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Article

A neural network bionic algorithm-based approach to modeling cost and efficiency management behaviors of financial BPOs from a biomechanical perspective

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Abstract: This study integrates principles of biomechanics to develop a neural network-based behavior modeling approach for enhancing cost and efficiency management in financial business process outsourcing (BPO). Drawing inspiration from the adaptive and efficient characteristics of biological systems, we model the financial BPO landscape using neural networks on cloud computing platforms. This approach mirrors the interconnected and dynamic nature of biomechanical networks, enabling proactive adaptation and optimization in financial environments. By utilizing financial SMOTE algorithms and integrating network storage infrastructure, data resources, management platforms, and financial service applications, we construct a comprehensive decision-support architecture. This model achieves a significant reduction in financial costs by 60% and enhances the adaptability and operational efficiency of financial management systems. By conceptualizing financial systems as dynamic, interactive networks, our method provides innovative solutions for mitigating operational risks and enhancing enterprise resilience in competitive markets. The incorporation of biomechanical concepts into financial modeling offers novel insights into optimizing resource allocation and improving system adaptability within complex financial ecosystems.

Keywords: biomechanical modeling; neural networks; financial BPO; cost control; decision-support architecture

1. Introduction

Cloud computing platforms represent a critical direction in the evolution of computer information technology [1]. These platforms rely on advanced data processing technologies to establish efficient and scalable information service ecosystems, enabling the aggregation, analysis, and synthesis of vast amounts of data. In essence, cloud computing functions as a "supercomputing ecosystem" that centralizes resources (e.g., information, processing power, and storage) from diverse devices such as personal computers and mobile phones, allowing them to work synergistically. This ecosystem significantly reduces enterprise IT costs through a pay-as-you-use model, offering public, private, and hybrid financial cloud services, each with distinct advantages and trade-offs [2].

The design and operation of cloud computing platforms are inspired by bionics and biological systems, a discipline that studies the structure and function of biological systems in nature and applies them to the fields of engineering and technology. For example, the construction of honeycomb networks originated from the study of the social behavior of insects, and cloud computing platforms have

characteristics similar to swarm collaboration, such as resource sharing, adaptability, and efficient input processing. Similar to the way cells dynamically allocate resources to maintain homeostasis in the body and respond to external stimuli, cloud platforms optimize resource allocation through intelligent scheduling algorithms to meet computational demands while minimizing operational costs. This optimization process draws on bionic algorithms, particularly adaptive genetic algorithms and ant colony optimization algorithms, to improve computational efficiency.

In addition, the powerful information processing capabilities of cloud computing platforms are highly similar to the workings of cell signaling networks in biomechanics. Biomechanics studies the movement and mechanical properties of living organisms, covering the physical structure and movement patterns from the molecular level to the overall organism. Cloud computing platforms utilize advanced neural networks and deep learning algorithms to aggregate, process, and disseminate information for more efficient data utilization. This process is analogous to how organisms optimize movement patterns through signaling during environmental adaptation, such as how the neuromuscular system adjusts energy distribution to external stimuli.

In this study, a neural network bionic algorithm-based biomechanical behavior modeling approach is proposed for cost and efficiency management of financial business process outsourcing (BPO) using cloud computing platforms. The proposed system incorporates financial SMOTE algorithms, integrated hardware, software, and data resources to construct a financial information architecture grounded in principles of resource optimization and dynamic allocation. From a biomechanical perspective, the cost-control mechanisms implemented in the system parallel the regulation of metabolic pathways in biological systems, where efficiency and adaptability are optimized to maintain systemic balance [3].

The combination of big data and cloud computing has brought about a paradigm shift in financial management, especially in complex environments such as universities. Similar to the integration of cellular subsystems into a cohesive network, cloud platforms enable a unified structure by integrating dispersed data-processing units, which dramatically reduces costs and improves operational efficiency. This resource optimization process is very similar to how biomechanical systems adapt to external changes through energy consumption and resource utilization.

Key innovations of this paper include:

(1) Process Efficiency: Inspired by the optimization of biomechanical metabolic pathways, the adoption of BPO algorithms streamlines routine processes, enabling executives to save time, enhance employee productivity, and improve organizational efficiency.

(2) Data Integration: A financial information-sharing platform, analogous to cellular communication networks, addresses disjointed systems by creating a cohesive framework for financial information exchange, improving accessibility and usability for end users.

(3) Resource Optimization: Combining cloud computing principles, bionic algorithms, and neural network models, the proposed method simulates the dynamic

allocation mechanism of resources in biomechanical systems, ensuring cost efficiency and enhanced performance.

The subsequent sections of this paper explore the architecture of the proposed financial information platform, delve into BPO cost-control strategies, examine the integration of SMOTE algorithms, and provide insights into future directions for financial management under the cloud computing paradigm. By adopting a neural network bionic algorithm-based approach influenced by biomechanical and bionic principles, this study provides a novel theoretical framework to address the financial BPO challenges in the modern digital age.

2. Related work

With the rapid advancements in computer technology, cloud computing platforms have become indispensable tools for enhancing enterprise management. Financial management, as a core component of enterprise operations, plays a vital role in fostering organizational growth and sustainability. However, enterprises often face challenges such as inefficiencies, fragmentation, and a lack of intelligence in traditional financial management systems, which hinder optimal performance and decision-making. Overcoming these challenges is essential for promoting enterprise development in increasingly competitive environments.

Jin highlights the pressing need to improve efficiency in financial management by addressing systemic gaps and inefficiencies within enterprise financial systems [4]. Similarly, Song emphasizes the importance of scientific information services in decision-making, noting their growing relevance across various industries [5]. Fei explores the transformative role of online financial management, which integrates advanced network technology into financial operations such as accounting, analysis, control, and decision-making, paving the way for modern, cloud-enabled financial management models [6]. Seung-Ho identifies informatization and intelligence as the primary focus areas in the current evolution of enterprise financial management, reflecting the increasing reliance on data-driven processes [7]. Furthermore, BU acknowledges the critical role of big data and cloud computing technologies in enhancing enterprise financial management efficiency [8].

Yuan discusses the evolution of financial management objectives in market-driven economies, shifting from “profit maximization” to “enterprise value maximization,” reflecting the broader material capital goals of industrial economies [9]. Jiang emphasizes the importance of integrating theoretical knowledge with practical experience in financial management education to address issues such as investment, financing, and fund management [10]. Li advocates for systematic and effective information processing as a cornerstone for improving decision-making and developing more scientific strategies [11].

