

Research on the Application of RPA Robots in Financial Shared Service Centers

Yan Junhua

Beijing Wuzi University, Beijing, China

ABSTRACT

In the context of global financial digital transformation, RPA has become a core technological tool for enhancing the efficiency of financial shared service centers. The distribution industry features a high degree of document standardization, making it naturally well-suited for RPA applications. However, small- and medium-sized circulation enterprises generally face practical challenges such as difficulty in quantifying implementation results and inefficient human-machine collaboration. This paper takes accounts payable and expense reimbursement-two key processes-as its research objects, constructing a three-dimensional quantitative evaluation system encompassing “efficiency, error rate, and cost.” By employing paired-sample tests and multi-case empirical methods, we measure the application effects at specific process nodes and propose a lightweight human-machine collaboration solution tailored to small- and medium-sized FSSCs. The study shows that RPA can boost process handling efficiency by more than 70%, reduce standardized operation error rates by around 90%, and cut direct labor costs by over 35%. Clearly defining the boundaries of human and machine responsibilities and establishing closed-loop integration mechanisms are essential prerequisites for fully unlocking the value of this technology. This research fills a gap in the quantitative study of RPA applications in specific financial processes within the distribution industry, providing reusable theoretical and practical references for small- and medium-sized circulation enterprises seeking to promote financial digital transformation at low cost.

KEYWORDS: *Financial Shared Service Center; Robotic Process Automation (RPA); Distribution Industry; Quantitative Assessment; Human-Machine Collaboration.*

1. INTRODUCTION

In the context of the digital economy, financial digital transformation has become a key strategic direction for high-quality development in the distribution industry. Owing to its advantages of low cost and rapid deployment, robotic process automation (RPA) has emerged as a core tool for enhancing the efficiency of financial shared service centers. The distribution industry features large volumes of documents and a high degree of standardization in business rules; among these, the accounts payable and expense reimbursement processes account for 72% of the basic accounting workload in financial shared service centers, making them naturally well-suited for RPA implementation. However, small- and medium-sized distribution enterprises, constrained by limited

resources, generally face challenges such as difficulty in quantifying implementation results and poor integration between human and machine workflows, thus failing to fully realize the value of digitalization. Existing research mostly focuses on customized solutions for large enterprises and relies primarily on qualitative analytical frameworks, leaving a significant gap in the development of quantitative assessment systems for specific business processes and in-depth studies on human-machine collaboration mechanisms tailored to small- and medium-sized enterprises. This paper takes the core financial processes of small- and medium-sized distribution enterprises as its sample, employs paired-sample tests and multi-case empirical methods, and constructs a

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three-dimensional quantitative assessment system. It measures the effectiveness of RPA implementation and proposes lightweight collaborative solutions, thereby providing theoretical support and practical guidance for financial digitalization in the distribution industry.

2. The Mechanism and Evaluation Framework for RPA-Enabled Core Processes in FSSC

2.1. Definition of Core Concepts

Financial Shared Service Center (FSSC): By centralizing the processing of standardized financial operations, it achieves cost reduction and efficiency improvement, serving as a core platform for enterprises' digital transformation in finance.

Robotic Process Automation (RPA): It can simulate human execution of repetitive tasks with clearly defined rules, characterized by non-invasiveness, low cost, and rapid implementation, making it highly suitable for financial accounting scenarios.

2.2. Value Transmission Mechanism

Accounts payable and expense reimbursement are the two core processes with the highest proportion and greatest repetitiveness in the FSSC of the distribution industry. RPA enhances their value through three clear pathways, forming a complete chain of impact.

First is the path to efficiency enhancement. The distribution industry, influenced by factors such as promotional seasons and month-end settlements, experiences significant fluctuations in document volume-sharp peaks and troughs. Under a manual processing model, peak periods often see document backlogs and delayed processing. RPA, however, can operate continuously 24 hours a day, 7 days a week, unrestricted by working hours or human capacity constraints. It can substantially shorten the average processing time per workflow, increase the number of documents processed per person per day, quickly respond to peak business demands, and break through the capacity bottlenecks inherent in manual processing.

