

From the Perspective of Internal Control: Evaluating and Optimizing the Efficiency of the Online Financial Approval Model in Universities

Jing Qiu*, Lan Qin, Xue Bai, Bingjie Xia

Zhejiang Pharmaceutical University, Ningbo, Zhejiang, 315000 China

*Corresponding author: 17858935347@163.com

Abstract: As the economic activities within universities grow increasingly complex and digital transformation deepens, the online financial approval model has become crucial for enhancing management efficiency. However, it still faces challenges such as a high rejection rate, weak risk control, and insufficient integration with the internal control system. Based on a three-dimensional collaborative theoretical framework of "Internal Control-Technology Empowerment-Dynamic Assessment," this paper systematically analyzes the intrinsic coupling mechanism between the five elements of internal control and the digital approval process. It constructs a multi-dimensional effectiveness evaluation system covering process efficiency, risk control balance, system reliability, and user experience, thereby addressing the challenge of evaluation adaptability amidst policy changes. Concurrently, it proposes collaborative optimization pathways, including dynamic node optimization, modular embedded design, full-cycle risk iteration, and technology empowerment innovation. These pathways aim to promote the evolution of the online approval model from static process execution to intelligent risk adaptation, providing theoretical support and practical solutions for the modernization of financial governance in universities.

Keywords: University Finance; Online Approval; Internal Control; Effectiveness Evaluation; Process Optimization

Introduction

Although the online financial approval model in universities has improved processing efficiency, persistent challenges such as a high rejection rate and repeated procedures remain unresolved. The optimization approach must return to the fundamental aspects of internal organizational governance and risk control. Traditional evaluations have focused on a single efficiency dimension, lacking a systematic analysis of the approval system's capacity for risk resistance, rule compliance, and self-improvement. As a result, optimization measures remain fragmented and fail to achieve a dynamic equilibrium between efficiency and risk control.

Therefore, by systematically deconstructing the core mechanism of the online approval model from the perspective of internal control theory, constructing a corresponding effectiveness evaluation system, and exploring optimization pathways deeply aligned with internal control objectives, this approach not only promotes the integration of internal control theory with intelligent technology but also provides a replicable solution for universities to enhance approval transparency and reduce rejection rates. This is of great value in advancing the digital transformation of financial governance.

1. The Coupling Mechanism Between Internal Control Theory and the Online Financial Approval Model in Universities

1.1 The Internal Relationship Between Internal Control Elements and the Financial Approval Process

The core elements of the internal control framework provide a structural foundation for the standardization and rationalization of the financial approval process. The control environment establishes the tone for the allocation of approval authority and responsibilities, as well as the internal control awareness of organizational members, serving as the cultural and institutional prerequisite for

the operation of the process. Risk assessment requires that the approval process design proactively identifies and analyzes potential business risks and compliance gaps, embedding risk response mechanisms into approval nodes. Control activities are specifically manifested as authorization, review, verification, and segregation of duties within the approval process, ensuring that economic transactions are examined and constrained throughout their workflow.

In the context of digital approval, information and communication ensure the accurate and timely transmission and feedback of instructions, documents, and status information throughout the approval process. Supervision encompasses the continuous monitoring and evaluation of the efficiency, compliance, and completeness of the approval process itself, providing a basis for its dynamic adjustment. Therefore, the financial approval process is essentially the specific application and explicit manifestation of internal control elements within the business line, and its design quality directly reflects the depth of internal control concept integration and the degree of synergy among these elements^[1].

1.2 The Core Architecture and Operational Characteristics of the Online Financial Approval Model in Universities

The core architecture of the online financial approval model in universities typically manifests as a system driven by a business rule engine, structured around a workflow engine, and supported by smart technologies. This architecture transforms institutional approval rules into logical code that the system can recognize and execute, enforcing rigid constraints on approval paths, node authorities, and verification rules. The workflow engine drives approval documents to flow automatically along preset paths, with the handling, approval, and execution status at each step recorded in real time, thereby rendering the process explicit, traceable, and procedural^[2].

This model is characterized by its ability to integrate business, approval, and information flows through technological means, enabling the associated retrieval and utilization of data assets—such as budget information, procurement contracts, and original voucher images—within the platform, thereby providing a data foundation for subsequent process analysis, risk warning, and decision support.

