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Research on Governance Mechanisms and Supply Chain Efficiency Optimization of the Smart Home Enterprise Ecological Collaboration Platform

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Abstract: This paper focuses on the core challenges of the smart home enterprise ecological collaboration platform, and deeply discusses the absence of a governance mechanism and the inefficiency of the supply chain. The purpose is to improve the overall efficiency by constructing an effective collaborative governance framework and optimizing the supply chain process. It is found that the implementation of multi-agent dynamic contract governance, the construction of an open data sharing middle platform, the introduction of AI-driven elastic supply chain planning, and the establishment of a distributed cloud manufacturing network are the key paths. From the research conclusion, these measures can significantly improve the transparency of cross-agent collaboration, break the data barriers, and achieve the accurate matching of supply and demand, and finally promote the ecological collaboration efficiency of the smart home industry to achieve a substantial leap.

Keywords: Smart home; Ecological collaboration platform; Governance mechanism; Supply chain efficiency; Optimization research

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1. Introduction

Smart home (home automation) is a residential platform that integrates wiring technology, network communication, security systems, automatic control, and audio-visual technologies to unify all home-related facilities. It aims to establish an efficient residential infrastructure and family agenda management system, enhancing home security, convenience, comfort, and aesthetics. Additionally, it promotes an environmentally friendly and energy-saving living environment. However, the effective collaboration between brands, suppliers, and service providers has fallen into a dilemma. The governance rules and the responsibilities of each party are unclear, the data is in an island state, and there are differences in technical standards, which further hinder the smooth flow of information. Exploring and solving the governance mechanism and supply chain efficiency

bottlenecks in the ecological collaboration platform has urgent practical significance for releasing the collaborative potential of the smart home industry and building an agile and efficient value network.

2. Theoretical basis of governance mechanism and supply chain management of ecological collaboration platform

2.1. Theoretical framework of platform governance

In the development of a smart home ecological collaborative platform, the exquisite design of the rule system guides the consistency of the behavior of various participants and reduces potential friction by constructing unified behavioral norms and interaction standards. Its systematic basis then facilitates the realization of the power and responsibility allocation mechanism, which carefully divides the power boundaries and responsibility categories of platform owners, suppliers, and users, to ensure the predictability and collaborative stability of the actions of all parties. On this basis, the benefit distribution scheme encourages resource exchange and value sharing through a fair incentive mechanism. For example, in the process of supply chain integration in the field of smart home, the key elements are described in detail.

Table 1. Key component dimensions of the governance framework of the ecological collaborative platform

Governance dimensions	Description of innovation function	Impact of supply chain optimization
Rule system construction	Establish a pre-specification based on intelligent algorithm to regulate the interaction mode of participants	Improve the transparency of order execution and reduce the risk of information asymmetry
Power and responsibility allocation mechanism	The responsibility module was dynamically allocated, and the smart contract right confirmation mode was integrated	The response delay was shortened and the responsiveness of cooperative decision-making was strengthened
Benefit distribution scheme	A multi-dimensional value sharing model was introduced to balance ecological profit and loss sharing	Resource sharing was encouraged to reduce inventory overstocking and cost redundancy

2.2. Evaluation dimensions of collaborative efficiency

When evaluating the operational effectiveness of smart home ecological collaboration platforms, collaboration efficiency constitutes a key measurement metric. Its meaning focuses on the overall ability of the platform to integrate multi-party resources and drive value flow. Specifically, it can be broken down into three interrelated and mutually reinforcing observation dimensions (as shown in **Table 2**). The response speed profoundly reflects the agility of the whole chain from information perception to decision-making conduction to service delivery in the face of terminal market demand fluctuations or emergencies, which is the immediate pulse of ecological health. Inventory turnover rate reveals the smoothness and economy of the flow of raw materials, work-in-process, and finished products in the complex collaboration network. Efficient turnover means the reduction of resource occupancy cost and the release of capital vitality [1]. Resource integration measures the degree to which the platform breaks traditional enterprise boundaries and connects decentralized capability units such as design, manufacturing, logistics, and service. High-level integration is represented by the seamless connection of cross-subject resource on-demand call and complementary advantages, and its multilateral network coupling strength directly shapes the overall resilience of the platform.

Table 2. Innovation analysis of the smart home ecological collaboration platform efficiency observation dimension

Observation dimension	Connotation extension	Ecological synergy value orientation	Analysis of innovation
Speed of response	The timeliness and accuracy of the ecological network for the closed loop of the demand signal from perception, decision to action	Market adaptability and instant guarantee of consumer satisfaction	Niche sensitivity coefficient
Inventory turnover	The economic efficiency and time and space optimization level of the movement of materials and products in cross-agent supply chain networks	Capital efficiency, operating cost optimization, risk buffer capacity	Dynamic balance coefficient
Degree of resource integration	The platform solves organizational barriers and promotes the depth of on-demand combination and collaborative innovation of heterogeneous capabilities such as design, manufacturing, and service	Economies of scope, emergence of innovation capabilities, and system resilience	Multilateral network coupling strength

3. Problems faced by smart home ecological collaboration platform

3.1. The absence of a cross-subject collaborative governance mechanism

Multiple types of agents, including brand owners, hardware suppliers, and service integrators, constitute a complex collaboration network. There is still room for improvement in the fine definition of the role positioning of each party. Such an inaccurate definition of rights and responsibilities can easily lead to functional overlap or responsibility vacuum in the process of business connection.

3.2. Data islands and technical standard barriers

The lack of a unified technical language between heterogeneous systems poses deep challenges. The independent technical routes of brands lead to natural barriers in product interconnection. The differentiated design of communication protocols is like an invisible digital tower of Babe, which hinders the smooth dialogue ability between devices and makes it difficult to truly achieve the seamless scene linkage expected by users. Data assets are imprisoned in an independent ecosystem due to insufficient system compatibility, cross-platform information flow is interrupted physically, a complete user behavior portrait and device running state cannot be effectively mapped in each link of the industrial chain, and the value mining chain is broken at key nodes.

3.3. Distortion of demand forecast and inventory imbalance

There is a natural hysteresis and asymmetry in the information transmission among the participants of the platform, and it is difficult for upstream manufacturers to capture the subtle changes in the terminal market in real time. Sales data provided by retailers is often lagging and fragmented, resulting in a lack of sensitivity in production plan adjustment. Long-tail products with frequent demand fluctuations are especially faced with forecasting difficulties. Their sales trajectories lack regularity, and it is difficult for the platform to establish accurate data models.

3.4. Sluggish response cycle of customized production

In the process of transformation from traditional large-scale manufacturing mode to customization, the complexity

of multi-node collaboration leads to the consumption of time factors when order information is transmitted among brand owners, designers, parts suppliers, and production units, and there is a natural rhythm difference in the chain from demand instructions to production instructions [2]. The structural mismatch of flexible production capacity makes it difficult for small batch orders to quickly integrate into the existing scheduling system. The coordination gap between the procurement cycle of special components and the inventory strategy of general parts objectively prolongs the preparation stage, and the scheduling of manufacturing resources shows the characteristics of local optimization and global fragmentation.

4. The governance mechanism of the ecological collaborative platform and the core measures of supply chain efficiency optimization

4.1. Multi-subject dynamic contract governance system

The multi-subject dynamic contract governance system clearly defines the function of the platform party's overall data center through the list of rights and responsibilities. The manufacturing enterprise bears the main responsibility for capacity flexibility adjustment, and the sales terminal needs to perform the obligation of real-time market information feedback. The system takes the risk-sharing mechanism as the core to construct the capital pool operation mode. When the inventory of long-tail products is overloaded, the three parties share the storage cost according to the preset proportion, and jointly inject capital to start the emergency supply chain response procedure in the face of a sudden shortage of explosive products. The contract clause sets a dynamic adjustment window period and recalibrates the responsibility boundary every quarter according to the sales fluctuation coefficient and inventory turnover efficiency index. For example, the manufacturing enterprise can apply to reduce the short-term inventory responsibility proportion in the new product launch cycle, and the sales terminal needs to improve the accuracy of demand forecast data and bear the corresponding deviation risk in the promotion season. Ping island continuously optimizes its intelligent algorithms, using blockchain technology to solidify each operational link. When delays in raw material procurement cause disruptions in production, an automatic responsibility traceability process is triggered. Based on an accrual list, an executable loss compensation scheme is generated, enabling the entire supply chain to possess self-repair capabilities.

4.2. Open data sharing middle office building

The platform operator takes the lead in establishing a unified API interaction specification, which covers core data field definitions and transmission protocols such as device status collection, user preference analysis, and production instruction transmission, so that intelligent gateways of different brands can interpret heterogeneous device information flow in standardized languages. The infrastructure layer is compatible with data access of multiple communication protocols. The service layer encapsulates public algorithm modules such as user portrait generation and production capacity prediction. The blockchain certificate storage mechanism is embedded in key data flow nodes, and the full link operation traces from raw material purchase order generation to terminal installation completion are generated into an immutable distributed ledger. Participants must comply with the certificate storage rules when they obtain data call permissions. The access enterprise obtains a real-time capacity map and regional inventory distribution through the authorization key. The parts supplier can adjust the stock plan according to the dynamic demand prediction, and the logistics service provider can accurately schedule the service resources based on the installation progress data verified by the blockchain. The multi-party realizes the second-level synchronization of manufacturing instructions and resource status under the premise of ensuring data sovereignty [3].

4.3. AI-driven elastic supply chain planning

Within the framework of the smart home ecological collaboration platform, artificial intelligence algorithms deeply integrate online and offline multi-channel consumption data, continuously capture social media public opinion and seasonal consumption preference changes, and form a highly sensitive demand prediction model [4]. The model dynamically outputs the expected sales range of different product lines, directly drives the production unit to flexibly configure raw material purchase batches and production beats, so that the traditional rigid production line has the ability to quickly switch between different product models. The production scheduling system automatically generates the optimal equipment utilization plan based on the real-time updated forecast data. When the supply of specific parts fluctuates, the alternative material scheduling procedure is immediately triggered, and the priority order of the assembly process is synchronously adjusted to minimize the risk of production interruption [5]. Based on the evolving production and marketing plan, the logistics collaboration module intelligently plans the distribution routes and storage resources, and comprehensively considers the real-time storage capacity of the regional distribution center, the load status of the transport vehicle in transit, and the order density of the end outlets to generate the immediate replenishing instructions with the optimal cost. The whole supply chain planning system has a self-iterative learning mechanism, and the actual shipment data and planning deviation after each sales cycle are automatically fed back to the algorithm core, which is used to calibrate the parameter weights of the subsequent prediction model, so as to build a continuously strengthened dynamic balance between the demand end and the supply end [6].

