

Research Article

Research on Management Accounting Framework and Quantitative Correlation Based on Hall Three-Dimensional Structure

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The management accounting framework aims to improve the operation control ability. It is the integration of the comprehensive use of management accounting tools. Given the lack of an internal relationship between management methods and operation control in the previous research on management accounting framework systems, this paper puts forward the purpose of this research. We use Hall's three-dimensional structure model for reference to construct the management accounting framework based on operation control and study the characteristics of operation control with the contingency elements such as organizational structure, control methods, and ability improvement as the logical dimension; taking eight tools such as comprehensive budget, performance evaluation, and responsibility body as the knowledge dimension to promote the application of management accounting, the enterprise operation matrix is defined. DSM method is used to study the quantitative correlation between operation control and management accounting tools and reveal the quantitative relationship between management accounting tools. Finally, the case of China Unicom verifies the core role of a comprehensive budget in enterprise operation management and reveals the significant correlation and hierarchical characteristics between management accounting tools. The research methods proposed in this paper can enrich the framework theory of management accounting and have enlightenment in guiding the practice of enterprise operation and management.

1. Introduction

Enterprise operation is a complex system, which is realized by the exchange of various information as well as the cooperation of various management methods. Promoting value creation by management is the ultimate goal of an enterprise, and its realization process is affected by many factors, such as organizational structure, control mode, ability improvement, and other internal and external objective factors [1]. Recently, management accounting tools such as comprehensive budget management, activity-based costing, internal risk control, and performance evaluation have been embedded into the operational control of enterprises and become the fundamentals for enterprise management innovation. The management principles and

operation mechanisms of different management accounting tools, however, overlap and interweave to a certain extent. In the application process, there are different practical emphases and management defects. We can neither apply one management accounting tool to support all operational controls, nor simply accumulate management accounting tools in practice, but we need to select properly under the guidance of the management accounting framework [2].

Aiming at improving the quality of enterprise operational control, the management accounting framework combines different management accounting tools based on a certain logic. Existing research puts forward a management accounting framework including value management, balanced scorecard [3], comprehensive budget and activity-based costing, and so on. However, these management

accounting frameworks lack analysis of the internal relationship between management accounting tools and operational control since they are mainly revolved around a certain management accounting tool. In the meanwhile, the existing research ignores the defects of a single management accounting tool and the correlation among different management accounting tools since it mainly focuses on the impact of a single management accounting tool on specific operational control. It is necessary to choose appropriate management accounting tools, and deeply analyze the correlation between operational controls and different management accounting tools and the synergy among management accounting tools according to organizational characteristics, to ensure that the selected management accounting toolset can effectively connect with the enterprise operational control mode. Therefore, it is of great theoretical and practical significance to build a management accounting framework based on operational control for the application of management accounting tools and the promotion of enterprise operational control ability.

Using Hall's three-dimensional structure model for reference, this paper constructed a management accounting framework based on operational control. We investigated the characteristics of operational control (logical dimension) such as organizational structure, control method, and ability improvement, management accounting tools (knowledge dimension) including a comprehensive budget, performance evaluation, and responsibility body. Based on the framework, we define the operation matrix. Using the method of DSM matrix, the quantitative correlation between operation control and management accounting tools, the quantitative correlation among management accounting tools were determined. The case study of China Unicom validates the central role of comprehensive budgeting in enterprise operations management. The research results reveal the significant correlation and hierarchical features among management accounting tools. Firstly, management accounting tools are hierarchical according to the relevance of operational characteristics, and each hierarchical tool cooperates with and complements each other and has hierarchical characteristics. Secondly, the basic functions of management accounting tools at different levels are positioned variably with quantitative intrinsic relationships with each other. Thirdly, the management accounting practice based on the operational dimension is the process of deeply promoting the integration of business and finance.

In accordance with the literature research, most of the research studies are carried out only by focusing on a certain theoretical level or focusing on a single management accounting tool, where it lacks of the combination of theory and practice. Few scholars have carried out theoretical research by the integration of operational control logic and management accounting tools from the perspective of system engineering; there is less evidence of the internal logic between the elements of enterprise value creation in response to the impact of contingency factors such as organizational structure reform (including responsible body and Amoeba) and incentive evaluation. With the aim of breaking through the above limitations, this paper proposes

a systematic management accounting framework based on the Hall three dimensions structure to integrate the research contents of value creation, management accounting, and operation elements. At the theoretical level, this study further promotes the theoretical depth and breadth of the management accounting framework. First, the theoretical research based on the contingency factors such as the business environment is enriched according to the Hall three dimensions structure, and a management accounting framework system with a systematic view is established. Second, this paper defines the enterprise operation Matrix based on the value creation theory and uses the Design Structure matrix (DSM) and other methods to study the internal correlation between management accounting tools and operation control features, to realize the internal logic and quantitative analysis of the components. In some relevant research studies, the management accounting theory have been innovated from the perspectives of system, contingency, integration, and coordination. At the practical level, empirical analysis is carried out based on the operation matrix model, which illustrates that the enterprise value creation is affected by the internal and external environment and contingency factors. First, it is proved that the implementation of management accounting needs to adapt to the requirements of organizational structure, control activities, resource allocation, and other elements and cannot be achieved in an action. Second, the research on the internal logic and hierarchy of management accounting tools is of practical significance for guiding enterprises to practice management accounting tools.

The rest of this paper is organized as follows: Section 2 summarizes the literature related to this study. Section 3 introduces the theoretical framework of this study, including two parts: the management accounting framework based on operational control and the enterprise operation matrix and expounds on the elements of the operational control dimension and the management accounting tool dimension. Section 4 briefly describes the quantitative analysis methods and steps of using the DSM matrix to study the related elements of the operation control matrix. Section 5 takes the financial transformation of China Unicom as a case to further verify the study results. Section 6 summarizes and looks forward to this study.

2. Literature Review

Based on the literature research, the dynamic strain capacity refers to the necessary characteristics of any enterprise that wants to obtain a lasting competitive advantage in a changing environment. The management accounting practice around value creation is a process of continuous improvement and dynamic optimization on the basis of the enterprise contingency factors [4]. Schreyogg and Kliesch Eberl emphasized to integrate a dynamic dimension into the management system [5], to promote the continuous innovation of enterprise management. The value oriented principle of management accounting refers to that the application of management accounting should be guided by the continuous value creation and be implemented to all

levels of organizations. CIMA's "Global Principles of Management Accounting" emphasize the importance of information communication and value creation as the core of enterprise management [6]. Environmental uncertainty depends on the complexity and variability of the environment and enhances the value creation ability by regulating the management accounting behavior among enterprises or organizations [7]. Management accounting is a method of contingency forecast and business decision-making embedded in the organization, to improve the efficiency and benefit of the enterprise operations through information support and management decision-making [8]. CGMA (2014) pointed out that management accounting focuses on high-quality decision-making and drives the process of enterprise value creation and appreciation through information integration and analysis [9].

