Research and Application of Workflow-Based Internal Control System of Tendering and Procurement

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Abstract

Aiming at the management of internal control of tendering and procurement in colleges and universities, learning from the management experience of internal control of tendering and procurement in domestic universities, based on the establishment of the tendering and procurement information management system, through sorting and optimization process, a SBMN internal control matrix based on rendering and procurement and processing was proposed. An internal control program based on the TFSP dimension was also developed, achieving real-time monitoring, risk assessment and early warning of abnormal activities of the rendering and procurement and processing in colleges and universities. Currently, this research have been applied to the tendering and procurement management system of domestic universities and achieved good results.

Key words: Rendering and procurement; Internal control management; Internal control node; Internal control program; Workflow

INTRODUCTION

Rendering and procurement of colleges and universities is an important task in the construction and development of colleges and universities. Procurement in colleges and universities involves three major categories: office supplies, engineering, and services based on the diversity of the merchandise, the complexity of processes, and the sensitivity of policies. In accordance with the requirements of the "Guiding Opinions on Strengthening the Internal Control and Management of Government Procurement Activities" issued by the Ministry of Finance in 2016, it clearly required that purchasers, centralized procurement agencies, and supervisory departments must deeply understand the importance and necessity of strengthening internal control management in government procurement activities, accurately grasp the inherent pattern of government procurement, accelerate innovation in systems and mechanisms, strengthen the institutional regulations, and effectively improve the level of government procurement internal control and management. According to this guidance, domestic universities and colleges are now strengthening the management of internal control of tendering and procurement, clarifying the risks, forming relevant rules and regulations, and improving their ability to prevent and control internal risks.

According to the earlier studies, the internal control management of tendering and procurement in most universities are currently focusing on research and discussion of system design, problem description,

improvement measures, risk analysis and assessment methods. There is not much research on strengthening the internal control of universities with the use of Internet and information technology. In addition to the research on the current status of the internal control system of tendering and procurement in domestic universities, this article combines the construction and application of the information management system for tendering and procurement in universities and studies of the key business processes and internal control of the rendering and procurement of universities and proposes a workflow-based internal control model of tendering and procurement, a SBMN matrix monitoring control method, and develops a workflow-based internal control management information system to achieve multi-dimensional dynamic monitoring, risk assessment, and early warning of abnormal activities of the key business links in tendering and procurement of universities.

Due to the workflow characteristics of the rendering and procurement, a certain matter, such as purchase application, procurement task arrangement, and tendering execution, has clear rules and regulations. Submitting the approval forms and handling procedures often involves cooperation among multiple departments to finally settle the matter. Because of the complexity of the tendering and procurement process, the workflow needs to adapt to a variety of different procedures. A workflow model that meets the needs of changing processes needs to be established. Therefore, the workflow model is based on the actual work procedures and job nodes, providing a flexible control path.

1. ANALYSIS OF SBMN INTERNAL CONTROL MATRIX MODEL BASED ON TENDERING AND PROCUREMENT AND PROCESSING

1.1 Issues with Internal Control

The internal control problem of college tendering and procurement is not a single problem, but a complex one. The analysis is done based on time, and the entire tendering and procurement process is divided into N internal control steps based on the time sequence, which mainly includes 8 steps: budget, plan, task, execution, contract, acceptance, payment and assets. There exists relations of time and logic among these steps. In addition to the steps themselves and the issues of internal node control, there are also issues of constraints imposed by steps themselves. These issues mainly include the use of funds, quota standards, procurement types, procurement methods, approval processes, classified management,

open tendering, fairness and impartiality, inspection and acceptance, and payment of funds.

1.2 Solutions

In view of the above-mentioned internal control issues, an integrated thinking of full-cycle management, hierarchical classification management and process control management is adopted. Here are the specific problem-solving steps: The first step is to divide the entire university tendering and procurement internal control problem into a series of relatively independent internal control issues and to clarify the related attributes and methods of each issue. The second step is to sort out each internal control step into a relatively independent workflow and to clarify its related attributes and methods. In the third step, based on the workflow, to determine the fulfillment nodes for transfer posts and arrange internal control nodes and to configure a multi-dimensional monitoring program. The fourth step is to dynamically collect data of post node performance data and to transmit and save it to the unified internal control data pool. The fifth step is to use the event-based internal control program and intelligent internal control data engine to output the results of internal control monitoring and intelligent analysis and to dynamically issue early warning signals of abnormal activities.

