

Reconstructing Enterprise Budgetary Control under Big data and Cloud Accounting: A Theoretical Approach

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Abstract. With the advent of the big data era and the widespread application of cloud accounting, data has become the key to creating more accurate budgets for enterprises. This forces many enterprises to rethink the suitability of their current budgeting systems in the context of modern developments. Enterprises may experience the drawbacks of traditional budgetary model when facing recurrent market fluctuations that are difficult to navigate. From the perspective of multidimensional definition of big data, this paper analyzes why traditional budgetary model is ill-suited to modern enterprises, reviews the development process of budgetary management theory both internationally and domestically (i.e., in China), and investigates the current situation of enterprises in the background of big data. leveraging the Balanced Scorecard (BSC)—a framework that effectively integrates enterprises' strategic objectives with budgeting and the Hadoop platform, a tool for big data support and processing, this paper explains how to build database of an enterprise and data management center to help reconstruct overall budgetary management system, and help enhance inter-departmental collaboration to avoid the formation of data silos, through the combination of Hadoop platform and other technology tools. The latter part of the paper concludes by addressing critical challenges enterprises may encounter during the process of reconstructing the overall budgetary management system: blurred separation of duties and data quality uncertainties inherent to new computing paradigms.

Keywords: Big Data, Cloud Accounting, Enterprise Budgetary Control.

1. Introduction

1.1. The multi-dimensional definition of big data

With the development of society and the continuous advancement of science and technology, we have entered into a period which is definitely different brand-new era: the big data era. Driven by the widespread adoption of technology and the internet, data in its various forms is experiencing explosive growth. Seizing this opportunity has become a critical factor for enterprises' success. Indeed, some organizations have emerged as industry leaders by fully leveraging big data and sophisticated internet technologies. Compared with those enterprises, companies that are less data-driven stay in an unfavorable position in the market. From the perspective of this study talking about, many enterprises still fail to emphasize the application of big data, particularly in key operational processes such as budgeting and management [1]. As a result, the data availability and utilization have become a limiting factor in effective budget formulation [2].

Big data is a concept that continues to evolve as it is analyzed globally. It is commonly defined through five key dimensions, often referred to as the "5Vs": The first defining characteristic is Volume, which refers to the immense scale of data generated. Traditional financial data may only be restricted to companies' financial reports or internally collected information. Big data encompasses vastly greater quantities. The second characteristic, Velocity, which represents the speed of producing data is incredibly high. This underscores the importance of collecting, processing, and analyzing real-time data to inform budgetary decisions. The third one is Variety. This denotes the wide spectrum of data types and formats, which extends far beyond the structured, numerical data traditionally confined to financial systems. The data that enterprises can use to make budgets includes non-financial data, qualitative data, quantitative data, and so on [2]. Through mastering big data, it will be more accurate to manage markets trends and make predictions. Furthermore, it significantly enhances accuracy of

budgets and facilitates strategic innovation within enterprises. The fourth characteristic is Veracity. We have to admit that inconsistent data quality exists with its abundant sources at the same time. Unlike traditional accounting data, big data often lacks inherent certainty and requires cleansing and validation. The final characteristic, Value, highlights that the worth of big data is not intrinsic but is realized through its processing and analysis; the ensuing insights then inform enterprise decision-making. It can be seen that the five characteristics of big data are closely related to each other.

1.2. Disadvantages of the traditional budget model

Fixed and flexible budget methods are traditional budgetary approaches widely employed in contemporary business. The fixed budgeting method establishes financial plans based on a forecasted and stable level of activity, resulting in a static budget for the upcoming period. On the other hand, the flexible budgeting method allows expenditures to be adjusted according to varying levels of business activity. Compared to fixed budgets, flexible budgeting can respond to markets fluctuations through dynamic adjustments to some extent. However, the contemporary market and environmental conditions—critical factors for corporate decision-making—are now evolving with increasing frequency and unpredictability.