Currently, however, there is no management accounting system that can be generally applied to all enterprises and organizations, which depends on the specific organizational environment of the enterprise [10]. The well operational and organizational performance cannot be achieved as long as the contingency characteristics of operational elements are not understood and a management accounting system is not built [11]. Therefore, enterprises need to conduct an in-depth analysis on the correlation and synergy between operation control and different management accounting tools when selecting management accounting tools, to effectively connect the characteristics of operation management [12]. The essence of enterprise value creation is the practice of management accounting actively responding to environmental uncertainty, and the sustainable value creation of enterprises should be promoted around the needs of customers' goals [13]. The practice of management accounting should adapt to the internal and external environment and adapt to the new environment through innovative organizational restructuring, ability iteration, and control activities; through introducing contingency factors such as the environment and obtaining sustainable competitive advantages and value creation capabilities, the transformation from the perspective of "ability acquisition" to the perspective of value creation and support for comprehensive decision-making is realized [14]. The process of enterprise operation control needs to select appropriate management accounting tools in accordance with the organizational characteristics [7] to ensure effective support for enterprise operation. Focusing on the business activities and business behaviors of enterprises, management accounting tools are used to achieve focused operation support and influence each other. The application needs are put forward through problem oriented or demand oriented in the process of applying management accounting in enterprises. For example, in terms of the decomposition of strategic objectives, the comprehensive budget method is often adopted; the problem of value creation ability can be solved by using a performance evaluation system; the problem of the supply chain can be solved by the supply chain model based on the Internet; the problem of target decomposition can be solved by the Balanced Scorecard [15]. The management

accounting tools have the integration attribute. Currently, less management accounting framework involves the research on the internal logic of management accounting tools and operation control since the existing management accounting framework mainly focuses on the research and practice of a single management objective or management accounting tool. With the fundamental goal of continuously creating shareholder value, Serebryakova et al. put forward a value management framework (VBM), which determines specific internal goals, selecting strategy and organizational design, identifying value drivers, formulating action plans, and selecting performance indicators and goals, performance evaluation, as well as feedback improvement [16]. Pareek and Mukherjee put forward a management framework based on the principle of the strategic management process, which takes the Balanced Scorecard (BSC) as the core and integrates tools such as budget, activity management, and shareholder value index [17]. Ploder et al. focused on the combination of agile project management and beyond budgeting [18]. From the perspectives of economics, psychology, and sociology, Choi et al. found imply that the patterns of budget ratcheting could be diverse based on how local government officials strategically respond to the dynamics between bargaining power and the pressure of justifying budgets [19]. The existing researches mainly discuss the influence of specific management accounting tools such as comprehensive budget, performance evaluation, and balanced scorecard on specific operational control when applying the management accounting framework to operational control. For example, Cools et al. study the role of budgets in a creative context [20]. They find expected creative firms use their budgets more interactive way and responsive creative firms use their budgets in a rather diagnostic way. Artz et al. [21] study the effect of performance measures used on functional strategic decisions. Tapinos et al. examine the impact of the Balanced Scorecard (BSC) on the strategy process [22]. Malagueño et al. investigate the effect of BSC in SMEs on their financial performance and innovation outcomes [23].

According to the literature research, the characteristics of the framework of management accounting integration are as follows: first, it is emphasized that the fundamental goal of the integration of management accounting tools is to create sustainable value for enterprises. Second, it is emphasized that the integration framework should focus on a core tool or objective. Third, it is recognized that a single tool is flawed and lacks of a complementary feature. At present, however, it lacks of methods to study the quantitative correlation between the theoretical framework and elements of management accounting based on a systematic view. It is specifically reflected as follows: first, the logic difference between the management accounting integration framework and the operation control activities needs to be further studied on its internal logic and integration application. Second, there is a lack of quantitative methods to systematically study the internal relations between enterprise management accounting and organizational structure, performance evaluation, etc. Third, we can further explore the synergy between management accounting tools through

the research on the internal relationship and hierarchy of management accounting tools. Thus, in the process of selecting management accounting tools, enterprises should deeply analyze the correlation between operational control and different management accounting tools and the synergy among management accounting tools according to organizational characteristics, to ensure that the selected management accounting toolset can effectively connect with the operational control mode of enterprises. Based on the system view, the construction of a management accounting framework on the basis of operation control and the quantitative analysis of internal logic can play the role of management accounting to a greater extent, improve the level of enterprise operation control, and thus enhance the ability of enterprise value creation.

3. Management Accounting Framework and Enterprise Operation Matrix

The application of management accounting tools in enterprises is to solve the management problems that restrict the ability of enterprise value creation. Therefore, enterprises should not only consider the internal relationship with enterprise operational control but also consider the correlation between management accounting tools when they implement management accounting tools. For quite a long period, the common topic concerned by both the practical and academic circles engaged in the research of management accounting is how to operate management accounting to better support the operational control of enterprises; what are the key elements of an effective management accounting framework; what is the relationship among these factors and enterprise operational control activities; what is the relationship between the internal elements of the management accounting framework? Based on operational control, this paper answers the above questions in the way of constructing a management accounting framework.

3.1. Management Accounting Framework Based on Hall's Three-Dimensional Structure. Hall's three-dimensional structure analysis method, a system engineering methodology put forward by American system engineering expert A D Hall in 1969, can be used to solve the planning, organization, and management problems of large and complex systems. Hall's three-dimensional structure divides the whole system engineering into different stages and steps closely connected before and after and combines various professional knowledge and skills needed to complete these stages and steps. Hence, it formed a three-dimensional structure composed of the time dimension, logic dimension, and knowledge dimension. This paper builds a management accounting framework based on operational control by drawing lessons from Hall's three-dimensional structure analysis method.

Firstly, the time dimension of Hall's three-dimensional structure represents the whole process of system engineering activities arranged in time sequence from beginning to end. The enterprise operation process is divided into the planning

stage, scheme formulation stage, implementation stage, and continuous improvement stage. Therefore, this paper defines the above four stages as time dimensions.

Secondly, the thinking procedure that should be followed in each stage of the time dimension is represented by the logical dimension of Hall's three-dimensional structure. The planning stage and the programming stage need to be conducted under the guidance of the organization's strategic objectives. In this paper, the procedures to be followed in these two stages are defined as organizational functions. In the implementation stage, enterprises need to effectively control the operation process to ensure the effective implementation of the scheme. In this paper, the procedures to be followed in the implementation stage are defined as control activities. Enterprises need to make the operation plan to create value continuously in the stage of continuous improvement. This paper defines the procedure to be followed in this stage as capability improvement.