4.4. Distributed cloud manufacturing resource sharing network

The platform operator abstracted the heterogeneous equipment of small and medium-sized manufacturing enterprises in the region, such as injection molding machines and patch production lines, into schedulable virtual manufacturing cells. The real-time updated capacity map was generated through the digital twin technology and the idle time of equipment and process accuracy parameters were marked [6]. The intelligent engine of the platform automatically disassembles the process route according to the geographical distribution and delivery time requirements of the order, and gives priority to matching the idle equipment cluster combination closest to the end user. The metal case stamping task may schedule the idle 2000-ton hydraulic press in factory A at noon, while the circuit board patches are assigned to the redundant SMT production line in enterprise B at night. The resource scheduling instructions were pushed to the corresponding equipment control terminal synchronously. The regional service alliance designated a three-hour delivery circle based on the physical distance, and the blockchain inspection procedure of the logistics service provider was triggered immediately after the manufacturing node completed the process. The semi-finished products were loaded by the circular packaging boxes certified by the alliance and loaded onto the next processing node. Flow from raw materials to the whole process of service delivery at the dynamic optimization of regional collaborative network resources [7].

5. Conclusion

This paper systematically demonstrates the strategy of optimizing the governance mechanism and supply chain efficiency of a smart home ecological collaboration platform. The key is to use dynamic contracts to clarify the responsibilities and risk sharing of multiple subjects, achieve information penetration by means of a standardized

data middle office, and use intelligent algorithms to reshape the demand-driven elastic supply chain plan. The distributed cloud manufacturing network is used to activate idle resources, so as to realize regional agile response. In practice, it is suggested that all parties in the industry actively embrace the concept of open collaboration, focus on building transparent and mutual trust governance rules and an efficient data circulation environment, and constantly update intelligent supply chain management tools.

Disclosure statement

The author declares no conflict of interest.

References

[1] Yan K, Xia E, Li D, 2024, Impact Path and Mechanism of Complementary Enterprise Platform Ecological Capability on Collaborative Innovation. Science Research Management, 45(11): 130–140.

[2] Wu Y, 2023, Research on Comprehensive Evaluation of Platform-Based Enterprises' Healthy Development Level from the Perspective of Ecological Synergy, dissertation, Southeast University.

[3] Wu Q, Zhu JY, 2022, Sustainability Measurement Model and Simulation Research on Collaborative Development of Platform-Based Logistics Enterprise Ecosystem. Journal of Jiangxi University of Finance and Economics, (06): 29–41.

[4] Qu L, 2024, Research on Internal Control Optimization of Smart Home Enterprises under the Background of Big Data—Taking Company A as an Example. Market Weekly, 37(26): 80–83.

[5] Chen L, 2024, Research on Smart Home Marketing Strategy Optimization of H Company, dissertation, Southwest University.

[6] Qian S, Gu R, Fu X, et al., 2025, Research on Data Middle Platform Architecture of Smart Home Product Chain Service Platform. Image and Signal Processing, 14(1): 85–91.

[7] Zhao C, Duan KN, 2024, Research on Intelligent Transformation of Financial Data of Large Household Enterprises. Industrial Innovation Research, 2024(3): 153–155.

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Research on Optimization of Project Procurement Management Process in Telecommunication Enterprises

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Abstract: In the project procurement management process of telecommunication enterprises, due to the complexity of technology, the professional procurement project manager is responsible for the whole process of professional procurement in a one-stop way. The integration of this management process superficially improves labor productivity, but in essence lacks effective checks and balances and supervision. In order to supervise the project procurement management process and ensure the legal compliance of procurement management, this paper studies the project procurement management process of telecommunication enterprises, proposes the optimization process of project procurement management in the segmentation of purchasing manager-business manager, and constructs a matrix project procurement management model, which will contribute to the overall improvement of the telecommunication enterprises' procurement performance.

Keywords: Telecommunication enterprises; Project procurement management; Process optimization

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1. Introduction

Due to the huge investment in communication infrastructure, the procurement of telecommunication enterprises is mainly based on communication equipment and materials, such as mobile communication base station equipment, transmission equipment, core network equipment and IT equipment, etc., and materials such as communication fiber optic cables, communication copper cables, telephone cables, and small components. At the same time, there are also large-scale communications engineering projects involving the design, construction, supervision, and other services procurement, as well as carrying out various types of business information systems integration, business platforms, and other project procurement. In addition, due to the intensification of competition in the market in recent years, with the marketing of advertising, marketing gifts, business hall configuration, and other items required for the procurement of telecommunications enterprises, procurement has become another major category, and the proportion of procurement has been gradually increasing. This is also an important manifestation of domestic op-

erators' response to competition and increasing marketization.

The communications industry is also a technology-intensive industry, with faster iteration of communications technology, and the demand for the application of various information technologies in the era of "Internet +" makes the situation more complex [1]. Based on the technical complexity of the traditional procurement project, the telecommunications enterprise procurement management organization formed a professional classification of the procurement manager project responsibility system, requires the procurement manager to have a certain technical background, familiar with the technical performance of communications equipment and materials, usually according to the procurement category distinction, delineation of professional procurement manager, who is responsible for the whole process of the procurement of this type of product. For example, it is divided into professional procurement managers of wireless communication equipment, professional procurement managers of transmission, professional procurement managers of core network, etc. The professional procurement manager is responsible for the whole process of project management of the procurement of these types of products, and the key business processes mainly include:

(1) Soliciting and defining procurement requirements: quantity, delivery time and place, main technical performance requirements, investment or cost budget, etc.;
(2) Developing procurement program: determining which procurement method to use, competitive negotiation, bidding, or directed negotiation, preparing procurement documents, commercial negotiation documents, or bidding documents;
(3) Identify suppliers, complete the procurement, and sign the contract;
(4) Supervise the arrival and delivery;
(5) Quality testing and acceptance;
(6) Payment;
(7) Supplier evaluation: According to the implementation and completion of the procurement project, the comprehensive ability of the supplier to form an assessment report for later procurement management and the development of medium- and long-term supplier partners to provide a reference basis.

The management of the project procurement process, which is a fundamental link connecting the enterprises in the supply chain, is no longer a simple operational management function under the traditional management model, but has gradually transformed into a strategic management function of modern enterprises. Project procurement strategy centralization, customer bargaining power, procurement management and governance standardization, procurement contract formalization, etc., will have an impact on the project procurement management and governance of the formalization of the use of various supplier selection criteria [2]. Supply chain management and procurement process is a key element in every public and private organization [3]. It is decisive for the long-term business development of the organization. Firstly, the system of selecting, managing, and evaluating suppliers has been strengthened. Unlike the traditional procurement management model, the relationship between modern enterprises and suppliers is no longer a simple commercial buying and selling relationship, but is converted into a long-term, mutually beneficial partnership. Establishing a strategic partnership with suppliers is an effective means to maintain the interests of enterprises and realize their business objectives. As the source of the supply chain, the status of suppliers is self-evident. The choice of suppliers will not only restrict the manufacturing capacity of downstream manufacturing enterprises but also seriously affect the harmony and stability of the entire supply chain. Secondly, it can improve and optimize the procurement process. The management and improvement of the procurement management process of the project under the supply chain management mode not only includes the

improvement of the internal management operation process of the enterprise, but also includes the management of the external information resources of the enterprise, as well as whether the operational efficiency of the overall supply chain of the enterprise has been improved, and whether it is in line with the principle of cost minimization. Optimize the organization's procurement process, strengthen the cooperation with suppliers, establish strategic partnerships with suppliers, strengthen information sharing and communication, maximize the benefits of both parties, and achieve a win-win situation. Furthermore, it can give full play to the profit leverage of procurement management. Nowadays, modern enterprises have increasingly recognized that procurement management can bring great value to the enterprise. A large part of the enterprise's profits from the savings in procurement costs, such as in the procurement of savings of 1 million yuan, you can directly create 1 million yuan of gross profit, if the enterprise's sales margin of 10%, the creation of equal profits need to increase sales by 10 million yuan, which the high value of the procurement activities created can be seen. In the telecommunication enterprise, this kind of huge investment-driven industry, the profit leverage of procurement is more prominent, the centralized purchasing scale is huge, and can also have negotiation price pressure, creating profit value in the space. By fully optimizing and coordinating the organization and management mode of the procurement project and giving full play to the profit leverage in procurement activities, the enterprise can be invincible for a long time. Finally, the country's external policy regulation and the double constraints of the internal control of enterprises, in the procurement management of the organizational management system and production organization process, must form a set of corresponding management system, checks and balances and supervision of procurement, anti-corrosion and anti-corruption, to ensure that the procurement management and the behavior of the healthy operation of the procurement management and behavior, to enhance the overall effectiveness of the procurement management of the fundamental guarantee.

2. Analysis of existing problems in the project procurement management process of telecommunication enterprises

With the progress of science and technology, the development of social productivity, the user demand has not only improved but also the increasingly fierce competition between enterprises, production, and product-centered management model has not been adapted to the needs of the modern market competition, and has been replaced by a customer demand-centered supply chain management model. Advances in science and technology and the diversification of user needs have shortened the product life cycle, enterprises are generally faced with the pressure to shorten the delivery period, improve product quality, reduce costs, and improve services. All these require enterprises to respond quickly to the changing market, and constantly develop customized products to meet user needs, to capture the market and win the competition. The existing project procurement management process cannot adapt to this change. Effective management of procurement projects requires a more agile and flexible management model [4]. In line with the market environment, telecommunication enterprises are facing new situations in competition, and at the same time, the national anti-corruption efforts have increased. The anti-corruption of large state-owned enterprises is a key area of supervision, and the characteristics of the procurement business determine that it has become a top priority in the anti-corruption, and the dual constraint mechanism of external supervision and internal control of telecommunication enterprises requires that they set up a set of more reasonable procurement organization and management mode, and solve the main existing problems at present.

(1) The internal procurement management system is not unified. A general group of companies has a lot of

procurement management rules and regulations, but these rules and regulations are not perfect, and most of them are based on the micro level of the specific operation to develop, from the macro level of the entire procurement decision-making system appears to be relatively lacking and insufficient. Purchasing management functions only within the group and the subsidiaries, branches of the coordination and standardization, but in the subsidiaries, many problems and obstacles exist in the communication between the branches, not to mention the external suppliers, partners between the exchanges and collaborations. Various enterprises in the manufacturing sector, that is, the procurement needs of the department, the lack of understanding of the enterprise procurement process, the market is not familiar enough, but they are often very tough on the views of the procurement department, unwilling to back down, while the procurement department for the two sides of the problems do not understand the explanation, so that the conflict is more intensified in the emergence of the problem, we blame each other and shirk their responsibilities.

(2) The system is not standardized, the degree of information technology is low, poor traceability. For mega enterprises, according to the enterprise's own procurement process to develop a complete set of standardized procurement management system is not an easy thing. Telecommunications enterprises have a huge system covering the whole country from top to bottom, the whole network, from the group to all levels of branches and subsidiaries of the procurement, both intensive and unified characteristics, as well as immediate and unexpected geographical characteristics. In recent years, telecommunications enterprises have gradually improved the centralized procurement-based, decentralized procurement as a supplement to the procurement management system, but many of the system is not specific refinement and quantification, many effective procurement methods and techniques cannot be documented for posterity to learn for reference, which also makes the procurement performance of the telecommunications enterprises greatly reduced, the procurement of internal audits cannot be adequately carried out. Moreover, the slow processing of procurement information, the lack of rapid and effective information updating, and the lack of analysis and research on the latest procurement data also make it difficult to improve procurement performance.