Consequently, flexible budgeting methods can lead to an excessive number of budget scenarios, as they must account for both fixed costs and fluctuating workloads. The development of these multiple versions often demands considerable resources in terms of time, labor, and cost. When the budgeting process grows this cumbersome, the subsequent comparison between budgeted and actual figures risks becoming a mere mechanical exercise, largely managerially irrelevant. Furthermore, integrating flexible budgeting with a rolling budget framework can enable periodic adjustments and continuous updates in response to market changes. Nevertheless, the fundamental challenges of resource consumption persist. When enterprises attempt to fully synchronize with every market fluctuation and leverage big data analytics comprehensively, they often encounter the aforementioned issues: excessive time and effort are diverted to budget preparation at the expense of operational execution.

When confronted with sudden disruptions, the application of traditional flexible budgeting methods often reveals significant time lags due to their lack of real-time responsiveness. A pertinent example is the COVID-19 pandemic. Nearly all airline companies, hotel groups, and travel platforms were unable to respond promptly to this sudden crisis. Budgets built on original business volume forecasts were quickly rendered obsolete. Faced with plummeting revenues and urgent shifts in priorities, many companies were forced to completely rebuild their budgets from the ground up. This experience underscores a critical weakness of traditional budgeting: its inability to respond effectively to unforeseen emergencies, such as Black Swan events.

Furthermore, Microsoft Excel remains the primary budgeting tool for numerous enterprises [1]. While spreadsheets offer undeniable convenience for storing, handling and analyzing data, their efficiency in the big data era is increasingly questioned. The core objectives of budgeting are to ensure forecast accuracy and timeliness, facilitate informed decision-making through relevant information, and enable rational resource allocation. Yet, traditional spreadsheet-based budgeting is increasingly inadequate. It cannot handle large-scale data, is inefficient, and makes coordination across departments difficult [3]. This makes it ill-suited for dynamic planning, forcing a transformation in how comprehensive budget management—a key management accounting function—must evolve.

1.3. Research Objectives

Building on the earlier discussion of traditional budgeting approaches and the emergence of big data, this paper examines how big data and cloud accounting can enhance the overall efficiency, transparency, cross-departmental coordination, and strategic alignment of enterprise budgeting systems. A gap in current research is the absence of studies on improving enterprise budgeting management systems to adapt to the big data wave and mine its information value more effectively. We have identified shortcomings in current enterprise practices, and while numerous studies have

analyzed the subjective and objective causes of outdated budgeting systems, few have offered clear guidance on how to comprehensively restructure budget management using big data. Therefore, based on an assessment of current enterprise budget platforms, this study adopts the Balanced Scorecard (BSC) as the strategic control framework to illustrate how budgeting can advance strategic goals. It also introduces Hadoop—combined with complementary IT tools—as a technical support architecture to enable the collection and storage of diverse big data types, enhance cross-departmental collaboration in budgeting, and eliminate budgetary silos. Additionally, the study outlines the process and rationale for enterprises to build proprietary databases, and explores how decision-makers can leverage intelligent budgeting platforms to improve effectiveness.

2. Literature review

2.1. International Development of Budgeting Theories

The concept of budgetary management first emerged in the United Kingdom, where as early as the 12th century, the English Crown was required to seek parliamentary approval for specific taxation measures—marking the embryonic stage of budget control. In 1921, the United States enacted *the Budget and Accounting Act*, which helped popularize the idea of budgetary control, leading some enterprises to adopt budgeting as a means of improving operational efficiency. A year later, James O. McKinsey, founder of the globally renowned consulting firm McKinsey & Company, published *Budgetary Control*, a seminal work that established the theoretical foundation of comprehensive budgeting. Unlike earlier generalized discussions, this book systematically elaborated the role of budgets as managerial tools within corporate settings.

From the 1930s to the 1950s, comprehensive budgeting systems continued to evolve and mature across Western economies. During this period, innovative budgeting techniques such as zero-based budgeting were introduced through corporate practice. Research by Zhu Xiaobo notes that by the 1950s, Western scholars began applying economic principles to analyze the characteristics and behavioral implications of budgeting, uncovering issues such as budgetary slack and variances in implementation across departments and hierarchical levels [4]. A 1952 study revealed significant differences in budget execution depending on employees' roles and departmental affiliations, leading to the introduction of the concept of “budget participation” [5]. In 1988, Chow et al. employed controlled experimental methods to identify subordinate-induced budget slack, further advancing the study of employee influence in the budgeting process. By the 1980s, American management accountants Robert Kaplan and David Norton developed the Balanced Scorecard—a strategic execution framework still widely applied today, including in this study. This framework incorporates non-financial metrics alongside financial ones, linking budget management more closely with strategic objectives across areas such as operations and organizational management, thereby enhancing budgetary flexibility and adaptability [6].

