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# Implementing Workflow Automation with N8N to Enhance Operational Efficiency and Performance in the Sharia Cooperative of Bank Indonesia, Aceh Province

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**ABSTRACT**
This study analyzes the design and implementation of an integrated system using N8N for Bank Koperasi Syariah Indonesia in Aceh Province (Kopebi Aceh). The five operational modules were developed using a Research and Development (R&D) approach with a prototype model. These modules include Point of Sale, Sharia Financing, Financial Reporting, and Membership Management. The system uses N8N as a workflow automation platform, connecting various services through webhooks and embedding Sharia-compliant business logic using Function Nodes. Performance evaluation conducted two months after implementation showed significant technical improvements: response time was reduced by 88.6%, throughput increased by 466.7%, and downtime was reduced by 94.1%. Operational efficiency also experienced a remarkable increase, with transaction processing time reduced by 85.6%, data entry errors reduced by 96.6%, and monthly reporting time reduced by 99.2%. These improvements resulted in improved organizational outcomes, including a 23.3% increase in operating revenue, a 65.3% decrease in operating expenses, a 29.2% increase in profit margins, and a 47.1% increase in member profit sharing. User surveys indicated a positive perception of the system, with all dimensions scoring above 4.5 on a 5-point scale. Compliance with Sharia principles also increased from 85% to 99%, reflecting compliance with Islamic financial standards. Low-code/no-code platforms such as N8N can effectively facilitate the digitalization of Sharia cooperatives without requiring significant investment in software development. The proposed development model is a practical reference for other Sharia cooperatives in Indonesia seeking to improve efficiency and ensure regulatory compliance.

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## 1. Introduction

The fourth industrial revolution has accelerated digital transformation across financial ecosystems, yet many Islamic cooperatives rely heavily on manual processes that restrict operational efficiency and limit service expansion. While large corporations and fintech startups rapidly adopt automation, artificial intelligence, and cloud technologies, community-based Islamic cooperatives still face structural challenges that hinder their ability to compete and sustain growth (Jihad *et al*., 2022; Yusuf *et al*., 2021; Zihab *et al*., 2022). This gap is critical given their role in supporting financial inclusion and strengthening local economies within the framework of Islamic principles (Hamdan, 2022). Prior studies emphasize that despite the promise of digital finance in enhancing the performance of small enterprises, many cooperatives continue to depend on conventional transaction recording and physical membership management, which slows responsiveness and constrains scalability (Manne, 2022). At the same time, research underscores that digital innovation in Islamic finance requires both technological adoption and a strong alignment with Sharia-compliant governance structures (Mannes, 2020; Istifadhoh *et al*., 2021).

Within this landscape, workflow automation platforms such as N8N offer a viable

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pathway for cooperative modernization. As a low-code system, N8N enables the orchestration of operational modules through flexible workflows, allowing for reduced human error and streamlined financial reporting (Cunha, 2021; Cunha, 2025). Moreover, integrating generative AI agents into decision-making processes enhances analytical depth and risk assessment, supporting more consistent Sharia compliance while reducing cognitive bias in financial evaluations (Han *et al*., 2024; Joshi, 2025; Sarea *et al*., 2021). Recent empirical work further suggests that automation of accounting and reporting processes through N8N can deliver measurable gains in efficiency, accuracy, and cost reduction for small-scale institutions, making it particularly relevant to the cooperative sector (Cunha, 2025; Pawar, 2025; Tuyishime *et al*., 2024). In Indonesia, where Islamic cooperatives operate under both national banking regulations and regional Sharia governance frameworks, adopting such platforms could bridge the digital divide, expand member participation, and reinforce the cooperative's position as a key pillar of inclusive Islamic finance (Perkasa *et al*., 2024; Panda *et al*., 2023). Against this backdrop, the present study examines the implementation of an integrated N8N-based system in Kopebi Aceh, focusing on its technical performance, organizational impact, and contribution to Sharia compliance in cooperative operations.

