



International Congress on Economics, Management and Business Studies

Hosted Online from New York, USA

Date: 23rd October, 2026

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OPTIMIZING BANKING OPERATIONS THROUGH PROCESS MINING, BIG DATA, AND MACHINE LEARNING

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Abstract

This thesis develops an integrated, governance-aware framework for improving banking operations through process mining, big-data engineering, and machine learning. Drawing on process-management literature and banking-risk standards, it explains how transactional event logs can reveal bottlenecks, how heterogeneous data can support timely decisions, and how validated predictive models can prioritize interventions. An illustrative application to payments, customer onboarding, and credit processing is proposed. The contribution is a measurable implementation architecture rather than a claim of achieved efficiency gains. The framework links operational speed, control effectiveness, customer experience, and model accountability.

Keywords: Process mining; banking operations; big data; machine learning; event logs; operational efficiency; Uzbekistan

1. Introduction

Banks manage interconnected workflows that span customer applications, identity verification, account servicing, payment execution, credit assessment, and post-transaction controls. These processes may be digitized without being efficient: repeated manual reviews, incomplete data, interdepartmental handoffs, and exception queues can remain hidden beneath customer-facing applications.



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The central research problem is therefore not merely how to automate individual tasks, but how to identify end-to-end inefficiencies and optimize them without weakening prudential safeguards.

Process mining provides evidence about how work actually proceeds, rather than relying exclusively on process diagrams or managerial interviews [1]. Its three principal functions—process discovery, conformance checking, and performance enhancement—can be combined with large-scale data integration and predictive analytics [2]. In banking, this combination is particularly relevant because transaction records are abundant but distributed across operational systems.

2. Research Approach and Analytical Framework

The study uses a conceptual and comparative analytical approach grounded in published methods and supervisory guidance. No confidential transaction-level dataset was supplied; accordingly, the proposed performance measures and use cases are methodological recommendations rather than empirical estimates. The unit of analysis is a business-process case, such as a payment instruction, loan application, or customer onboarding request. A usable event log requires a case identifier, activity name, timestamp, process outcome, and preferably resource and channel attributes [1, 2].

After deduplication, timestamp harmonization, role-based access controls, and de-identification where feasible, events should be linked to a common case history. Process discovery reconstructs frequent paths; conformance checking compares observed and authorized sequences; and enhancement methods locate rework loops, queue delays, and departures from service-level commitments. These diagnostics then become explainable features for models that predict breach probability, exception escalation, or case completion time.



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GOVERNANCE ACROSS THE FULL PIPELINE: PRIVACY | SECURITY | AUDITABILITY | HUMAN OVERSIGHT

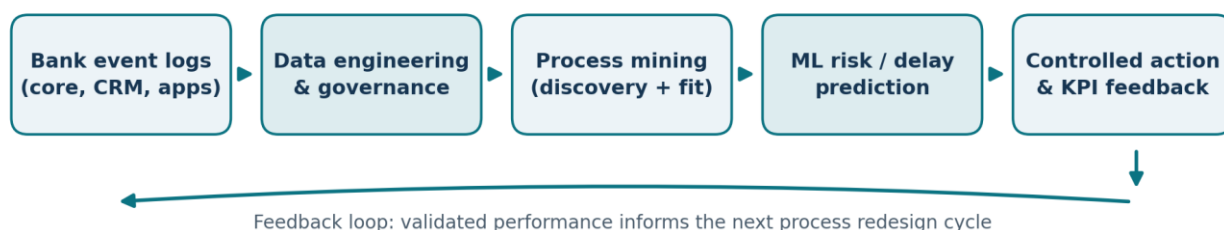


Figure 1. Proposed integrated architecture for evidence-based banking process optimization. Source: Author's conceptual design based on [1–4, 6].

3. Integration of Process Mining, Big Data, and Machine Learning

First, process mining can identify operational friction with traceable evidence. For example, if a payment case moves repeatedly between screening and manual verification, event-based analysis can quantify the share of repeated steps and isolate the paths associated with the longest delays. The resulting remedy may be redesign of decision rules or document intake, rather than the indiscriminate introduction of robotic automation. Exception-heavy flows should be analyzed separately from routine transactions to avoid distorted averages.

Second, big-data engineering links core banking events with mobile applications, customer-relationship management records, fraud alerts, and service-center interactions. Data stewardship must define source-of-truth fields, retention policies, quality thresholds, and lineage. The Basel Committee's risk-data principles emphasize completeness, accuracy, adaptability, and governance; these principles are relevant even when a bank applies them proportionately to operational analytics [5].

Third, machine learning can rank cases by their likelihood of exceeding a service deadline or requiring enhanced investigation. Gradient-boosted decision trees,



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including XGBoost, offer a practical approach to tabular prediction where nonlinear relationships and interactions are important [3]. However, classification accuracy alone is insufficient: banks should monitor recall, precision, calibration, false-positive investigation costs, subgroup disparities, and concept drift. Human review must remain available where a model result materially affects customers [4].