By the late 1990s, the digital transformation began enabling more efficient budget formulation, with systems like Enterprise Resource Planning (ERP) being integrated into corporate management practices.

2.2. Development of Budgeting Theories in China

Compared with Western countries, the development of budget management in China began relatively late. However, this also implies that China has been able to draw upon a more mature body of international methodologies. In 1999, Wang Bin introduced the concept of enterprise budget management, emphasizing that its purpose is to serve as a bridge linking corporate strategy with performance outcomes. He also highlighted the principle of decentralization under shared authority, noting that budget management should not be treated in isolation from other management accounting tools [4]. His work provided important direction for enterprises seeking to leverage budgeting effectively.

Over the following decade, scholarly discussions largely centered on the following aspects: First, the top-down budgeting approach resulted in limited departmental participation and initiative, leading to superficial implementation with modest practical impact; Second, efforts were made to enhance the strategic budget management system based on the balanced scorecard, emphasizing the integration of non-financial indicators in performance evaluation; Third, studies examined the influence of human behavior in the budgeting process under different incentive and compensation structures [4].

A review of the evolution of budget management both in China and abroad reveals that existing theoretical frameworks have yet to fully adapt to the challenges posed by digitalization. Research in this area remains relatively scarce, and there is still a lack of a comprehensive budget management theory suited to the big data era.

2.3. Current State of Enterprise Budget Management

2.3.1. Technological Innovations in Budgeting Models

In recent years, AI-powered financial budget management cloud platforms have been developed and implemented, enabling fully automated, real-time accounting processes. For instance, the UFIDA cloud platform effectively integrates budgeting and financial systems. By automatically converting business operations into accounting vouchers stored within the financial system, the platform utilizes AI-driven decision-making to monitor and control data in the budget system based on actual enterprise activities. Its modular architecture and unified data storage facilitate seamless data exchange between subsystems, supporting real-time analytics and dynamic management informed by historical data [7].

Furthermore, scholars have proposed and analyzed EVA-based budgeting methods to strengthen the alignment between enterprise budgets and strategic objectives. Enterprises can apply EVA to develop budgets from both operational and capital perspectives, further dividing them into revenue and expenditure budgets, as well as capital quantity and cost of capital budgets. These are then continuously compared with predefined EVA targets, forming a dynamic and cyclical management process [8]. This approach offers an effective mechanism for maximizing strategic outcomes, though it emphasizes procedural rigor and systematic operation.

While technological advancements provide enterprises with advanced platforms and methodologies for more precise budgeting, many organizations remain uncertain about establishing big data-enabled budgeting systems. The data considered during budget preparation is often limited, and budget-related decision-making continues to be heavily influenced by the individual characteristics and preferences of managers.

2.3.2. Limitations of Existing Research

Currently, the digital transformation of many enterprises remains insufficient, revealing gaps both in organizational practices and academic research. Firstly, there is often a lack of in-depth understanding among management regarding the strategic role of budgeting, with limited awareness of its impact on long-term enterprise development. Secondly, many companies overlook the importance of integrating data governance mechanisms with the budget system. This results in poor alignment between budgeting and other management controls, rendering the budget process superficial and ritualistic rather than operational. Additionally, existing cloud-based accounting platforms often lack the technological advancement and adaptability required for contemporary dynamic environments.

Academic literature has predominantly focused on innovating budgeting methodologies and refining theoretical frameworks—such as budget categorization and scope—while paying less attention to practical integration. Notably, there remains a scarcity of systematic research examining the tripartite relationship among “budgeting, big data, and cloud platforms”. Most existing studies treat these elements in isolation rather than as interconnected components of a modern management system. Therefore, this study aims to address this gap by exploring the redesign of budgetary

processes in the big data era, the effective deployment of cloud platforms, and the associated risks and strategic recommendations.

3. Theoretical Framework

A recurrent challenge faced by many enterprises is the misalignment between strategic objectives and budgetary planning. Survey data indicates that while 99.25% of enterprises recognize the importance of implementing budget management, 96% attribute their motivation for doing so to internal management needs [7]. This suggests that internal management factors are considered a primary driver of budget implementation—at least from the corporate perspective. However, even after strategic goals are established, budgetary targets often fail to reflect these objectives effectively. Moreover, budget formulation tends to prioritize short-term operational goals rather than supporting long-term strategic initiatives [8].