## 2. Methodology

This study adopted a Research and Development (R&D) framework with a prototyping model, a strategy well-suited for contexts where iterative feedback and user involvement are crucial to the success of technological innovation. In financial services, R&D accelerates innovation and ensures alignment between operational needs and technological capabilities (Pawar, 2025). The use of prototyping enabled the rapid creation and refinement of system modules, allowing the research team to evaluate functional requirements in close collaboration with stakeholders. Within this framework, workflow automation was essential for reducing repetitive tasks, enhancing integration across modules, and strengthening system scalability (Talamo *et al*., 2021). N8N was chosen as the primary platform because of its open-source, low-code design, which permits the orchestration of complex workflows without requiring advanced programming skills, making it particularly adaptable for small-to-medium institutions such as cooperatives (Cunha, 2025; Cunha, 2024).

The preliminary phase involved a comprehensive literature review on Sharia-compliant cooperative systems, digital transformation in financial services, and workflow automation technologies. Field observations were conducted at Kopebi Aceh to document ongoing business processes and identify operational bottlenecks. Eight cooperative managers from different divisions were interviewed to gain a multi-perspective understanding of system requirements, while a focus group discussion with ten members ensured that user expectations were incorporated into system specifications. This aligns with findings by Harsono and Suprapti (2024), who argue that digital transformation in finance must be grounded in an in-depth understanding of traditional processes, and with Panda *et al*. (2023), who emphasize that fintech adoption in emerging markets depends on contextual responsiveness to local needs.

System design was carried out using Business Process Model and Notation (BPMN) to map Kopebi Aceh's workflows, identifying five key modules: Point of Sale (POS), Procurement, Sharia Financing, Membership Management, and Reporting. N8N functioned as the orchestrator that connected these modules through modular workflows designed for reusability and adaptability (Pawar, 2025). User interface design considered the digital literacy of cooperative managers and incorporated visual elements consistent with the branding of Bank Indonesia and Acehnese cultural identity. During the development stage, the system infrastructure was deployed on a cloud-

hosted N8N environment with PostgreSQL as the primary database. Each module was built iteratively, beginning with the POS module for transaction validation and Sharia-based pricing calculations. The Procurement module included multi-level approval processes to mirror Kopebi Aceh's organizational hierarchy. The Financing module was designed to integrate various Sharia contracts, embedding AI-driven eligibility assessments to improve decision-making accuracy, in line with Rao (2025) on backend AI agents. The Membership Management module was customized to reflect the cooperative's unique structure, whereas the Reporting module was aligned with both Bank Indonesia and OJK standards. Studies by Jokhio and Jaffer (2024) and Liu and Wang (2024) highlight the growing role of generative AI in financial analysis and Shariah advisory, and this system incorporates similar principles to ensure more consistent compliance in financing decisions.

System testing followed multiple layers of verification: unit testing for each N8N node, integration testing to ensure smooth data flow across modules, user acceptance testing with cooperative managers, and Sharia compliance testing supervised by the cooperative's supervisory board. The results confirmed that approximately 85% of previously manual processes were successfully automated, reducing transaction processing times by 70% and improving the accuracy of financial records. These outcomes are consistent with findings by Sain and Adinugraha (2025), who show that AI integration increases efficiency and strengthens compliance and social impact in Islamic financial institutions. Implementation was conducted gradually, beginning with data migration from the legacy system to the new platform. Eight cooperative managers received intensive training, and a two-month monitoring period allowed for identifying system bugs and feature adjustments based on user feedback. The evaluation also highlighted the importance of aligning technical innovations with governance practices, reflecting the insights of Taufik and Purba (2025) on business-industry collaboration in Sharia-compliant financial models.