(3) Lack of assessment and evaluation mechanisms for procurement. Although the procurement departments of telecommunication enterprises have formulated corresponding procurement management systems, there is a lack of corresponding assessment mechanisms for the personnel of the procurement departments (procurement project managers) and for the activity of procurement project management itself, which results in the system being non-binding and lacking in enforceability. Procurement analysis and decision-making is a major issue, but the leadership decision-making system, that is, the purchaser does not have their own views only according to the leader's decision to implement the procurement project, the leader's decision-making certainly has the inviolability, but due to the leadership of the time and energy of the finite nature of their lack of understanding of the procurement market, it is easy to make decisions based on their own subjective views and experience background. This is quite unscientific.

(4) The supplier assessment and evaluation index system is not sound, and the results are difficult to effectively quantify and apply in procurement. Long-term, stable, and good supplier relationships are the basis of supply chain value enhancement; if you cannot make a comprehensive, accurate, and objective evaluation of suppliers, it will affect the stability of the supply chain and value acquisition. The assessment and evaluation system of suppliers generally includes quality, cost, delivery capability, service level, technical strength, corporate strength, social value, and other aspects, both simple and quantifiable indicators, as well as soft and difficult-to-quantify evaluation dimensions. How to fully consider the actual production

and operation of telecom enterprises, combined with the history of supplier cooperation and practical experience, to establish a scientific and reasonable indicator system and apply it in the procurement behavior is a relatively large topic. Supplier assessment and evaluation index system is often set up to over-pursue the "big and comprehensive," resulting in the index system being too large, with too many levels of indicators, indicators of the classification are too detailed, which may mislead the decision-makers and shift their attention to some insignificant issues. The key is to effectively quantify the application in specific procurement projects.

(5) Excessive pursuit of business process integration and a lack of corresponding check and balance mechanisms in procurement organization management. As mentioned above, due to the technical complexity of telecommunication enterprises, the professional procurement project manager is responsible for the whole process of professional procurement in a one-stop shop, and the integration of the business process has improved the labor productivity superficially, but lacks effective checks and balances and supervision in essence. Moreover, the daily purchasing of the enterprise procurement department is often decided by the procurement department, and other departments do not have the right to speak, and cannot objectively and systematically supervise the activities of the procurement management department and judge the level of purchasing. Most of the procurement activities do not involve participation beforehand, supervision during the process, and control afterward, and the decision-making power of procurement is mostly in the hands of the leaders, who lack the corresponding check and balance mechanism, which is not conducive to the improvement of the overall effectiveness of procurement.

3. Optimizing the project procurement management process

The current situation of the project procurement management mode of telecommunication enterprises is the division of labor among procurement managers based on the attributes of the procured materials, and the management of the whole business process of procurement according to the project manager system. The closed management of the project manager responsibility system from the beginning to the end is theoretically more efficient, but it lacks the supervision and evaluation in essence, and the agility of project managers is not high, which is not conducive to the horizontal intervention of the managers and the horizontal evaluation and comparison of different project managers.

According to the characteristics of the business process of procurement, you can separate the three business processes of payment, quality testing and acceptance, and supplier post-evaluation, and set up a comprehensive position independent of the project manager's procurement business to undertake the business. The resulting construction of a matrix procurement organization management model, which can improve work efficiency, but also the formation of a certain regulatory constraints, the overall improvement of procurement performance to play a catalytic role (**Figure 1**).

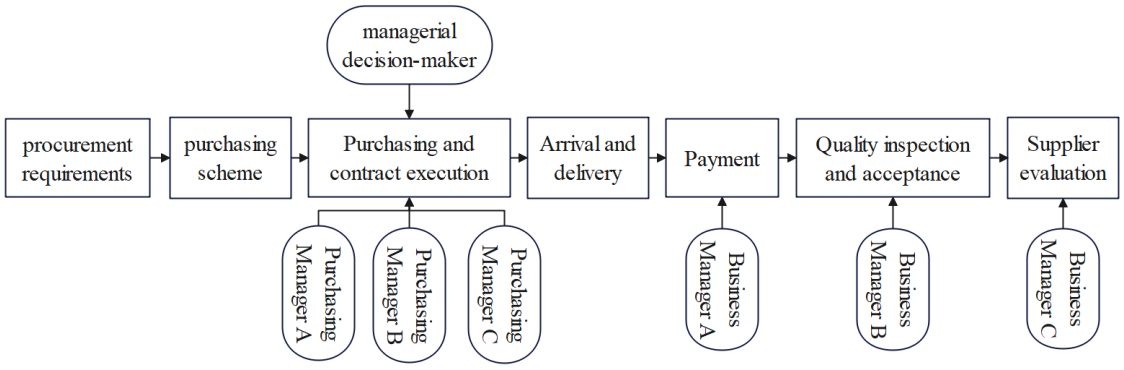

Figure 1. Optimization diagram of procurement project management process

Compared with the procurement program and technical specifications, the three business processes of payment, quality testing and acceptance, and supplier evaluation are relatively independent, and their technical complexity is not high, so they do not require too much technical background, and can be undertaken by general business personnel. Payment business process is relatively simple, according to the agreement of the procurement contract can be initiated, as shown in the figure, the business manager A to undertake all the procurement manager's payment business, greatly enhancing the overall coordination of fund scheduling, such as the effective integration of different procurement projects may involve the same supplier's payment needs, to facilitate communication with the financial into the fund-raising and scheduling. Quality testing and acceptance, due to the key elements of the procurement program has been clear in the technical specifications of the procurement of products or services, quality testing and acceptance of a clear quantifiable standards and requirements, so this business is also relatively simple, quality testing is generally commissioned to independent, national and industry-qualified third-party testing organizations, business manager B only need to submit the requirements of the technical specifications of the testing organization in accordance with the specifications. The test results and physical acceptance can be combined to complete the business; at the same time, the conclusion of whether the procurement project meets the technical performance. The business of supplier evaluation is relatively complex, as mentioned earlier, it is a multi-dimensional, quantitative, and qualitative evaluation system. In each specific procurement project, the business behavior of the procurement project manager determines the supplier selection, i.e., the procurement project manager selects a particular supplier, and the good or bad evaluation of the selected supplier indirectly affects the performance assessment of the procurement project manager. This association is not conducive to the objective, fair, and effective evaluation of suppliers, so the business organization process should be separated, business manager C is responsible for obtaining relevant information from the procurement project manager, payment business manager, quality testing and acceptance of business manager, integration of the first six business process output of the specific information on the cooperation of the supplier, to formulate a scientifically sound supplier evaluation index system, to carry out a comprehensive evaluation and the formation of the results provide decision-making basis and reference for procurement management decision-makers. At the same time, the results can also be exported to the procurement manager, payment business manager, quality testing and acceptance business manager, in their respective business processes according to the results of different supplier evaluation, the application of different business strategies to improve the performance of their own business processes, so as to improve the overall performance of procurement project management. Such as a supplier evaluation results are A-class strategic partners, the procurement manager in the procurement project scoring for "corporate strength and prospects for

cooperation" in the score should be given a high value different from ordinary partners, payment business manager should be given priority to ensure that the payment of funds, quality testing and acceptance of the business manager in the huge business volume, can be given to the supplier. In the huge business volume, the quality inspection and acceptance business manager can give the supplier the privilege of exemption from inspection and inspection; on the contrary, the procurement manager will give the project a low score evaluation, and the order of payment of funds to be ranked after the increase in sampling batches and efforts, strict acceptance. The supplier to obtain a high level of evaluation qualification, it is necessary to cost, delivery, service, quality, and other aspects of the enterprise to making more efforts. Procurement project organization and management process of the closed loop thus formed, the matrix optimization structure not only takes into account the characteristics of the business of the production organization process, while separates part of the relatively independent business, the formation of effective checks and balances and supervision. In the long run, the overall effectiveness of procurement management can also be improved.

4. Conclusion

This paper analyzes the development status quo of the project procurement management mode of telecommunication enterprises to analyze the problem, and puts forward the project procurement management optimization process, and builds a matrix procurement organization management mode, which can improve the work efficiency and form certain regulatory constraints, and play a facilitating role in the overall enhancement of procurement performance.

Disclosure statement

The author declares no conflict of interest.

References

[1] Skachko AG, Efimova SN, Surkova VE, et al., 2024, Management of Procurement Business Processes at an Industrial Enterprise. Russian Engineering Research, 44(6): 886–889.

[2] Głodziński E, Szymborski M, 2024, Vendor Selection Criteria and Formalization of Project Procurement Management and Governance. Procedia Computer Science, 246: 4470–4480.

[3] Tammy R, Darin M, 2021, Collaboration in Procurement and Supply Chain Management: Cooperative Strategies for Ensuring Continuity of Supply. Journal of Supply Chain Management, Logistics and Procurement, 4(2): 193–201.

[4] Rane SB, Narvel YAM, 2021, Leveraging the Industry 4.0 Technologies for Improving Agility of Project Procurement Management Processes. International Journal of System Assurance Engineering and Management, 12(6): 1–27.

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Research on the Optimization of Enterprise Business Environment from the Perspective of Public Administration

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Abstract: The business environment directly impacts the level of regional economic development. As times change and society progresses, it is essential to create a favorable business environment for enterprises to better promote economic growth and social civilization. This paper explores methods and strategies for optimizing the business environment from a public management perspective. By analyzing the significance of optimizing the business environment and addressing its current limitations, it offers practical recommendations aimed at comprehensively advancing business environment optimization and providing a solid foundation for the healthy development of enterprises.

Keywords: Public administration; Business environment for enterprises; Optimization

Online publication: September 9, 2025

1. Introduction

Public administration, led by the government, is a crucial component of regional economic development and social stability. From a public administration perspective, to effectively promote local economic development and progress, it is necessary to create a favorable business environment for enterprises. By leveraging geographical advantages, targeted solutions should be implemented to address existing issues in the business environment, thereby further safeguarding the healthy and sustainable development of enterprises.

2. Significance of optimizing the business environment for enterprises from a public management perspective

Optimizing the business environment for enterprises from a public management perspective holds significant practical importance. First, for regional economic development, optimizing the business environment can attract more external investment, injecting momentum into local economic growth and fully leveraging the “catfish effect” to

effectively promote the healthy development of the local economy; Second, optimizing the business environment can better stimulate the vitality of enterprises. During production and operations, enterprises can focus their efforts on expanding and deepening their business operations. By leveraging the policies of a favorable business environment, enterprises can further upgrade their products and services, thereby enhancing the efficiency of their production and operations. Additionally, a favorable business environment is an important means of enhancing the local government's image and credibility. By actively fulfilling its duties, the government can provide strong support and guidance for business development. Through the establishment of efficient service mechanisms, businesses can gain a deeper understanding of government policies, thereby strengthening their sense of belonging and mission, and promoting the sustained development and progress of the local economy. Therefore, from the perspective of public management, optimizing the business environment for enterprises is beneficial to economic development from any angle and is an important measure that must be persistently improved during the reform process [1].

