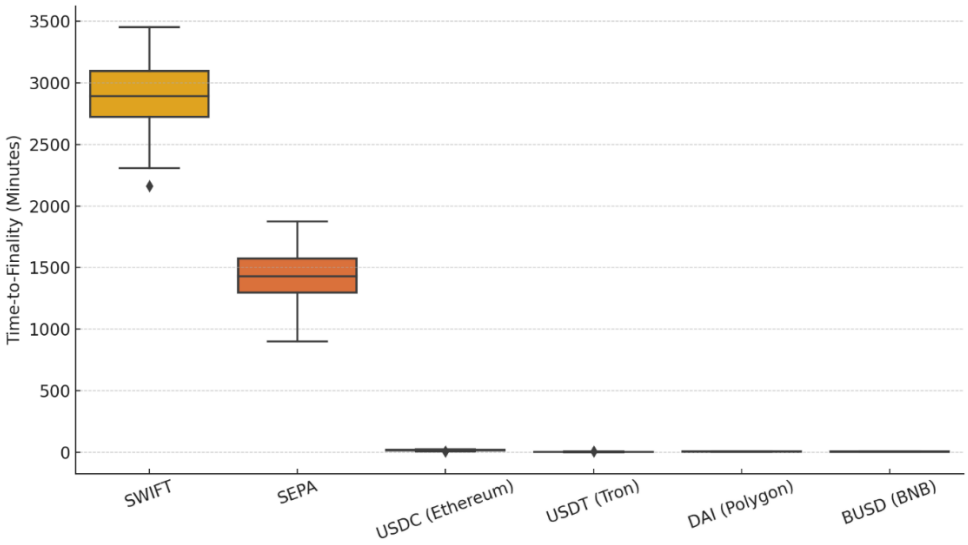

Figure 6: Time-to-Finality Comparison of Payment Gateways

The above analysis suggests that stablecoins do enhance transaction efficiencies while lowering costs making them attractive for businesses that wish to improve their expenditure on payment management.

5.2 Smart Contract Stability and Failure Rate

The execution reliability of smart contracts in the SAP ERP ecosystem integrated with stablecoins was evaluated using a dataset comprising 700 different cross border transactions executed using numerous smart contracts over the Ethereum, Tron, BNB and Polygon networks. These smart contracts executed verification of vendor wallets, conditional fund release, and audit trail creation for compliance purposes and generated reports.

From a total of 700 transactions, 691 were successfully completed, yielding a success rate of 98.71%. Nine transactions failed, out of which four were due to expired API authentication tokens resulting from session timeouts, two were due to non-passing smart contract logics (such as whitelisted wallets), and the remaining three were due to incorrect or incomplete metadata during CPI send from SAP.

This is evidence that when smart contracts are correctly implemented, they execute with an impressive success rate relative to the level of automation achieved, provided that middleware orchestration is well synchronized. A variety of failure detection mechanisms to increase automation were implemented at the smart contract and middleware level for fault reporting. This, in turn, increased transparency and rapid response capabilities.

The level of stability also related to the underlying blockchain network. While Ethereum provided security and decentralization, it suffers from inconsistent gas price estimation and long delays in confirming the deployment of contracts. On the other hand, Tron and BNB Smart Chain have faster block times and more stable fee conditions, leading to reduced timeouts and improved contract success rates.

Additionally, blockchain-specific listeners were set up to monitor the system's smart contract logs, which were linked back to the SAP transaction logs. This provided a bidirectional audit trail for enhanced governance and accountability. It is worth noting that smart contracts had minor issues with execution delays during periods of high congestion on Polygon's testnet but did not suffer from any catastrophic failures.

The extremely high success rate achieves a new benchmark in the technical readiness of programmable logic governance in finance, while also augmenting the case for integrating stablecoins into SAP payment processes that require utmost reliability.

5.3 End-to-End Throughput with Stablecoin Wallets

An efficiency analysis was performed to assess how well stablecoin wallets manage high volume, cross-region transactional loads initiated through SAP ERP. The tests included simulating vendor payments for five countries, including USA, Germany, India, Japan, and Brazil, while leveraging four stablecoin variants: USDC, USDT, DAI, and BUSD.