Second, the path to quality optimization. The distribution industry features a large number of suppliers and a wide variety of invoice types, making manual verification prone to input errors and matching discrepancies due to fatigue or oversight. RPA executes operations strictly according to pre-set rules, automatically performing tasks such as invoice authenticity checks, three-document matching, and compliance validation. By eliminating human operational errors at the source, RPA reduces document error rates and rework rates, enhances the accuracy and compliance of financial data, and minimizes the additional workload associated with subsequent reconciliation and adjustment processes.

Third is the cost-saving pathway. On the one hand, RPA replaces a large volume of repetitive tasks in basic accounting roles, directly reducing the number of positions required and lowering enterprises' direct labor costs. On the other hand, the improved accuracy of operations reduces implicit operational costs such as error correction, exception backtracking, and compliance rectification, resulting in significantly enhanced overall input-output efficiency. For small and medium-sized distribution enterprises with limited profit margins, the value of cost savings is particularly pronounced.

2.3. Three-Dimensional Quantitative Assessment System

Addressing the limitations of existing research, which primarily rely on qualitative descriptions, and taking into account the specific characteristics of financial processes in the distribution industry, we have developed an RPA application effectiveness evaluation system comprising 12 core indicators across three dimensions: efficiency, error rate, and cost. This system covers key metrics such as single-process handling time, per capita processing efficiency, operational error rate, and cost per document, enabling quantifiable measurement, comparability, and reusability of real-world implementation results.

3. Empirical Analysis of the Application of FSSC RPA in the Distribution Industry

3.1. Samples and Research Methods

We selected three small- and medium-sized commercial distribution enterprises in the Beijing area, each with annual revenues ranging from 200 million to 1 billion yuan, as our research sample. We collected de-identified operational data on accounts payable and expense reimbursement processes for the six months preceding and the six months following the launch of RPA implementation.

This study employs the paired-samples t-test for empirical analysis. Operational data from before an enterprise implements RPA serves as the control group, while data collected after implementation forms the experimental group. By comparing the mean differences between these two groups, we quantitatively assess the actual effectiveness of RPA implementation. The advantage of the paired-samples test lies in its ability to control for individual enterprise characteristics, thereby minimizing interference from confounding factors and more accurately identifying performance changes attributable solely to the RPA technology itself.

Simultaneously, a multi-case comparative approach is employed to conduct a horizontal comparison of RPA application models, implementation results, and

existing issues across the three enterprises. This identifies common patterns and prevalent pain points in RPA adoption by small- and medium-sized distribution enterprises, providing empirical support for the development of subsequent optimization strategies.

3.2. Empirical Calculation Results

The calculation results based on paired-sample tests show that, after RPA was implemented, the operational performance of two core processes—accounts payable and expense reimbursement—at the sample enterprises significantly improved. The improvement effects across the three dimensions are consistent with theoretical expectations.

Efficiency Dimension: The processing efficiency of individual workflows has improved by more than 70%, and the per capita document-processing performance has increased by more than 60%. The system's capacity to handle peak business volumes has been significantly enhanced, effectively alleviating the processing delays caused by the concentrated submission of documents at month-end and during promotional seasons.

Quality Dimension: The error rate for standardized operations has dropped from 1.5%–3% to below 0.3%, resulting in an overall reduction of approximately 90% in error rates. Data entry accuracy has improved to over 99.9%. This reduction in error rates not only enhances the quality of financial data but also significantly decreases the workload associated with subsequent reconciliation and adjustment processes, thereby indirectly freeing up managerial resources for finance personnel.

Cost Dimension: Direct calculation shows a reduction of over 35% in labor costs, and an over 50% decrease in implicit operating costs. The project's investment payback period is approximately 6 to 12 months, demonstrating a high return on investment.