3. Current limitations in the business environment for enterprises

3.1. Failure to leverage geographical advantages

The business environment plays a crucial role in the healthy and sustainable development of enterprises. However, due to various constraints, the current business environment for enterprises faces certain limitations, with the failure to leverage geographical advantages being the most prominent issue. China is a vast country with diverse regional development disparities, yet each region possesses unique advantages and characteristics. However, in practice, these advantages and characteristics are not fully realized. Some regions, despite being located at transportation hubs with inherent geographical advantages, suffer from high logistics costs due to lagging infrastructure development and poor management, severely impacting operational efficiency and competitiveness. Additionally, some regions possess abundant mineral resources, but due to the lack of effective development and utilization, there is a phenomenon of resource waste, which has a negative impact on the local business environment [2].

3.2. Challenges in talent recruitment

Talent is a crucial dimension of the business environment and a key factor supporting business development. Talent recruitment must be prioritized in business environment optimization efforts. However, this remains a significant challenge. Many regions face issues such as inadequate living conditions and the absence of systematic talent policies, making it difficult to attract high-end talent. Even when talent is recruited, retaining them long-term proves challenging. One reason lies in the inadequacy of urban infrastructure, medical facilities, and cultural and recreational services, which fail to meet the high-quality living standards demanded by high-end talent. Another reason is the limitations in talent recruitment policies and their implementation, which fail to attract talent. This directly results in businesses lacking the necessary resources for talent utilization, often facing talent shortages that hinder long-term development and the implementation of strategic plans [3].

3.3. Market regulation requires standardization

Market regulation is an important component of optimizing the business environment. Effective market regulation helps build a fair market environment and enhances the attractiveness of the business environment. However, in reality, the market regulation dimension of the business environment in many regions needs to be standardized. Due to insufficient regulatory enforcement and lax law enforcement, some enterprises engage in illegal activities, severely disrupting the market environment. This has a negative impact on normally operating enterprises, harms

consumers' legitimate interests, and undermines the local business environment. As a result, law-abiding enterprises find themselves at a disadvantage in intense market competition, struggling to secure their rightful market share and profits. Additionally, inadequate market regulation can trigger industry chaos, with issues like malicious competition and price wars popping up all the time, which seriously affects the industry's overall image and sustainable development [4].

4. Strategies for optimizing the business environment from a public management perspective

4.1. Leveraging geographical advantages to create a distinctive business environment

Optimizing the business environment from a public management perspective requires leveraging geographical advantages to create a business environment with regional characteristics. China's vast territory has seen the development of distinct cultural phenomena and resource distributions across different regions over its long history. As the primary social management entity, government departments must thoroughly explore these unique geographical advantages, convert them into driving forces for optimizing the business environment, and through scientific planning and rational layout, fully leverage these advantages to foster the formation of distinctive business environments [5]. Taking regions rich in tourism resources as an example, governments can leverage the trend of cultural and tourism industry development to actively build new tourism industry models. They can construct high-standard tourism infrastructure to enhance tourism service quality, develop diverse tourism products to meet the needs of different tourists, and integrate local advantageous industries to promote industrial cluster development, forming a value chain with core competitiveness and enhancing the overall competitiveness of enterprises. In this process, the government should actively provide policy incentives and guidance, encouraging and supporting enterprises to innovate using local resources. For enterprises relying on natural resource development, the government can offer preferential policies such as land use rights and tax exemptions to reduce operational costs. Additionally, the government can guide enterprises to strengthen technological R&D and brand building to enhance product value-added, forming core competitiveness with independent intellectual property rights, and promoting coordinated development among upstream and downstream enterprises in the industrial chain. Additionally, in the process of optimizing the business environment, efforts should be made to protect local unique resources and culture, consistently adhering to a sustainable development strategy. While optimizing the local business environment, ecological protection should also be considered to promote the coordinated development of material and spiritual civilization. By leveraging geographical advantages to create a distinctive business environment, regional economic development can be better promoted, fostering a favorable atmosphere for the healthy development of enterprises, and stimulating their motivation and enthusiasm for continuous innovation to better serve the local socio-economic development [6].

4.2. Emphasizing talent recruitment and formulating talent attraction policies

In a market economy, talent is extremely important for the development of enterprises. Talent has become an important soft power for enterprise development and is also an important guarantee for the core competitiveness of enterprises. From the perspective of public management, the optimization of the business environment for enterprises should start from the perspective of talent and provide strong support for enterprise talent recruitment. Local governments should prioritize talent recruitment from a public management perspective, formulating policies that align with contemporary trends and practical needs. By enhancing talent benefits, more high-level talent can be at-

tracted to the region. This can be achieved through a tiered talent classification system, offering housing subsidies and educational benefits for children with talent of different levels and fields, and providing ample development opportunities to enable outstanding talent to contribute to local economic development [7]. Additionally, talent services should be optimized to provide tangible support for talent. Many regions have already established talent service centers to offer a range of services for recruited talent, including household registration and relocation assistance. Some regions have even implemented policies specifically targeting the families of talent, which is crucial for enhancing talent stability and a key focus in the process of optimizing the business environment. Furthermore, the talent dimension of business environment optimization should not only focus on talent recruitment but also prioritize the cultivation of local talent. Such talent has a stronger sense of regional belonging and is more enthusiastic about local economic development. The government can take the lead in connecting universities with enterprises, establishing a comprehensive talent cultivation system, encouraging close cooperation between schools and enterprises, and constructing talent co-development plans to continuously enhance the comprehensive quality and professional skills of local talent. By prioritizing talent recruitment and formulating policies to attract talent, sufficient talent reserves can be provided for enterprises, attracting them to invest and build in the local area, thereby better promoting regional economic development [8].

4.3. Enhancing service efficiency and standardizing market supervision behavior

Optimizing the business environment for enterprises from a public management perspective requires continuously enhancing government service efficiency and standardizing market supervision behavior. First, in terms of government service efficiency, convenient and efficient public services should be provided to support business development. This can be achieved by establishing a one-stop service platform, streamlining approval processes to reduce the time businesses spend on administrative procedures, integrating resources across departments to facilitate information sharing, avoiding duplicate submissions of materials by businesses to improve efficiency, and strengthening training for public officials to enhance their professional capabilities and service standards, ensuring they can provide accurate and professional guidance during service delivery; Second, an effective feedback mechanism should be established to collect businesses' opinions and suggestions on government service efficiency. For constructive feedback, timely improvements should be made, continuously adjusting and optimizing service content to meet businesses' diverse needs, and creating an efficient and convenient business environment [9]. Finally, at the operational level, market supervision should be strengthened to promote standardization, increase regulatory intensity, and establish scientific and reasonable regulatory policies to ensure transparency and fairness in market operations. Regular market inspections and complaint reporting channels should be established to strictly enforce unfair competition and illegal activities, maintain a fair and competitive market order, and provide a healthy and orderly market environment for businesses and talent. By enhancing service efficiency and standardizing market supervision behavior, the regional business environment can be fundamentally improved, providing necessary support for the healthy development of enterprises [10].

5. Conclusion

From a public management perspective, optimizing the business environment for enterprises has become an important driving force for modern regional economic development and a key focus in the process of China's reform and opening-up. It is essential to continuously improve the efficiency of public management services, promote the

standardization of the market environment, and create a better business environment for enterprise development, thereby achieving enterprise operational goals while driving regional economic growth. In future development, we should continue to explore new methods for optimizing the business environment for enterprises, continuously injecting sustained momentum into local economic development, and promoting the sustainable development of the local economy.

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References

[1] Zhu Y, Pan Y, 2025, Research on the Construction of Digital Business Environment Standard System. Standard Science, (06): 6–13.

[2] Wang J, Guo J, Cheng Y, 2020, Optimization of Tax Business Environment and Ascent of Enterprise Value Chain. Finance & Trade Economics, 46(06): 25–40.

[3] Yang K, 2024, Discussion on the Methods of Enterprise Management in the New Economic Environment. Modern Business, (02): 94–97.

[4] Zheng X, Wu Q, Zhou Y, 2025, Business Environment Optimization and Innovation in Small and Medium-Sized Enterprises: Empirical Evidence from the China Enterprise Innovation and Entrepreneurship Survey. Journal of Yunnan University of Finance and Economics, 41(06): 82–97.

[5] Ren L, Jiang X, 2025, The Mechanism and Countermeasures of the Impact of the Cultural Industry on Economic Growth from the Perspective of the Business Environment. Journal of Chang'an University (Social Sciences Edition), 27(02): 105–124.

[6] Wang J, Gao Y, Zhang J, 2025, The Impact of Industrial Policy on the Performance of Photovoltaic Enterprises: Based on the Moderating Role of the Business Environment. Accounting Friend, (11): 29–36.

[7] Li B, 2025, A Study on the Pathways for Enhancing Employees' Professional Competence and Capabilities from a Public Management Perspective. Enterprise Reform and Management, (02): 74–76.

[8] Li X, 2025, A Study on the Application of Business Administration in Public Management. Shanghai Enterprise, (01): 51–53.

[9] Zhou C, 2024, The Application of the Metaverse in Enterprise Management and Social Management. Value Engineering, 43(34): 139–141.

[10] Li T, 2024, A Study on the Optimization Pathways of Human Resource Management in State-Owned Enterprises from the Perspective of New Public Management. Enterprise Reform and Management, (22): 63–65.

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Good Faith as a Compromise between Civil Law and Common Law Jurisdictions in the Legislative History of the CISG

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Abstract: There is a wide recognition that encompassing an obligation of good faith in every commercial contract is one of the most important advances in contract law in the twentieth century [1]. Despite the fact that this concept has been incorporated in the vast majority of national legal systems, its precise scope and application may vary from one to another, depending on the commercial traditions and customs of each legal system [2]. The fact that good faith has been treated differently in different national legal systems has also been reflected on the international level through its inclusion in international legal instruments, one of which is the United Nations Convention on Contracts for the International Sale of Goods (hereafter CISG). In this article, the legislative history of the CISG will be closely examined with the purpose of finding out how a compromise was reached between the common law countries, which expressly objected to the imposition of a duty of good faith, and the civil law countries, which explicitly endorse its incorporation. A logical result flowing from this historical examination, as will be submitted, is that the conceptual ambiguity of good faith is the underlying reasoning behind their fundamentally different attitudes towards the incorporation of this notion in the international commercial context.

Keywords: CISG; International economic law; Commercial law; Good faith

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1. Introduction

Recognizing or applying the principle of good faith in commercial contract law has long been believed to be one of the major differences between civil and common law legal systems around the world. As Michael Bridge noted, "it is a notorious fact that one of the pressure points emerging when the common law and the civil law are set against each other lies in their differing attitudes to the notion of good faith. This was a matter of some significance during the evolution of the CISG" [3]. Before revealing the controversies surrounding the concept of good faith in the legislative history of this Convention, it is pertinent to understand its importance in the international

economic context. Commonly referred to as "…one of the most successful multilateral treaties ever in the field of agreements designed to unify rules traditionally addressed only in domestic legal systems," CISG was adopted in a diplomatic conference held in Vienna in 1980, which was attended by representatives of 62 countries and eight international organizations, after which it was accepted by two-thirds of the participants and came into force in the year 1988 and today includes more than 80 countries [4]. Since the CISG is a sales convention with the objective of providing a uniform and fair regime for the international sale of goods among the members [5], examining its legislative history will lead to a clearer understanding of why the incorporation of good faith is essentially a compromise reached by the representatives of different national legal systems [6].