In the case of small and medium-sized enterprises (SMEs), intense market competition is often compounded by a lack of managerial expertise in leveraging big data for budgeting [7]. Among larger enterprises, while resources may be more abundant, the intelligent transformation of budget systems often remains underdeveloped. Many lack a dedicated, structured database, and budgetary decisions continue to be heavily influenced by subjective judgment rather than data-driven insights. In general, restructuring the budget management system for the big data era requires not only collaboration with technology platform providers but also a shift in management's mindset toward budgeting. As Yi Zhang emphasizes, successful platform restructuring must be built upon sound processes and a supportive management environment [8].

Therefore, guided by both strategic execution needs and technological advancement, this paper adopts the Balanced Scorecard (BSC) as the strategic control framework and Hadoop—along with complementary IT tools—as the technical foundation to explore the reconstruction of an enterprise budget management system suited to contemporary demands.

3.1. The balanced Scorecard: A strategic Budgeting Framework

The Balanced Scorecard (BSC) provides a comprehensive framework that incorporates both financial and non-financial indicators, translating strategic vision into a structured and measurable performance management system. As one of the first widely adopted and systematic approaches to integrate multi-dimensional metrics, BSC emphasizes the critical role of non-financial indicators in aligning operational activities with strategic objectives. This represents a significant advancement over earlier models that relied predominantly on accounting-based measures, which have been criticized for their narrow focus and inadequacy in guiding long-term strategy [9].

By facilitating the execution of strategy, BSC supports more effective resource allocation and budget optimization. Furthermore, when combined with visualization tools such as the Tableau de Bord, the strategic objectives outlined in the BSC can be dynamically monitored and communicated. Unlike traditional budgeting tools that often emphasize static control, the Tableau de Bord focuses on continuous prediction and responsive adjustment, enabling dynamic management. This shift from static execution to proactive, feedback-driven budgeting constitutes a key theme explored in this study.

3.2. A Hadoop cloud platform system based on soft computing

Hadoop technology enhances data transparency and supports parallel processing, thereby improving both storage capacity and cluster computing performance in database systems. Furthermore, as highlighted by Zhang Shuxiang, establishing interconnected accounts for both budgetary and financial accounting—and clarifying their relationships—enables the automatic generation of accounting vouchers through predefined system rules or logical inference [10]. However, when budgetary and financial ledgers operate concurrently, discrepancies may arise. In such cases, Hadoop enables multi-dimensional comparative analysis—not only between the two

ledgers but also against historical budget data—to efficiently identify the root causes of variances. This approach contributes to more dynamic and responsive budgetary management.

Moreover, Hadoop will serve as a critical tool for data mining and collection within the restructured comprehensive budget management system, as will be detailed in subsequent sections.

4. Mechanism Discussion

4.1. Data-driven budgeting process reconstruction

As previously emphasized, leveraging big data for budgeting necessitates the effective management of its substantial volume and diverse sources. Data acquisition and screening serve as critical prerequisites for meaningful analysis, as the comprehensiveness and quality of data directly influence the effectiveness of the budgetary process. Within the data-driven dynamic budgeting model we propose, the role of data mining tools is indispensable. Technologies such as SAP, IBM’s advanced analytics suites, and Python’s programming libraries enable not only rapid scanning of large-scale databases but also in-depth exploration of hidden correlations within the data.

Enterprises can utilize Hadoop’s data migration and tiered storage management capabilities to achieve centralized integration of internal and external data. As noted in relevant studies, the Hadoop Distributed File System (HDFS) supports high-capacity offline storage while also functioning as a next-generation disk storage facility, automatically transferring frequently accessed data to online databases and seamlessly bridging offline and online storage modes [10]. Through this mechanism, frequently used data identified by intelligent detection is stored in high-performance databases, while less-accessed data is systematically archived in secondary storage systems. This structured approach allows enterprises to progressively filter and refine big data through ongoing collection and consolidation, thereby enhancing the quality of data used in budget formulation.