In the end, the knowledge dimension of Hall's three-dimensional structure represents the professional knowledge needed to complete these stages and steps. Management accounting is carried out around enterprise operational control, and it is a control system that directly participates in enterprise operation process management. Management accounting tools are the concretization of management accounting concepts and form important support for the operational control of enterprises. Therefore, this paper positions management accounting tools as a knowledge dimension. As shown in Figure 1, this paper establishes a management accounting framework based on operational control by using Hall's three-dimensional structure model for reference and studies the internal relations and quantitative methods among management accounting tools based on enterprise operation characteristics.

3.2. Proposition of this Paper. To focus on the quantitative research of enterprise operation control and management accounting tools, we set the following conditions for the logical dimension and knowledge dimension elements of the management accounting framework based on operation control:

- (1) The operation of the enterprise is the growth stage and mature stage of an enterprise or enterprise group. The enterprise is facing full market competition and has the demand to actively improve its competitiveness and value creation ability by optimizing the operation ability and management accounting application.
- (2) We set the operation control dimension studied as three first-class elements: organizational function, control activity, and capacity improvement, covering the management activities of enterprise static control, dynamic control, and resource investment.
- (3) We choose the eight methods commonly used by enterprises: comprehensive budget, performance evaluation, responsibility body, lean cost, supply chain, sales support, industry finance integration,

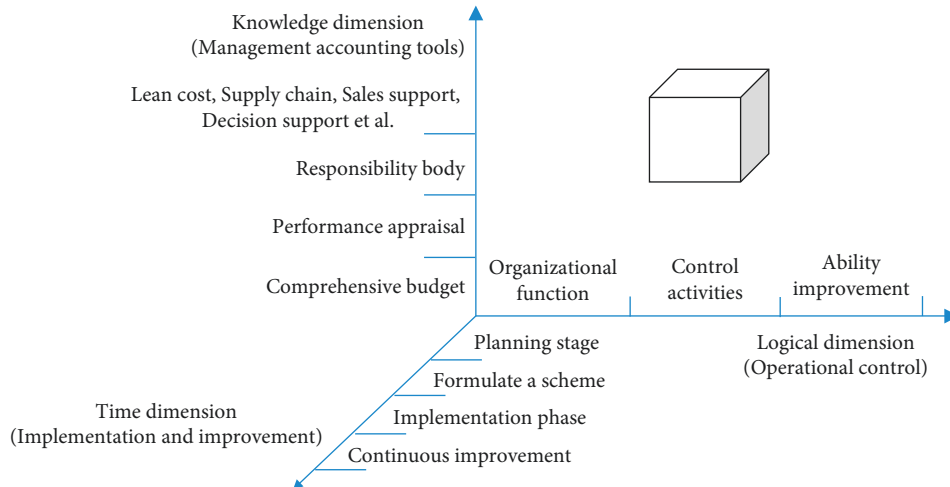


FIGURE 1: Management accounting framework model based on Hall's three-dimensional structure.

and decision support as the management accounting tools to support the improvement of enterprise operation in this paper.

In general, the proposition of this paper is put forward.

Proposition 1. *There is a quantitative correlation between organizational function, control activity, capacity improvement, and management accounting tools in the operation control dimension.*

Proposition 2. *There is a quantitative correlation between enterprise management accounting tools, and there are hierarchically differential characteristics.*

3.3. Enterprise Operation Matrix. Contingency theory holds that there is no universally applicable management practice, but an appropriate management scheme should be designed according to the specific environment and structure of the organization. Operational control and management accounting tools need to be implemented and selected according to the specific situation of the organization in the management accounting framework model proposed in this paper. Operational control is a management activity implemented by managers to achieve the strategic objectives of enterprises. Enterprises can provide higher quality information for operational control activities by using management accounting tools, thus improving the level of operational control. However, the operational control activities are attached to the functional departments in practice. Different functional departments need different management accounting information according to their functional orientation when carrying out specific operational control activities, so they use different management accounting tools. The core problem is how to select a suitable set of management accounting tools for different operational control activities, and what kind of relationship between these management accounting tools. Therefore, this paper further constructs an enterprise operation matrix according to the logic dimension (operational control) and knowledge

dimension (management accounting tools) in Hall's three-dimensional structure model and probes into the correlation between operational control and management accounting tools, as well as the correlation within management accounting tools.

3.3.1. Operational Control Dimension. Enterprise operation transformation and management mode innovation have become the path for enterprises to achieve high-quality development. Management coordination among functional departments should be solved first in enterprise operation transformation, and the operational control dimension refers to management elements related to basic business activities and auxiliary business activities of enterprises. As shown in Table 1, according to the operational characteristics of enterprises, the operational control activities are abstracted into three levels: organizational functions, control activities, and capability improvement, and the management elements of enterprises are presented from three aspects including static rules, dynamic control, and resource input.

Organizational functions include four secondary contents: mission objectives, department functions, behavior activities, and process specifications, which correspond to the static definition of management elements related to department functions. First, the departmental mission and goals are presented based on the function, including the departmental mission, departmental planning, rolling plans or budget goals, etc., which define the why to do the job. Second, based on departmental functions, we propose functional positioning, division of responsibilities, business input, and output, organizational structure, etc., which defines the problem of who does it. Third, the behavioral activities related to department responsibilities, including main business activities, auxiliary business activities, innovation activities, key drivers, etc., define what to do. Fourth, the system norms and processes related to department functions support the compliance of enterprise operation activities, guard against enterprise operation risks, and define how to do it.

TABLE 1: Dimension table of operational control.

Control dimension	Secondary content	Three-level elements
Organizational function	Mission objective	Departmental mission, strategic planning, rolling plan, budget target, etc.
	Departmental functions	Function orientation, division of responsibilities, business input and output, organizational structure, etc.
	Behavioral activity	Main business activities, auxiliary business activities, innovation activities, key drivers, etc.
	Process specification	Laws, regulations, business processes, control standards, etc.
Control activities	Identify shortboard	Resource matching, benefit restriction, efficiency restriction, potential influence, etc.
	Risk management and control	Risk identification, risk assessment, risk control, risk response, etc.
	Information communication	Business routing slip, business negative list, report and statement, supporting information, etc.
	Performance supervision	Performance appraisal, accounting supervision, audit supervision, other supervision, etc.
Ability improvement	Quality improvement	Talent echelon, job rotation, postallocation, vocational training, etc.
	Resource input	Infrastructure, regional marketing, staffing, business license, etc.
	Collaborative optimization	Process optimization, architecture optimization, resource optimization, performance optimization, etc.
	Innovation and promotion	Management innovation, technology innovation, product innovation, method innovation, etc.