4. Practical Use Cases and Measurement

A phased bank-level pilot could prioritize three workflows based on case volume, exception frequency, regulatory criticality, and availability of reliable event data. The main objective is to reduce avoidable processing time while preserving required customer due diligence, segregation of duties, and supervisory reporting. Comparison of baseline and pilot outcomes should be risk-adjusted and based on comparable cases.

Process	Analytical technique	Primary evaluation indicator
Retail customer onboarding	Discover rework loops; predict incomplete submissions	Median end-to-end cycle time; first-time-right rate
Domestic payment processing	Analyze exception paths; forecast delayed settlement	95th-percentile completion time; exception rate
SME credit origination	Identify handoff delays; triage missing documents	Time to decision; manual touches per approved case
Fraud-alert investigation	Cluster similar alerts; risk-based case prioritization	False-positive workload; detection recall; audit completeness

Table 1. Suggested use cases and evaluation metrics. Source: Author's methodological synthesis; proposed indicators are not observed performance results.



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OPERATIONAL DECISION

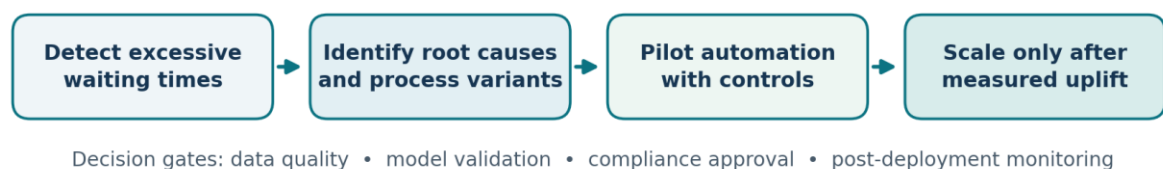


Figure 2. Stage-gated optimization and implementation logic. Source: Author's conceptual design.

5. Discussion, Safeguards, and Conclusion

A defensible evaluation protocol includes a pre-registered baseline period, a matched or randomized pilot where operationally feasible, a documented change log, and post-deployment monitoring. Improvement should be judged across multiple dimensions: throughput, customer waiting time, error frequency, compliance exceptions, employee workload, and unit processing cost. A faster approval process is not an improvement if it produces greater operational losses or weakens control compliance.

The principal implementation risks are inaccurate event reconstruction, unauthorized reuse of sensitive data, biased training samples, unstable predictive performance, dependence on external technology providers, and poorly controlled workflow changes. Operational resilience principles require critical services and dependencies to be mapped, tested, and recoverable under disruption [6]. Local feasibility should also take into account Uzbekistan's banking-sector reform agenda and the IMF's emphasis on stronger risk management and supervisory implementation [7].

In conclusion, process mining identifies where operational behavior diverges from an efficient and compliant design; big-data infrastructure makes the



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evidence reliable and timely; and machine learning improves the prioritization of interventions. These technologies are complementary rather than interchangeable. Their combined value should be established through auditable, controlled pilots and demonstrated improvements in customer, risk, and cost outcomes. Future empirical research should test the framework using anonymized case-level logs from Uzbek commercial banks.

References

1. van der Aalst W.M.P. Process Mining: Data Science in Action. – 2nd ed. – Berlin; Heidelberg: Springer, 2016. – 467 p. – DOI: 10.1007/978-3-662-49851-4.
2. van der Aalst W.M.P. et al. Process Mining Manifesto // Business Process Management Workshops / ed. F. Daniel, K. Barkaoui, S. Dustdar. – Berlin: Springer, 2012. – Vol. 99. – P. 169–194. – DOI: 10.1007/978-3-642-28108-2_19.
3. Chen T., Guestrin C. XGBoost: A Scalable Tree Boosting System // Proceedings of the 22nd ACM SIGKDD International Conference on Knowledge Discovery and Data Mining. – New York: ACM, 2016. – P. 785–794. – DOI: 10.1145/2939672.2939785.
4. Tabassi E. Artificial Intelligence Risk Management Framework (AI RMF 1.0). – Gaithersburg: NIST, 2023. – NIST AI 100-1. – DOI: 10.6028/NIST.AI.100-1.
5. Basel Committee on Banking Supervision. Principles for Effective Risk Data Aggregation and Risk Reporting. – Basel: Bank for International Settlements, 2013. – 28 p. – URL: <https://www.bis.org/publications/201301-guidelines-principles-effective-risk-data-aggregation-and-risk-reporting>.
6. Basel Committee on Banking Supervision. Principles for Operational Resilience. – Basel: Bank for International Settlements, 2021. – 12 p. – URL:



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<https://www.bis.org/publications/202103-guidelines-principles-operational-resilience>.

7. International Monetary Fund. Republic of Uzbekistan: Financial Sector Assessment Program—Financial System Stability Assessment. – Washington, DC: IMF, 2025. – Country Report No. 25/145. – 45 p. – DOI: 10.5089/9798229015103.002.