The central argument advanced in this article is that the inability to precisely define the notion of good faith from a conceptual perspective is the main reason why the route to incorporate it in the CISG has been extremely controversial, which can be vividly demonstrated by its legislative history, particularly with regard to the Article 7(1) which focuses on "the observance of good faith in international trade." As will be shown below, the interpretation rule of the good faith principle in the CISG included in Article 7 is hugely vague and ambiguous, the interpretation of which essentially calls for the application of different national application techniques that are predicated on different national legal systems. In light of the jurisdictional differences between different legal systems towards good faith, reaching a consensus on the incorporation of a standard of such kind on the international level is understandably thorny.

2. An examination of the legislative history of good faith in the CISG

Due to the divergences and inconsistencies of domestic laws, certain matters should be compromised in the legislative history of the CISG, and good faith is undoubtedly one of them, which is considered to be contained in Article 7 and is regarded by some legal scholars as the most significant article in the Convention [7]. As a result, investigating the historical and legislative context of Article 7, albeit briefly, is crucial to discovering and ascertaining the original understanding of the good faith principle and its related interpretation and application in international trade. Honnold summarizes the legislative history of Article 7 in the CISG and groups it into four stages [8], each of which will be analyzed below.

2.1. Stage one: An initial proposed draft consisting of three paragraphs

In the initial stage of drafting Article 7 (stage one), various drafts and proposals were considered by the representative, which constitutes an early foundation for forming the current version. In fact, it was the Hungarian representative who submitted a proposal consisting of two paragraphs and the representative from the German Democratic Republic who proposed the third paragraph, which read as follows:

Paragraph I: In the course of the formation of the contract the parties must observe the principles of fair dealing and act in good faith. Conduct violating these principles is devoid of any legal protection.

Paragraph II: The exclusion of liability for damage caused intentionally or with gross negligence is void.

Paragraph III: In case a party violates the duties of care customary in the preparation and formation of a contract of sale, the other party may claim compensation for costs borne by it.

Although the inclusion of good faith in the CISG triggered heated debates in the course of the discussion, no consensus was reached except for the first sentence of the first paragraph, which was eventually adopted by the Working Group with mature deliberation. The first sentence in the first paragraph was supported by the represen-

tatives on the grounds that it incorporated a desirable standard of business conduct in the process of the formation of contracts [9], a "good faith" standard which was recognized and codified in many civil legal systems, thus rendering it unreasonable to be excluded from the international trade. The second and third paragraphs above, by contrast, did not receive significant support from the representatives. Even the formulation of the proposed first paragraph was, in fact, deluged with antagonistic voices, mainly concerning the imprecision and vagueness of these terms enunciating the good faith principle [10]. Besides, the dissenting arguments also pointed at the judicial interpretation problems regarding these terms, alleging that the first sentence in the first paragraph would not have much effect until it had been judicially interpreted and applied over a long period of time. Clearly, Article 7 was not as accurate as everyone would have expected after more than 50 years of intensive work, and one may find it unsurprising to see that the compromises among draftsman from different jurisdictions regarding Article 7, albeit less explicitly, indeed dates back to the very starting point of its discussion, which was rightly observed by Andersen who argued that the drafting process of the CISG is "purely diplomatic" [11], combined with the "inequality of bargaining power" and "years of debate and compromise" among the representatives from different legal systems involved in that drafting.

2.2. Stage two: Legal certainty as a core debate

The second round of the debate, which has the strongest bearing on this article, centers on a more fundamental question: whether a more specific article with regard to good faith should be included in the CISG, which caused lengthy and heated discussions during which different views from different national representatives were expressed. Having a brief overview of the different stances taken by different jurisdictions in the drafting process, coupled with a detailed assessment of the good faith principle from a more conceptual perspective that has taken root in each jurisdiction, respectively [12].

Specifically, the supporters and defenders towards the inclusion of good faith principle in the CISG were mainly concerned with two questions: whether there should be a specific article dealing with good faith and if there should be one, and whether the consequence of breaching it should be expressly stipulated, both of which are related to the issue about legal certainty. Regarding the first question, those who supported the inclusion of a specific article on good faith (mainly civilian representatives) argued that many domestic legal systems have already incorporated good faith as an overarching contractual principle, so that it should be generally and universally recognized and accepted by the CISG as well to govern international trade. he opponents, by contrast, contended that adding a specific provision to act in good faith was entirely unnecessary, in the sense that this notion has already become implicit in almost all legal systems dealing with business activities. Similar to the first question, the debate on the second question has the same bearing on the matter on legal certainty: the main justification proposed by the opponents lies with the fact that the draft article did not stipulate the consequences of the failure to observe good faith, while those taking an opposite line believed that the gap regarding the lack of specification about the consequences of the breach of good faith could be filled by the subsequent development of case law in the future application of the CISG.

The second stage of the legislative process essentially reveals that good faith is a concept that might cause uncertainty in the contract. Traditionally, certainty was often regarded as a crucial factor when it comes to evaluating the intention of the contracting parties and boosting confidence in the commercial relationship, which was noted by Lord Browne-Wilkinson in Westdeutsche that:

[judges] have often warned against the wholesale importation into commercial law of equitable principles inconsistent with the certainty and speed which are essential requirements for the orderly conduct of business affairs.

Some scholars argued that legal certainty in commercial transactions is closely linked to legal predictability, in the sense that the contracting parties need to know where they stand by determining the specific terms of their contract and acting accordingly. Another reason these two elements are essentially interchangeable with each other is that only by entering into the contract with certainty can the contracting parties pre-determine their contractual rights and obligations. Without legal certainty and predictability, how could courts respect their agreement, enforce it, and solve any contractual dispute? Insofar as good faith is concerned, the difficulty in merging it with commercial certainty is the absence of a crystal clear definition of its conceptual understanding, which leaves little room for the judge to resort to the conceptual significance of this term to solve the dispute in a principled manner [13].

2.3. Stage three: The acceptance of the proposed draft

Stage three witnessed a significant breakthrough, in that a new article on good faith, going through a process of heated debates, various amendments as well as extensive revisions, was finally proposed by the special Working Group, which reads as follows:

In the interpretation and application of the provisions of this Convention, regard is to be had to its international character and to the need to promote uniformity and the observation of good faith in international trade.

2.4. Stage four: The codification of the current version of Article 7(1) and (2)

The preparation of the article with reference to good faith mentioned above was finally adopted with some minor changes, which reads exactly the same as the existing Article 7(1) Besides, the current version of Article 7(2) was proposed to solve those problematically unforeseen gaps that might potentially emerge in the future, which reads:

Questions concerning matters governed by this Convention which are not expressly settled in it are to be settled in conformity with the general principles on which it is based or, in the absence of such principles, in conformity with the law applicable by virtue of the rules of private international law.

3. Article 7 CISG calls for further interpretations

As mentioned above, Article 7, consisting of two paragraphs, was eventually approved by the Diplomatic Conference. However, as argued by some scholars, gaining a foothold of the principle of good faith in the CISG only represents a 'modest start,' which was open for further signature and ratification in the future. That is to say, including Article 7 in the CISG is far from the end of the story in respect of conceptualizing the notion of good faith at an international level; rather, it signifies the start of seemingly endless debates and discussions, just like a 'war minus the shooting.' Unlike other international instruments such as the Principles of European Contract Law and the Unidroit Principles of International Commercial Contracts that expressly impose a duty of good faith on the contracting parties, Article 7(1) was silent on this issue as this article was, in fact, a compromise reached after a number of common law countries objected to the imposition of a duty of good faith on the contracting parties themselves, which calls for further interpretation with regard being paid to "the observance of good faith in international trade." Michael Bridge noted that Article 7(1) was expressed in the "passive voice" and did not indicate exactly who or what should be paying regard to good faith. He went on to argue that for a contractual duty such as good faith, it must be mediated through the States parties to the CISG. At the risk of oversimplifying the English version of this article in the CISG, he thought Article 7(1) could be interpreted in the following vein:

"Parties derive their rights and duties from the contract in accordance with the CISG; the CISG is to be inter-

preted in accordance with good faith; therefore the parties' rights and duties are subject to good faith."

Similar to Article 7(1), Article 7(2) also calls for further interpretation regarding the precise gap-filling role played by it. Does a reference to the general principles on which the CISG was based when it came to matters that were dealt with in the CISG but not expressly settled by it essentially mean that this formula has opened the door to those who see good faith as an existing, universal norm? If so, how far can we argue that good faith has been recognized as a general principle underlying the CISG? More fundamentally, a harder question: can those unresolved matters be settled by invoking good faith to make a dynamic difference to the outcome? Bundles of questions should be further clarified regarding what Article 7(2) exactly means.

Since the adoption of Article 7, many scholars have attempted to comment on the role played by these two articles respectively, for the purpose of further uncovering different facets and functions of the good faith principle within the CISG. For example, Honold and Fransworth argue that Article 7 should be read literally, which should be applied no more than as guidance for a court in the interpretation of the CISG itself but not as a duty imposed on contracting parties [14]. Schlechtriem, by contrast, is of the view that good faith is applied not only in the interpretation of the CISG according to the strict textual meaning of Article 7(1), but also to the legal relations between the parties, but with regard to the later, it is possible only through Article 7(2), by being regarded as one of the general principles on which the CISG is based [15]. However, the issue that is of great interest and importance to this article with regard to the legislative history of Article 7, is not related to the question whether good faith should be applied only in the interpretation of the CISG itself or be applied both to the interpretation of the CISG and to the relationship between the contracting parties, which have been numerously investigated by many scholars. Rather, for the present purposes, regard has to be primarily made to something that is beyond the ultimate compromise of Article 7 manifested by its legislative history and something that would convincingly justify the differences between the stances taken by different jurisdictions towards the conceptual meaning of good faith. If the notion of good faith cannot be clarified to the fullest extent, how could this notion be expected to be transplanted into the international soil and thus to form an integral part of the international commercial transaction?

Clearly, since the legislative history of the CISG, or more precisely to say, any provisions included in the CISG, are in fact silent on the clarification of the notion of good faith, it is paramount to resort to national laws to achieve this purpose, which indisputably requires a comparative understanding of legal culture behind civil and common law jurisdictions towards this notion, particularly with regard to how it was formed and developed in a particular cultural community and gradually results in a irreconcilable discrepancy over the legal matters on this notion.

4. Conclusion

To sum up, the legislative history of the CISG shows that the concept of good faith is indeed a controversial issue, and opinion is divided between those who support its inclusion and those who are against it. It is not the purpose of this article to determine how to animate the further development of the Convention as regards the issue of good faith. Rather, on the basis of delineating the legislative history of Article 7, the main focus of this article is to demonstrate that a lack of conceptualization of the notion of good faith, including the difficulty of clarifying its conceptual background and synthesizing its core meanings, is the primary reasoning behind the controversy that has been triggered in the legislative history of the Article 7 CISG. Without clarifying the conceptual vagueness of good faith, any further attempt to develop it further in the context of international economic law would be impractical and unsound.

