

Research on the Development Trends of AI-RPA Applications in the Banking Sector—A Case Study of Industrial and Commercial Bank of China

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Abstract. In the digital transformation of the banking industry, AI-RPA serves as a core tool for automation and intelligence, progressing from simple process automation to complex decision-making integration. This paper employs a case study approach, taking Industrial and Commercial Bank of China (ICBC) as an example. By analyzing the deployment pathways and practical outcomes of AI-RPA within ICBC, and combining insights into the underlying logic and developmental trends of AI and RPA, we extrapolate the technological evolution patterns of AI-RPA in banking and forecast future development trajectories. The study identifies four key trends: first, the technological convergence of generative AI and RPA; second, the shift from operational to strategic decision-making scenarios; third, the formation of a platform-based ecosystem for collaborative integration; and fourth, enhanced predictive capabilities and multi-layered risk control measures. Additionally, the paper predicts potential risks associated with future technological advancements and proposes corresponding mitigation strategies. The findings aim to inform and support the formulation of digital strategies within banking institutions.

Keywords: AI-RPA, banking industry, development trends, technological integration.

1. Introduction

The "14th Five-Year Plan" outlines the strategic goal of accelerating digital development and building a Digital China. As AI technology rapidly advances and market demands for efficiency and quality intensify, the integration of Robotic Process Automation (RPA) with AI has become a crucial approach to overcoming efficiency bottlenecks and reducing operational costs. As the world's largest commercial bank by asset size, Industrial and Commercial Bank of China (ICBC) initiated the "Digital Transformation Partnership Initiative" on May 13, 2020, alongside the National Development and Reform Commission and other government departments, as one of the first proponents. According to ICBC's 2023 annual report, its AI-RPA applications now cover 37 business lines, achieving significant breakthroughs in scenarios such as cross-border remittances and credit approval—reducing payroll printing from two days to one hour, with over 80% automation in credit approval processes, and annual cost savings exceeding one million yuan, setting industry benchmarks. This study uses ICBC as a case example, aiming to analyze its multi-agent collaboration and cross-industry data linkage practices to reveal the technological development logic and application trends of AI-RPA, providing valuable insights for the banking sector's digital transformation challenges.

2. Application Status and Implementation Path of AI-RPA in Banking

2.1 AI-RPA

Robotic Process Automation (RPA) is a business process automation technology based on software robots and artificial intelligence. It simulates and enhances human-computer interaction, executes repeatable tasks based on predefined rules, and facilitates data exchange between heterogeneous business systems. By replacing manual operations with digital labor, RPA significantly improves operational efficiency, drives business process reengineering, and enables automated process handling to achieve cost reduction, efficiency enhancement, and operational risk

mitigation [1]. The architecture of RPA technology typically comprises three main components: the control console, the runtime engine, and the robots. These components communicate and interact via API to facilitate efficient automation task execution [2]. In practical applications, the RPA architecture may be adjusted and optimized according to specific requirements and scenarios. The advent of AI has empowered RPA with computer vision and natural language processing capabilities, enabling it to recognize and extract unstructured data such as invoices and impact documents, understand textual content, and parse contractual clauses. This allows the system to learn and optimize autonomously from data, overcoming the limitations of handling only rule-based tasks, and enabling AI-RPA to address complex scenarios [3].

2.2 Current Application Status

2.2.1. Technology Platform Development

In terms of technology platform development, according to the Industrial and Commercial Bank of China's Software Development Center report titled "Deepening RPA Ecosystem Collaboration to Support Digital Industry Upgrades," the center initiated RPA research in early 2019. They developed an RPA platform characterized by multi-mode development support, comprehensive operational management, and intelligent automation integration. By 2021, the platform was the first to pass the Ministry of Industry and Information Technology's RPA application maturity assessment, achieving the highest level 3+ rating. In 2023, efforts to advance platform construction continued, resulting in the creation of the industry's first fully autonomous and controllable AI large model technology system with a scale of over 100 billion parameters. The initiative also strengthened enterprise-level data middle-platform capabilities and established an enterprise-level intelligent digital workforce system that combines "machine intelligence" with "human intelligence."