3.3. Industry-wide Common Application Bottlenecks

Although RPA has achieved remarkable results in implementation, the practices of sample enterprises have also revealed common bottlenecks faced by small- and medium-sized distribution companies, which are hindering the further realization of the technology's full potential. First, there is a lack of quantitative assessment capabilities—most companies can only perceive an overall improvement in efficiency but cannot accurately measure the input-output ratio for individual processes or specific nodes, making it difficult to support subsequent process optimization and technological iteration. Second, the

efficiency of human-machine collaboration remains low. Companies generally exhibit a cognitive bias toward “overemphasizing automation substitution while underestimating the importance of human-machine collaboration,” failing to clearly define the boundaries between standardized operations and human judgment. Moreover, the rules governing the handling of exception documents remain unclear, leading to breakpoints in process integration and inadvertently increasing communication costs across different job roles. Third, the depth of RPA application is insufficient. Constrained by financial and technical capabilities, most SMEs use RPA only for basic data entry tasks, without extending its use to higher-value areas such as auditing and control. As a result, the technology's potential for management empowerment has not been fully realized.

4. FSSC Human-Machine Collaboration Optimization Solution for Small and Medium-Sized Distribution Enterprises

4.1. Lightweight Implementation Principles

Adapt to the resource endowments of small and medium-sized circulation enterprises, and adhere to three core principles: low cost and lightweight design—replacing high-cost custom development with general-purpose tools; human-machine collaboration rather than full automation—balancing the advantages of technological efficiency with the value of human decision-making; and gradual expansion—prioritizing the implementation of high-frequency, core processes.

4.2. Division of Human-Machine Rights and Responsibilities

Divide the entire financial process into two types of nodes, clearly defining the boundaries of authority and responsibility: All standardized operational nodes—such as document recognition, three-document matching, data entry, voucher generation, and basic compliance checks—are automatically executed by RPA; while judgment and decision-making nodes—including review of abnormal documents, verification of risk factors, iteration of process rules, and RPA operations and management—are handled by finance personnel.

4.3. Closed-loop Collaborative Mechanism

Establish a closed-loop collaborative mechanism featuring “automation-exception prioritization and alerting—manual handling—result feedback—rule iteration”: Push exception tasks categorized by risk level to minimize ineffective communication; seamlessly integrate human and machine workflows; and regularly transform high-frequency exception scenarios into automated rules, continuously expanding the coverage of RPA.

5. Conclusions and Implications

5.1. Research Conclusions

First, RPA can significantly optimize FSSC operational performance in three key areas—efficiency, quality, and cost. It demonstrates outstanding value when applied to high-frequency, standardized processes in the distribution industry and serves as a cost-effective tool for financial digitalization among small and medium-sized enterprises. Second, the lack of quantitative evaluation, inefficient human-machine collaboration, and insufficient depth of application are the core bottlenecks hindering SMEs in the distribution sector from fully realizing the value of RPA technology. Third, the lightweight human-machine collaboration model is highly compatible with the characteristics of SMEs and enables them to maximize both technological and managerial value at a relatively low cost.

5.2. Practical Implications

At the enterprise level, we should dispel the misconception that “RPA can completely replace human labor,” establish a quantified evaluation system, clearly define the boundaries of responsibilities and authorities between humans and machines, and implement RPA in a phased manner with continuous iteration. At the industry level, we should introduce unified application guidelines and evaluation standards, promote replicable, lightweight implementation solutions, and lower the threshold for SMEs to undergo digital transformation. At the university level, we should integrate RPA applications into financial practice training programs, cultivating versatile financial professionals who possess both specialized expertise and digital skills.

5.3. Study Limitations and Future Directions

This study focuses on small and medium-sized distribution enterprises in the Beijing area; the generalizability of its conclusions remains to be further explored. In the future, we could expand the sample scope to conduct cross-industry comparisons and explore pathways for integrating RPA with artificial intelligence and big data technologies.

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