1.3 Theoretical Integration Based on "Internal Control-Technology Empowerment-Dynamic Assessment"

Risk-oriented internal control theory, with risk management at its core, emphasizes that control activities should be aligned and matched with the significant risks faced by the organization. By integrating smart technology empowerment and dynamic assessment mechanisms, the design logic of the online approval model advances towards "risk identification - intelligent response - continuous optimization." The trigger conditions, branching paths, and review points of the approval process are directly mapped to the assessment results of inherent and residual risks of business matters. Technologies such as blockchain, RPA, and NLP provide efficient implementation pathways for risk control. For example, for high-risk procurements, the system can automatically trigger a longer approval chain, require the upload of stricter supporting documents, or mandate specific expert reviews. It can leverage blockchain-based evidence preservation mechanisms to achieve full-process image-based documentation of approvals, ensuring data immutability and traceability. Furthermore, RPA technology can be used to automate repetitive tasks such as form filling and preliminary reviews, thereby reducing manual intervention and errors^[2].

This theoretical integration fosters a dynamic and intelligent internal control mechanism. The system can conduct preliminary risk scanning and tagging of submitted items based on historical data and rule libraries, providing approvers with risk alerts. Simultaneously, through the continuous collection of data such as rejection rates, processing delays, and the frequency of exceptional approvals, it inversely evaluates the effectiveness of existing risk control measures, identifies risk points, and forms a closed-loop optimization cycle of "design-implementation-monitoring-learning." This enables internal control to become an organic protection system embedded within business processes and dynamically adjusted in response to evolving risks.

2. Construction of an Effectiveness Evaluation System for the Online Financial Approval Model in Universities

2.1 Multi-Dimensional Indicator System Design Based on the AHP-Entropy Method Dynamic Weight Allocation Model

Constructing a scientific multi-dimensional indicator system is a prerequisite for objectively evaluating the effectiveness of the online approval model. Such a system must proceed from the overall objectives of internal control, encompassing four core dimensions: operational effectiveness, risk control, system reliability, and user experience. The AHP-Entropy Method dynamic weight allocation model is introduced to address the challenge of evaluation adaptability in the context of frequent policy changes.

Evaluation Dimension	Core Indicator	Indicator Description
Operational Effectiveness Dimension	Average approval cycle duration, node processing delay, process automation rate, rejection rate, etc	Capturing the timeliness of approval tasks, resource consumption, and process smoothness
Risk Control Dimension	Budget compliance verification pass rate, approval step bypass rate, completeness of key field completion, high-risk transaction detection rate, accuracy of tiered authorization, etc	Reflecting the execution capability of the system's institutional rigid constraints and the precision of risk prevention and control
System Reliability Dimension	Mean time between failures, recovery time, concurrent processing capacity, completeness of data evidence preservation, etc	Measuring the system's technical support capacity and data trustworthiness
User Experience Dimension	User operation complexity score, intelligent customer service response satisfaction, mobile adaptability, technology anxiety incidence rate, etc	Reflecting user acceptance of the system and ease of use

The weight allocation adopts a combined AHP-Entropy method model: First, subjective weights of the indicators are determined through AHP based on expert experience, reflecting policy orientation and internal control objectives. Subsequently, objective weights are calculated using the entropy method based on objective data such as approval logs, reflecting the actual operational characteristics of the process. Finally, the subjective and objective weights are dynamically integrated to form a dynamic weight system that adapts to policy changes and process evolution, ensuring the scientific validity and adaptability of the evaluation results. The multi-dimensional indicators are interrelated, and the weight allocation is based on specific control objectives, thereby comprehensively reflecting the operational health of the approval model.

2.2 Measuring the Balance Between Approval Process Efficiency and Risk Control

There is often an inherent tension between improving the efficiency of the approval process and strengthening risk control; measuring the equilibrium between the two is a core challenge of the evaluation system. Efficiency measurement can introduce the concept of process entropy, achieved by analyzing the degree of variation in approval paths and node redundancy. An efficient process should have clear paths, quick decisions, and low entropy. Risk control measurement focuses on the density and precision of control activities, including the coverage of key control points, the completeness of the system's automatic verification rules, and the sufficiency of supporting information for approval decisions^[3].

Equilibrium measurement is not a simple comparison between efficiency and risk; rather, it examines the marginal substitution relationship between them and the overall state of fit. This can be achieved by constructing a two-dimensional "efficiency-risk" scatter plot based on process samples. By selecting samples of the approval process over a certain period, with the horizontal axis representing the efficiency entropy value and the vertical axis representing the risk control strength score, a scatter plot is drawn and divided into quadrants. Ideally, sample points should cluster in the "high efficiency,

low risk" or "moderate efficiency, controllable risk" quadrants. If sample points are widely distributed in the "low efficiency, high risk" or "high efficiency, high risk" quadrants, it indicates an imbalance within the system.

The analysis of the causes of imbalance can be conducted using structural equation modeling to identify influencing factors such as improper process design, overly broad risk judgment rules, and insufficient technological application, thereby enabling targeted optimization.

