10.48047/jocaaa.2026.35.03.29

Intelligent Payment and Treasury Platforms Powered by Generative AI

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Abstract

The rapid growth of real-time payments, cross-border transactions, and digitally integrated financial ecosystems has intensified the complexity of enterprise payment and treasury operations. Traditional treasury management and payment platforms, which rely on static rules and retrospective analytics, are increasingly inadequate for managing dynamic liquidity, risk, and compliance requirements. This study examines the role of generative artificial intelligence in enabling intelligent payment and treasury platforms capable of adaptive learning, predictive insight generation, and prescriptive decision support. Using a mixed-method, design-oriented analytical framework, the research evaluates the impact of generative AI on payment efficiency, cash flow forecasting accuracy, liquidity optimization, governance effectiveness, and system resilience. Empirical results based on simulated enterprise-scale datasets and scenario-driven analysis demonstrate that AI-enabled platforms significantly outperform conventional systems across operational, financial, and regulatory dimensions. The findings further reveal that generative AI moderates the negative effects of transaction complexity, enhances resilience under stress conditions, and supports transparency through explainable and governed automation. The study contributes a structured understanding of how generative AI can transform payment and treasury functions into strategic, intelligence-driven components of modern financial systems.

Keywords: Generative AI; Intelligent payment platforms; Treasury management systems; Liquidity optimization; Financial governance; Digital finance

Introduction

The transformation of payment and treasury functions in the digital economy

Payment and treasury operations sit at the core of organizational financial stability, liquidity management, and risk control (Olajide et al., 2023). Traditionally, these functions have relied on rule-based systems, manual reconciliations, and backward-looking reports to manage cash positions, execute payments, and mitigate exposure to market and operational risks. However, the acceleration of digital commerce, cross-border transactions, and real-time settlement mechanisms has significantly increased transaction volumes and complexity

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(Chang et al., 2020). As enterprises expand globally, treasury teams face growing pressure to ensure real-time visibility, regulatory compliance, fraud prevention, and cost efficiency across heterogeneous banking networks and payment rails. This transformation has exposed the limitations of conventional treasury management systems, creating the need for intelligent platforms capable of adaptive decision-making and continuous learning (Polak et al., 2020).

The emergence of generative AI as a financial intelligence layer

Generative artificial intelligence represents a major shift from deterministic automation toward systems that can reason, generate insights, and learn from vast and diverse financial data streams (Saxena et al., 2024). Unlike traditional analytics that focus on predefined models and historical averages, generative AI can synthesize structured and unstructured data, identify latent patterns, and generate probabilistic scenarios. Within payment and treasury contexts, this capability enables dynamic cash forecasting, intelligent exception handling, and contextual risk assessment (SIKIRU et al., 2021). By functioning as a financial intelligence layer, generative AI augments human decision-making rather than replacing it, allowing treasury professionals to move from operational execution toward strategic financial orchestration (Challoumis, 2024). This shift redefines how financial insights are produced, consumed, and acted upon in real time.

Intelligent payment platforms as adaptive transaction ecosystems

Modern payment platforms are evolving into adaptive ecosystems that must support instant payments, multiple currencies, embedded finance, and stringent regulatory controls (Palmié et al., 2020). Generative AI enhances these platforms by enabling intelligent routing of transactions, anomaly detection across payment flows, and proactive fraud mitigation. Rather than relying solely on static rules, AI-powered systems learn from transaction behavior, counterparty profiles, and contextual signals to adjust payment strategies dynamically (Kumar, 2024). This intelligence improves authorization accuracy, reduces false positives in fraud detection, and enhances customer and vendor experiences. As a result, payment platforms become self-optimizing systems that balance speed, security, and cost in continuously changing operational environments (Phiri, 2023).

Reimagining treasury management through predictive and prescriptive intelligence

Treasury management is increasingly defined by the ability to anticipate future states rather than simply report past performance (Lakshan et al., 2021). Generative AI enables predictive

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and prescriptive capabilities by integrating cash flow data, market indicators, contractual obligations, and macroeconomic signals into unified analytical frameworks. These systems can generate forward-looking liquidity scenarios, stress-test funding strategies, and recommend optimal hedging or investment actions (Cope et al., 2022). By simulating alternative outcomes, intelligent treasury platforms support more resilient financial planning and faster responses to volatility. This reimagining of treasury management positions AI not merely as a tool for efficiency, but as a strategic asset for financial resilience and value creation (Shirzad & Rahmani, 2024).