1.3 Internal Control Model for Tendering and Procurement

University tendering and procurement is a complex information system project. A 4-layer structured model of the internal control and management of tendering and procurement business is constructed based on the requirements of the internal process of tendering and procurement, management characteristics and risk control. It includes system layer, branch layer, module layer and node layer. Among them, the system layer is the top layer of tendering and procurement management. In the branch layer, the system decomposes several relatively independent industry branch layers (branch steps), and each branch layer can be decomposed into the next-level module layer (module steps), which can be further decomposed into the smallest non-separable process steps. The node layer is a collection of nodes for the smallest process steps. This structured a four-layer SBMN model with system (S), branch (B), module (M), and node (N), including the SB classification matrix model and the MN module node matrix. Based on the two matrix models, internal control points and node control matrices (NC) are deployed, and internal control algorithms and programs are used to implement real-time multi-dimensional intelligent monitoring of any number of internal control nodes (Hao, Zheng, Hao, & Yu, 2018). As demonstrated in Figure 1.
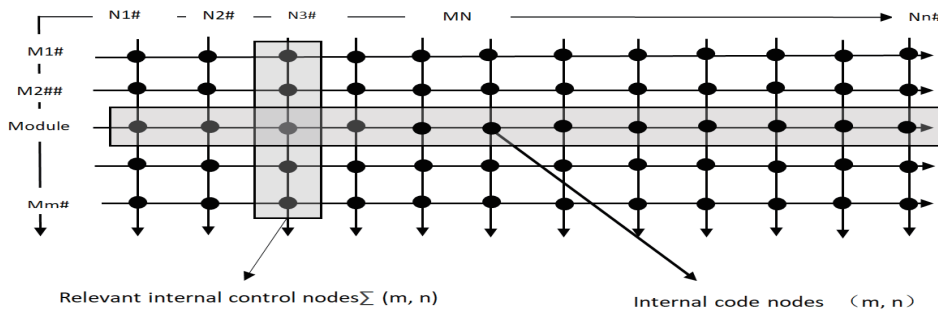
Figure 1
Figure for MN internal control matrix

The horizontal direction of the module matrix model represents the event module M = (M1, M2…Mm), and the vertical direction represents the process node N = (N1, N2…Nn). Crossover nodes (m,n) of the matrix are configurable internal control nodes for data collection and node control.

2. DEVELOPMENT OF INTERNAL CONTROL PROCEDURES BASED ON THE TFSP: MONITORING, EVALUATION AND EARLY WARNING

The internal control program is a monitoring program based on the nodes in the SBMN matrix. It can be divided into 1-3 levels according to the risk level of the position, and it can take up to 4 dimensions of risk control node according to the risk level, including time limit, funding, regulations, and procedures. It monitors the operating time limit, the funding limit, pre-regulated conditions, and event approval procedures separately.

Theoretically, it is possible to perform monitoring procedures for any position node in the internal control matrix and establish a node-oriented internal control tendering system and internal control rules. The control indicators mainly include node operation time limit,