Disclosure statement

The author declares no conflict of interest.

References

[1] Van Alstine M, 1908, The Death of Good Faith in Treaty Jurisprudence and a Call for Resurrection (2005) 93 Geo. L.J. 1885.

[2] MacQueen H, 1999, Good Faith in the Scots Law of Contract; An Undisclosed Principle? Hart Publishing Oxford, 5–37.

[3] Bridge M, 2017, Good Faith, the Common Law, and the CISG. Uniform Law Review, 22(1): 98–115.

[4] United Nations Commission on International Trade Law (UNCITRAL), 1980, United Nations Convention on Contracts for the International Sale of Goods (CISG). viewed March 11, 2025, http://www.uncitral.org/uncitral/en/uncitral_texts/sale_goods/1980CISG.html

[5] Honnold J, 1999, Uniform Law for International Sales, 3rd edn, Kluwer Law International.

[6] Felemegas J, n.d., The United Nations Convention on Contracts for the International Sale of Goods: Article 7 and Uniform Interpretation, Pace Review of the Convention on Contracts for the International Sale of Goods (CISG), Chapter 3, para 1.

[7] Koneru P, 1997, The International Interpretation of the UN Convention on Contracts for the International Sale of Goods: An Approach Based on General Principles. Minnesota Journal of Global Trade, 6: 105, 106.

[8] Honnold JO, 1989, Documentary History of the Uniform Law for International Sales, Kluwer Law and Taxation Publishers, 298.

[9] Huang X, Wan H, 2023, Determination and Application of General Principles of the United Nations Convention on Contracts for the International Sale of Goods. People's Justice, (08): 71–74.

[10] Zheng X, Han X, 2023, Research on the Applicable Rules of the United Nations Convention on Contracts for the International Sale of Goods (CISG)—Based on the Analysis of the Applicable Rules in the Chinese Mainland Region. North Economic and Trade, (01): 79–84.

[11] Wang H, Zhang S, 2021, Application of the United Nations Convention on Contracts for the International Sale of Goods in Chinese Courts. People's Justice, (31): 21–25.

[12] Wang L, 2021, Research on the Limitation and Exemption of Seller's Intellectual Property Rights Guarantee Liability in the United Nations Convention on Contracts for the International Sale of Goods. Heilongjiang Human Resources and Social Security, (08): 62–64.

[13] Liu Z, 2021, Research on the Exemption Clause of Article 79 of the United Nations Convention on Contracts for the International Sale of Goods, dissertation, Yunnan University.

[14] Honnold JO, 1999, Uniform Law for International Sales, Kluwer Law International, 3rd ed.

[15] Schlechtriem P, Schwenzer I, (eds), 2005, Commentary on the UN Convention on the International Sale of Goods (CISG), Oxford University Press, 2nd (English) ed, 812.95.

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A Study on the Effectiveness of Corporate Culture Management in the Context of Artificial Intelligence Development

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Abstract: This study focuses on the real-world context where artificial intelligence (AI) deeply permeates corporate operations, systematically exploring the core value, challenges, and optimization paths of corporate culture management during the process of intelligent transformation. By deeply analyzing the semantic deviations in the digitalization of cultural elements and the potential conflicts between algorithm-based decision-making and humanistic values in human-machine collaboration scenarios, and combining theories of organizational behavior with the characteristics of AI technology, a series of strategies for enhancing effectiveness are proposed, including dynamic cultural modeling and embedding cognitive-collaborative rules. With detailed empirical data and case studies, this research provides a theoretical basis and practical guidance for enterprises to achieve a dynamic balance between technological rationality and humanistic care.

Keywords: Artificial intelligence; Corporate culture management; Human-machine collaboration; Dynamic modeling; Cognitive collaboration

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1. Introduction

Artificial intelligence (AI) technology is reshaping corporate operation models and management ecosystems with disruptive force. Research from the International Data Corporation (IDC) shows that global corporate investment in artificial intelligence is expected to exceed $200 billion by 2025, and more than 70% of enterprises will complete the intelligent transformation of at least one core business process [1]. Against the backdrop of emerging scenarios such as intelligent decision-making systems replacing traditional approval processes and generative AI assisting in content creation, corporate culture management has evolved from a traditional value-dissemination system into a key governance mechanism for coordinating the relationship between technological systems and

organizational members. This transformation not only requires enterprises to redefine the digital expression of cultural elements but also to build a new collaborative paradigm between algorithm logic and humanistic values. How to enhance the adaptability and effectiveness of corporate culture management in the intelligent era through systematic management innovation has become an important proposition for corporate sustainable development.

2. Significance of corporate culture management in the context of artificial intelligence development

2.1. Construction of cultural buffer mechanisms for technological ecology adaptation

The intelligent transformation of enterprises inevitably involves the reconstruction of business processes and profound changes in job functions, which will inevitably cause internal organizational shocks. Take a large manufacturing enterprise that introduced an industrial robot system as an example. In the initial stage of project implementation, due to employees' unfamiliarity and concerns about new technologies, the equipment utilization rate remained below 60% for a long time, and the improvement of production efficiency was slow. The enterprise management realized that simply introducing technology could not solve employees' resistance. Therefore, it began to build a "human-machine collaboration learning community" and deeply integrated the cultural concept of "technology empowering growth" into the employee training system. Through targeted technical training courses and incentive measures such as setting up the "Human-Machine Collaboration Innovation Award," the equipment utilization rate significantly increased to 85% within three months, and employees' acceptance and participation in new technologies also increased substantially. The cultural buffer mechanism effectively alleviates the pressure brought by technological transformation by reducing internal organizational friction. Relevant survey data show that for enterprises with a clear cultural orientation of technological adaptation, the average implementation cycle of intelligent projects is 22% shorter, and the employee turnover rate is 18% lower compared to those without such a cultural orientation (**Table 1**).

Table 1. Comparison of intelligent project implementation cycles and employee turnover rates in enterprises with and without cultural buffer mechanisms

Enterprise type	Average implementation cycle of intelligent projects (months)	Employee turnover rate (%)
With cultural buffer mechanism	8.2	9.5
Without cultural buffer mechanism	10.5	11.6

2.2. Establishment of the basic framework for cognitive decision-making collaboration

The decision-making logic of artificial intelligence systems based on data models is fundamentally different from human judgment based on experience and intuition. In the field of credit approval, a financial institution transformed the corporate value of "balancing risk control and customer care" into specific algorithm constraints to address this contradiction. In the credit scoring model, in addition to traditional financial data indicators, special weighting factors for customers in difficult situations but with good credit records were added. This measure enabled the institution to maintain a stable non-performing loan rate while significantly increasing customer satisfaction by 15 percentage points. This "data-driven + value-oriented" hybrid decision-making framework achieves the goal that the output of intelligent systems conforms to both technical logic and organizational value orientation. Research shows that for enterprises adopting a collaborative decision-making framework, the accuracy

of strategic decision-making is 19% higher, and the decision-making time is approximately 44% shorter compared to the traditional decision-making model (**Table 2**).

Table 2. Comparison of strategic decision-making accuracy and time consumption between collaborative decision-making and traditional decision-making models

Decision-making mode	Accuracy of strategic decision-making (%)	Decision-making time consumption (hours)
Collaborative decision-making	82.3	4.2
Traditional decision-making	69.8	7.5

2.3. Construction of digital carriers for the continuity of organizational memory

The development of artificial intelligence technology provides a new digital carrier for the inheritance of corporate culture. A technology enterprise with a history of more than 30 years, with the help of knowledge graph technology, transformed more than 1,200 typical cases, value statements, and other cultural elements in its development process into a structured semantic network. In this way, the enterprise achieved accurate retrieval and dynamic update of cultural elements, allowing employees to quickly obtain specific cases and knowledge content related to corporate culture through keywords. More importantly, the enterprise used machine learning algorithms to deeply analyze the data in the cultural knowledge graph, excavate the internal laws of cultural evolution, and predict the changing trends of employees' value orientations, so as to adjust management strategies in advance. After the system was launched, the pass rate of new employees in cultural assessments increased significantly from 72% to 89%, and the consistency of cultural cognition across departments increased by 27% [2].

2.4. Shaping of trust systems for cross-time and space collaboration

With the popularity of remote work and distributed collaboration models, enterprises face the challenge of building trust in cross-time and space collaboration. A multinational internet enterprise used blockchain technology to establish a traceable task collaboration platform. This platform records employees' behavior data on the blockchain in real time, enabling transparent evaluation of work results. During the project execution process, every link of task initiation, execution, and acceptance is completely recorded on the blockchain, and any participant can check the task progress and related data at any time. After implementing this platform, the on-time delivery rate of the enterprise's virtual team projects increased from 78% to 91%, and the trust score among team members increased by 22%. This digital trust system, with code as the constraint and data as the evidence, effectively reduces management costs and communication losses, solves problems such as information asymmetry and difficult liability determination in cross-time and space collaboration, and provides strong support for enterprises to achieve efficient collaboration in the digital age.

3. Problems in corporate culture management in the context of artificial intelligence development

3.1. Semantic deviations in the digital representation of cultural elements

During the transformation of corporate culture into digital forms, it faces the dual problems of insufficient abstraction of value concepts and semantic ambiguities. An analysis of the cultural slogans of 100 enterprises from different industries using natural language processing found that 43% of the expressions were semantically

ambiguous, resulting in an algorithm misjudgment rate as high as 31%. For example, the common cultural slogan "Innovation leads the future" is difficult to clearly define its specific focus, whether it refers to technological innovation, business model innovation, or management innovation, from an algorithmic perspective. Such semantic ambiguities make it difficult for intelligent management systems to precisely guide employees' behaviors and convey corporate values. In addition, some abstract concepts in corporate culture, such as "team spirit" and "customer-first," are prone to misunderstandings when transformed into digital forms that can be processed by computers due to the lack of standardized definitions and clear boundaries.

3.2. Potential conflicts between algorithmic decision-making and humanistic values

In the design and operation of artificial intelligence systems, efficiency and accuracy are often the top priorities, which may lead to the neglect of humanistic care and ethical considerations. A well-known e-commerce platform designed a performance appraisal algorithm based on sales data to improve operational efficiency, overemphasizing the order volume indicator. Driven by this algorithm, customer service staff frequently used standardized quick-reply templates to pursue performance, ignoring customers' personalized needs and emotional appeals, resulting in a 40% surge in customer complaints. Survey data shows that in enterprises that solely rely on algorithms for employee evaluation, employee engagement is 23% lower, and customer satisfaction is 15.7% lower compared to those using comprehensive evaluation methods (**Table 3**).