For enterprises, particularly large organizations, leveraging cloud computing platforms to analyze, share, and process financial data is critical for strategic decision-making. These platforms provide robust support for formulating and adjusting business initiatives, enabling enterprises to refine internal management practices and optimize resource allocation. By harnessing cloud-based tools, organizations can significantly enhance operational efficiency and agility.

As management reforms progress, financial management is transitioning from traditional, growth-oriented, and accounting-centric models to performance appraisal and decision-making-centric approaches. The integration of emerging technologies such as cloud computing and neural networks is reshaping financial processes, including accounting, fund settlement, and operational workflows. By designing business processes across service, accounting, and management levels, enterprises can achieve cross-departmental and cross-system collaboration. This includes synchronizing workflows, ensuring seamless transitions between key business cycle nodes, and enabling real-time data sharing.

This paradigm shift towards platform-centered financial process models represents a significant advancement in modern financial management practices. Enterprises that adopt these innovative models will be better equipped to enhance adaptability, streamline operations, and achieve sustainable growth in dynamic and competitive markets [12].

As the research of biomechanics and bionics continues to deepen, its related principles have been widely used in several fields with a wide range of application prospects, especially in the medical field [13]. The financial field is also gradually borrowing mechanisms from nature to optimize decision-making, improve efficiency, and reduce risk. Among them, biomechanics, bionics, and bionic algorithms, as important interdisciplinary approaches, are providing innovative solutions for financial modeling, risk management, and resource optimization.

Ye combines biomechanical principles with neural network architecture to propose a novel approach to financial decision-making that provides a more robust and adaptive framework for financial decision-making, leading to improved accuracy, risk management, and responsiveness [14]. Ji predicts stock market financing behaviors by constructing an index of investor sentiment and combining it with a plan recognition model, based on the close connection between biomechanics and emotions, and dissects the biomechanical representations of different emotions of investors and their effects on behavior [15].

Wang designed and optimized a back propagation neural network (BPNN) model based on a bionic algorithm and ant colony algorithm (ACA) of deep learning (DL), and the improved model can optimize the time index of financial engineering to improve the efficiency of financial decision-making [16]. Du proposed a deep learning credit scoring model based on RNN and BRNN, combined with a bionic optimization algorithm to construct an integrated model on three real credit datasets to predict the probability of defaulted or overdue customers, thus realizing effective credit risk management [17]. Lu proposed an improved LSTM neural network for predicting financial time series (FTS), combined with the attention mechanism to improve the prediction effect, which has advantages in nonlinear, nonsmooth, and noisy financial data [18].

The market stability analysis of biomechanics, the financial adaptability research of bionics, and the optimization methods of bionic algorithms all provide new ideas for the development of financial technology. In the future, interdisciplinary integration and AI combination will further promote the deep application of these methods in finance.

3. Financial information platform business process and information platform architecture

3.1. Financial accounting business processes from a biomechanical perspective

First, reimbursement personnel log in to the financial information platform's reimbursement system using their username, password, and e-authentication credentials. They complete the reimbursement form online, upload electronic versions of original vouchers, and submit the reimbursement application. Simultaneously, original vouchers are uniformly organized and coded before being submitted to the Finance Department for review [19]. Once the application is approved, the platform automatically forwards the information to the designated approver based on the relevant department or project. Using e-authentication credentials, the approver verifies their identity and approval authority through the system. After reviewing the application and electronic vouchers, the approver provides digital authorization. Similar to the information transfer and feedback mechanism of the neuromuscular system in living organisms, this process ensures efficient and precise data transfer and real-time regulation among various links.

To support this process, the financial information platform relies on a robust infrastructure layer built on hardware resources such as computing power, storage, and networking. These resources form the foundation for financial software operations. The infrastructure leverages virtualization technologies, including server, storage, and network virtualization, to quantify IT resources and maximize their utilization [20]. Currently, the leasing model is widely adopted, where cloud service providers provide quantitative resources, manage maintenance, and allow users to procure resources on demand. The model allows for real-time scaling of resources, cost reductions, and increased operational flexibility, and its principle of dynamic resource allocation coincides with the principle of biomechanics whereby the organism adaptively adjusts to external loads.

To overcome the challenge of isolated financial data, colleges and universities should establish a cloud data service center centered around the financial department. This center would integrate with other business systems and connect with the information systems of functional departments such as the Academic Affairs Office, Personnel Office, Scientific Research Office, and Logistics Management Office. Adaptable interfaces should also be developed to accommodate advancements in information platform construction. For instance, integrating the cloud data service center with the payroll system on the financial platform can minimize redundancy between departments and mitigate risks associated with manual data entry. Cross-sectoral data linkages are analogous to the synergies between the systems of an organism, enabling the efficient transfer of information and energy.

In the realm of scientific research management, specialized systems handle various stages, including project initiation, approval, implementation, reimbursement, and completion. By linking the scientific research management system to the cloud data service center, funds allocated to each stage are automatically synchronized with the accounting system. This integration ensures

unified fund management, prevents overspending, and reduces the risk of resource misallocation [21,22]. This system-level integration mechanism can be regarded as a biomechanically coordinated movement, in which modules are regulated through mutual collaboration and feedback so that the whole organization, like a body, maintains an optimal state of operation.

This system-level integration not only improves the efficiency and accuracy of financial operations but also simplifies organizational workflows, enabling agencies to allocate resources more efficiently and make data-driven decisions in real time, just as living organisms achieve efficient energy conversion and dynamic balance regulation through complex biomechanical principles.

As shown in **Figure 1**.