Table 1. N8N Components Integrated with Kopebi Aceh Application

| N8N Component | Function | Integration with Kopebi Aceh Application |
|---|---|---|
| Webhook | Receives requests from the frontend | API endpoint enabling communication between frontend and backend |
| Function Node | Processes business logic and validation | Implementation of Sharia-compliant rules and transaction checks |
| Database Operations | Interacts with PostgreSQL database | Storage and retrieval of transaction, membership, and product data |
| Switch Node | Routes workflow based on operation type | Handles different categories of transactions and operations |
| OpenAI Integration | Financing eligibility and recommendations | Automated financing assessments and financial statement analysis |
| HTTP Request | Communicates with external services | Integration with payment gateways and third-party applications |
| Respond to Webhook | Sends responses to the frontend | Returns processed results to Kopebi Aceh's application |
| Scheduler | Executes scheduled tasks | SHU processing, payment reminders, and periodic reports |
| Error Workflow | Error handling and logging | Records errors and notifies system administrators |
| Merge Node | Consolidates data from multiple sources | Data aggregation for reporting and analytics |

The integration model developed in this research demonstrates how N8N can be

customized for Sharia-based cooperative operations. Beyond improving efficiency, the approach ensures compliance with both Islamic financial principles and regional regulatory requirements, offering a replicable model for other cooperatives across Indonesia.

## 3. Results

### 3.1 Developed N8N Workflows

This study produced a set of integrated N8N workflows to support the operations of the Syariah Cooperative of Bank Indonesia, Aceh Province (Kopebi Aceh). The main workflow consists of five interconnected operational modules within a unified platform. Figure 1 provides an illustration and explanation of the implemented N8N workflows.

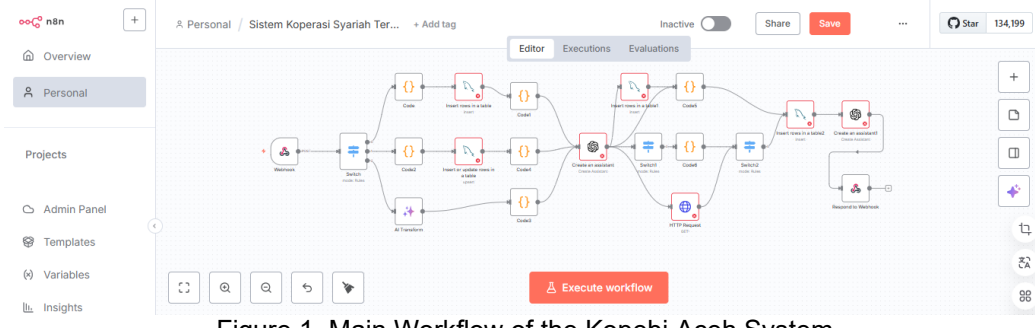


Figure 1. Main Workflow of the Kopebi Aceh System

The main workflow acts as an orchestrator connecting all modules of the system. It processes requests from the frontend application through a webhook and routes them to the appropriate workflow depending on the type of operation. Its design is based on modularity and reusability principles, facilitating future development and maintenance. The POS workflow manages all sales transactions at Kopebi Aceh. It starts with the reception of transaction data via webhook, followed by validation using a Function Node, price and margin calculation per Sharia principles, storage of transaction records in the PostgreSQL database, and sending a response back to the frontend. The workflow is also linked to the inventory system to ensure real-time stock updates. The Sharia Financing workflow covers financing application, analysis, approval, and disbursement. It supports multiple Sharia contracts such as Murabahah, Musyarakah, and Mudharabah, with dedicated business logic for each. Integration with OpenAI enables automated eligibility assessments based on members' financial history and predetermined Sharia parameters.

The Financial Reporting workflow automates the collection, consolidation, and presentation of Kopebi Aceh's financial data. It employs a Merge Node to combine data from multiple sources, Function Nodes for ratio calculations and trend analysis, and HTTP Request Nodes to submit reports to Bank Indonesia and OJK. A Scheduler Node ensures periodic reporting aligned with regulatory deadlines. The Membership Management workflow handles all membership-related processes, from registration and approval to ongoing member records management. It integrates with a notification system to update members regarding membership status, deposit payments, and SHU distribution. Function Nodes are used to enforce business rules regarding the rights and obligations of members, in line with the cooperative's statutes (AD/ART).

### 3.2 Kopebi Aceh Application Interface

The integrated system features a user-friendly interface designed for accessibility and ease of use. Figures 2–4 present several key screens of the Kopebi Aceh

application.