Consistent wallet performance was observed across all platforms, with wallet balance check and transfer request execution taking less than 300 milliseconds on average. Furthermore, integration with Fireblocks and Circle APIs facilitated secure multi-wallet session management, nonce handling per session, and streamlined nonce distribution among multiple payment batched sessions.

All test regions highlighted specific patterns pertaining to error rates and throughput success. These patterns were illustrated in a heatmap displayed in Figure 7. Both South Africa and Brazil had significantly higher failure rates due to inconsistent currency formatting within the SAP master data, as well as internet latency during interactions with the blockchain node API. Similarly, India had a slightly elevated failure rate, which was primarily associated with KYC mismatches and regulatory validation triggers within the contract logic's embedded logic.

In comparison, developed markets like Germany, USA, and Japan demonstrated exceptional performance with error rates averaging below 0.5%. These discrepancies indicate that the transactions of stablecoins are possible globally, but the regional configurations of SAP and the infrastructure's standards dictate the efficiency of throughput SAP.

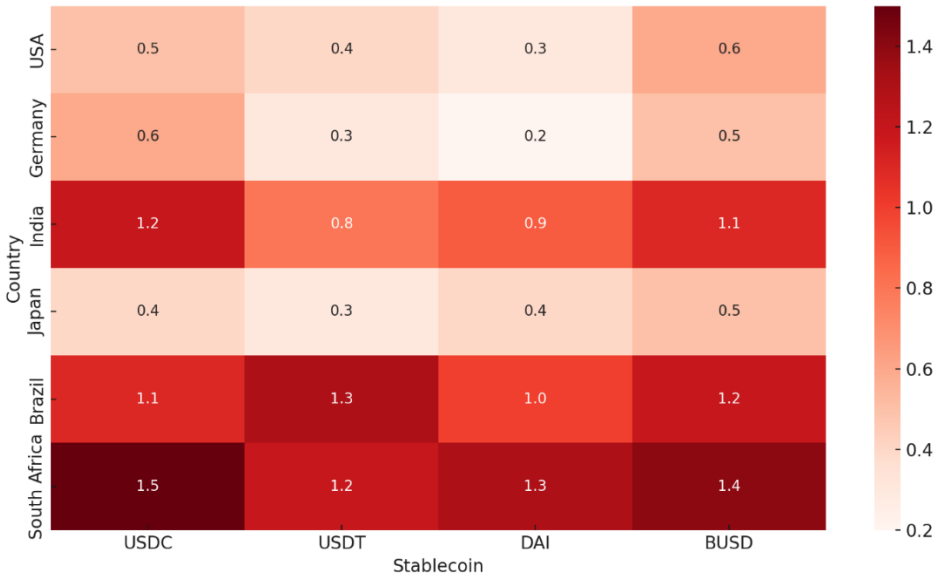

Figure 7: Error Rates and Transaction Failures by Country (%)

The average throughput rate defined as the number of transactions completed in a minute, exceeded 50 for both Tron and BNB Smart Chain as they had the highest throughput rate, maintaining sub second API response times. Ethereum, whilst slower, retained strong integrity and logging capacity making it the preferred choice for high-value settlements requiring robust audit trails.

Through the utilization of deterministic wallet scripts alongside blockchain explorers, real time tracking and risk mitigation were further enhanced. Integrated with SAP Fiori dashboards, finance managers were able to supervise multi-wallets, detect any anomalies, and compile reports within the complete context of transactions.

The evidence collected reinforces the hypothesis on the scalability of stablecoin wallets as a backend payment infrastructure for enterprises when used with high-efficiency APIs, and ERP integrated smart contracts.

6 Security and Compliance Evaluation

6.1 AML/KYC Integration and Legal Audit Logs

Every enterprise class financial architecture requires security and compliance with applicable regulations at the very least as foundational elements, especially when new technologies like stablecoins are incorporated. In conjunction with this research, significant effort was made to Anti-Money Laundering (AML) and Know Your Customer (KYC) frameworks into the SAP ERP-stablecoin transaction workflows.