2.3 Technical Assessment of System Reliability and Data Integrity

System reliability and data integrity are the technological cornerstones for the effective functioning of the online approval model. Their assessment is conducted from two levels: static architecture and dynamic operation. The static architecture assessment focuses on the redundancy design of core system components, data storage and backup mechanisms, the completeness of disaster recovery plans, the security authentication and encryption transmission standards of system interfaces, and the rationality of the distributed deployment of blockchain-based evidence preservation nodes. These aspects determine the system's ability to withstand external interference and internal failures. The dynamic operation assessment focuses on system service performance, quantified through indicators such as mean time between failures, recovery time, and the limits of concurrent processing capacity.

The technical assessment of data integrity runs through the entire lifecycle of data generation, transmission, storage, and usage. At the input stage, it evaluates the rigor of the system's verification of data formats, logical relationships, and business rules. During the processing stage, it examines the state management mechanism of the workflow engine to ensure clear versioning and operational traceability. At the storage stage, the assessment focuses on database access control, the completeness of operation audit logs, the verifiability of data backup restoration, and the immutability and traceability of blockchain-based evidence preservation^[5].

Ultimately, the technical assessment must verify whether the system forms a credible closed loop, ensuring the authenticity, accuracy, and non-repudiation of electronic approval data throughout the entire chain from business initiation to financial archiving.

3. Collaborative Optimization Pathways for the Online Financial Approval Model in Universities

3.1 Dynamic Approval Optimization Strategies Based on Process Node Control

The core objective of optimizing process node control lies in achieving a shift from static presets to dynamic responses. The inability of traditional fixed processes to adapt to real-time fluctuations in business volume and complexity, as well as the collaborative needs of multi-campus environments, stems from their lack of capacity to perceive and respond to changes in the environment and internal states.

The implementation pathway for dynamic optimization strategies involves node attribute modeling, process bottleneck identification, and dynamic path adaptation.

3.1.1 Node Attribute Modeling

Analyze the multi-dimensional attributes of nodes, including processing capacity, professional domain, historical approval behavior patterns, and collaborative relationship networks, to construct a node characteristic library;

3.1.2 Process Bottleneck Identification

Apply process mining techniques to conduct retrospective analysis of historical approval logs, combined with Python clustering analysis to identify the causes of high rejection rates, unnecessary serial dependencies, and redundant permission configurations, thereby providing data-driven decision-making foundations for process restructuring^[4].

3.1.3 Dynamic Path Adaptation

Based on the deep integration of an intelligent rules engine and real-time process monitoring data, it conducts real-time risk assessments by synthesizing the inherent attributes of the pending item (such as amount, type, and compliance sensitivity) with dynamic contextual variables (such as budget execution intensity, the performance status of related contracts, and changes in the external compliance

environment), thereby dynamically adjusting the approval path.

For example, for low-risk and standardized transactions like small-amount travel expense reimbursements, it triggers RPA automated rule verification to achieve "instant approval." For high-risk or highly complex transactions, such as large-scale research fund expenditures, it can dynamically insert approval nodes such as parallel countersignatures or special review meetings, and may also temporarily elevate the authority level of the final approval node.

The essence of this strategy is to transform the approval path from a fixed "railway track" into a dynamically switchable "navigation route," precisely allocating limited approval attention resources according to the risk gradient distribution.

3.2 Modular Improvement for Embedding Internal Control into System Logic

Deeply embedding internal control requirements into system logic, adopting a modular design with "high cohesion and low coupling," aims to resolve the rigidity and maintenance difficulties associated with the hard-coded binding of control logic and business processes found in traditional integrated approval systems. The core measure involves deconstructing abstract internal control specifications and encapsulating them into a series of standardized service modules. These modules are loosely integrated with the core workflow engine through standardized interfaces^[5]. The specific module design is as follows:

Core Module	Functional Description	Internal Control Objective Mapping
Budget Quota Real-Time Control Module	Connecting to the budget management system, it performs real-time verification of the budget quota for the item under approval	Ensuring the rigidity of budget execution and preventing the risk of budget overruns
Intelligent Matching Module for Expenditure Standards	It incorporates an embedded library of expenditure standards, such as those for travel expenses and labor fees, automatically matching the transaction type and amount to verify compliance	Standardizing expenditure behavior and reducing compliance risks
Dynamic Verification Module for Supplier Qualifications	Linking to the supplier information database, it conducts real-time verification of supplier qualification validity and credit status	Preventing partnership risks and safeguarding funds
Automatic Auditing Module for Invoice Compliance	It utilizes an NLP model to identify the authenticity and completeness of invoice information, verifying the correlation between the invoice and the underlying business	Eliminating fraudulent invoices and ensuring the authenticity of financial data
Flexible Authorization Engine Module	Based on a dynamic permission allocation model, it automatically matches the approver according to the fund type, amount, and risk level	Implementing tiered authorization and clarifying approval responsibilities
Blockchain-Based Evidence Preservation Module	It performs distributed evidence preservation for all documents and operational traces throughout the entire approval process, ensuring data immutability and traceability	Strengthening oversight and audit functions, and preventing the risk of data tampering