2.2.2. Business Scenario Coverage

Since launching the first application scenario in May 2019, by the end of 2021, nearly 700 core and subsidiary business scenarios had been covered. These include daily operational efficiency statistics, conversion rates and exchange rate downloads, and exception reporting queries, all achieved through scheduled tasks for automated data processing and delivery. By 2023, the scope of application expanded to 37 business lines, with the development of 13 comprehensive digital employees and over 1,000 process automation digital workers, resulting in an intelligent efficiency increase of over 30,000 person-hours annually.

2.2.3. Customer Service

In the field of customer service, according to the RPA application case study "Industrial and Commercial Bank of China RPA Application Practice," in 2022, a credit policy favoring four specific groups was implemented. RPA was introduced to process interest and fee adjustment work orders within three days, enabling 24/7 service. The process achieved a 100% success rate in work order completion and was finalized by T+1 day, establishing a benchmark for online business automation.

2.2.4. Credit Operations and Risk Management

In credit operations and risk management, RPA automates the entry of loan documentation, enhancing reporting efficiency and accuracy, reducing human resource consumption, and reallocating resources toward loan investigation and marketing efforts. This approach minimizes operational risks and improves customer service efficiency.

2.3 Implementation Pathways

Industrial and Commercial Bank of China (ICBC) has achieved an intelligent upgrade of operational and business processes through the integration of RPA technology.

2.3.1. Operational Phase

To address the inefficiency of traditional manual monitoring of over 20 key indicators such as deposits and loans across the bank, which previously took more than four hours, RPA automates the entire process including system login, indicator selection, and file downloading, reducing the total processing time to 20 minutes with a 100% accuracy rate. Additionally, as detailed in Liu Ziming's article, "RPA Technology Facilitates Digital Transformation in Commercial Banks—Application Practice of RPA at ICBC Changchun Branch," the complex task of manually downloading over 30 analytical reports and verifying each one for regulatory reporting was automated using RPA. This automation enabled the downloading, data entry, and validation processes to be completed automatically, reducing the time required to just 15 minutes and significantly enhancing data integrity and compliance [4].

2.3.2. Business Processing

Robotic Process Automation (RPA) simulates manual execution of repetitive tasks, automatically intercepting potential risks during credit card application reviews according to predefined rules.[5] It efficiently handles over 100 card issuance investigation cases daily, with the generated supervisory reports providing precise support for decision-making.

2.3.3. Operational Risk Control

Industrial and Commercial Bank of China (ICBC) has achieved a triple breakthrough in risk identification accuracy, response speed, and coverage through the deep integration of RPA with the "ICBC Rongan e" risk control platform. RPA automation covers more than 200 risk control scenarios, including credit approval, anti-money laundering monitoring, and compliance checks. By real-time data collection from multiple sources and executing rule-based verification tasks, the risk warning response efficiency has increased tenfold compared to manual processing—over 500,000 risk warning tickets were triggered in 2023, significantly reducing response times relative to traditional manual methods.

In terms of fraud detection accuracy, RPA combined with AI models enables intelligent upgrades. For example, Qingdao ICBC automatically captures credit card application data and performs real-time analysis, successfully intercepting over 20,000 high-risk fraudulent applications in 2023, effectively blocking large-scale fraud infiltration. Additionally, RPA operates continuously 24/7 to perform risk verification tasks such as automatic data reconciliation, anomaly transaction scanning, and warning report generation. This not only prevents human oversight but also elevates the accuracy of complex operations like fee and interest write-offs to 100%, eliminating operational risks caused by human error.

By establishing a comprehensive risk prevention and control system across the entire process chain, the bank has significantly enhanced its ability to intercept high-risk activities and improve the accuracy of risk identification [5].