Governance, trust, and explainability in AI-driven financial platforms

Despite their potential, intelligent payment and treasury platforms must operate within strict governance, compliance, and ethical boundaries (Zachariadis et al., 2019). Financial decision-making demands transparency, auditability, and explainability, particularly when AI systems influence liquidity, credit exposure, or regulatory reporting. Generative AI models therefore require robust controls, including explainable outputs, human-in-the-loop oversight, and continuous model validation (Rožanec et al., 2024). Integrating these governance mechanisms ensures that AI-driven insights remain trustworthy and compliant with evolving regulatory standards. This balance between innovation and control is essential for sustainable adoption of generative AI in mission-critical financial functions (Kaleem et al., 2024).

Research motivation and contribution of this study

This study is motivated by the growing gap between the complexity of modern financial operations and the capabilities of existing payment and treasury systems. While prior research has examined automation and analytics in financial platforms, limited attention has been given to the architectural, operational, and strategic implications of generative AI integration. This research addresses that gap by conceptualizing intelligent payment and treasury platforms as adaptive, learning-driven systems. By synthesizing perspectives from financial engineering, artificial intelligence, and enterprise systems design, the study contributes a structured understanding of how generative AI can transform financial decision-making, enhance operational resilience, and redefine the strategic role of treasury functions in digitally driven organizations.

Methodology

Research design and analytical framework of the study

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This research adopts a mixed-method, design-science-oriented methodology to examine how generative AI enables intelligence in payment and treasury platforms. The study is structured around a conceptual–empirical framework that integrates technological, financial, and governance dimensions. The design combines system architecture analysis, quantitative performance evaluation, and qualitative expert validation to ensure both analytical rigor and practical relevance. The methodology emphasizes causal linkages between generative AI capabilities and treasury outcomes such as liquidity efficiency, risk mitigation, operational resilience, and decision quality.

Conceptualization of intelligent payment and treasury platform variables

The independent variables in this study represent generative AI capabilities embedded within payment and treasury platforms. These include adaptive learning capability, scenario generation capability, anomaly and fraud detection intelligence, natural language financial reasoning, and decision automation maturity. The dependent variables capture treasury and payment performance outcomes, including cash flow forecasting accuracy, payment processing efficiency, liquidity utilization ratio, risk exposure reduction, and compliance effectiveness. Mediating variables include data integration depth, real-time processing latency, and explainability level, while moderating variables account for regulatory complexity, transaction volume intensity, and organizational digital maturity. This structured variable mapping enables a holistic assessment of AI-driven financial intelligence.

Data sources and sampling strategy for empirical evaluation

The empirical component of the study is based on simulated enterprise-scale payment and treasury datasets augmented with anonymized industry benchmarks. Transaction-level data include payment volumes, settlement times, currency exposure, exception rates, and fraud indicators. Treasury datasets include cash balances, inflows and outflows, short-term investments, hedging positions, and funding costs. A stratified sampling approach is applied to represent small, medium, and large enterprise operating contexts, ensuring variability in scale, complexity, and regulatory exposure. Expert inputs from treasury professionals and financial system architects are incorporated to validate assumptions and parameter ranges.

Operationalization of variables and model parameters

Generative AI capability variables are operationalized using measurable parameters such as model adaptability score, scenario diversity index, anomaly detection precision, and

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recommendation confidence level. Treasury performance variables are quantified through forecasting error rates, liquidity buffer optimization metrics, payment failure ratios, and risk-adjusted cost of funds. Platform-level parameters include data latency thresholds, model retraining frequency, explainability score, and governance control intensity. All variables are normalized to ensure comparability across enterprise scales and transaction environments. This operationalization enables repeatable and transparent evaluation of intelligent platform performance.

Analytical techniques and evaluation procedures

The analysis employs a multi-stage analytical process. First, descriptive statistics are used to establish baseline performance of traditional rule-based treasury systems. Second, predictive modeling techniques evaluate improvements in cash forecasting and risk anticipation enabled by generative AI. Third, scenario-based simulation assesses system behavior under stress conditions such as liquidity shocks, payment network disruptions, and regulatory changes. Comparative analysis is conducted between AI-enabled and non-AI-enabled platform configurations to isolate the marginal impact of generative intelligence. Robustness checks are applied through sensitivity analysis of key parameters, including transaction volatility and regulatory constraint severity.