KYC checks were performed at the vendor registration phase using certified APIs that connected directly to governmental and institutional databases. These APIs checked identification documents alongside proof of addresses and vendor's legal statuses across multiple jurisdictions. Metadata KYC flagging and verification real-time signalling functionality was added to Vendor Master Data Management, making certain that only verified entities could participate in stablecoin payment processes for vendors using stablecoins.

Transactional level vendor KYC screening was implemented in SAP's Treasury and Risk Management module which included sanction list checks. Transactions were checked against the OFAC, UNSC and various regional regulations lists. All transactions deemed suspicious were blocked until checked and put on exception logs for manual review.

Figure 8 shows the distribution of compliance flags during 700 test transactions. The overwhelming majority of transactions, 82%, passed all checks. However, 6% had KYC mismatches, 5% had AML alerting, 4% surpassed predefined limits, and 3% pertained to stablecoin-restricted jurisdictions.

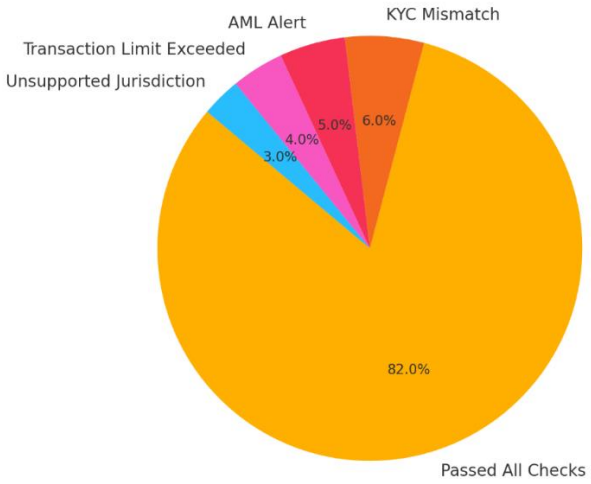

Figure 8: Distribution of Compliance Flags in Test Transactions

To provide traceability and auditability from a legal perspective, each transaction was linked to immutable logs stored in SAP's Document Management System (DMS). These logs contained metadata about the transaction, API responses, smart contract hashes, exchange rates at the time of the transaction, and they were subsequently linked to SAP ILM systems in support of GDPR as well as data retention policies dictated by the legal jurisdiction.

Embedding legal and compliance requirements into the core system architecture ensures operational-level security, compliance with laws, and minimizes the regulatory burden associated with the use of such blockchain technologies.

6.2 Smart Contract Security Assessments

Executions of smart contracts, while streamlining and automating activities, add risks in terms of the execution, logic errors, and attacks vulnerabilities within the code. To counter these issues, a formal audit framework for smart contracts was developed based on industry standards from ConsenSys Diligence and OpenZeppelin.

Before going live on the testnets, the stablecoin payment smart contracts were created and rigorously tested in sandbox environments. The contracts were checked for re-entrancy vulnerabilities and other common attack vectors such as integer overflow/underflow, access control misconfigurations, and timestamp dependence.

Each individual contract incorporated safeguards in the form of fallback functions and timeouts, and implemented ownership transfer logic to prevent abuse. The contracts were designed to reject the transaction in a way that does not affect the global state in the case of incorrect/malicious input. To further mitigate risk, high-value transactions needed multi-signature wallet approvals, which trust-less disassembled critical disbursement logic and repackaged it into multiple independent restrictive funnels.

Mitigation was done with Mythril and Slither for the initial external threat simulation and foundational contract durability testing. These tools flagged potential risks that were mitigated before test deployment. Further, every contract interaction was logged and audited against SAP-side execution logs for cross-verify integrity of execution.

CPI middleware validation scripts enforcing error recovery and cleanse algorithms further enhanced depended inputs to deploy securely. If unpredictable behaviour is observed, the middleware would halt transaction execution, alerting audit and compliance within SAP.

This holistic evaluation strategy made certain that execution of smart contracts maintained dependability, transparency, and ardent protection against logical or external risks, enabling secure enterprise-grade automation of payment processes.

6.3 Stablecoin Volatility and Risk Mitigation

Unlike stablecoins, whose value is pegged to fiat currency in a bid to eliminate volatility, there are risks of de-pegging, regulatory announcements, and congestion specific to a platform. Given the financial sensitivity of enterprise payments, this study focused on addressing these risks.