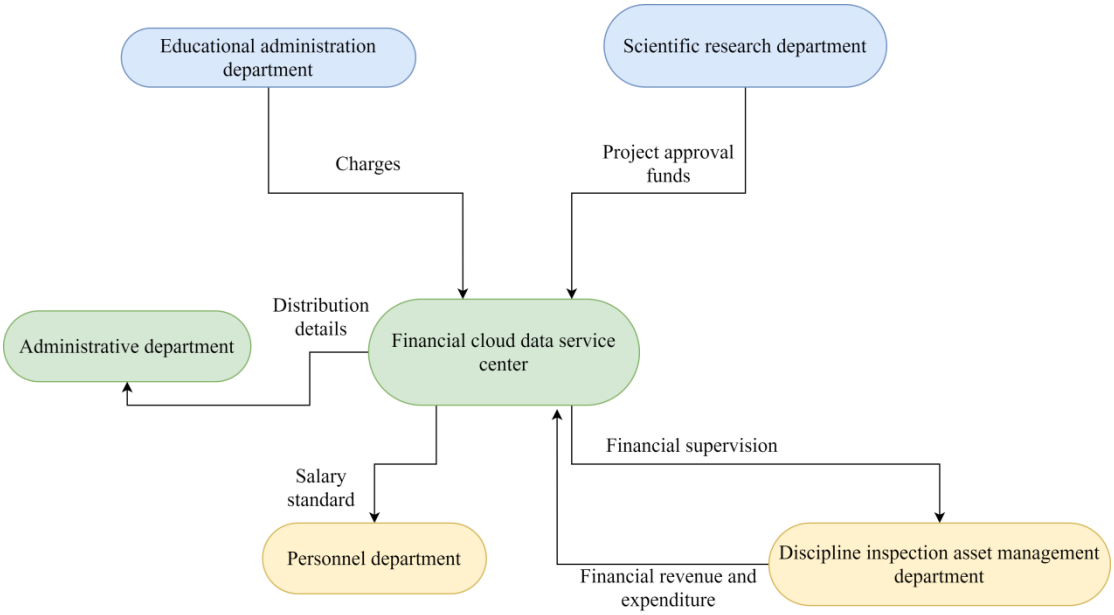

Figure 1. Cloud data service center collaboration with functional departments.

3.2. Cloud computing-based financial information platform architecture and online service model from biomechanical perspective

Based on the principles and characteristics of cloud computing that work similarly to cell signaling networks in biomechanics. IT software and hardware resources provided by service providers are used to access the resource pool through the Internet to obtain the required application services. Based on the service-oriented architecture, the financial data resources and services of colleges and universities are integrated to build a distributed architecture, which provides users with high-speed financial business processing, cloud data access and storage services, and also provides users with a unified communication mode. The financial platform architecture is divided into user layer, software and service layer (Saa S), platform and service layer (Paa S) and infrastructure and service layer (Iaa S). It integrates the existing infrastructure platform with cloud services to realize the unified management, distribution, deployment, and monitoring of hardware resources, software resources, and data resources [23,24]. The financial platform architecture is shown in **Figure 2**.

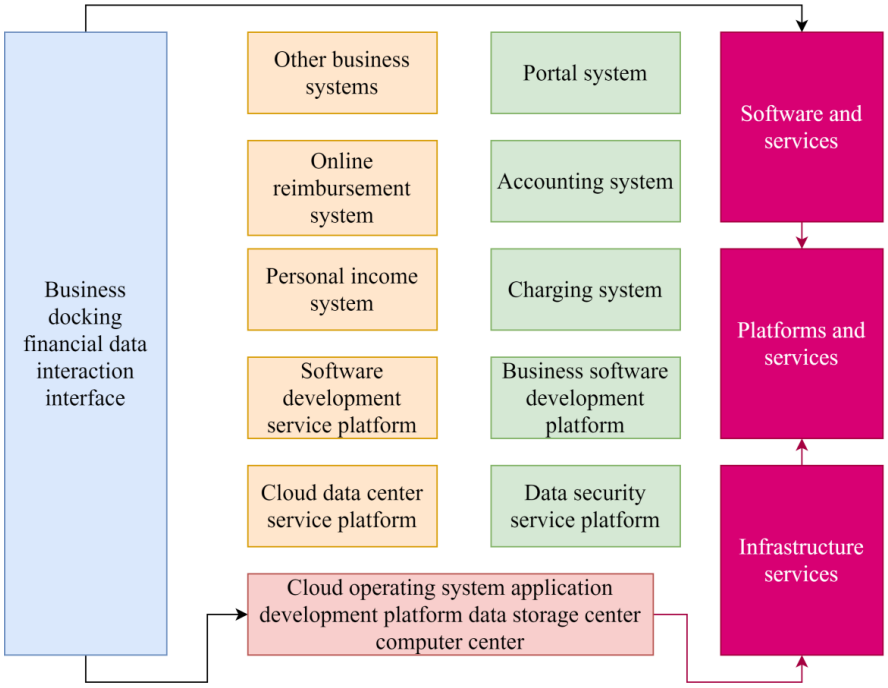

Figure 2. Financial information platform architecture.

The first is the SaaS (Software as a Service) model. SaaS delivers software over the Internet, allowing users to rent web-based software from providers rather than purchasing it outright. This model employs a pay-per-use pricing strategy based on user needs and functionalities, and its operational mechanism is analogous to the receptor-ligand interaction system on the cell membrane. Users are not required to manage software installation, upgrades, or maintenance, as these responsibilities are assumed by the SaaS provider—much like a cell does not autonomously synthesize signaling molecules but rather activates functions via specialized service interfaces. SaaS represents an innovation in financial outsourcing by externalizing software, hardware, and maintenance while enabling enterprises to retain control of their accounts. This approach minimizes the risk of core data leakage. Additionally, it allows real-time access to enterprise financial data, enhancing the synchronization and sharing of information.

The second is the PaaS (Platform as a Service) model. PaaS extends and evolves from SaaS by providing server or development platform environments in the cloud computing era. This model emphasizes customization, allowing users to develop enterprise management software such as CRM, HR, SCM, and invoicing systems using the PaaS platform without requiring programming skills or additional software development tools. The developed outcomes can be deployed immediately; their agility is akin to the dynamic response of cytoskeletal remodeling induced by mechanical stress, thereby facilitating a seamless integration from technical adaptation to functional output.

The dynamic equilibrium mechanism within the cellular microenvironment exhibits a closed-loop feedback characteristic analogous to cloud computing resource scheduling. When the user layer initiates a business request (comparable to a cell receiving external stimuli), the elastic resource pool at the software service

layer (SaaS) triggers an adaptive response in the platform layer (PaaS) middleware via API interfaces (similar to the second messenger system). Ultimately, the infrastructure layer (IaaS) facilitates the targeted allocation of storage and computing power. This hierarchical propagation mechanism is structurally homologous to the stepwise amplification observed in the MAPK signaling pathway.