Following Hadoop-based storage and processing, the information available to enterprises extends beyond traditional financial data to encompass a broad spectrum of internal and external variables. This enriched data environment provides a solid foundation for building a big data-driven decision-support system, enabling the formulation of more accurate and market-responsive budgets, as illustrated in Figure 1.

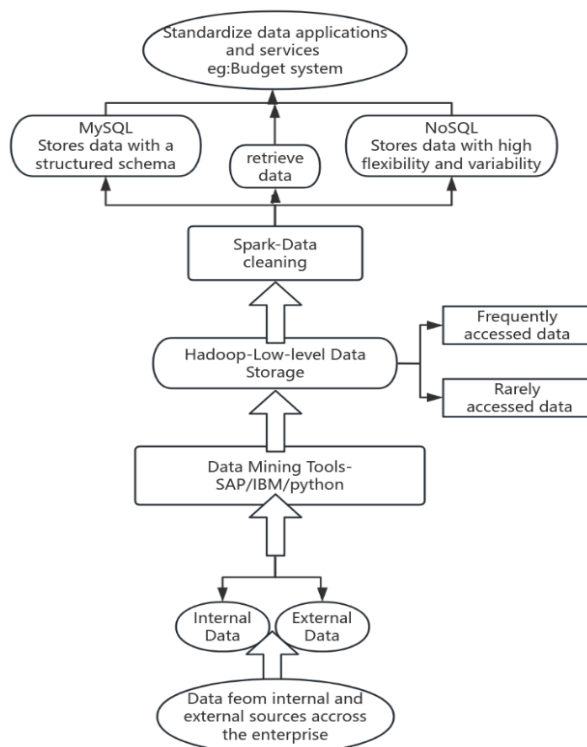


Figure 1. Big data-driven enterprise data architecture for dynamic budgeting

4.2. Enhancing Budget Coordination via Cloud-Based Budget Co-Construction

4.2.1. Cross-Department collaboration: Cloud-based Budget Co-Construction

As the underlying data storage infrastructure within an enterprise, Hadoop enables the collection and integration of information from diverse functional areas—such as marketing, operations, and finance. Its distributed architecture supports the storage of massive datasets and addresses key challenges related to enterprise-wide data consolidation. However, in the daily operations of enterprises, departments often function independently, leading to data silos and inconsistent data definitions. For instance, the finance department primarily deals with quantitative information—such as revenue, expenses, and cash flow—whereas marketing relies on qualitative and semi-structured data, including customer satisfaction scores and survey feedback. Such disparities in data structure and interpretation hinder effective data integration and cross-departmental circulation.

To overcome these obstacles, enterprises can establish a unified data platform based on a cloud-enabled architecture. In this framework, Hadoop serves as the foundational storage layer, retaining raw data from all departments. Spark processes and transforms this data, identifying relationships and converting it into a standardized format. For budgetary coordination, NoSQL databases store the “cleaned” operational data generated by various units, accommodating diverse and semi-structured data formats with high flexibility. The integration of Hadoop, Spark, and NoSQL enables more adaptable data storage solutions while ensuring all departments utilize a common data environment.

Finally, by establishing a unified, cloud-based interface for collaborative budget management, both recent departmental data and historical datasets—used for forecasting—can be retrieved on-demand via APIs and accessed across the organization. This operational data layer facilitates true dynamic budgeting, linking historical trends with real-time inputs to support forward-looking budget design. Moreover, NoSQL’s capability to handle high-concurrency scenarios ensures smooth multi-departmental querying and enhances collaborative budget oversight.

4.2.2. Bridging Data Silos to Enhance Collaboration

As previously noted, functional departments within an enterprise often operate with a high degree of independence. While many organizations structure their budgeting process along departmental lines—which simplifies data collection and reporting—this approach also reinforces organizational silos and inhibits cross-functional collaboration. As a result, data becomes fragmented, formats are inconsistent, and “data islands” emerge. Simply accumulating large volumes of data is insufficient; enterprises must establish a unified, centralized data center according to their specific operational needs. Equally important is the ability of enterprises to effectively utilize this centralized database [1].