3. Analysis of Future Trends in AI-RPA

3.1 Driving Factors

3.1.1. Technological Factors

Traditional RPA is limited to rule-based automation of repetitive tasks, such as data entry and form verification. However, it lacks autonomous learning capabilities and cannot interpret unstructured data in complex scenarios. AI leverages computer vision and natural language processing to enable RPA to perform high-efficiency tasks based on text and speech understanding, with self-regulation abilities. This allows for autonomous process construction and comprehension of complex environments. Computer vision enables machines to interpret visual data—such as images and real-time video—by performing tasks like object detection, scene understanding, and image segmentation. It simulates human visual perception, extracting valuable information from visual inputs and

responding accordingly. Natural language processing, on the other hand, allows computers to understand, analyze, and generate human language, facilitating natural and seamless human-machine interactions. Through deep learning models, NLP enables machines to "read" and "express" language in a manner akin to human comprehension [3].

3.1.2. Demand Factors

At the efficiency level, the integration of AI has broken through the limitations of traditional RPA, which could only handle structured data. For example, in the credit approval process at Industrial and Commercial Bank of China (ICBC), RPA combined with AI technology automatically extracts applicant information and completes intelligent verification. This integration has significantly improved the processing efficiency of cross-border remittance workflows, from declaration and verification to settlement, increasing throughput by several times [6].

In terms of cost optimization, among ICBC's RPA applications across 37 business lines, the machine learning capabilities of AI continuously optimize process design. For instance, in anti-money laundering screening, replacing traditional rule engines with AI models has reduced false positive rates by 40%, directly lowering subsequent manual review costs. In supply chain scenarios, AI-RPA automatically captures logistics and e-commerce platform data to verify trade authenticity, replacing manual review teams of 3-5 personnel, resulting in annual human resource cost savings exceeding one million yuan per project. Notably, AI's self-learning features substantially reduce long-term operational and maintenance costs. For example, ICBC in Fujian dynamically optimizes RPA robot workflows through AI, establishing automated networks such as joint logistics and government service platforms, further amortizing technological investment costs [7].

Market and policy factors: The "14th Five-Year Plan" emphasizes accelerating digital development and building a Digital China. As a major state-owned bank, ICBC bears the responsibility to align with national strategic requirements. Compared to industry peers, ICBC has taken the lead in conducting research on the innovative application of integrated AI and RPA digital technologies.

3.2 Trend Analysis

3.2.1. Upgrading RPA Application Methods to Enable Automated Process Design

Artificial Intelligence can serve as a process design engine, for example, by automatically generating RPA scripts through natural language commands, thereby enhancing development efficiency in daily operations. This includes automating tasks such as monthly cross-border remittance fee reconciliation. The Industrial and Commercial Bank of China's "ICBC Zhiyong" large-scale model has already achieved automatic script generation in certain scenarios, with plans to expand coverage to entire workflows. In the future, the integration of knowledge models and AI will become crucial, enabling real-time analysis of regulatory policy texts, automatic updates to RPA rule repositories, replacing manual rule maintenance, reducing human resource waste, and improving overall efficiency.

3.2.2. The application scenario shifts from the operational level to strategic decision-making.

The deep integration of AI technology has enabled RPA to transcend its traditional role of simple execution. The bank has developed a trillion-yuan-scale AI large model capable of processing unstructured data and analyzing complex correlations, thereby providing data-driven support for decision-making. As the automation of data integration at the operational level matures, financial institutions require more efficient strategic decision support, such as risk forecasting and customer insight analysis. AI-RPA can integrate cross-system data and dynamically optimize analytical models—for example, upgrading credit approval from mere data entry to automatic generation of risk assessment reports, or advancing cross-border transaction analysis from data scraping to exchange rate trend prediction. This represents a leap from "what to do" to "how to do it better" [8]. RPA will evolve into an automation tool with business process mining capabilities, revealing the true state of

processes from a data-driven perspective, and identifying rule-based, repetitive, and high-volume workflows to determine their suitability for RPA implementation.

3.2.3. Transition from Internal Bank Self-Development and Utilization to a Platform-Based Collaborative Ecosystem Model

In the future, the AI-RPA landscape within banking will evolve towards a collaborative ecosystem, forming an interconnected automation network across industries. This developmental trajectory is clearly observable from the existing application foundation of the Industrial and Commercial Bank of China (ICBC). Currently, ICBC's RPA solutions cover 37 business lines, with individual robots independently performing functions such as anti-money laundering screening and account management. The next step involves implementing a "smart central hub" to enable coordinated scheduling among multiple robots. For example, in ICBC's cross-border remittance operations, processes from declaration and verification to settlement still require manual integration across various systems. Future developments will see a central system orchestrate different RPA bots to automatically execute data extraction, compliance validation, and fund transfers, creating a full-chain closed-loop process that significantly enhances efficiency—multiplying current automation capabilities [9].