Self-service development of financial software on enterprise PaaS platforms offers a cost-effective approach to financial informatization. Enterprises benefit from low investment and implementation costs, as there is no need to purchase separate servers or software. The testing environment for financial software development is hosted on the cloud platform. Since internal processes and permission configurations vary among enterprises, PaaS platforms enable business personnel to design and implement customized solutions tailored to their specific needs.

PaaS platform development of financial software has low technical requirements for developers, making it an ideal solution for small and medium-sized enterprises facing shortages of skilled professionals [23].

As shown in **Figure 3**.

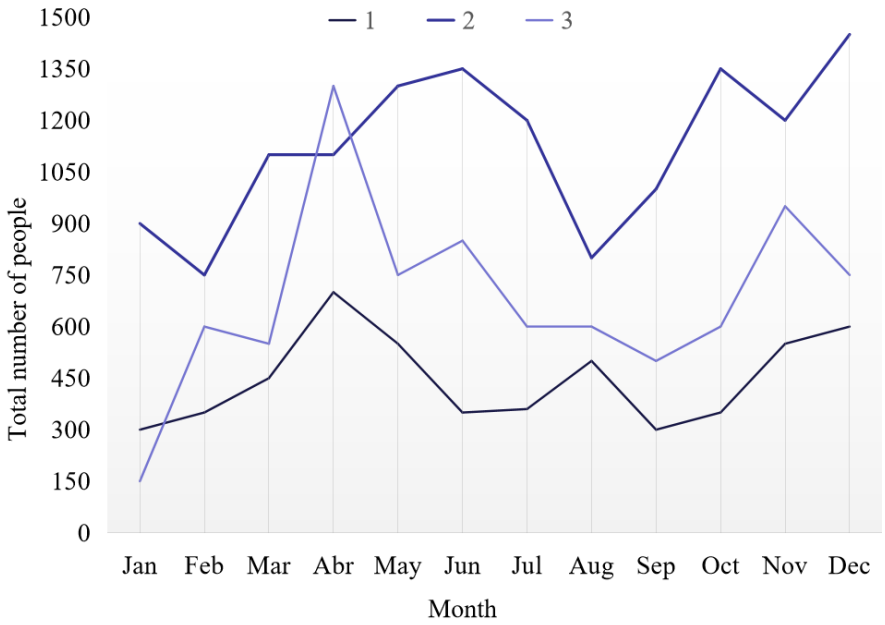

Figure 3. Growth in the number of enterprises.

In the overall design and optimization of enterprise financial management models, effective control of accounting costs not only enables comprehensive management and oversight of market operations—analogous to the dynamic equilibrium maintained among various systems in a living organism through biomechanical principles—but also helps avoid unnecessary expenditures during market expansion. Moreover, by drawing on the collaborative functioning of various organs in the organism, enterprises can fully integrate internal financial resources and make rational adjustments by controlling accounting costs and refining their financial management systems. This approach results in cost savings in market operations, enhanced operational efficiency, and ultimately, an overall improvement

in market competitiveness, thereby fostering healthy and sustainable corporate development.

In this respect, data standardization is to scale the data proportionally to make it fall into a small specific interval. The general purpose is to remove the unit limit of the data and transform it into dimensionless pure values so that indicators of different units or magnitudes can be compared and weighted. In practical research, we often encounter data sets with different data characteristics, which often have different distribution patterns and intervals and different orders of magnitude. For example, the change of data in tens of thousands is more significant than that in single digits, but it is of little significance. Data standardization exists to eliminate the influence of scale, characteristics, and distribution differences on the model. At present, there are three ways of data standardization: *Z*-standardization, min-max normalization, and maximum absolute value normalization. In this study, the more commonly used *Z*-score standardization method is adopted, which is based on the mean and standard deviation of the original data. The formula is

$$Z = \frac{x_2 - u}{a} \tag{1}$$

$$U = \frac{1}{n}\sum im\, xi, a = \sqrt{\frac{1}{n}\sum m = i(xi - u)^2} \tag{2}$$

The new data set Z is a data set with a mean of 0 and a variance of 1. Where z is the converted data and x is the original data, which is the average value of the whole group of data. However, there are two different ways to standardize the processing of training sets and test sets. One is to standardize the whole data and then divide the training sets and test sets; the other is to distinguish the test sets from the training sets and then standardize the training sets and then apply the rules to the test sets. Here, the author thinks that the second standardized treatment is more appropriate, and adopting the standardized rules of the training set is more in line with scientific logic. The formula is as follows.

$$Z_{\text{new}} = x_i + (x - x_i) \times i \tag{3}$$

Under the effect of accounting cost control, enterprise managers can comprehensively optimize the financial management mode, and at the same time, with the help of financial management, they can provide various data information for future development decisions for enterprise management, at the same time, position the future development goals of enterprises, realize the comprehensive optimization and innovation of enterprise financial management mode, and avoid the problems existing in enterprise financial management in time, which has played a certain role in promoting the sample to solve the related problems of enterprise internal financial management and formulate the financial management implementation plan. The sample matrix F is the data set of the k-means clustering algorithm, and the clustering number is set to 6. In order to classify and explore the overall financial situation and characteristics of similar listed companies, optimize enterprise resource allocation, and make reasonable decisions and arrangements for future strategic development planning, six cluster centers are randomly selected. A=$\{a_1, a_2, \ldots, a_3\}$,

in analyzing the company's financial status data, the objective function of the clustering algorithm is expressed by Ln, and the formula is.

$$L = \sum \min\{x - a\} \tag{4}$$

$$a = \frac{1}{A}\sum_{x}^{2} x2 \tag{5}$$

4. Financial BPO cost control

Business process outsourcing, a subset of outsourcing, involves contracting specific business process operations and responsibilities to third-party service providers. At first, manufacturing enterprises are particularly inclined to choose outsourcing business processing. For example, Coca-Cola Company outsourced most of its supply chain management business modules to BPO. BPO is usually divided into two categories: Back-office BPO outsourcing, including the outsourcing of business of enterprise functional departments, such as financial accounting, procurement and human resources BPO outsourcing; Front-office BPO outsourcing, including customer service and other service outsourcing, such as sales or IT technical support. BPO can also be divided into the following three categories according to the region where outsourcing service providers are located: Offshore BPO outsourcing refers to BPO cooperative outsourcing projects signed outside the company; Near-shore BPO outsourcing refers to the outsourcing projects that conclude BPO contracts with the company's neighboring (or nearby) countries; Onshore BPO outsourcing refers to the outsourcing of BPO to domestic contractors. The reason why the world has become a gathering place for outsourcing. BPO and biomechanics share notable similarities in optimizing overall system performance. Biomechanics examines how various organs within a biological organism achieve efficient coordination and dynamic equilibrium through mechanical principles, thereby ensuring optimal functionality. In contrast, BPO involves outsourcing non-core business processes to specialized entities to enable rational resource allocation and process optimization, which in turn enhances operational efficiency and competitiveness. Both approaches emphasize the coordinated interaction and adaptive regulation among their constituent components to maximize overall effectiveness.