When budgeting requires high-concurrency queries with low latency and strong consistency, relying solely on NoSQL may lead to inefficiencies and limited departmental relevance. A more robust approach involves implementing multi-layered, multidimensional analysis on a foundation of shared and centrally managed data [1]. Introducing MySQL into the architecture allows Spark-integrated data to be stored in a structured manner, providing departments with a consistent and reliable data source. This ensures that budget-related queries retrieve structurally uniform data, with all users accessing the same version at any given time—thereby enhancing consistency, traceability, and auditability across the budget cycle. The combined use of Hadoop and MySQL enables enterprises to effectively integrate data where structural consistency and transactional reliability are critical, supporting both analytical flexibility and operational rigor.

4.3. Intelligentization of budget execution and feedback mechanism

Based on the integrated framework proposed above, it becomes evident that all departments can upload data in real time during the budgeting period, while both financial and budget data become accessible on a unified platform. When enterprises proceed to formulate or adjust budgets for subsequent periods, they can draw upon budget data, real-time financial data, and historical data from

comparable stages as foundational data sources. This approach not only enhances the accuracy of budgets but also enables full utilization of diverse big data resources.

Current challenges faced by enterprises—such as fragmented budget data and delayed information feedback—are often caused by insufficient data governance practices [10]. Different organizations have varying needs regarding data application, making it essential to establish a real-time updatable database with high data efficiency. A well-functioning data center must be built upon a reliable enterprise data management system. This highlights the critical role of the database in budgeting, as well as the necessity of establishing a dedicated data management center. Without such a center, budgeting efficiency would be significantly compromised. From the initiation of the budgeting process, continuous monitoring should be implemented. Budget formulation should integrate real-time operational data from each department with internal and external enterprise data. If significant deviations are detected during execution, the responsible department should take immediate corrective measures and conduct in-depth analysis of the variances [1], thereby avoiding budgets that are either overly lax or excessively rigid.

In summary, enterprises can leverage technology to establish a specialized data management center, overseeing the end-to-end process of data collection, analysis, and sharing. Such a center provides critical support for budget formulation and enhances the functional effectiveness of the platform.

4.4. Challenges and risk control in Budget Restructuring

4.4.1. Unequal data quality leads to inaccurate budget

Big data is characterized by its diverse sources and vast volume, which inherently raises concerns regarding data quality. Despite the presence of an underlying platform such as Hadoop—capable of storing massive datasets and integrating formatted data from various departments—the reliability of the data cannot be fully assured. Issues such as duplication, incompleteness, and lack of timeliness may persist in aggregated datasets [2]. If inaccurate or unverified information is used during budget preparation, it may not only fail to enhance budgetary accuracy and efficiency but could also amplify inaccuracies present in the underlying database. This would increase the burden on the budgeting process and lead to significant time inefficiencies. Therefore, in addition to establishing a big data-enabled technical platform, continuous data governance and systematic data management are essential throughout the budgeting process.

4.4.2. The influence of budget decision-makers on the budget

Budgets are often adjusted to be more lenient in response to external risks or internal management shortcomings. It is undeniable that a moderate degree of budgetary slack can, to some extent, serve as a motivational tool—providing employees with attainable targets and reducing excessive pressure [1]. However, such incentives are subject to intentional manipulation, which may lead to resource misallocation and inefficient use of operational variances.

Furthermore, studies indicate that in small and medium-sized enterprises, the demographic and psychological characteristics of key budget decision-makers—such as age, background, and personality—significantly influence the adoption and adaptation of budgeting practices. For instance, open-minded CEOs are more likely to utilize new budgeting tools, while those with higher education levels tend to engage in more sophisticated budget utilization [11]. Therefore, when examining challenges in corporate budgeting, it is essential to look beyond technical or hardware limitations and consider the human behavioral factors at play.

That said, in the big data era, with the support of extensive internal and external datasets and the growing application of AI technologies, the budgeting process can be designed to minimize artificially introduced slack. This enables a more objective and in-depth analysis of budgetary rationality.

4.4.3. Lack of restructuring driving force and talents

An additional challenge lies in the inadequate utilization of enterprise information tools, insufficient understanding of employee concerning big-data-era technologies, and the incomplete restructuring of corporate budgeting systems [1]. The transition toward intelligent budgeting represents an inevitable trend in the big data era. In an age defined by digital transformation, only by embracing data-driven opportunities and modernizing budgetary processes can enterprises fully leverage the potential of their budgeting systems. A critical step in addressing this gap is to help employees recognize the necessity of budget system restructuring and understand its distinctions from traditional budgeting methods, through targeted training and change management initiatives.