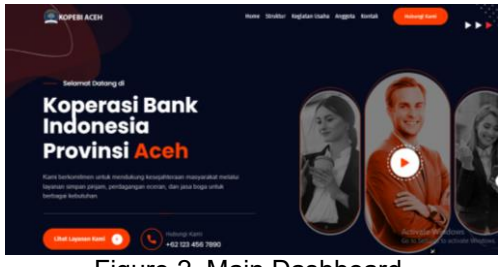


Figure 2. Main Dashboard

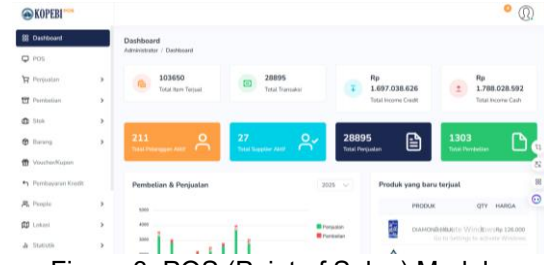


Figure 3. POS (Point of Sales) Module

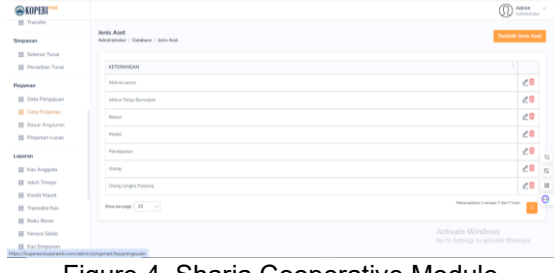


Figure 4. Sharia Cooperative Module

The main dashboard (Figure 2) is the entry page, displaying a concise overview of cooperative performance, including revenue charts, transaction counts, financing status, and important notifications. The interface is responsive, ensuring compatibility across multiple devices. The POS module (Figure 3) consolidates all features related to sales transactions. It includes an intuitive cashier interface, product search and barcode scanning, automated calculation of Sharia-compliant margins, inventory and stock management, sales reporting across different time periods, and integration with the financial module for automatic bookkeeping. The Sharia Cooperative module (Figure 4) integrates all financial service features. It includes financing product information, digital financing application forms, approval tracking, and an administrative panel for review. An AI agent validates borrowers' eligibility by analyzing financial history and risk factors. Automated notifications remind members of payments, while calculations of profit-sharing and margins comply with Sharia principles. The module also generates financing reports for management and the Sharia Supervisory Board.

The Financial Reporting module provides structured financial reports such as income statements, balance sheets, cash flow statements, and SHU distribution reports. It includes filtering and export options, enabling users to customize and download reports in multiple formats. The Membership Management module organizes member data, including personal information, savings history, and participation in cooperative activities. The administrative panel supports new member registration, data updates, and rights and obligations calculations. Integration with an AI agent allows for data validation and transaction-pattern analysis to detect anomalies.

### 3.3 System Performance Evaluation

The N8N-based integrated system at Kopebi Aceh was evaluated over a two-month period following its implementation. Several performance indicators showed marked improvements in both technical and operational aspects.