Generally speaking, BPO means that enterprises outsource some repetitive core or non-core business processes to professional outsourcing service companies to reduce costs and improve service quality. Financial BPO outsourcing has already become an important auxiliary means for many large multinational enterprises in the world to conduct financial management. The research shows that the Asia-Pacific region has strong market potential because the rapid growth of information technology in these regions, coupled with the current development of telecommunications technology and credit management, also provides a great expansion scale for the financial BPO outsourcing business. To undertake the financial BPO mentioned above can achieve cost control and an economical

management mechanism, so the places where BPO outsourcing global services are undertaken are listed in **Table 1**.

Table 1. Global BPO service undertaking cluster.

Variable		**The Asian-Pacific region**		**Central and eastern Europe**	
Main undertaking place	International low cost Finance IT	Ukraine	International undertaking	Brazil	Latin America
Newly-accepted land		Slovenia		United States of America	
Service area		Euro-market		North America	
Undertaking reason		Good language skills		Spain	
Outsourcing content		Technical service		Business process outsourcing	

Although financial BPO outsourcing originally came from the mature commercial financial management model in Europe and America, this model has grown rapidly. Foreign-funded enterprises such as IBM, HP, Pfizer, Hitachi, Nissan, and Merck have set up corresponding financial BPO or SSC (Shared Service Center) outsourcing contractors. Nowadays, many local international enterprises are inclined to the BPO financial outsourcing management mode. It is believed that in the tide of economic globalization, BPO financial outsourcing will become an inevitable trend in the future financial management activities of enterprises. As shown in **Figure 4**.

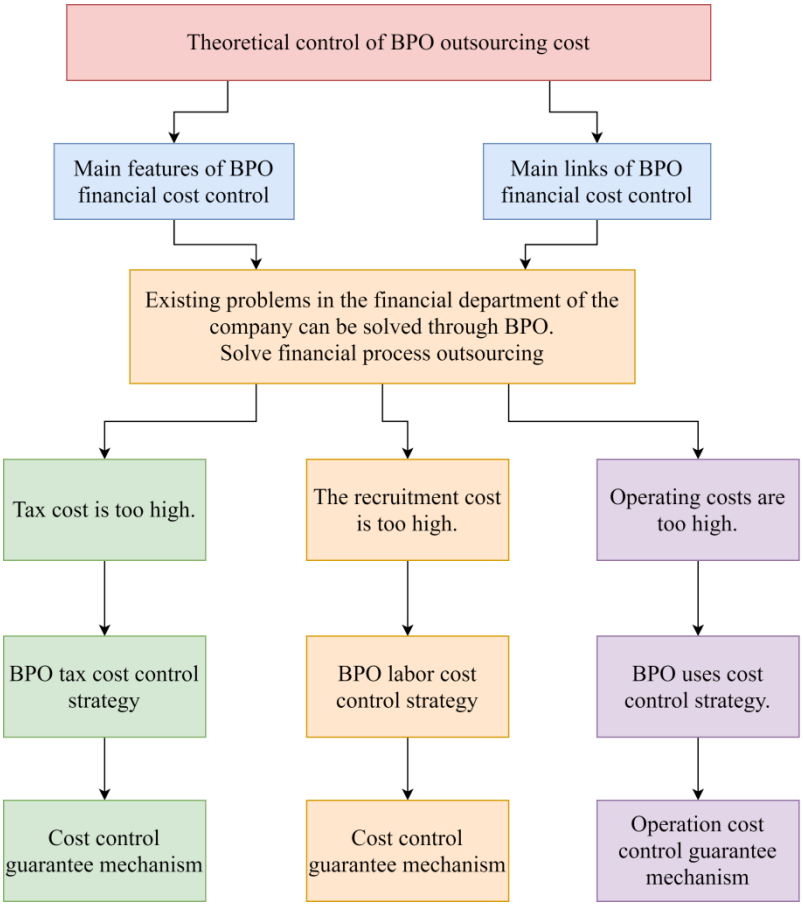

Figure 4. BPO trend.

From the figure, it is evident from external reviews that the era of Business Process Outsourcing (BPO) has firmly arrived. As more enterprises recognize the advantages of outsourcing business processes, the BPO industry has transcended its original scope of services and professional information consultation. Effective financial BPO outsourcing is no longer just about delegating processes; it now involves restructuring and improving the client companies' business processes. When implemented successfully, financial BPO outsourcing can enhance a company's value, reduce costs, and improve overall management efficiency. By adopting BPO outsourcing, enterprises can significantly lower their management and operational costs. In today's competitive market, focusing on core business functions has become a vital survival strategy for enterprises.

Currently, the BPO outsourcing industry is in a growth phase, bringing challenges related to scaling and competition among developing countries. A critical component of financial cost control in BPO involves gradually outsourcing basic and low-risk processes. Selecting professional, cooperative teams for process transfers and refining the division of labor within financial operations are essential. By dividing traditional financial workflows into specific modules that BPO companies manage, enterprises can increase the speed of business processing, standardize management, and better handle business expansions.

The implementation of financial business process outsourcing (BPO) projects involves three key cost control strategies that bear significant resemblance to the principles of system optimization and resource allocation in biomechanics. Just as living organisms maintain overall health and optimal function by coordinating the operation of various organs and effectively distributing energy, BPO enhances financial management efficiency by streamlining redundant positions, optimizing workflows, and allocating resources efficiently.

(1) Tax Cost Control Strategy: Analogous to the regulation of metabolic processes in living organisms, financial BPO reduces tax costs by streamlining redundant roles and optimizing tax workflows to mitigate penalties resulting from insufficient tax expertise. Standardizing tax procedures functions similarly to biological feedback mechanisms that minimize inefficiencies, ensuring compliance and bolstering core business management capabilities. Furthermore, outsourcing financial processes helps optimize organizational structure and improve overall work efficiency, forming a streamlined and effective "team" akin to the coordinated organ systems in a biological entity.