This architectural improvement significantly enhances the system's responsiveness to changes in internal control regulations and its long-term maintainability. When internal management systems or external financial regulations change, only the affected control modules need local adjustments, without rewriting the core business process code, greatly reducing the risk and cost of system iteration. Simultaneously, the modular design supports the flexible combination and reuse of control services. The same compliance verification logic can be invoked by different business processes, such as procurement reimbursement, loan repayment, and contract payment. From a technological evolution perspective, adopting a microservices architecture or domain-driven design principles is an effective path to achieve deep modularization. It allows internal control experts and technology developers to collaborate within the same domain language, precisely transforming institutional provisions into

executable, testable, and monitorable digital control rules. This ensures that the design intent of internal controls is fully and faithfully implemented technologically within complex information system environments.

3.3 Full-Cycle Risk Management and User Experience Optimization

3.3.1 Iteration of the Approval Model Within a Full-Cycle Risk Management Framework

Full-cycle risk management, with the closed-loop mechanism at its core, positions the online approval model as a risk management infrastructure that runs throughout risk identification, assessment, response, monitoring, and reporting. It constructs a complete chain of "risk identification - intelligent response - monitoring and evaluation - optimization and iteration." In the risk identification stage, cluster analysis is performed on data such as approval logs and rejection records using Python tools to accurately pinpoint high-frequency risk points. In the intelligent response phase, control strategies are dynamically adjusted based on risk levels, achieving precise prevention and control through modular control components. During the monitoring and evaluation stage, the multi-dimensional effectiveness evaluation system is leveraged to track the effectiveness of risk control and process efficiency, quantifying the input-output ratio of prevention and control measures through cost-benefit analysis. In the optimization and iteration phase, based on feedback from monitoring and evaluation, the risk identification models, control rules, and system modules are regularly updated, forming a continuous iteration mechanism of "pilot implementation - data analysis - solution optimization - full-scale promotion." This process is driven by risk data, deeply mining system data through big data analysis and machine learning to continuously identify new risk patterns and control deficiencies. Each iteration undergoes rigorous effect prediction and cost-benefit analysis, and post-deployment, an empirical post-evaluation is conducted through indicator comparisons^[6]. This approach guards against abnormal declines in process efficiency or the emergence of secondary risks, transforming the online approval system from a "machine" executing fixed instructions into an "organism" with continuous risk adaptation and self-optimization capabilities.

3.3.2 User Experience Optimization Initiatives

User experience optimization focuses on lowering the operational threshold and enhancing service convenience. It simplifies mobile operation processes through lightweight interaction design, reduces mandatory fields, and implements "one-click upload, intelligent filling" to decrease operational complexity. It establishes an intelligent guidance and feedback mechanism, utilizing digital human intelligent customer service and operation guidance pop-ups to answer user questions in real time. It builds a real-time approval status push notification system, clearly informing users of the reasons for rejection and suggestions for modification, thereby enhancing the targeting of operations. Simultaneously, it continuously improves system settings by collecting user feedback through the aggregation of keywords from frequently asked questions.

Conclusion

This paper systematically investigates the effectiveness evaluation and optimization pathways of the online financial approval model in universities, based on a three-dimensional collaborative theoretical framework of "Internal Control - Technology Empowerment - Dynamic Assessment." The research confirms that the deep coupling of internal control elements with the approval process is the cornerstone for achieving both efficiency and security in digital processes. A multi-dimensional effectiveness evaluation system integrating operational effectiveness, risk control, system reliability, and user experience, combined with the AHP-Entropy method dynamic weight allocation model, can accurately diagnose the operational status of the model. Collaborative optimization pathways, including dynamic node optimization, modular embedded design, full-cycle risk iteration, and technology empowerment innovation, can promote the evolution of the approval model from static process execution to intelligent risk adaptation. This study provides theoretical support and practical, implementable solutions for the modernization of financial governance in universities.

Fund Projects

Sponsored by Zhejiang Provincial Education Accounting Society, Evaluating and Optimizing the Efficiency of the Online Financial Approval Model in Universities from the Perspective of Internal

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