approval time, process time, funds, quota standards, budget, transactions, contract, payment, cumulative payments, payment period, pre-approval conditions, and business logic procedures. Develop internal control procedures to monitor the operating status of internal control nodes corresponding to post nodes in multiple dimensions. Figure 2 is a schematic diagram of the internal control program of the post node. Among them, M1, M2, and M3 are SBMN internal control business process modules, G1, G2, and G3 correspond to internal control post nodes, and N1, N2, and N3 are module process nodes, respectively. The post node can be associated with multiple module nodes G (i) = (N1, N2 ⋯ Nn). k1, k2, and k3 are internal control points configured by the node, C1, C2, and C3 are the control programs, and TFSP is a multi-dimensional internal control program of the time limit, funds, regulations, and procedures of the internal control nodes.
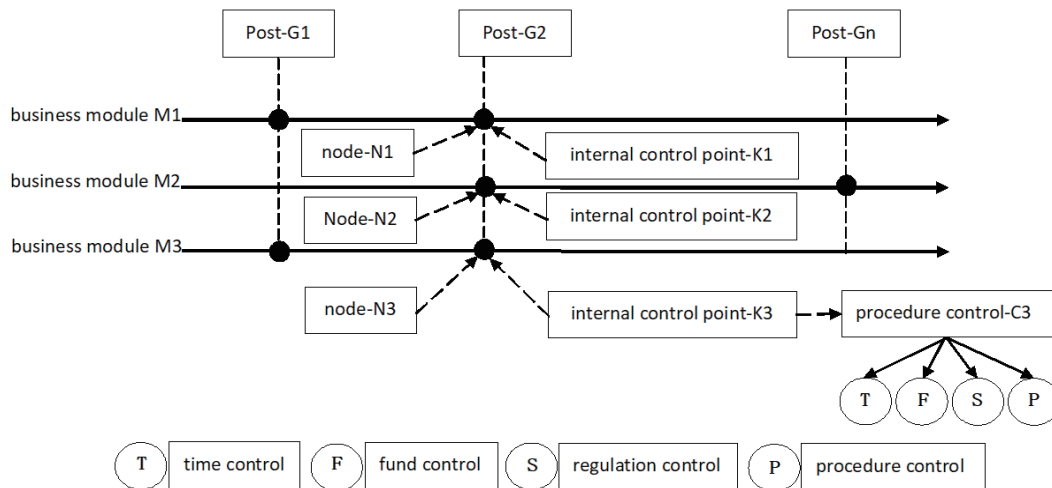

Figure 2
Demonstration of the internal control program

The internal control program is a multi-agent data processing engine based on the node control matrix (NC). We need to develop a data processing engine based on internal control node configuration parameters (including node number, job number, risk level, TFSP

dimension, internal control step size, control rules, etc.). When a process event occurs, the intelligent data processing program of the node is automatically triggered to collect events data, collect regular data and conduct comprehensive analysis of the TFSP dimension, and

output node internal control signals. If an abnormal activity occurs, a warning signal (yellow and red cards) is issued, and the result description of the warning is also given (Li & Zhu, 2016).

3. ESTABLISH AND IMPROVE AN INTEGRATED APPLICATION SYSTEM FOR TENDERING AND PROCUREMENT AND INTERNAL CONTROL MANAGEMENT

In accordance with the requirements for the construction of an internal control information system for tendering and procurement, an integrated application system for tendering and procurement and internal control management based on the internal control model and procedures of tendering and procurement is established. We introduce management and control methods such as full-cycle management (FCM), business process management (BPM), and state process control (SPC) to optimize business processes and design and to develop an internal control management system for tendering and procurement based on workflow. The overall architecture and functional structure of the system are shown in Figures 3 and 4.
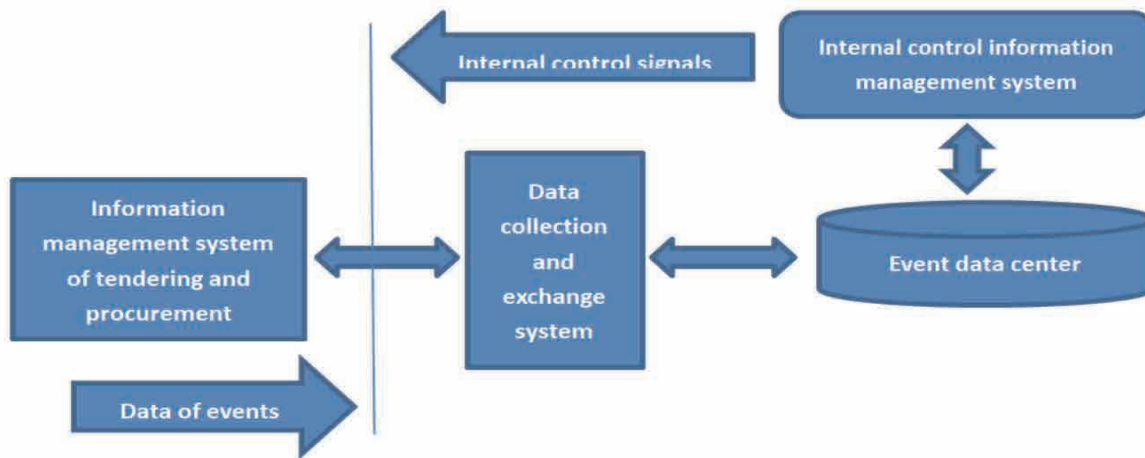
3.1 System Structure