(2) Operational Cost Control Strategy: In biomechanics, the synergistic interaction among various systems and the effective transmission of information are critical for optimal performance. Similarly, BPO refines business process standards and establishes professional operational management procedures, promoting the specialization and systematization of financial workflows. This process-oriented management approach effectively reduces operational costs, much like how fine-tuned regulation and rational resource allocation optimize overall efficiency in biological systems.

(3) Process Standardization and Risk Management: The adaptive capacity of living organisms allows them to fine-tune and optimize physiological responses to external changes. In the context of financial BPO, standardizing processes such as

invoice issuance and payment workflows reduces the risks associated with unprocessed transactions and extended billing cycles. Post-outsourcing, clearer delineation of responsibilities and streamlined division of labor further enhance process efficiency and organizational responsiveness.

Through financial BPO, enterprises can self-regulate and adapt similarly to biological systems, optimizing resource allocation and enhancing overall system performance. These cost control strategies contribute to the establishment of robust management mechanisms while simultaneously improving operational efficiency and market competitiveness, paralleling the optimization mechanisms observed in biomechanics. The benefits of tax cost reductions achieved through financial BPO outsourcing are illustrated in **Figure 5**.

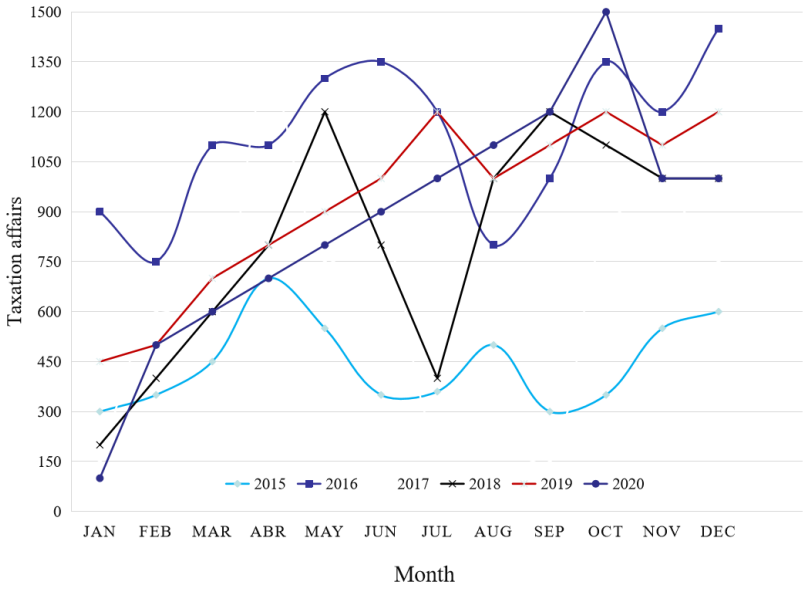

Figure 5. Tax data.

The data utilized in this analysis is sourced entirely from the company's internal records and database, ensuring accuracy and relevance. These strategies demonstrate how financial BPO outsourcing can help enterprises achieve robust cost control mechanisms while improving operational efficiency and positioning themselves competitively in the market.

Here, it's not that BPO financial outsourcing will not generate transaction costs, but it can reduce the tax risk cost and avoid the improper employment of people. Therefore, if the tax-related process business is outsourced, the company can control the tax cost well, pay taxes on time, and avoid the generation of fines and the collection of tax late fees. After signing the contract with the company's financial BPO outsourcing company, both parties have reached a consensus on the standard work flow of tax receipts and implemented it: The financial BPO outsourcing contractor is guaranteed to complete the entry of invoices within three days from the date when it receives the original or duplicate invoices mailed or scanned by the company's finance department to the BPO company. If you encounter invoices with questions to be asked and clarified, you should sort out the list, document records, and track them. In principle, it is required that at the end of each month, there should

be no unfinished VAT input tax deduction of the remaining bills, and the bookkeeping and tax payment and deduction should be completed on time. After signing the contract with the BPO outsourcing company, at the proposal of the BPO outsourcing company, the company's financial system set the payment period, re-strengthened the payment business execution standard, and better implemented the BPO tax cost control as shown in **Table 2**.

Table 2. BPO tax cost control.

Items of taxation	Payment request	Audit supervision
Value-added tax	Timely tax receipt	15th of every month
Additional tax	Pay taxes on time	20th of every month
Income tax	Personal application and income tax declaration	Quarterly declaration and payment

Through the above table, it can be found that after the financial BPO outsourcing work, the company successfully controlled the operating costs. In order to show the results more intuitively, **Figure 6** shows the analysis and comparison of operating costs in recent years:

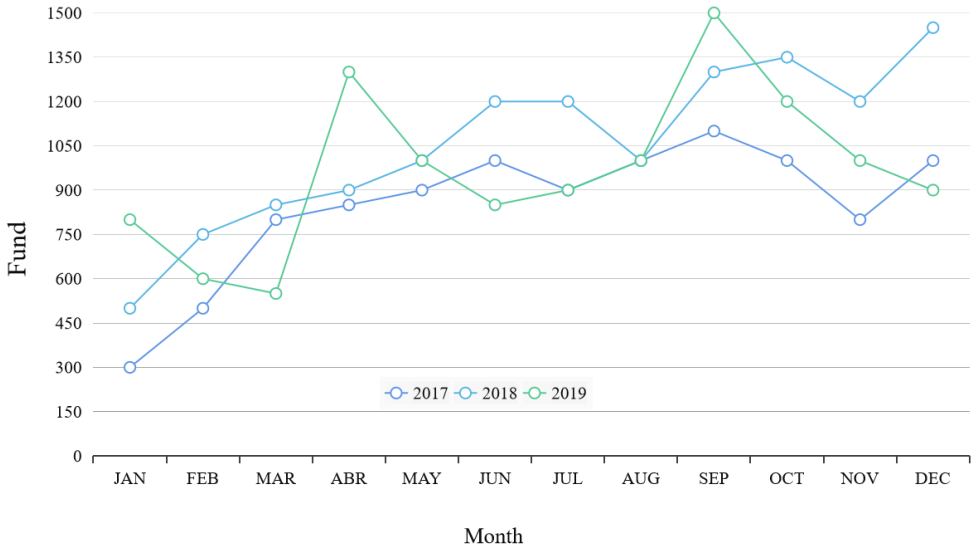

Figure 6. Comparison of operating costs.