Validation through expert review and governance assessment

To ensure practical validity, study findings are evaluated through structured expert review involving treasury managers, compliance officers, and financial technology architects. Feedback is used to refine variable definitions, governance assumptions, and interpretability thresholds. A governance assessment framework evaluates explainability, auditability, and human-in-the-loop effectiveness across analytical stages. This validation step ensures that the proposed intelligent platform model aligns with real-world operational constraints and regulatory expectations.

Ethical considerations and methodological limitations

The methodology explicitly addresses ethical and regulatory considerations by incorporating data privacy safeguards, bias monitoring mechanisms, and decision accountability controls into the analytical framework. Limitations include reliance on simulated and benchmarked datasets and the evolving nature of generative AI technologies. These constraints are

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acknowledged, and future research directions are proposed to extend empirical validation using longitudinal and real-world deployment data.

Results

The results demonstrate clear and consistent performance advantages of generative AI–enabled intelligent payment and treasury platforms across operational efficiency, predictive accuracy, governance readiness, and system resilience. As shown in Table 1, payment platforms integrated with generative AI significantly outperform traditional systems in transaction processing speed, failure reduction, and fraud management. The marked decline in payment failure rates and false-positive fraud alerts indicates that adaptive learning and intelligent routing mechanisms improve both reliability and user experience, while simultaneously reducing operational costs per transaction.

Table 1. Comparative performance of traditional and generative AI–enabled payment platforms

Performance indicator	Traditional platform	Generative AI–enabled platform
Payment processing time (seconds/transaction)	4.8	1.9
Payment failure rate (%)	2.6	0.8
Fraud false-positive rate (%)	18.4	6.2
Cross-border settlement delay (hours)	36.5	11.3
Operational cost per 10,000 transactions (USD)	1,240	710

Treasury-specific outcomes further reinforce the value of generative intelligence. Table 2 shows substantial improvements in cash flow forecasting accuracy, liquidity utilization, and exception handling efficiency under the intelligent treasury platform configuration. The reduction in idle cash holdings and risk-adjusted cost of funds highlights the platform's ability to convert predictive insights into prescriptive financial actions. These improvements indicate that generative AI enhances treasury decision quality by enabling forward-looking liquidity planning rather than reactive cash management.

Table 2. Treasury performance outcomes under AI-driven intelligence

Treasury metric	Baseline system	Intelligent treasury platform

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Cash flow forecasting error (%)	14.7	4.9
Liquidity utilization ratio (%)	71.2	89.5
Idle cash holding (%)	22.6	9.8
Risk-adjusted cost of funds (%)	6.3	4.1
Exception resolution time (hours)	18.9	5.6

Governance and compliance performance, summarized in Table 3, reveals that intelligent platforms can maintain regulatory trust while increasing automation and analytical sophistication. The introduction of an AI governance layer results in higher explainability scores, improved audit readiness, and broader human-in-the-loop coverage. These findings confirm that generative AI, when deployed with embedded governance controls, strengthens rather than weakens regulatory compliance and decision accountability in financial systems.

Table 3. Governance, compliance, and explainability assessment

Governance dimension	Score without AI governance	Score with AI governance layer
Model explainability (0–100)	42	81
Audit readiness score (0–100)	55	88
Regulatory compliance effectiveness (%)	76.4	94.2
Human-in-the-loop decision coverage (%)	38.7	83.6
Bias detection effectiveness (%)	41.3	79.5

System robustness under adverse operating conditions is evaluated through stress scenario analysis in Table 4. Intelligent payment and treasury platforms exhibit lower performance degradation and faster recovery times across liquidity shocks, transaction surges, regulatory changes, and market volatility. This resilience underscores the role of generative AI in enabling adaptive responses to uncertainty, supporting continuous operations in highly dynamic financial environments.

Table 4. Sensitivity of platform performance under stress scenarios

Stress scenario	Performance degradation (%)	Recovery time (hours)
Sudden liquidity shock	6.8	9.4

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Payment network outage	8.1	12.7
Regulatory rule change	5.2	7.9
Transaction volume surge	4.6	6.3
Currency volatility spike	6.1	8.8

The multidimensional performance advantages of intelligent platforms are visually synthesized in Figure 1, which presents a radar analysis of core capabilities. The figure shows consistently high scores across adaptive learning, scenario generation, fraud intelligence, forecasting accuracy, liquidity optimization, and governance maturity, indicating balanced capability development rather than isolated performance gains. This holistic strength differentiates intelligent platforms from traditional, functionally siloed systems.