Control activities include four secondary contents: management shortcomings, risk management and control, communication and informatization, and performance incentive, which reflect the dynamic management closed loop composed of identifying management shortcomings, evaluating operational risks, improving information communication ability, and performance appraisal and supervision. Operations management is a process of setting goals, identifying deviations, and correcting methods or targets. First, it is necessary to identify shortcomings, including elements such as resource matching, effectiveness constraint, efficiency constraint, and potential impact, and clarify key management points and critical links. Secondly, risk assessment includes steps of risk identification, risk assessment, risk control, and risk response to control target deviation. Third, information and communication consist of business transmittal sheets, negative lists, reports, and statements to achieve information-supported management decision needs. Fourthly, performance supervision consists of performance appraisal, accounting supervision, auditing supervision, and other supervision, and performance evaluation and supervision and management constitute closed-loop management and positive incentive.

Capacity enhancement refers to the drivers of value creation and expansion of value recreation capability and consists of four elements: quality enhancement, resource input, synergy and optimization enhancement, and innovation enhancement, which represent improving productivity, increasing resource input, optimizing intrinsic management, and innovating product technology methods, respectively. First of all, quality improvement mainly refers to the management activities related to talent capacity building, including talent echelon, job rotation, postallocation, vocational training, and so on. Secondly, resource input mainly refers to the allocation of human, financial, and material resources and quantity for the responsible body,

including infrastructure, marketing resources, talent allocation, and business license. Third, system optimization refers to the improvement of benefits and efficiency, including process optimization, framework optimization, resource optimization, and performance optimization. Fourth, innovation enhancement refers to technological innovation and application for new markets and new fields or product iterations and upgrades, including management innovation, technological innovation, product innovation, and method innovation.

As mentioned above, the logical dimension defines the three dimensions of static description, dynamic control, and capability enhancement of operational control activities based on functional divisions, while the knowledge dimension refers to the collection of management accounting tools that provide operational reporting and support operational activities internally.

3.3.2. Management Accounting Tools Dimension. Eight tools such as comprehensive budget, performance evaluation, and responsibility body as the research method of knowledge dimension to promote the application of management accounting, which is widely represented in the current enterprise practice.

(1) Comprehensive budget

The introduction of budget management in enterprises can promote the implementation of strategies and guide the decomposition of business plans. The comprehensive budget focuses on the standardization, institutionalization, and formatting of operating data in the budget outline to implement the general requirement of capital management-oriented preparation. A comprehensive balance of shareholder requirements for return on value and

corporate operating characteristics and performance objectives form the mainline of corporate budgeting. The budget allocates resources around capital efficiency and benefits, enhances the vitality of enterprises, and promotes the transformation of comprehensive budgeting from business-oriented to capital-oriented. First, pay attention to the return on capital, including capital gains and dividend plans. Secondly, pay attention to capital management, allocate resources around industries, and guide enterprises to set up, increase or decrease capital, merge and exit by budget. Third, leading the industrial upgrading with the rational capital distribution. Fourth, through the governance mechanism, strengthen the risk management and control ability of capital. The comprehensive budget has become an important means to implement the capital management-oriented assessment method, optimize the allocation of resources and lead the industrial layout.

(2) Performance appraisal

If the operation efficiency of an enterprise is low and out of touch with the production and operation, KPI performance can be introduced to guide the value creation of the enterprise. The corporate value creation process tends to be synergistic in approach, taking into account long-term and short-term interests, and the alignment of performance appraisal objectives from a stakeholder perspective. Enterprises further define their value creation goals and execution strategies from the KPI key indicator model. The characteristics of the performance system are as follows: (1) The corporate performance system promotes the achievement of the strategic goals of the enterprise. (2) Corporate performance and departmental performance have a transmission effect. (3) Departmental performance reflects the unity of responsibility, power, and benefit and reflects the ability to allocate and create resources. (4) The performance assessment for the responsible body is reflected in its relevance and controllability to the business activities of the enterprise, reflecting the level of efficiency and effectiveness. The performance system is a bridge between the organizational structure, corporate values, and employee demands and is an important tool for management accounting and value creation. The performance appraisal on the ground constitutes the closed-loop of business operation management.

(3) Responsibility body

If the powers and responsibilities of internal functional departments are unclear, the responsibility center system can be introduced. Kazuo Inamori, a famous Japanese entrepreneur, divided his enterprise into several amoebas, each of which is an independent accounting operation that integrates production, operation, and accounting. The construction of the project way to stimulate the vitality

of the unit introduced the responsibility body system, building a vertically integrated resource allocation mechanism, sinking resources to the grassroots business units, and giving the grassroots business units full autonomy in management. The system of stimulating unit vitality not only refines the organizational structure of the responsible body but also takes the responsible body as the carrier and endows it with clear and definite “responsibilities, rights, and benefits.” Unified allocation of resources, performance objectives, and assessment of enterprises, departments, and employees. Taking the responsible body as the object to collect the management accounting data and taking a complete value chain as the analysis unit, the management accounting information with more decision-making relevance is provided.

(4) Lean cost

Cost leadership strategy is the basic strategy for enterprises to face competition. Low cost is not a simple low-price competition, but a cost management system and control ability. The cost management system is of great significance to realize the strategic objectives and enhance the competitiveness of enterprises. To achieve its goal by cost management and control, it is usually necessary to reduce the cost as much as possible based on maintaining the advantages of existing cost management of using the cooperation among basic elements such as organization, business process, resource input, and process management and control. The secret of enterprise cost reduction is to give full play to advantages, control cost growth factors, accurately grasp the nature of costs, and reduce costs.

(5) Supply chain

Enterprise value creation is a process of materialization of resources. The resource allocation model and accounting method are the basis for measuring the performance of responsible bodies. The supply chain system under the Internet condition is mainly based on online shopping malls, realizing the management goals of direct distribution of resources, direct cost accounting, higher-level units making rules without using resources, and grassroots units using resources without using cash. The supply chain model not only determines the cost of purchasing materials but also determines the inventory turnover rate and capital occupation. Therefore, it is very of great importance to establish the supply mode of separating logistics from the capital flow. Through the “internal online mall,” the supply chain system is integrated to realize the sharing of financial information and the control of logistics, information flow, and capital flow. This model changes the business model and value distribution model of the industrial chain, strengthens the core position of enterprises in the industrial

chain, and excavates the ability of enterprises to continuously create value. Enterprises move all kinds of operating resources to “internal online shopping malls,” which can effectively reduce operating costs.