Beyond a lack of internal motivation, companies also face a shortage of technical talent. Although the restructuring of budget platforms relies heavily on technology integration, human expertise remains essential for data processing and system coordination—tasks that require a high level of professional knowledge. This shortage of skilled professionals has become a particular pain point for small and medium-sized enterprises [1]. To mitigate talent constraints of enterprises, in addition to upskilling existing finance and operational staff, companies may explore collaborative partnerships with technology platform providers as a viable strategy.

4.4.4. Internal control risks caused by system dependence

In traditional budgeting processes, the segregation of duties is typically achieved by involving personnel from different departments and hierarchical levels, as illustrated by the overall budget management organizational structures found in the literature. Flowcharts often present a vertical budget management relationship, where department heads are responsible for their respective unit's budgets.

However, the introduction of a highly integrated information system, where access is controlled through user accounts, can undermine this principle. The existence of accounts with excessive privileges—capable of both data entry/approval and budget review—compromises the segregation of duties. This creates conditions conducive to undetected errors or fraud, as the system's permission settings may not accurately mirror the enterprise's intended internal controls, thereby introducing significant control risks [12].

Furthermore, budget systems rebuilt on big data are heavily reliant on computational models and automated workflows. Inherent risks arise from potential design flaws or logical errors within these models. A further behavioral risk is that employees, trusting the technology without thinking, may overlook obviously anomalous results generated by the system. The effectiveness of highly integrated systems is also critically dependent on data quality. As noted in the literature, “data quality” is a multi-dimensional concept [13]. Deficiencies in any dimension, such as accuracy or timeliness, will be rapidly amplified throughout the system, leading to widespread inaccuracies if erroneous data is introduced.

5. Conclusion

The traditional budgeting approach relies heavily on tools such as Excel and often employs flexible budgeting methods. In terms of process, individual departments typically formulate their budgets in isolation. This reactive approach risks rendering the budgeting process less meaningful—particularly in the big data era—where traditional budgeting still suffers from limited data collection scope. Without a supporting technological platform, enterprises struggle to respond immediately to changes in market supply and demand or other competitive dynamics.

The advent of cloud accounting and big data is now driving a shift in corporate budgeting from a “formula + experience” model toward a “system + intelligence” paradigm. As the volume and scope of data continue to grow, intelligent budgeting systems are replacing fragmentation and isolation with integration and collaboration. This transformation also promotes the establishment of enterprise-wide data centers that support data-driven decision-making across functions.

This study takes the big data era as its backdrop and adopts the Balanced Scorecard (BSC) as its theoretical foundation, together with a technology stack comprising Hadoop, NoSQL, and MySQL, to explore how enterprises can shift their focus from internal financial data to incorporating both internal and external data sources. The objective is to facilitate data-driven budgeting and enhance cross-departmental synergy—moving beyond traditional top-down or bottom-up approaches to formulate a more comprehensive and integrated budget. This fully realizes the purpose of budgeting: to prepare future action plans numerically and allocate enterprise resources rationally.

The move toward intelligent budgeting offers several key implications for enterprises. First, it is essential to redesign budgeting processes and institutional frameworks in tandem with the adoption of new technologies. The effective use of intelligent platforms requires a targeted data governance system to oversee the entire lifecycle. Second, there is a need to cultivate talent in management accounting, guiding employees to recognize the necessity of intelligent budgeting systems and fostering a culture of using data tools to support decision-making.

For many small and medium-sized enterprises (SMEs), progress in informatization is often restricted by limited funding. While larger enterprises may be more willing to explore platform reconstruction exploiting advanced technology with sufficient financial resources, SMEs can focus more on leveraging relevant policy support and optimizing their budgeting processes within feasible cost boundaries.

This study also suggests that enterprises can build proprietary databases based on their specific data usage patterns and industry characteristics. As data accumulates, subsequent budget formulation will become more efficient, creating valuable “data assets” in the digital era. Furthermore, research could explore differences in the adoption of digital budgeting across enterprises of varying sizes and industries, providing more detailed insights for platform developers and helping organizations identify comprehensive budget management approaches that are suitable for their specific contexts.

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