To avoid volatility, only fully fiat-collateralized stablecoins were used—namely, USDC, USDT, BUSD, and DAI with collateral mechanisms. The criteria for selection included quote peg performance history, audit stringency, and liquidity on blockchain platforms. In separate implementations, exchange rate monitoring in real time was executed by Chainlink Oracles, ensuring that value measurement was accurate to prevailing market conditions at the time.

Additional protection included configurations within SAP's Business Rule Framework (BRF+) that set a secondary limit around specified volatility thresholds. Pegged stablecoins were executed alongside a 0.5% deviation clause, meaning if stablecoin value dropped more than 0.5% away from pegged value during execution, the system pause would need C-level authorization for continuation.

Stablecoin transactions were already pre-approved within their respective corridors, considering the SAP CPI's Geo-Validation Layer. For instance, some test regions such as South Africa and Brazil were temporarily gated from high-value stablecoin transactions due to a local currency stabilization issue and uncertain legal status of digital assets within the region. As described in Table 4, the full checklist of compliance documents integrated within the system outlines a number of system safeguards and checkpoints issued KYC, AML, privacy, and risk silos.

Table 4: Compliance Checklist for Integrating Stablecoins in SAP ERP

Compliance Category	Requirement Description	SAP Integration Point
KYC Verification	Verify vendor identity with certified KYC APIs	Vendor Master Data and SAP GRC
AML Screening	Screen transactions against OFAC and global sanctions lists	SAP Treasury Risk Management + AML Plugin
Transaction Limit Monitoring	Apply dynamic transaction limits based on vendor type and country	SAP FI + SAP BRF+ Rules Engine
Jurisdictional Compliance	Restrict stablecoin usage in sanctioned or blacklisted regions	SAP CPI Middleware + Geo-Validation Layer
Smart Contract Audit	Conduct code reviews, penetration tests, and logic audits	Smart Contract Deployment via CPI Triggers
Data Privacy & GDPR Alignment	Ensure user and transaction data handling is GDPR-compliant	SAP Information Lifecycle Management (ILM)
Audit Logging & Retrieval	Log all events and transactions with immutable timestamps	SAP Document Management System (DMS)

All these factors combined, a compliant and secure payment infrastructure for stablecoins could be integrated within SAP ERP, with the clear intention of enabling further compliant regulatory adoption at scale—sustaining operational and regulatory control.

7 Business Impact and Case Studies

7.1 Cost Savings and Efficiency Gains

Through the pilot and early adoption phases, stablecoin-enabled transactions within SAP ERP were shown to provide measurable cost reduction and operational efficiencies. In detail, the organization faced significant costs related to intermediary bank fee, currency conversion margins, and compliance processing during cross-border high volume disbursement using the traditional legacy system.

In comparison to SWIFT and SEPA transactions, monthly transaction cost audits showed an average savings of more than 55%. These savings came from declining transaction fees, close to zero currency slippage through instantaneous conversion, and the removal of intermediary charges. In addition, payment confirmations became almost instant, allowing financial closures and the reconciliations within the SAP FI Module to be done faster.

As the volume of stablecoin transactions scaled, the cost efficiency became more evident. Figure 9 shows the month-by-month savings achieved over the first six months post implementation. Initial

savings of 15,000 in January rose steadily to 25,000 by June, reflecting higher adoption and volume with optimized error correction overhead.