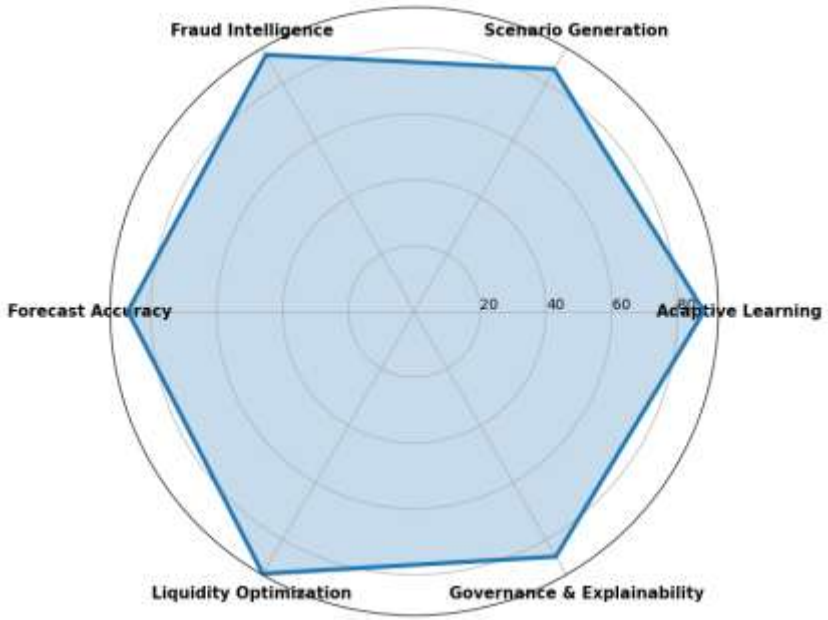

Figure 1. Radar analysis of intelligent payment and treasury capabilities

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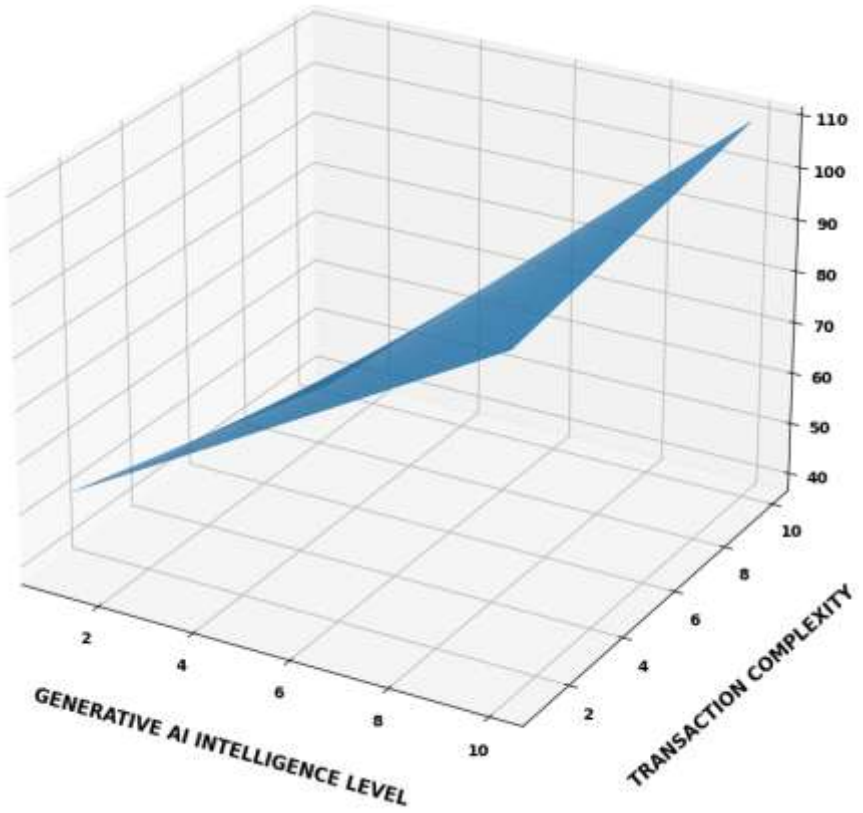

Figure 2. Surface response of liquidity efficiency across AI intelligence and transaction complexity

The interaction between intelligence and operational complexity is further illustrated in Figure 2, which presents a surface response of liquidity efficiency across varying levels of generative AI intelligence and transaction complexity. The upward gradient of the surface demonstrates that higher intelligence levels effectively offset complexity-induced inefficiencies, resulting in improved liquidity outcomes even in high-volume, high-variability transaction environments. Together, the tabular and visual results confirm that generative AI functions as a systemic enabler of efficiency, resilience, and strategic financial control in modern payment and treasury platforms.