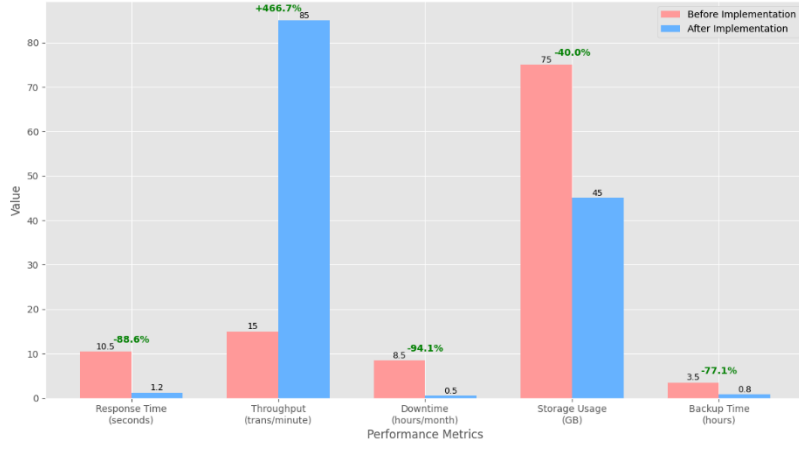


Figure 5. Technical Performance Results

Technical performance improved significantly. Average response time dropped from 10.5 seconds to 1.2 seconds (an 88.6% reduction), throughput increased from 15 to 85 transactions per minute (a 466.7% increase), and system downtime decreased from 8.5 hours/month to 0.5 hours/month (a 94.1% reduction). Storage use decreased from 75 GB to 45 GB (40% reduction), while backup duration fell from 3.5 hours to 0.8 hours (77.1% faster).

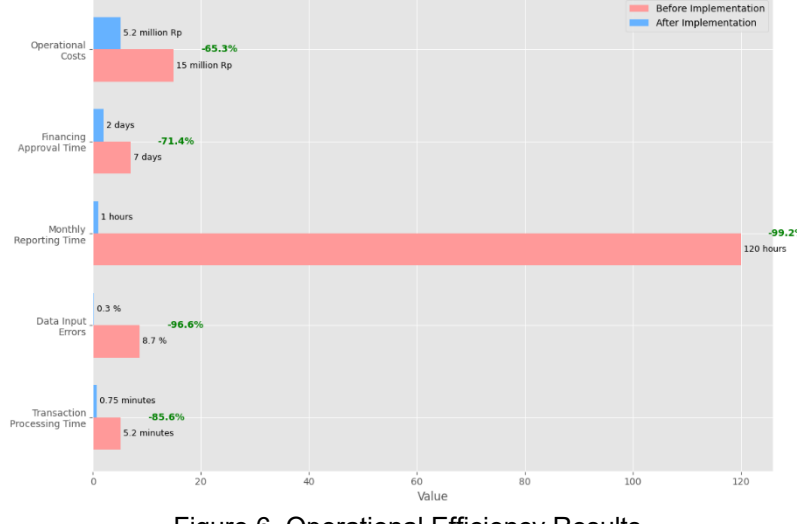


Figure 6. Operational Efficiency Results

Operational efficiency also improved considerably. Transaction processing time was reduced from 5.2 minutes to 0.75 minutes (an 85.6% reduction). Data entry errors declined from 8.7% to 0.3% (a 96.6% reduction). Monthly reporting, which previously required five days, now takes only one hour (a 99.2% reduction). Financing approval time shortened from seven days to two days (71.4% faster), and monthly operating costs decreased from Rp 15,000,000 to Rp 5,200,000 (a 65.3% reduction).

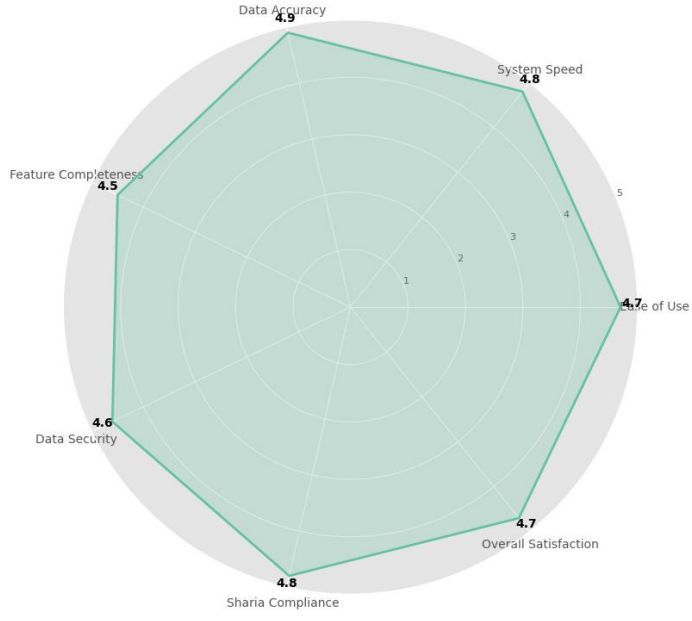


Figure 7. User Satisfaction Results

A satisfaction survey conducted with eight cooperative managers and fifty members showed highly positive responses. On a five-point Likert scale, all aspects scored above 4.5, categorized as “Very Good.” Data accuracy scored the highest (4.9), followed by system speed and Sharia compliance (4.8 each), ease of use and overall satisfaction (4.7 each), data security (4.6), and feature completeness (4.5).