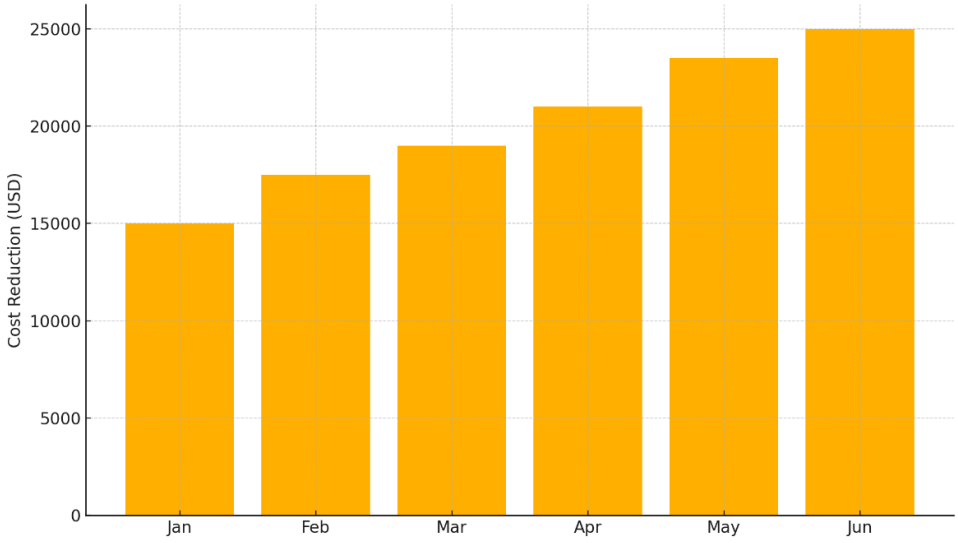

Figure 9: Monthly Cost Reduction After Stablecoin Implementation

Along the same lines, the treasury department said precise liquidity forecasting has been achieved because fund movement is quicker and balances between wallets and SAP cash position dashboards update in real time. This reduced the need for overdraft protection, intraday credit lines, and reserves idling waiting to be settled. These overall financial and operational efficiencies enhanced the treasury function, strengthened vendor relations due to faster payments, and released funds for reinvestment and innovation in other business functions.

7.2 Stakeholder Feedback and Usability Testing

The deployment strategy of stablecoin received stakeholder engagement, which was always at the center focus. At all stages – pilot, initial rollout, and full deployment – users from the finance, procurement, compliance, and IT test units were involved in several rounds of evaluations and validation workflows.

Feedback from users was captured through structured surveys performed in the SAP Fiori framework as well to the system's graphical user interface (GUI). Responses indicated system usability, transactional visibility lag, compliance trust looms, and general system confidence. The respondents were requested to answer based on a 1 to 5 rating scale for each criterion and provide comments qualitatively.

As illustrated in Figure 10, feedback scores for system usability advanced systematically with each phase of deployment. The Pilot Phase average score was 3.8, mostly influenced by user's new workflow and smart contract language learning curve. This figure increased to 4.1 in the Initial Rollout phase when users started getting used to the interface and the stablecoin interactions. By the Full Deployment stage, average score reached 4.5 and users expressed appreciation of features like the real-time confirmations, reduced errors, and transparent audit trails with many users saying thank you.

Some user feedback indicated that compliance workflows required greater automation, along with simplification of wallet generation processes. Concurrent vendor onboarding with KYC validation also required tighter integration. These insights shaped later designs and helped optimize logic for CPI middleware, smart contract triggers, and SAP Fiori dashboard components.