(6) Sales support

The business supporting sales by accounting work is called BU Finance, which includes B2B online platform and bidding and quotation game strategy. B2B is a supply and sales platform for enterprises to exchange products, services, and information technology through the network. Quotation support refers to the method of combining game theory with quotation strategy to improve the probability of winning the bid. B2B platform promotes the change of enterprise business model. The Internet makes it possible for enterprises to establish cooperation in market, product, or operation and establish a business model facing full market competition through horizontal and vertical business integration. Bidding quotation is an important support of management accounting forbidding business. In practice, there is the possibility of cooperation among bidders, and even there are implicit competing behaviors such as bidding rigging. Therefore, competition scenarios become the primary factor in analyzing bidders' bidding decisions. Through the study of competition scenarios and evaluation rules, the decision-making of winning the bid is supported by financial methods, and the probability of winning the bid is improved.

(7) Integration of industry and finance

The integration of industry and finance is embodied as a large ERP system integrating financial and business information systems. The development of big data, cloud computing, and other Internet information technology has broken the situation of independent operation of enterprise departments, and the concept of industry and finance integration has become the necessary path under the existing market economy. The effective connection between the financial department and the business department should be realized, to provide more comprehensive, accurate, and efficient information and data resources for management accounting. The integration of industry and finance refers to a large ERP system built by organically integrating the three main processes in business operation, namely, business process, accounting process, and management process, in an IT environment including network, database, management software platform, and other elements. The establishment of business and financial integration information systems based on business activities has promoted the deep integration of business and finance. With the application of AI finance, financial agents, scenario computing, and financial theory will constantly innovate intelligent financial theory.

(8) Decision support

To do well in management accounting is to establish a decision support system based on management, that is, to do well in accounting based on management decision and accounting based on management control. Management accounting has the function of natural management cockpit. The enterprise financial early warning system is based on enterprise financial informationization and monitors the potential business risks of enterprises in real-time. The financial early warning runs through the whole process of business activities of enterprises. Based on the financial statements, business plans, and other relevant financial data of enterprises, it uses the theories of accounting, finance, enterprise management, and marketing and adopts the methods of proportional analysis and mathematical model to identify the risks existing in enterprises and give early warning to operators. A dynamic and comprehensive financial early warning system is established to monitor the business conditions of enterprises in real-time and reduce the operational risks of enterprises.

3.3.3. Enterprise Operation Matrix. This process should not only reflect the consistency of management from the static aspects such as mission objectives, departmental functions, behavior activities and process specifications of the company organization, but it is also necessary to manage the executive power from dynamic aspects including identification, risk management, and control, information communication and performance supervision, and so on and integrate with enterprise strategic planning, capital strategy, business operation, and various functional objectives in terms of quality improvement, resource input, collaborative optimization, and innovation promotion. Usually, based on the changes of the internal and external environment, enterprises choose the management accounting tools they need. In fully competitive industries, enterprises are more willing to apply management accounting tools to improve operational efficiency and benefits when the internal and external environment of enterprises tends to be complex and changeable, to enhance their competitiveness.

We construct the enterprise operation matrix based on the above-given analysis. The logical dimension refers to the collection of elements controlling operation activities, which constitutes the ordinate of the enterprise operation matrix and describes the static planning and dynamic allocation of organizational structure, control mode, ability improvement, and other elements realizing business objectives under the condition of functional division. The knowledge dimension means the collection of management accounting tools. The abscissa of enterprise operation matrix proposed in this paper consists of a comprehensive budget, performance evaluation, responsibility body, lean cost, supply chain, sales support, integration of industry and finance, decision support, and other methods as shown in Table 2.

The enterprise operation matrix reflects the internal logical relationship between the operation control dimension and management accounting tools. The correlation between the elements of the enterprise operation matrix is different due to the influence of the enterprise on the operating environment. From the perspective of system engineering, the correlation and impact of operation matrix elements can be scientifically quantified and evaluated. Therefore, we further select the verification method for the quantitative correlation of enterprise operation matrix elements. If we can prove that there is an internal correlation between the constituent elements of the operation control dimension and management accounting tools, the internal correlation between management accounting tools can also be indirectly proved.

4. Methods for Quantitative Analysis

DSM is mainly divided into process DSM, product DSM, and organization DSM [24]. Organizational DSM, a common method in management and histology, is used to analyze the interdependence within organizations. Tripathy and Eppinger (2013) used the DSM model to study how to assign tasks within product development organizations to design and development centers distributed around the world [25]. Millhiser et al. used the DSM model to study the effectiveness of different strategies for assigning interdependent employees to teams [26]. The enterprise operation matrix composed of operation control and management accounting tools is a complex of the correlation of factors such as products, processes, organizations, and activities. Therefore, the quantitative research using the DSM model is suitable for the enterprise operation matrix model proposed in this paper [27].

4.1. Designing the Structure Matrix. This paper designed the structure matrix to represent the correlation between elements and accordingly analysed the quantitative correlation between the elements of the two dimensions that make up the business operations matrix. The defined DSM matrix of enterprise operational control dimension is shown in Table 3. The defined management accounting tool DSM matrix is shown in Table 4. The basic elements that make up the DSM matrix are represented by diagonal lines, and the correlations between the elements are marked by nondiagonal information. The quantitative correlation between elements is expressed by numerical values, in which the value of row i and column j in the matrix is expressed as $DSM(i, j)$ [28].

4.2. Identifying the Quantitative Correlations. To represent more accurately the quantitative correlation between the elements, the following criteria were used for rating the correlation scores:

- Makes sense: 5 points
- Meaningful: 4 points
- Partly true: 3 points
- Worth considering: 2 points
- Worth a little consideration: 1 point

TABLE 3: DSM matrix of control dimension.

	α	β	γ
Organizational function α	α		
Control activity β		β	
Ability enhancement γ			γ

TABLE 4: Management accounting tools DSM matrix.

	A	B	C	D	E	F	G	H
Comprehensive budget A	A							
Performance evaluation B		B						
Responsible body C			C					
Lean cost D				D				
Supply chain E					E			
Sales support F						F		
Integration of industry and finance G							G	
Decision support H								H

Unconsidered: 0 points

The relevance score follows the following criteria:

Unconsidered: 0 points. The reason it is not worth considering is that someone in the organization has identified it as a relevant factor and the decision-maker considers it to be irrelevant. Although the score is 0, it shows that this factor has not been ignored.

Worth a little consideration: a score of 1. When a factor has little influence on the final decision, give it a score of 1. This can only be done after carefully verifying that the factor really cannot be attributed to "Unconsidered."