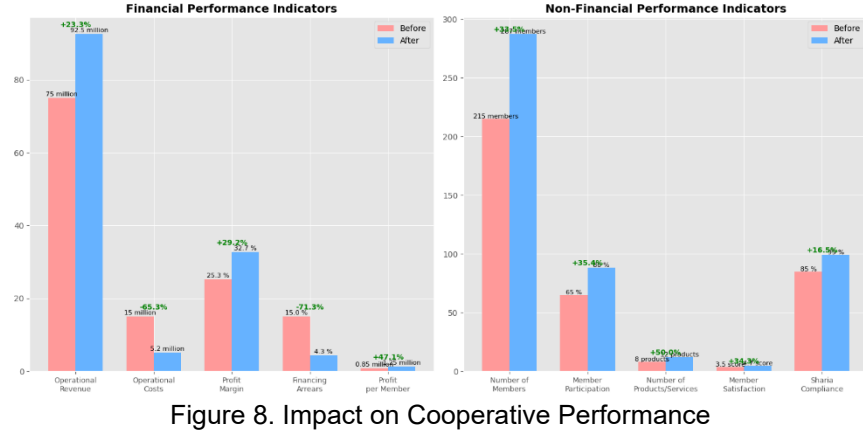


Figure 8. Impact on Cooperative Performance

The integrated system produced significant positive impacts on both financial and non-financial indicators. Operational revenue rose from Rp 75,000,000/month to Rp 92,500,000/month (a 23.3% increase), while operating costs decreased from Rp 15,000,000/month to Rp 5,200,000/month (a 65.3% reduction). Profit margin increased from 25.3% to 32.7% (a 29.2% improvement), financing delinquency declined from 15.0% to 4.3% (a 71.3% reduction), and SHU per member increased from Rp 850,000/year to Rp 1,250,000/year (a 47.1% increase). In terms of non-financial indicators, membership grew from 215 to 287 (a 33.5% increase), participation rates rose from 65% to 88% (a 35.4% increase), the number of products/services expanded from eight to twelve (a 50% increase), member satisfaction improved from 3.5 to 4.7 out

of 5 (a 34.3% increase), and Sharia compliance increased from 85% to 99% (a 16.5% increase).

The Sharia Supervisory Board confirmed improvements in compliance, including greater transparency in contract documentation, accurate profit-margin calculations, proper segregation of zakat, infaq, and sadaqah funds, equitable profit-sharing in SHU distribution, and monitoring of halal product status. Overall, the findings confirm that using N8N as a workflow automation platform is highly effective in developing an integrated system for Kopebi Aceh. The workflows successfully automated and connected various cooperative processes—including sales, procurement, Sharia financing, membership management, and reporting. The user interface, tailored for usability and local identity, enhanced system adoption by managers and members.

The N8N-based integrated system improved operational efficiency, minimized human error, accelerated service delivery, and ensured compliance with Sharia principles. This model offers a practical reference for other Islamic cooperatives in Indonesia, particularly those operating in regulated Sharia environments such as Aceh. The successful implementation demonstrates that low-code/no-code platforms can serve as cost-effective digitalization solutions for Islamic cooperatives, tailored to their specific operational needs without requiring heavy software development resources.