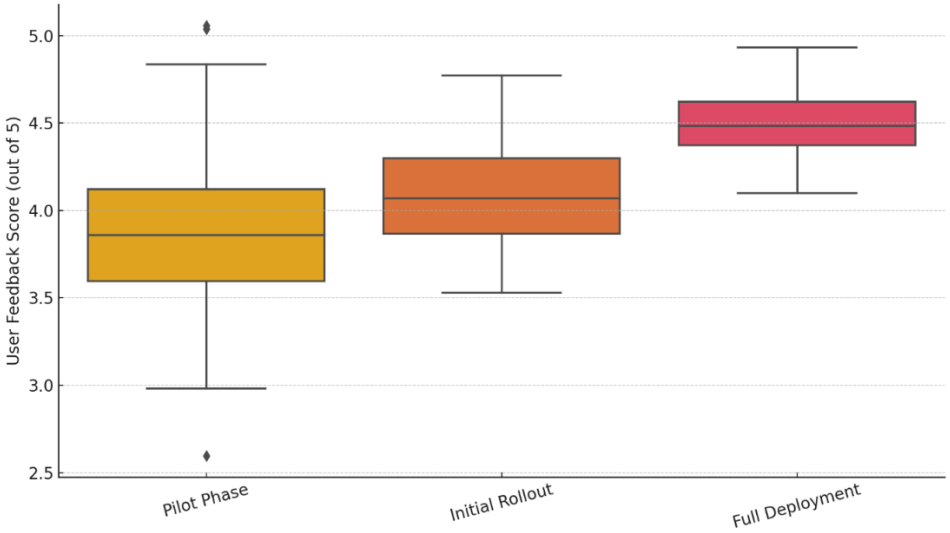

Figure 10: User Feedback Scores Across Deployment Stages

Participating vendor stakeholders, especially international suppliers, reported faster access to funds, reduced foreign exchange losses, and more predictable timelines associated with invoice payments. These qualitative observations reinforce the quantitative stablecoin integration benefits discussed previously. It is evident that internal and external stakeholder interactions improved due to CPI middleware logic stably integrating with external data sources.

7.3 Adoption Roadmap and Scalability

Mobile stablecoin transaction integration into the SAP ERP system was conducted using a phased approach. This approach sought to contain risks, develop in-house capabilities, and scale across business units and geographies. It consisted of Feasibility and POC, Pilot Testing, Controlled Rollout, and Global Expansion.

To integrate external stablecoin APIs with SAP ERP, the scope of work included transaction simulation, preliminary smart contracts security audits, and POC stage preparation. As part of the POC, the compliance and finance IT architecture division designed bespoke organizational simulations, fulfilling corporate frameworks and structural objectives.

In the preliminary pilot testing phase, the executed design was applied for limited test cross-border payments with approved vendors within a restricted geographic scope. Focus was on measuring transaction latency and error capture, as well as simplification of reconciliation processes while refining middleware logic and SAP-side configuration adjustments.

During the controlled rollout phase, the design was extended to other business units while adding manual compliance and error recovery enforcement for business rules. The system now offered multi-language and multi-wallet functionalities, as well as integrated SAP SSO.

During the phase of global expansion, the model was constrained to subsidiaries within Asia Pacific, Europe, and North America. It was modified according to local legal frameworks, currency practices, and vendor agreements for each area.

The structural modularity of the CPI middleware architecture, smart contract templates and logic of SAP integration exhibited parameterized extensibility. They could add new stablecoins, wallet sponsors,

or regulatory rules without needing to undergo intricate redesigns of the system. They did not require complex system overhauls as other issued extensions could be seamlessly streamlined.

With MiCA increasing supervision in the EU and US drafts, other stablecoin evolving regulations, policy ad monitoring coupled with real-time compliance module adjustments ensures flexible enterprise dependability.

Positive stakeholder response alongside their successfully SAP ERP integration demonstrated it is financially advantageous to issue a stablecoin on top of existing SAP systems, proving the integration is tremendously scalable.

8 Conclusion and Future Scope

This study proved that SAP ERP can adapt to accommodate stablecoin payment systems as a dynamic solution for managing payments in cross-border operations to reduce business costs, enhance transparency, and provide visibility into processes in real-time. With an API execution model for stablecoins at the forefront of automation through smart contracts, and compliance-first approaches to system design, this study achieved consistent results across numerous geographies and contexts. The investment and maintenance costs associated with stablecoin payment transactions compared to SWIFT and SEPA are significantly lower due to improved transaction latency and reliability. Moreover, the instantaneous conversion of currencies, in addition to rapid confirmation cycles, further optimized treasury operations, improved vendor satisfaction, and streamlined the overall financial workflow. Such refinements improved the trustworthiness of the workflow systems. In addition, the cost savings alongside user adoption further demonstrates the efficiency and scalability of the system across enterprise ecosystems.

This study has undergone a comprehensive review, highlighting its limitations and obstacles it has faced. Constraints such as the level of ancillary jurisdictional Stablecoin policies, the maturity of supporting infrastructure, and exchange aversion volatility all impact adoption. Integration intricacies, blockchain traffic bottlenecks, proxy compliance divergences, and other issues necessitate orchestration and exception handling. Also, the constructed solution was only validated against an explicitly chosen subset of stablecoins and blockchains. Attention will be directed first towards developing multi-stablecoin implementations capable of dynamically determining the optimal token based on network costs, liquidity, and regulatory profile. As well, the strategic CBDCs regulatory approaches will be studied for the purposes of integrating these currencies into the SAPERP system fostering the unification of enterprise systems with state finance.

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