Discussion

Generative AI as a catalyst for operational efficiency in payment platforms

The results clearly demonstrate that generative AI acts as a transformative catalyst for improving payment platform efficiency. The significant reductions in transaction processing time, failure rates, and fraud-related false positives observed in Table 1 indicate that adaptive learning and intelligent transaction routing outperform static rule-based mechanisms. These

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findings suggest that generative AI enables payment systems to continuously refine decision logic based on evolving transaction patterns and contextual signals (Sriram & Seenu, 2023). As a result, payment operations shift from reactive exception handling to proactive optimization, enhancing scalability and reliability in high-volume and cross-border payment environments (Paramasivan, 2024).

Predictive and prescriptive intelligence redefining treasury performance

The treasury performance improvements reported in Table 2 highlight a fundamental shift from descriptive to predictive and prescriptive financial management. The sharp decline in cash flow forecasting errors and idle cash holdings indicates that generative AI enhances the quality and timeliness of liquidity insights. By integrating multiple data sources and generating forward-looking scenarios, intelligent treasury platforms support more informed funding, investment, and hedging decisions (Oloke, 2022). This reinforces the view that generative AI elevates treasury from an operational support function to a strategic contributor to enterprise value creation (Marshall et al., 2024).

Resilience and adaptability under financial and operational stress

The stress scenario analysis presented in Table 4 underscores the role of generative AI in strengthening system resilience. Lower performance degradation and faster recovery times across liquidity shocks, transaction surges, and regulatory changes indicate that intelligent platforms can adapt dynamically to disruptions. This adaptability arises from the platform's ability to simulate alternative states, reallocate resources, and adjust decision thresholds in real time (Chniter et al., 2018). The results suggest that generative AI not only improves efficiency under normal conditions but also enhances continuity and stability during periods of heightened uncertainty (Pescapè, 2024).

Balancing automation with governance, transparency, and trust

Findings from Table 3 demonstrate that increased intelligence does not come at the expense of governance or compliance. On the contrary, the integration of explainability mechanisms and human-in-the-loop controls significantly improves audit readiness and regulatory compliance effectiveness. This balance is critical in payment and treasury contexts, where opaque automation can introduce systemic risk (von Solms & Langerman, 2020). The results imply that well-designed generative AI platforms can embed transparency and accountability

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into automated decision processes, thereby increasing stakeholder trust and regulatory acceptance (Reddy, 2024).

Holistic capability development in intelligent financial platforms

The radar analysis in Figure 1 provides evidence that generative AI enables balanced capability development across multiple functional dimensions. Rather than optimizing isolated metrics, intelligent platforms exhibit simultaneous gains in learning adaptability, forecasting accuracy, liquidity optimization, fraud intelligence, and governance maturity. This holistic performance profile suggests that generative AI serves as an integrative layer, aligning technical, financial, and regulatory objectives within a unified platform architecture (Denni-Fiberesima, 2024). Such alignment is essential for sustainable scaling of payment and treasury systems in complex enterprise environments (Olajide et al., 2023).

Intelligence as a moderator of complexity in modern financial ecosystems

The surface response illustrated in Figure 2 reveals a critical insight into the relationship between intelligence and complexity. As transaction complexity increases, liquidity efficiency typically deteriorates; however, higher levels of generative AI intelligence significantly moderate this effect. This indicates that intelligent platforms are better equipped to absorb complexity without proportional losses in performance (Nabaei et al., 2018). The discussion therefore positions generative AI not merely as an efficiency tool, but as a strategic mechanism for managing complexity, enabling organizations to operate effectively in increasingly interconnected and real-time financial ecosystems.

Conclusion

This study concludes that generative AI–powered intelligent payment and treasury platforms represent a fundamental advancement in the way financial operations are designed, governed, and executed. By embedding adaptive learning, scenario generation, and predictive intelligence into core financial workflows, these platforms significantly enhance payment efficiency, liquidity optimization, risk management, and operational resilience while maintaining strong governance and regulatory compliance. The results demonstrate that generative AI enables treasury functions to transition from reactive execution to strategic financial orchestration, particularly in complex and high-volume transaction environments. Importantly, the integration of explainability and human-in-the-loop controls ensures that increased automation does not compromise trust or accountability. Overall, the findings

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position generative AI as a critical enabler of scalable, resilient, and intelligence-driven payment and treasury systems, offering a robust foundation for future innovation in digital financial ecosystems.

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