According to the existing BPO outsourcing contract, in principle, the service consulting fee will be increased for every year of service provided by the outsourcer, and the outsourcing cost of the enterprise will also increase. In order for BPO outsourcing business to serve enterprises more effectively, enterprises can achieve sustainable cost reduction by stipulating in the contract that the service fee of BPO outsourcing service providers will be refunded in full every year. As shown in **Figure 7**, the cost has decreased in recent months.

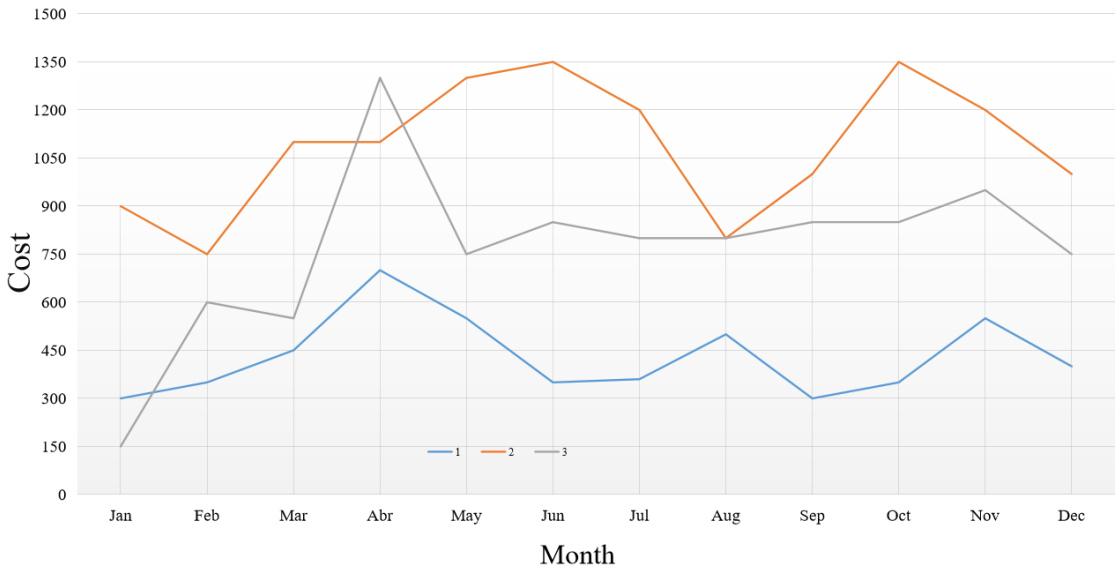

Figure 7. Cost reduction.

The research shows that the most effective way to reduce the labor cost is to get the highest operational performance with the fewest staff. The feasible methods include simplifying organizational structure, streamlining staff, strengthening professional training, simplifying and optimizing working procedures and strengthening overtime control. According to the financial BPO development results published by some survey companies, the method of value analysis can better redistribute the human resources of the company. As shown in **Figure 8**, the labor cost is reduced.

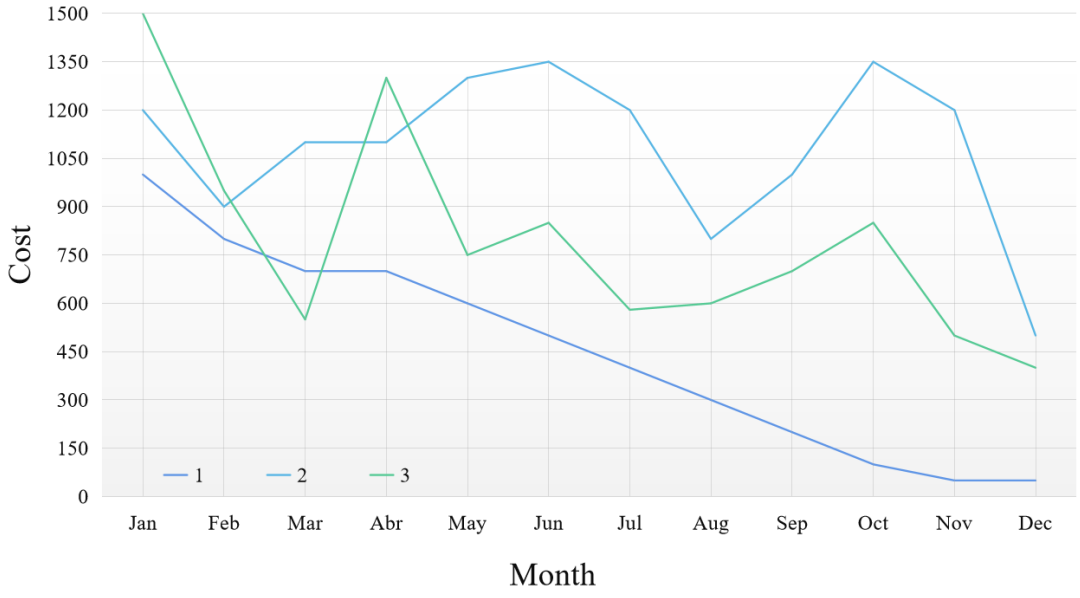

Figure 8. Labor cost reduction.

5. SMOTE algorithm

How to define the financial crisis is a controversial issue, and academic circles have different opinions on the definition of the financial crisis. Some researchers

believe that the financial crisis occurs when an enterprise faces the problem of insolvency, while some scholars believe that it is the financial crisis of an enterprise when it faces the risk of delisting due to its poor management. This paper is more in favor of the second view, that is, the financial problem exists when the enterprise's operation is damaged and its development is doubtful.

SMOTE (Synthetic Minority Over-sampling Technique) is an enhanced over-sampling algorithm that generates new minority class samples through random sampling to mitigate class imbalance issues. Its design is inspired by processes used to address challenges in biomechanics. When processing mammography images, Nitesh Chawla needed to develop a binary classifier to categorize pixels as either normal or cancerous; however, due to a severe imbalance in sample quantities, he introduced the SMOTE algorithm to improve the model's ability to identify the minority class [25]. This method also exemplifies the principles of self-repair and dynamic equilibrium inherent in biomechanics. If there is a serious imbalance in the sample data, that is, when the positive sample is much larger than the negative sample, the model will be fitted to the side with more samples, and the predicted conclusion will often be biased. However, in ordinary research, unbalanced data is more common than balanced data.