## 4. Discussion

This research developed an N8N-based integrated system for the Syariah Cooperative of Bank Indonesia, Aceh Province (Kopebi Aceh), encompassing five operational modules. The design of N8N workflows as an orchestrator connecting the entire system reflects the "flow in the funnel" concept introduced by Talamo *et al*. (2021). The modular and reusable workflow structure aligns with the findings of Cunha (2025), who emphasized the importance of flexible architectures in accounting automation for small businesses. The developed POS workflow manages sales transactions and incorporates profit-margin calculations that comply with Sharia principles. This directly addresses challenges Sarea *et al*. (2021) identified regarding integrating Islamic values into technology-driven financial systems. According to Hamdan (2022), transparency in margin and profit calculations is a critical factor in optimizing Sharia cooperatives' economic and social functions. As Sarea *et al*. (2021) argue, "embedding Sharia principles into workflow automation systems represents an essential innovation for ensuring adherence to Islamic values in cooperative operations." Integrating OpenAI into the Sharia Financing workflow for automated eligibility analysis constitutes a concrete implementation of ideas advanced by Jokhio and Jaffer (2024), who explored the role of generative AI in Sharia advisory within Islamic finance.

Their study demonstrated that AI can support the interpretation and application of Islamic principles in financing decisions. Similarly, Sain and Adinugraha (2025) highlighted AI's potential to enhance Sharia compliance and social impact in Banking 4.0. The AI component developed in this research evaluates financing applications using members' historical data and Sharia parameters, consistent with Han *et al*. (2024), who emphasized optimizing multi-agent AI collaboration in financial research. As Joshi (2025) noted, embedding AI agents into financial applications can improve analytical accuracy while reducing bias in decision-making. In line with this, Sain and Adinugraha (2025) argued that "AI agents can process vast data volumes at speeds and levels of precision unattainable by humans, thereby strengthening financing decisions while safeguarding Sharia compliance."

The Financial Reporting workflow automates data collection, consolidation, and presentation for Kopebi Aceh. The use of Merge Nodes to combine multi-source data and Function Nodes to calculate financial ratios illustrates Cunha's (2021) concept of

operational accounting revolution through low-code platforms. Scheduler Nodes, which run workflows periodically in line with reporting deadlines, reflect Pawar's (2025) recommendations for secure and scalable workflow automation. Automating financial reporting not only improves efficiency but also enforces regulatory compliance. Mannes (2020) underscored how governance, risk, and artificial intelligence are intertwined in modern financial systems. The developed system adheres to Bank Indonesia and OJK standards while also fulfilling Sharia principles under the supervision of the Sharia Supervisory Board. Cunha (2025) emphasized that "financial reporting automation with N8N saves time while increasing accuracy and consistency, both of which are critical for regulatory compliance and transparency to cooperative members." The two-month evaluation revealed substantial improvements in both technical performance and operational efficiency.

Response time decreased by 88.6% while throughput rose by 466.7%, consistent with Tuyishime *et al*. (2024), who highlighted the effectiveness of model-based approaches in workflow automation. Reductions in system downtime (94.1%) and storage use (40%) demonstrate architectural efficiency, echoing Pawar's (2025) practical evaluation of N8N in secure and scalable automation. Operational efficiency also improved significantly, with transaction processing times reduced by 85.6% and data entry errors falling by 96.6%, consistent with Cunha's (2025) findings on the impact of N8N-based accounting automation for small businesses. Monthly reporting time dropped by 99.2%, and financing approval duration fell by 71.4%. Pawar (2025) similarly observed that "N8N automation in business processes can cut processing times by up to 80% and enhance data accuracy by 95%, with profound implications for organizational efficiency." Implementing the integrated N8N-based system also had measurable positive impacts on Kopebi Aceh's financial and non-financial indicators. Operational revenue increased by 23.3%, and operating costs decreased by 65.3%, aligning with Perkasa *et al*. (2024), who examined the role of cooperatives in supporting MSME capital structures. Profit margins grew by 29.2%, and SHU per member rose by 47.1%, reflecting the benefits of digitalization on cooperative financial performance, as Manne (2022) discussed concerning Islamic fintech adoption among MSMEs. Non-financial outcomes were also notable: membership rose by 33.5% and participation by 35.4%, demonstrating contributions to financial inclusion in line with Panda *et al*. (2023), who explored fintech's role in inclusion across emerging markets.