Worth considering: 2 points. Factors worth considering will influence decision-making.

Partly true: 3 points. Although this kind of factor makes some sense, it is not very meaningful. Decision-makers sometimes find that others perceive these factors to have different levels of importance, but decision-makers place them lower.

Meaningful: 4 points. Such factors play an important role in decision-making. Meaningful factors are not indifferent, but mean that any so-called factors must be taken into consideration.

Makes sense: 5 points. If a meaningful factor indicates something that matters, then a thing that makes sense indicates something that matters tremendously.

Using the above-given valuation scale and applying the Delphi review method to expand the sample size can reflect the objective impact to some extent [7].

4.3. Domaining the Mapping Matrix and Logical Relations. The coupling relationship between operational control activities and management accounting tools was studied by using the method of designing a structure matrix for reference [15]. As shown in Figure 2(a), the operational control dimension activities include three elements of organizational functions, control activities, and capability

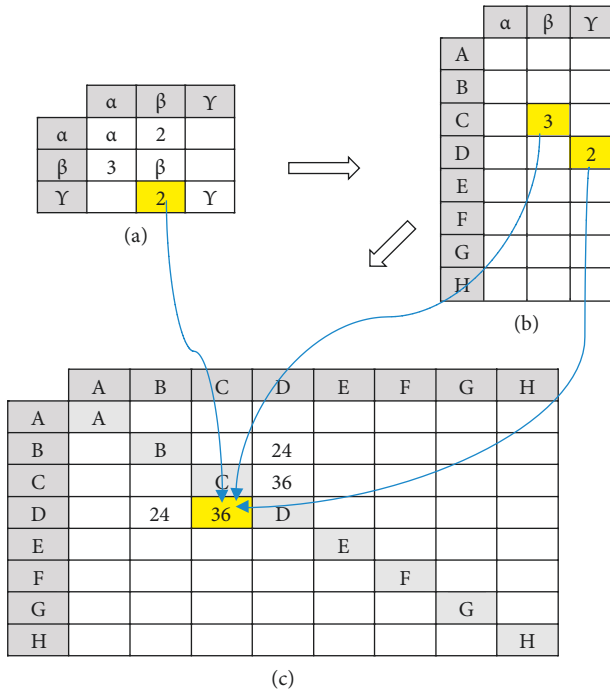


FIGURE 2: Logical relationship between control dimension DSM and management accounting tool DSM. (a) Operational control dimension DSM. (b) Operational control activities/management accounting tools DMM. (c) Management accounting tools DSM.

enhancement, called operational control dimension DSM. DSM (i, j) represents the values in the I-th row and J-column of the matrix and represents the quantitative correlation values among the elements in the operational control dimension DSM [16].

4.3.1. *Operational Control Dimension DSM.* The quantitative correlation among various operational control activities is expressed by the numbers in the operational control dimension DSM, as shown in Figure 2(a). Operational control activity α transmits correlation information to operational control activity β , which in turn feeds its impact results back to operational control activity α . The value of DSM $(2, 1)$ is larger than that of DSM $(1, 2)$, which indicates that the operational control activity β has a high influence on the quantitative correlation of α .

4.3.2. *Domain Mapping Matrix.* The operational control dimension DSM is connected to the management accounting tool DSM through the Domain Mapping Matrix (DMM), as shown in Figure 2(c). A domain mapping matrix is a nonsquare matrix that reflects the correlation between elements in two different domains. The numbers in the domain mapping matrix represent the quantitative correlation between management accounting tools and operational control activities.

4.4. *Developing the Multidomain Matrix and Doing Correlation Calculation.* The multidomain matrix (MDM) can

also represent the relationship between two or more DSM models in different domains. The DSM matrix for each domain is represented on the diagonal of the multidomain matrix, where the domain mapping matrix is the corresponding data region on the nondiagonal. As shown in Figure 3(a), in the multidomain matrix, the diagonal position data in the upper left corner are the operational control dimension DSM, the diagonal position data in the lower right corner is the management accounting tool DSM, and the nondiagonal position data in the lower-left corner represents the domain mapping matrix. This paper uses the multidomain matrix to identify the relationship between operational control activities and management accounting tools.

4.4.1. *Identifying the Information Flow between Activities.*

The management accounting tool DSM reflects the internal relationship between each tool as input/output or mutual influence, and the multidomain matrix reflects the correlation between the management accounting tool and the elements of operational control activities, that is the information or support provided by operational control activities for realizing the related functions of management accounting tools. Therefore, according to the correlation between the operational control dimension DSM and the domain mapping matrix, the information flow direction between management accounting tools can be judged. For example, from $C_DSM(3,2) = 2$ in Figure 3(a), operational control activity β passes information to operational control activity γ . Furthermore, from the domain mapping matrix, operational control activities β and γ are realized through management accounting tools C and D, respectively. Therefore, it is judged that there is an “implicit” correlation between management accounting tools C and D. Figure 3(b) shows the logical framework for deriving the “implicit” correlation between management accounting tools from the correlation between operational control activities. Among them, the quantitative relationship determined between elements is represented by solid lines, such as control dimension DSM and operational control activities/management accounting tools DMM; the implied or deduced relationship between elements is indicated by dotted lines, such as management accounting tools DSM.

4.4.2. *Doing Quantitative Correlation between Measuring Tools.*

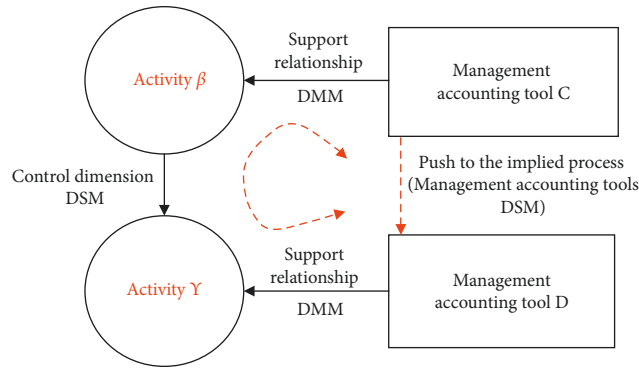
In the multidomain matrix, if the quantitative correlation $C_DSM(i, j)$, DMM (J, j) and DMM (I, i) between operational control activity I and management accounting tool I are known, the quantitative correlation $P_DSM(I, J)$ between management accounting tool DSM can be calculated by the following formula fd1:

$$P_{DSM(I,J)} = \sum_{i=1}^m \sum_{j=1, j \neq i}^m (DMM(I, i) \times DMM(J, j) \times C_DSM(i, j)). \tag{1}$$

Here, $i, j = 1, 2, \dots, m, I, J = 1, 2, \dots, n$. Among them, m and n , respectively, represent the number of management

	α	β	Y	A	B	C	D	E	F	G	H
Activity α	α	2									
Activity β	3	β									
Activity Y		2	Y	A	B	C	D	E	F	G	H
Comprehensive budget A				A							
Performance evaluation B		2			B		24				
Responsible body C		3				C	36				
Lean cost D	4		2		24	36	D				
Supply chain E								E			
Sales support F									F		
Integration of industry and finance G										G	
Decision support H											H

(a)



(b)

FIGURE 3: MDM schematic diagram. (a) Multidomain matrix MDM. (b) Information flow between elements.

accounting tools and the number of operational control activities. In this paper, we do not consider the correlation between different management accounting instruments carried out to achieve the same operational control activity so that $j \neq i$ in the formula.