Figure 3
A complete structure of the internal control system

As can be seen from Figure 3, the internal control system structure is mainly composed of four parts, including an internal control information management system, an event data center, a data collection and exchange system, and an information management system of tendering and procurement. The flow from left to right is the data flow of tendering and procurement business processing, which is collected and exchanged and passed to the event data center of the internal control information management system; and from right to left, the internal control monitoring signals (early warning) are sent to the rendering and procurement information management system. This achieves a two-way data exchange. The biggest feature of this structure design is that it can achieve unified internal control management and supervision in multiple key business areas and improve the efficiency of internal control management in universities.
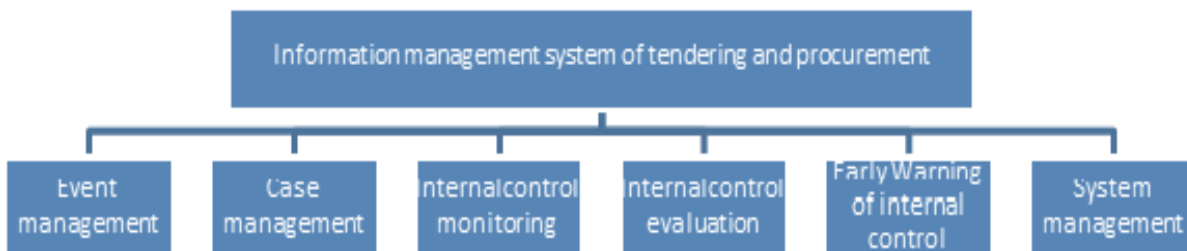
3.2 System Functions

Figure 4
Functional Structure of Internal Control Information Management System

As can be seen from Figure 4, the internal control information management system is mainly designed with 6 functions: event management, case management, internal control monitoring, internal control evaluation, early warning of internal control, and system management.

3.3 Realization of internal control system

According to the SBMN internal control model and the actual situation of tendering and procurement management in colleges and universities, an optimized SMN structure model is used to construct the tendering and procurement internal control system. The tendering and procurement functions, including procurement budget, procurement plan, procurement task, procurement execution, procurement contract, procurement acceptance, procurement payment, and procurement assets, are defined as eight internal control events. It establishes SM, MN, and NC internal control matrix models, defines internal control nodes and TFSP dimension monitoring on them, and configures corresponding node internal control procedures. Driven by business events, the internal control program is automatically triggered to perform intelligent monitoring of dynamic data, output the result signal, and issue an early warning signal if an abnormal activity is found (Wu, 2018).

The main functions of the system's internal control include internal control event management, event management, internal control monitoring, internal control evaluation, early warning of internal control, and system management.

Internal control event management includes the addition, deletion, modification, and checking of primary and secondary events, event process and node management and maintenance, and configuration of corresponding internal control nodes, TFSP dimensions, and internal control procedures.

Event management refers to the actions and data generated by the workflow nodes during the business process. The event data comes from the tendering and procurement workflow process and has functions such as dynamic tracking, multi-dimensional query, and early warnings of abnormal activity.

Internal control monitoring. Based on the event-driven internal control program monitoring, the monitoring result signals are outputted, and the monitoring status of various internal control points is displayed according to events, departments, post nodes, procurement types, procurement projects, internal control types, monitoring signals, and classified statistics are performed.

Internal control evaluation. Based on the establishment of the secondary and internal control evaluation indicators of the department and the school, according to the internal control evaluation model, an internal control risk index and risk level based on the probability of early warning events are established to achieve the internal control evaluation of the tendering and procurement department.

Early warnings of Internal control: Based on the risk assessment results, five levels of risk are classified according to the size of the risk index, which are divided into micro, small, medium, large, and high. the system automatically issues early warning signals for internal control for risk level of medium and above.

System management: User role authority control and assignment management of internal control system.

CONCLUSION

The informationization of university tendering and procurement is the basis for effective internal control management, and it is also an important means and method to strengthen internal control management in universities. Through the process of sorting, analyzing and optimizing the internal control matters of tendering and procurement, this article uses theories and methods such as full-cycle management, classification management and process control to develop a workflow-based SBMN model and the internal control management information system of tendering and procurement, and applies it to the daily management of the tendering and procurement center in universities. The eight internal control events for tendering and procurement, as well as the TFSP dimension of its own internal control points are being effective controlled.

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