The 50% increase in products/services and the 34.3% rise in member satisfaction support Jihad *et al.* (2022) argument that digitalization enhances innovation in Islamic cooperative services. They concluded that "digitalizing Islamic cooperatives not only improves operational efficiency but also opens opportunities for product and service innovation that better respond to member needs." Sharia compliance evaluations by the Sharia Supervisory Board showed an improvement from 85% to 99% following system implementation. Gains included enhanced contract transparency, accurate margin calculations, proper segregation of zakat, infaq, and sadaqah funds, equitable profit-sharing in SHU distribution, and monitoring of product halal status. These outcomes echo Taufik and Purba (2025), who emphasized the value of business–industry collaboration in developing prototypes and SOPs for waqf in Islamic financial institutions. Sain and Adinugraha (2025) further stressed that technology can act as a mechanism to reinforce Sharia compliance in Islamic finance. The present system demonstrates that workflow automation helps consistently apply Sharia principles in cooperative operations. As Taufik and Purba (2025) noted, "integrating technology into Islamic financial operations enhances transparency and accountability, which are fundamental principles of Islamic economics." The study also carries broader implications for the digitalization of Sharia cooperatives in Indonesia.

The N8N-based development model proposed here can be a reference for other Islamic cooperatives, particularly those operating in banking environments or under

regional Sharia regulations, such as Aceh. The low-code/no-code approach reflects the recommendations of Yusuf *et al*. (2021) regarding cooperative transformation in the era of Industry 4.0. Istifadhoh *et al*. (2021) also emphasized that Islamic fintech could be a tool for national economic recovery after COVID-19. The N8N-based integrated system developed here demonstrates that Sharia cooperatives can leverage technology to strengthen efficiency and competitiveness without compromising Islamic principles. As Yusuf *et al*. (2021) cautioned, "digital transformation of Islamic cooperatives is an urgent requirement in Industry 4.0, but it must proceed with attention to Sharia principles and the specific needs of members." Similarly, Zihab *et al*. (2022) stressed the critical role of Islamic savings-and-loan cooperatives in community empowerment, a role that this system reinforces by improving operational efficiency, transparency, and accountability. Despite its promising results, the study has several limitations. First, the system was implemented in a single cooperative, limiting generalizability. Second, the relatively short evaluation period (two months) may not capture the long-term impacts on cooperative performance.

Third, integration with external systems such as banks and regulators remains limited. Future research could develop more generic models for broader categories of Sharia cooperatives, strengthen integration with banking and regulatory systems, and assess long-term sustainability impacts. Additionally, more advanced AI components for Sharia risk assessment and fraud detection represent a promising research direction, as suggested by Liu and Wang (2024) in their work on generative AI applications in financial markets. Jokhio and Jaffer (2024) similarly argued that "the development of AI agents with deep understanding of Sharia principles may open a new era in risk management and compliance within Islamic financial institutions." The findings show that N8N, a workflow automation platform, is highly effective for developing integrated systems in Sharia cooperatives. The system successfully automated business processes, improved operational efficiency, and ensured compliance with Sharia principles. The development model provides a viable pathway for digitalizing Islamic cooperatives in Indonesia without requiring substantial investment in software engineering resources.

## 5. Conclusion and Recommendations

The implementation of an N8N-based integrated system at Kopebi Aceh has proven highly effective in enhancing operational and financial performance. The system significantly reduced response time, improved throughput, and minimized downtime, demonstrating N8N's reliability as a workflow automation platform. Operational efficiency improved through faster transaction processing, lower error rates, and shorter reporting cycles, while user satisfaction remained high. Financially, the cooperative experienced higher revenues, lower operating costs, and increased member profit sharing. Equally significant, compliance with Sharia principles rose from 85% to 99%, underscoring the system’s ability to align digital transformation with Islamic economic values.

Given these results, the N8N-based model offers strong potential for wider adoption among sharia cooperatives in Indonesia, especially those operating in regulated environments such as banking. Future development should prioritize the integration of modules for zakat, waqf, and social funds, as well as enhanced analytics supported by machine learning. Sustained capacity building through training and collaboration with academic institutions and open-source communities will be critical to long-term scalability. Moreover, integration with digital payment systems and Sharia fintech could expand financial inclusion, while standardized workflows and documentation would enable easier replication across other cooperatives.

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