Simultaneously, human-machine collaboration will become more mature. Currently, ICBC employs digital employees to handle standardized tasks while human staff focus on complex decision-making. This model will be further refined; for instance, in corporate credit approval, RPA bots will automatically consolidate corporate data, AI models will generate preliminary recommendations, and relationship managers will concentrate on uncovering client needs and optimizing solutions—freeing up human resources for high-value services.

Cross-industry collaboration will also deepen. ICBC has already experimented with external partnerships in supply chain finance to achieve "four flows in one," integrating logistics, capital, information, and services. Moving forward, this model will expand into additional sectors, such as collaborating with logistics and e-commerce platforms to build automated data networks. RPA will directly capture logistics information to verify trade authenticity, similar to current integrations with mobile communication companies for data access. This will break down information silos across banking and industry supply chains, ultimately establishing a comprehensive, cross-industry automation ecosystem encompassing finance, commerce, and government services.

4. Development Challenges and Response Strategies

4.1 Development Challenges

The advancement of AI-RPA faces several significant hurdles. Technologically, AI occasionally exhibits logical errors that are imperceptible to humans, potentially leading to incorrect rule generation or flawed judgments, such as misjudging compliance risks. Financially, small and medium-sized banks often have limited capital, and the high costs and expertise required for deploying AI-RPA can hinder widespread adoption. Additionally, regulatory adaptation remains a concern; currently, there is a lack of clear industry guidelines and legal frameworks. For instance, issues arising from automated loan approvals may result in accountability gaps, leaving questions about responsibility and proper handling unresolved [10].

4.2 Response Strategies

To address AI logical issues, a technical approach involves integrating explainable AI technologies to decompose AI decision-making processes into visualized workflows in scenarios such as compliance risk assessment. These workflows are broken down into simpler, multiple steps, effectively reducing the likelihood of logical errors in AI. Additionally, a dual-layer control mechanism is established, where initial AI assessments are followed by manual review. If the assessed risk probability of an event is high, a manual re-evaluation is triggered [10].

From a cost perspective, the central bank or banking industry association could lead the development of an industry-wide shared AI-RPA platform, collaborating with leading institutions like ICBC. Small and medium-sized banks can access the platform through paid subscriptions, and the government may provide incentive funding to alleviate their capital pressures and encourage talent acquisition.

In terms of regulation, laws should clearly delineate responsibilities, such as liability in automatic loan approval processes. Furthermore, the central bank and other major financial regulators could convene multi-departmental coordination groups to address compliance disputes and legal adaptation issues, fostering a risk-controlled and legally compliant development environment.

5. Conclusion

This paper uses Industrial and Commercial Bank of China as a case study to explore the underlying logic of AI-RPA and the anticipated future development trends of AI. It concludes that AI-RPA serves as the core driver that transforms RPA from a purely operational tool into an intelligent, self-regulating system. A systematic analysis of its current application in the banking sector, implementation pathways, and development trajectory reveals that this technology not only broadens RPA's application scenarios—enabling it to handle unstructured data and complex decision-making—but also enhances its adaptability, accuracy, and human-machine collaboration capabilities. Consequently, AI-RPA has become a central tool in the digital transformation of banking. Its development trend is characterized by deep technological integration, applicability to complex scenarios, and ecosystem collaboration expansion.

However, numerous challenges related to technology and funding remain. To address these, banks can leverage explainable AI techniques and segment AI operational tasks to ensure controllability. Relying on shared platforms of large banks and government subsidies can reduce deployment and talent acquisition barriers for small and medium-sized banks. Additionally, proactive regulation of emerging technologies is necessary to maximize AI-RPA's value.

Looking ahead, AI will empower RPA to evolve from a process executor into a business decision-maker. This technological integration will demonstrate significant value in daily banking operations and contribute substantially to the ongoing digital transformation of the industry.

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