Table 3. Comparison of employee engagement and customer satisfaction between enterprises using pure algorithmic evaluation and comprehensive evaluation

Evaluation mode	Employee engagement (%)	Customer satisfaction (%)
Pure algorithmic evaluation	61.5	73.2
Comprehensive evaluation	84.7	88.9

This indicates that when algorithmic decision-making conflicts with humanistic values, it not only affects employees' work enthusiasm and satisfaction but also has a negative impact on the enterprise's customer relationships and brand image. How to ensure that algorithmic decision-making conforms to the enterprise's humanistic value concept while pursuing efficiency is an important challenge for corporate culture management.

3.3. Cultural perception gap in human-machine interaction scenarios

In scenarios where intelligent devices frequently interact with users, there is a significant gap between the mechanical feedback of technical systems and the emotional interaction expected by humans. Take the intelligent customer service system of a bank as an example. Although the system can shorten the service response time to within 10 seconds, significantly improving service efficiency, due to the lack of emotional resonance design, it can only provide standardized mechanical answers when facing customers' complex questions or emotional outbursts, unable to offer emotional comfort and understanding. This leads to a 65% rate of customers requesting to switch to human services, seriously affecting the customer experience. Such differences in human-machine interaction experiences not only reduce the effectiveness of intelligent devices but also cause a disconnection between the enterprise's external image and internal cultural promotion. Enterprises emphasize the service concept of "customer-centricity" in their publicity, but the actual performance of intelligent customer service systems fails to reflect this concept, greatly reducing the effectiveness of cultural value transmission and preventing it from truly

taking root in people's hearts.

3.4. Lag in the responsiveness of dynamic cultural evolution

Traditional corporate culture management models show an obvious lag in responding to the rapid changes brought about by artificial intelligence technology. A follow-up study on 50 enterprises undergoing intelligent transformation found that, on average, it takes 8.3 months to complete the adaptive adjustment of the cultural system, while business models change significantly every 3.2 months on average during the same period [3]. This time difference makes it difficult for corporate culture management to keep up with the pace of business development, resulting in a lag in cultural management effectiveness. In a rapidly changing technological environment, corporate business models, organizational structures, and employees' needs are constantly evolving, but traditional cultural management models often rely on fixed processes and cycles and lack flexibility and agility. When enterprises launch new intelligent businesses or apply new technologies, the original cultural system may not be able to provide effective support and guidance in a timely manner, thus restricting the development of the enterprise.

4. Paths to improve the effectiveness of corporate culture management in the context of artificial intelligence

4.1. Construction of a dual-cycle mechanism for dynamic cultural modeling

Establishing a closed-loop of cultural management, namely "data collection-model training-effectiveness evaluation-iterative optimization," is the key to realizing the intelligent upgrading of cultural management. An automobile manufacturing enterprise, during its intelligent transformation process, made full use of natural language processing technology to collect and analyze text data such as internal meeting minutes, employee feedback, and emails in real time. Combining with external industry public opinion data, it constructed a cultural evolution prediction model. This model is continuously optimized through machine learning algorithms and can accurately identify the dynamic evolution trends of cultural elements with a prediction accuracy of 82%. Based on the model's prediction results, the enterprise can formulate and adjust cultural strategies 3–6 months in advance. For example, when predicting that employees would resist a certain new technology, the enterprise carried out relevant training and publicity activities in advance, effectively increasing employees' acceptance of change by 35%. This dual-cycle mechanism of dynamic cultural modeling realizes the transformation of cultural management from passive response to active prediction, significantly enhancing the effectiveness of cultural management.

4.2. Design of rule-embedding schemes for cognitive collaboration

Transforming corporate core values into executable algorithm constraints during the development of artificial intelligence systems is an important way to achieve cognitive collaboration. An internet recruitment platform fully considered the key factor of corporate culture fit and set corresponding weights in its talent recommendation algorithm. By disassembling and quantifying corporate values, they were transformed into specific parameters and rules in the algorithm. During the talent recommendation process, the algorithm not only matches candidates based on their professional skills and work experience but also evaluates the fit between candidates' values and corporate culture. After implementing this scheme, the matching degree between the recommended talents and corporate values on this platform increased by 28%, and the retention rate of new employees increased by 22 percentage points. This method of rule embedding makes intelligent technology an effective carrier for corporate culture

dissemination, realizing the deep integration of technical logic and humanistic values.

4.3. Development of emotional computing interfaces for human-machine interaction

Introducing emotional computing technology to endow intelligent devices with the ability to perceive and respond to human emotions is an important means to improve the human-machine interaction experience. A technology company integrated an advanced emotion recognition module into its intelligent office system. This module can capture employees' emotional cues such as facial expressions and speech intonations in real time through devices like cameras and microphones, and determine employees' emotional states. When negative emotions are detected, the system automatically pushes personalized care plans, such as recommending relevant psychological counseling courses or arranging colleagues for communication. After implementing this system, employees' acceptance of the intelligent system increased significantly from 67% to 89%, and work efficiency increased by 14% [4]. The development of emotional computing interfaces compensates for the lack of emotion in human-machine communication, enhances the interaction and trust between employees and intelligent systems, and makes intelligent management systems more human-oriented.

4.4. Establishment of an agile response system for cultural evolution

Constructing a cultural management framework that includes grassroots feedback channels, intelligent monitoring nodes, and a rapid decision-making center can significantly improve the response speed of corporate cultural evolution [5]. A large retail enterprise deployed Internet of Things devices in its stores to collect multi-dimensional information such as sales data, employees' behavior data, and customer feedback data in real time. Using anomaly detection algorithms to analyze this data, it can promptly identify cultural deviation signals, such as a decline in employees' service attitudes or an increase in customer complaints. Once an abnormal situation is detected, the system immediately triggers an early-warning mechanism and notifies a cross-departmental agile team composed of senior management, department heads, and grassroots employee representatives. After receiving the notice, the agile team can quickly analyze the problem, make decisions, and formulate corresponding cultural adjustment plans. After the implementation of this system, the enterprise's cultural adjustment cycle was shortened from an average of 6 months to 1.5 months, and business collaboration efficiency increased by 30%. This agile response system enables corporate culture to quickly adapt to the needs of technological changes and business development, maintaining the timeliness and effectiveness of cultural management.

5. Conclusion

Under the profound influence of artificial intelligence technology, corporate culture management has become an indispensable key element in the intelligent transformation of enterprises. Facing many challenges such as semantic deviations in the digital representation of cultural elements, conflicts between algorithmic decision-making and humanistic values, cultural perception gaps in human-machine interaction, and lag in the responsiveness of cultural evolution, enterprises need to break free from the constraints of traditional management thinking and construct a new cultural management system with data-driven as the foundation, cognitive collaboration as the core, emotional interaction as the link, and agile response as the guarantee. Through quantitative analysis and technological empowerment, the transformation of corporate culture management from experience-driven to intelligent decision-making can be realized, and a dynamic balance between technological

rationality and humanistic care can be found, providing solid cultural support for the sustainable development of enterprises. In the future, with the continuous development of artificial intelligence technology and the continuous expansion of application scenarios, corporate culture management also needs to further explore model innovation within the ethical framework of artificial intelligence and new forms of cultural management in emerging technology scenarios such as the meta-universe to adapt to the ever-changing development needs of enterprises.

Disclosure statement

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References

[1] Huang T, 2025, Research on the Optimization Path of State-Owned Enterprise Management under the New Normal of the Economy. Market Modernization, (11): 126–129.

[2] Han L, 2025, The Impact of Corporate Culture on Corporate Economic Development and Its Promotion Methods. Industrial Innovation Research, (10): 135–137.

[3] Sun H, Zhang J, 2025, Exploration of the Work Path for Strengthening Corporate Culture Construction. Agriculture Development and Finance, (05): 88–90.

[4] Zhou X, 2025, Research on the Role of Corporate Culture in Enterprise Management. Urban Development, (09): 173–175.

[5] Qin P, 2024, The Development Path of Enterprise Management in the Context of Artificial Intelligence. Cloud, (29): 109–111.

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Investment Risk Assessment of Sporting Goods Manufacturing Enterprises in Countries Along the Belt and Road Initiative

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Abstract: With the continuous promotion of the Belt and Road initiative, the sporting goods manufacturing industry, as a key sector of Chinese enterprises' "going global" strategy, is actively expanding the markets of countries along the Belt and Road. However, there are significant differences in political, economic, and social environments among countries along the Belt and Road, which bring considerable uncertainties to the transnational investment of enterprises. Based on the investment environment of 70 countries along the Belt and Road, this paper constructs a risk evaluation index system including five dimensions: political and legal, economic and financial, socio-cultural, investment environment, and bilateral relations. The Criteria Importance Through Intercriteria Correlation (CRITIC) method is used to determine weight, Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method is employed to evaluate the investment risks of each country. Furthermore, cluster analysis is used to classify the countries into low, medium, and high-risk levels. Finally, policy recommendations are proposed based on the characteristics of countries with different risk levels, providing decision-making references for sporting goods manufacturing enterprises in selecting suitable countries for investment, enhancing risk prevention capabilities, and improving investment success rates.

Keywords: The Belt and Road Initiative; Sporting goods manufacturing enterprises; Risk assessment; CRITIC method; TOPSIS method

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1. Introduction

The Belt and Road Initiative (BRI) is an important attempt by China to achieve sustained economic growth by exploring new forms of international economic cooperation with new partners [1]. Although the initiative has aroused doubts from some countries, it aims to achieve mutual benefit and win-win with partners and promote common development [2]. In the continuous exchanges, the areas of cooperation between China and other co-construction

countries have been continuously expanded, and the level of cooperation has been continuously deepened, which has made contributions to promoting the economic and social progress of the co-construction countries. Since it was put forward in 2013, more than 150 countries and more than 30 international organizations have joined the BRI, with China's cumulative trade with partner countries exceeding USD 21 trillion and direct investment exceeding USD 270 billion. Against the backdrop of the deepening BRI cooperation, the sporting goods manufacturing industry, as one of the important sectors in China's "going global" strategy, is actively participating in the initiative by developing and collaborating in the markets of BRI countries.

In recent years, with the traction of large-scale events such as the Olympic Games and the World Cup, as well as the rising global fitness trend, the demand for sportswear, fitness equipment, and outdoor equipment in countries along the BRI continues to increase. In 2024, China's sporting goods exports totaled US$29.883 billion, of which US$5.7 billion was exceeded in the BRI and RCEP regions. Furthermore, 15.6% of Chinese sporting goods enterprises have already established or planned overseas operations. The potential of emerging markets such as Southeast Asia, the Middle East, and Latin America continues to be released, and the export of sporting goods to these regions is growing rapidly, attracting Chinese sporting goods manufacturers to take the initiative to invest. However, opportunities and challenges coexist. Different development stages, social culture, and institutional environment of countries along the BRI have brought many uncertainties to the investment and operation management of sporting goods manufacturing enterprises. How to effectively and scientifically evaluate and manage the risks brought by these uncertainties has become the premise of successful transnational investment.