For example, the quantitative correlation between the information passed from C to D and the quantitative correlation between the information fed back from D to B in Figure 3(b) is given by formula (1).

$$\begin{aligned}
 P_{DSM}(4, 3) &= DM M(3, 2) \times DM M(4, 1) \\
 &\quad \times C_{DSM}(1, 2) + DM M(3, 2) \\
 &\quad \times DM M(4, 3) \times C_{DSM}(3, 2) \\
 &= 3 \times 4 \times 2 + 3 \times 2 \times 2 = 36 \quad (2)
 \end{aligned}$$

$$\begin{aligned}
 P_{DSM}(2, 4) &= DM M(2, 2) \times DM M(4, 1) \\
 &\quad \times C_{DSM}(2, 1) \\
 &= 2 \times 4 \times 3 = 24.
 \end{aligned}$$

To sum up, the multidomain matrix measures the “implicit” quantitative correlation between management accounting tools as follows:

Step 1. For any point $P_{DSM}(I, J)$ in the operational control dimension DSM, the corresponding management

accounting tool I (row I) and management accounting tool J (row J) can be found in the domain mapping matrix, i.e., $DMM(I, i)$ and $DMM(J, j)$ ($i, j = 1, 2, \dots, m$).

Step 2. If $DMM(I, i)$ and $DMM(J, j)$ are not zero, it indicates that management accounting tool I (or management accounting tool j) has an impact on operational control activity I (or operational control activity j) and identifies $C_{DSM}(I, j)$ in management accounting tool DSM.

Step 3. If the value of $C_{DSM}(i, j)$ is also nonzero, it indicates that operational control activity i affects operational control activity j . Therefore, the quantitative correlation $P_{DSM}(I, j)$ between management accounting tools I and j related to operational control activities I and j can be calculated by formula (1).

Step 4. Repeat Steps 2 and 3 to identify all the parameters that make $DMM(I, i)$ and $DMM(J, j)$ ($i, j = 1, 2, \dots, m$) whose values are not equal to zero and accumulate the $P_{DSM}(I, J)$ obtained each time to finally obtain the value of $P_{DSM}(I, J)$ in the management accounting tool DSM.

Therefore, the above-given methods and steps can measure the quantitative correlation between the elements of the enterprise operation matrix. To verify the applicability

of the model and algorithm, we use the case of the financial transformation of China Unicom as the object of analysis to further investigate the characteristics of the management accounting tools applied by the enterprise.

5. Case Analysis

To analyze the characteristics of operation control and management accounting tools, we introduce the Delphi evaluation method to quantitatively evaluate the score of the correlation of the constituent elements of China Unicom’s enterprise operation matrix.

5.1. Quantifying the Impact of Operational Control on Management Accounting Tools. The quantitative correlation of operational control matrix evaluation is shown in Table 5. The quantitative correlation between organizational function α and control activity β is 5, while the quantitative correlation between control activity β and organizational function α is 4, indicating that organizational function α has a greater influence on control activity β than control activity β has on organizational function α . Meanwhile, there is another typical correlation relationship between capability enhancement Υ and control activity β . The quantitative correlation effect of capability enhancement Υ on the correlation with control activity β is 3, while the quantitative correlation effect of control activity β on capability enhancement Υ is 1. It shows that the influence of ability improvement on control activity β is greater than that of control activity β on ability improvement. Similarly, the quantitative correlation effect of organizational function α on capability enhancement Υ is 1, while the quantitative correlation effect of capability enhancement Υ on organizational function α is 2. It shows that the influence of capability enhancement on organizational function α is greater than that of organizational function α on capability enhancement.

The quantitative relevance of operational control activities to the assessment of management accounting tools is represented in a domain mapping matrix, as detailed in Table 6. Among them, comprehensive budget A, as a tool of strategy implementation, is affected by the quantitative correlation of organizational function α , control activity β , and ability improvement, all of which are 5. Organizational function α is to define the mission and rules of the organization, control activity β advances the implementation goals, and capability enhancement Υ is to match and invest resources, indicating that the operational control elements are all important in influencing the quantitative relevance of the comprehensive budget and advancing the comprehensive budget A is influenced by the combination of organizational function α , control activity β , and capability enhancement Υ . At the same time, another typical correlation is that the quantitative correlation of organizational function α , control activity β , and ability promotion affects decision support G by 3, 2, and 1 respectively. It shows that decision support G has a great correlation with organizational process α , but Υ is less affected by ability improvement, and the influence of control activity β on decision support G

TABLE 5: Operational control dimension matrix DSM.

	α	β	Υ
Organizational function α	α	4	2
Control activity β	5	β	3
Ability improvement Υ	1	1	Υ

is between them. Other management accounting tools are influenced by the quantitative relevance of operational control elements as detailed in Table 6.

The multidomain matrix is an analysis of the characteristics of the application of management accounting tools in a business and is reflected as an intrinsic link between management accounting tools in a business operations control environment. The multidomain matrix constructed by using operational control dimension DSM (Table 5) and domain mapping matrix (Table 6) is shown in Table 7, and the quantitative correlation between management accounting tools is calculated according to formula (1).