In order to solve the problem of data imbalance, the theory of sampling data, that is, the oversampling technique of synthesizing a few classes, is an improved scheme based on a random oversampling algorithm. First, select a sample from a few kinds of samples X_iO. Secondly, according to the sampling ratio n, randomly select n samples from the k nearest neighbors of X_i. $X_{z_i}O$ Finally, in turn X_{zi} and X_i Randomly synthesize new samples, and the synthesis formula is as follows:

$$X_N = X_{I+} = \beta \times (X_{ZI} - X_I) \tag{6}$$

The overall accuracy rate is the ratio of the number of correctly predicted samples in all samples. This value measures the overall prediction rate of the model. However, in extreme cases, such as the imbalance between correct and incorrect samples, and all the models predict correctly, the overall sample accuracy rate will also be higher, but the model has no actual effect. Therefore, it needs to be judged in combination with other indicators. The accuracy rate calculation formula is:

$$Percision = \frac{TP}{TP + FP} \tag{7}$$

$$ACC = \frac{TP + TN}{TP + TN + FP + FN} \tag{8}$$

On the other hand, there is no non-ST enterprise judged as a financial crisis in this model; that is, the enterprise judged by the model that may have a financial crisis has a great probability of a financial crisis, and the formula is as follows:

$$RECALL = \frac{TP}{TP + FN} \tag{9}$$

$$F1 = \frac{2 \times PR + CA}{PE + CI + SION} \tag{10}$$

Generally speaking, there are sampling methods, data synthesis methods, and weighting methods to deal with unbalanced data in applied statistics. Because random oversampling adopts the strategy of simply copying samples to increase a few kinds of samples, it is easy to cause the problem of model overfitting, even if the information learned by the model is too special to be generalized. The data synthesis method selected in this paper is the SMOTE algorithm. SMOTE's method is to use the existing samples to generate more samples according to the algorithm.

6. Cloud computing financial management

Under the traditional financial management model, seamless collaboration between financial operations and business activities is challenged by the lack of support from computer networks and the principles of biomechanics and bionics. Online financial management, however, has transformed this dynamic, enabling integrated collaboration across a broader scope of corporate functions. This integration extends beyond internal operations and supply chain management to include interactions with external social departments, such as online auditing, tax filing, and online banking. Drawing on insights from bionics into the optimization of the structure and function of living organisms, the shift requires finance staff to act like highly efficient neural networks within living organisms, providing timely processing and feedback on activities across departments, branches, and business nodes involving customers and suppliers, including supply, production, sales, control, and forecasting.

To achieve this seamless integration, enterprise financial personnel must not only manage internal financial processes but also coordinate the financial relationships between their company and external organizations. Strengthening advanced cloud infrastructure is a critical enabler for this level of collaboration. However, many IT vendors face challenges related to capital and technical expertise. To address these challenges, governments can play a pivotal role in promoting cross-industry resource integration, pooling expertise and resources to accelerate the development of cloud computing platforms. Initiatives such as a "Cloud Computing Platform Demonstration Project" can stimulate investment in cloud infrastructure, encourage IT vendors to build advanced platforms, and reduce the risks associated with cloud computing development.

One effective approach for enterprises is the development of customized "private" cloud services. This model allows businesses to rent cloud computing platforms based on their needs, enabling them to develop their own applications using supported programming languages and tools, which can then be deployed on these platforms. This flexibility helps companies meet their individual needs and adapt their financial information systems to changing business conditions by introducing interdisciplinary theories such as biomechanics and bionics. Online financial management represents an evolution of traditional practices, combining core financial principles with innovations tailored to the modern, networked environment. With the rise of cloud computing—particularly SaaS and PaaS models—financial management has entered a new phase of development [26].

Looking ahead, the success of intelligent financial management terminals will heavily depend on the information literacy of employees. Enterprises must prioritize the improvement of employee competence in smart financial management, starting with a change in mindset and conceptual innovation by combining interdisciplinary theories such as biomechanics and bionics. Enhancing employees' understanding of cloud platforms and intelligent financial tools will require robust training programs and skill development initiatives. By integrating employee training, skill enhancement, and performance appraisal into their human resource management systems, enterprises can foster a workforce capable of maximizing the functionality of cloud computing platforms.

However, a persistent shortage of qualified financial management professionals often limits the effectiveness of these initiatives. In some enterprises, inconsistent training programs and underdeveloped employee development efforts exacerbate this gap. Additionally, a lack of integrity and professionalism among financial staff may hinder progress in adopting advanced financial management practices. Addressing these challenges requires enterprises to implement targeted employee training programs and ensure consistent professional development opportunities. Enhancing the intellectual capacity of financial management systems should be a priority, supported by initiatives to improve integrity and professionalism among financial management staff [27].

By investing in employee training and upgrading human resource systems, enterprises can ensure that cloud computing platforms are effectively utilized to meet evolving financial management needs. This biomechanical, bionic-based approach will help bridge the gap between technological advances and human resource capabilities, enabling companies to thrive in a digitally driven financial environment.

7. Conclusion

The advancement of any field follows a step-by-step process, and online financial management is no exception. Biomechanical principles, the introduction of bionic algorithms, big data, and cloud computing technologies have revolutionized financial management, especially within academic institutions such as universities. These technologies provide powerful tools for financial data mining and analysis, facilitating real-time sharing and synchronization of financial information. Consequently, they significantly reduce information processing costs and greatly enhance the efficiency and effectiveness of financial management. To remain competitive, colleges and universities should proactively adopt these innovative technologies to improve their management capabilities and operational efficiency, enabling better allocation and utilization of financial resources.

Similarly, enterprises facing intense market competition must prioritize the optimization and innovation of their financial management models. This entails actively controlling costs in alignment with accounting principles and tailoring financial strategies to their specific development needs. The method proposed in this paper, through the integration of biomechanical principles and neural network applications, not only increased financial management efficiency by 60% but also provided significant insights for strategic market decision-making. Moreover, the

utilization of bionic algorithms, designed based on biomechanical concepts, further reinforced the dynamic adaptability of the financial system, ensuring that enterprises can respond flexibly to complex market environments.

By embracing modern technologies and refining financial management practices, both academic institutions and enterprises can effectively respond to evolving market demands. This approach ensures robust resource management, strategic decision-making, and long-term competitiveness in an increasingly digital and data-driven environment.

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