5.2. Quantifying the Correlation between Management Accounting Tools. The management accounting tool DSM is derived from the multidomain matrix MDM (Table 7) by optimizing the ranking according to the correlation value and increasing the color scale, as shown in Table 8. Firstly, the quantitative relevance of comprehensive budgets to other management accounting tools is at the top of the list. It can be seen that the strategic position and function of the comprehensive budget have quantitatively verified the position of the comprehensive budget as the core tool of enterprise management and control. Secondly, the quantitative correlation among comprehensive budget, performance evaluation, and responsibility body is above 316, which also shows that these three management accounting tools together constitute the key elements to enhance the operational capability of enterprises. Thirdly, among the impacts on the comprehensive budget, the quantitative relevance of the responsibility body 390 ranks first, the quantitative relevance of the performance evaluation system 340, while the quantitative relevance of the business-financial integration 340, the quantitative relevance of the lean cost 300, the quantitative relevance of the supply chain 280, the quantitative relevance of the sales support 250, and the quantitative relevance of the decision support 180, indicating that the responsible body is the core element to achieve the budget decomposition. Fourthly, the financial integration to comprehensive budgeting is relatively large and must be considered in the process of implementing the management accounting framework. Fifthly, the quantitative relevance of lean cost, supply chain, and sales support to other management accounting tools is at a medium level, which is related to the fact that they are operation-oriented management accounting tools and the management attributes supporting the operation level. Sixthly, the quantitative relevance of decision support to various management accounting tools is weak, which is related to the fact that decision support is based on the information integration attribute of various management accounting tools and also

TABLE 6: Management accounting tools and operations control matrix DMM.

	Organizational function α	Control activity β	Ability improvement
Comprehensive budget A	5	5	5
Performance evaluation B	5	4	3
Responsible body C	5	5	4
Lean cost D	3	4	5
Supply chain E	3	4	3
Sales support F	2	4	3
Integration of industry and finance G	4	5	2
Decision support H	3	2	1

TABLE 7: Operational control and management accounting tool MDM.

	α	β	γ									
Organizational function α	α	4	2									
Control activity β	5	β	3									
Ability improvement	1	1	γ	A	B	C	D	E	F	G	H	
Comprehensive budget A	5	5	5	A	325	375	315	265	235	295	165	
Performance evaluation B	5	4	3	340	B	318	271	227	204	251	137	
Responsible body C	5	5	4	390	316	C	308	258	229	286	160	
Lean cost D	3	4	5	300	247	282	D	197	172	221	127	
Supply chain E	3	4	3	280	229	262	219	E	160	203	117	
Sales support F	2	4	3	250	207	234	193	161	F	179	107	
Integration of industry and finance G	4	5	2	340	276	317	268	222	195	G	140	
Decision support H	3	2	1	180	143	168	145	121	110	133	H	

TABLE 8: Management accounting tool DSM.

	A	C	B	G	D	E	F	H
A	A	375	325	295	315	265	235	165
C	390	C	316	286	308	258	229	160
B	340	318	B	251	271	227	204	137
G	340	317	276	G	268	222	195	140
D	300	282	247	221	D	197	172	127
E	280	262	229	203	219	E	160	117
F	250	234	207	179	193	161	F	107
H	180	168	143	133	145	121	110	H

related to the fact that decision support is the management attribute supporting the management of enterprises. Seventhly, the quantitative correlations among lean cost, supply chain, and sales support are less than their quantitative correlations among comprehensive budget, performance evaluation, and accountability body, indicating a significant hierarchical nature of quantitative correlations among management accounting tools.

Table 8 shows the following characteristics. First of all, the comprehensive budget is the core tool to realize the enterprise strategy and lead the operational objectives, and it constitutes a key support method to encourage enterprises to improve their operational capabilities together with the two factors of responsibility and performance evaluation, which belongs to the first level. Secondly, except for the impact on

the comprehensive budget and responsibility body, the impact of the integration of industry and finance on various management accounting tools is between 200 and 300, and its impact on the application of various management accounting tools is less than that on various management accounting tools, which shows that the integration of industry and finance constitutes the basic attribute supporting other management accounting tools. Thirdly, lean cost, supply chain, and sales support are management accounting tools to improve operational efficiency and benefit by enterprises according to professional division, which belong to the important support method of the second level. Fourthly, decision support has a relatively weak correlation influence on other management accounting tools due to its information integration function and comprehensive management characteristics and belongs to the operation support method of the third level.

To sum up, DSM is used to prove that there is a quantitative correlation between the operation control elements of the case enterprise and the management accounting tools, as well as between the management accounting tools, and the support of the management accounting tools for the operation has hierarchical characteristics, to demonstrate the effectiveness of the enterprise operation matrix. Therefore, the research proposition proposed in this paper is tenable.

6. Conclusions

To overcome the defects of the former management framework system lacking quantitative research on the internal

relationship between management methods and operation control. Firstly, this paper uses Hall's three-dimensional structure model to construct a management accounting framework based on operational control. This research can effectively respond to the contingency characteristics such as enterprise environment and organizational change since it integrates the management methods and operation environment and is beneficial for enterprises to solve the contradictions and conflicts in the process of operation and management. Second, taking the contingency elements such as organizational structure, control methods, and ability improvement as the logical dimension, this paper studies the characteristics of enterprise operation control, takes eight tools such as comprehensive budget, performance evaluation, and responsibility body as the knowledge dimension to promote the application of management accounting and defines the enterprise operation matrix accordingly. This research has changed the traditional research model based on a single theoretical basis, innovated the framework theory of management accounting, and promoted the theoretical and empirical research of management accounting in application scenarios, internal logic, quantitative analysis, etc. Thirdly, using the method of DSM matrix, this paper studies the quantitative correlation between operation control and management accounting tools, and the quantitative correlation between management accounting tools. The business operation matrix lays a theoretical foundation for the identification of the internal relationship between management accounting tools, which is conducive to the coordination and integration of the application of management accounting tools according to the operational characteristics and the enhancement of the enterprise value creation ability. Finally, a case study is conducted to verify the core role of a comprehensive budget in enterprise operation management, and it constitutes the key method affecting enterprise operation ability together with responsibility body and performance evaluation. The results reveal that there are significant correlations and hierarchical characteristics among management accounting tools.

The development of the Internet and artificial intelligence will continuously enrich the theory and practice of enterprise operation and management and promote the continuous integration and innovation of enterprise value creation concepts and management accounting tools. The value creation system is also a process of continuous integration, innovation, and systematization with the changes in the internal and external business environment of the enterprise. It is a contingency decision-making process for enterprises to realize value creation by using management accounting, and the practice of management accounting among different enterprises is different. Consequently, the research methods of enterprise operation matrix and quantitative correlation of management accounting put forward in this paper enrich the framework theory of management accounting and also have an enlightening role in guiding enterprise operation management practice. In addition, this study does not involve the impact of capital operation in the public market on corporate valuation and the law of its evolution. It is widely representative to study

the corporate management accounting framework with 8 typical tools, but there are some limitations. The application of management accounting is ultimately reflected in improving the ability of enterprise value creation, and its impact on the valuation of enterprises in the capital market will become the direction of further research. The enterprise operation control and management accounting tools will be deeply integrated and unified driven by information technology in the future with the application of intelligent finance. The management accounting framework based on big data and intelligent finance will also become the field of future research [29].

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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