Based on this, this paper constructs an investment risk evaluation index system from the perspective of five risk dimensions faced by Chinese sporting goods manufacturing enterprises when investing in countries along the BRI, and quantitatively analyzes the risk level of the BRI countries, aiming to improve the success rate and scientific decision-making of transnational investment of sporting goods manufacturing enterprises. The main contributions of this paper are as follows: (1) From the perspective of political and legal, economic and financial, socio-cultural, investment environment, and bilateral relations, appropriate indicators are selected to construct a comprehensive investment risk evaluation index system, which systematically captures the potential risks that sporting goods manufacturing enterprises may encounter in transnational investments; (2) Criteria Importance Through Intercriteria Correlation (CRITIC) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) are used to comprehensively evaluate the investment risks of 70 countries along the BRI, and cluster analysis is used to classify them according to the risk levels, which provides investment decision-making reference for sporting goods manufacturing enterprises.

2. Literature review

2.1. Research on investment risk of the Belt and Road Initiative

Since the Belt and Road Initiative was put forward, the risks faced by Chinese enterprises in foreign investment in BRI countries have attracted wide attention. Existing research has primarily focused on traditional industries such as energy, infrastructure, and mineral resources. Duan *et al.* developed a fuzzy comprehensive evaluation model based on the entropy weight method to assess the energy investment risks in 50 BRI countries [3]. Yuan *et al.* put forward a nine-dimensional index system including economic, financial, social, political, power prospect, resources, and environmental risks, and constructed a fuzzy comprehensive evaluation model based on entropy weight to evaluate the power investment risks of 21 BRI countries [4]. Andrić *et al.* proposed a novel risk assessment method,

which combined fuzzy matrix, fuzzy logic, and this road theory, and assessed the risks of BRI infrastructure projects [5]. Xiang *et al.* constructed a six-dimensional investment index evaluation system including political, socio-economic, resource potential, environmental risks, and China factors, and evaluated the investment risks of mineral resources in 50 BRI partner countries [6]. Yang *et al.* systematically studied the political risks of China's energy infrastructure investment in countries along the BRI within a unified framework [7]. Tang *et al.* used the game theory model combined with global entropy method and the analytic hierarchy process to determine the combination weight and utilized the TOPSIS-GRA model to evaluate the oil and gas investment risk in BRI countries [8].

In the existing literature, the sporting goods manufacturing industry is a non-resource-dependent, asset-light, export-oriented industry; its overseas investment-related risk research is relatively few. Although representative enterprises such as Anta, Li-Ning, and Peak have actively carried out international layout in recent years, systematic identification, evaluation, and analysis of investment risks faced by this industry under the BRI framework are still insufficient. Therefore, this paper focuses on the investment risks of sporting goods manufacturers in BRI countries and enriches the research system of foreign investment risks from the perspective of specific industries.

2.2. Research on risk factors of foreign investment

The identification of foreign investment risk factors is the core content of constructing an investment risk evaluation system. Scholars mostly used qualitative analysis and quantitative empirical approaches in this field. Nikjow *et al.* identified 11 major risks in BRI infrastructure projects by systematic literature review, and constructed a hierarchical relationship model among risks by interpretative structure modeling and the MICMAC analysis method. It was found that economic, environmental, and political risks were highly influential and significantly affected project outcomes [9]. Jiang and Jiang argued that improper supervision will cause the host country to interrupt the development of overseas investment projects to protect its own interests. It is necessary to standardize the investment behavior of Chinese overseas investors and improve their adaptability in the BRI countries, so as to better achieve the sustainable development goal of overseas investment [10]. Li and Tang, based on panel data from 58 BRI countries, empirically tested the influence mechanism of national financial risks on China's OFDI. They concluded that the host country's financial risks will inhibit China's OFDI inflow and squeeze investment into neighboring countries [11]. Guo combed the tax risks and concrete performances faced by enterprises in participating in the construction of BRI, and proposed coping strategies from the perspectives of enterprises, governments, and international cooperation [12]. Xiang *et al.* constructed an investment risk evaluation index system for BRI countries from five dimensions—political, social, economic, construction environment, and relations with China—and revealed the dynamic temporal and spatial patterns of railway investment risks in BRI countries from 2010 to 2018 [13].

Existing research generally categorizes outbound investment risks into multiple dimensions, such as political, economic, and social risks. Building on the established frameworks of outbound investment risk identification and considering the characteristics of the sporting goods manufacturing industry, this paper constructs a risk evaluation index system suitable for sporting goods enterprises investing in BRI countries from five dimensions: political and legal, economic and financial, socio-cultural, investment environment, and bilateral relations.

In summary, the research on the risk of foreign investment under the BRI framework has been sufficient, covering many dimensions such as political, economic, and social factors, and the relevant theoretical framework and evaluation methods have gradually matured, but the research on the specific industry of sporting goods manufacturing is still relatively scarce. The existing literature generally lacks in-depth analysis of the foreign investment risks of this industry and has not yet established a targeted risk identification and evaluation model. Therefore,

combined with the characteristics of the industry, this paper integrates the characteristics of the industry, constructs a multi-dimensional risk assessment index system, and applies the CRITIC method and the TOPSIS method to evaluate the investment risks of BRI countries, with the aim of providing decision-making references for relevant enterprises and contributing to the literature on investment risk research in industry-specific contexts.

3. Construction of investment risk evaluation index system for Chinese sporting goods manufacturing enterprises

Establishing a scientific and reasonable index system is a crucial step in investment risk evaluation. Based on existing research, combined with the industry characteristics of sporting goods manufacturing enterprises, this paper comprehensively evaluates the transnational investment risks of sporting goods manufacturing enterprises from five dimensions: political and legal, economic and financial, socio-cultural, investment environment, and bilateral relations. Each dimension contains several secondary indicators, and ultimately, a risk assessment index system comprising five primary indicators and 24 secondary indicators is constructed.

3.1. Political and legal risk

Political and legal risks are a key factor affecting the success or failure of enterprises' foreign investment. The stability of the political situation and the soundness of laws and regulations in the host country are directly related to whether enterprises can operate smoothly in the local area, achieve the expected goals, and protect their legitimate rights and interests [14]. In cases of political turmoil or weak legal institutions, enterprises may face risks such as contract breach, property right loss, and expropriation. This paper selects the following secondary indicators to describe political and legal risk:

(1) Government efficiency: Measures the capacity and efficiency of the host government in public service delivery, policy implementation, and public sector management.

(2) Government stability: Measures the ability of the host government to implement its announced plan and its ability to continue to govern.

(3) Control of corruption: Measures the ability of the host government to curb corruption.

(4) Political freedom: Measures the participation degree of citizens in the host country in the election of the government, as well as freedom of speech and press.

(5) Regulatory quality: Measures the capacity and efficiency of the host government in designing and implementing policies and regulations.

(6) Rule of law: Measures the effectiveness and fairness of the host country's legal system and its binding effect on social behavior.

(7) Geopolitics: The geopolitical risk index is used to measure the political stability of the host country, the risk of conflict, and its international strategic position.

3.2. Economic and financial risk

A country's economic development level and financial system stability will directly affect the profitability and capital security of enterprises [15]. High inflation, high unemployment rate, or significant exchange rate fluctuations increase operational uncertainty and financial risk for enterprises. This paper selects the following secondary indicators to describe economic and financial risk:

(1) Exchange rate fluctuations: Exchange rate stability is used to measure fluctuations in the exchange rate of

the host country's currency.

(2) Economic development level: Per capita GDP is used to measure the economic development level of the host country.

(3) Inflation: Inflation is measured by the annual growth rate of the GDP implicit price deflator.

(4) Investment openness: The proportion of foreign direct investment (FDI) to GDP is used to measure the host country's dependence on foreign capital and its investment openness [16].

(5) Unemployment rate: Measures the stability of the labor market and the ability of the economy to absorb employment in the host country.

3.3. Socio-cultural risk

Socio-cultural risk mainly stems from the unstable social environment of the host country and the differences in language, religion, and values between the host country and the home country [17]. This paper selects the following secondary indicators to describe socio-cultural risk:

(1) Social security: The crime index is used to measure the level of security in the host society.

(2) Cultural differences: The cultural distance index is used to measure the cultural differences between the home and host countries.

(3) Labor quality: Measures the quality of the host country's labor force by the average number of years of schooling of the labor force.

(4) Religious tensions: Measures the level of conflict and tension between different religious groups in the host country.

(5) Ethnic relations: Measures the degree of tension between different ethnic or racial groups within the host country.

3.4. Investment environment risk

The risk of the investment environment is mainly the institutional obstacles and market access costs faced by enterprises carrying out business in the host country. In this paper, the following secondary indicators are selected to describe the investment environment risk:

(1) Investment profile: Measures the host country's institutional guarantee ability for foreign-funded enterprises in terms of contract guarantee, profit repatriation, and government payment.

(2) Taxation: Measures the complexity and cost burden of tax payment procedures of enterprises in host countries.

(3) Dispute resolution: Measures the timeliness and fairness of the host country in contract dispute resolution.

(4) Business environment: Measures the business environment of the host country using the ease of doing business index.

3.5. Bilateral relations

With the continuous evolution of the international situation, bilateral relations have become an important external risk variable affecting the overseas investment decisions and security of enterprises [18]. This paper selects the following secondary indicators to describe bilateral relations:

(1) BIT signing status: Whether the host country has signed a Bilateral Investment Treaty (BIT) with China, with 1 for signed and 0 for not signed.

(2) Diplomatic relations: The time when China and the host country established diplomatic relations is used to measure the foundation of political cooperation and the stability of relations between the two countries.

(3) Scale of Chinese investment: China's investment stock in the host country is used to measure the close degree of bilateral economic relations.

This paper is based on data from 2022, with data primarily obtained from official databases. The attributes of each indicator and their data sources are detailed in **Table 1**.

Table 1. Investment risk evaluation indicators for sporting goods manufacturing enterprises

First-level indicators	Second-level indicators	Type	Data source
Political and legal risk	Government efficiency	+	WGI
	Government stability	+	WGI
	Control of corruption	+	WGI
	Political freedom	+	WGI
	Regulatory quality	+	WGI
	Rule of law	+	WGI
	Geopolitics	−	CEIC
Economic and financial risk	Exchange rate fluctuations	+	ICRG
	Economic development level	+	WDI
	Inflation	−	WDI
	Investment openness	+	WDI
	Unemployment rate	−	WDI
Socio-cultural risk	Social security	−	Numbeo
	Cultural differences	−	Hofstede
	Labor quality	+	UNDP
	Religious tensions	+	ICRG
	Ethnic relations	−	ICRG
Investment environment risk	Investment profile	+	ICRG
	Taxation	−	WDI
	Dispute resolution	−	WDI
	Business environment	−	WDI
Bilateral relations	BIT signing status	+	Ministry of Commerce
	Diplomatic relations	+	Ministry of Foreign Affairs
	Scale of Chinese investment	+	Bulletin on Foreign Investment

4. Investment risk evaluation of Chinese sporting goods manufacturing enterprises

4.1. Sample selection

Since the Belt and Road Initiative was put forward, Chinese sporting goods manufacturers have actively expanded overseas markets and carried out multi-form and multi-level cooperation with BRI countries. Based on available data, this paper selects 70 representative countries as the research objects. The names and regional distribution of these countries are presented in **Table 2**.

Table 2. Countries and regions of distribution

Region	Country
Asia	Afghanistan, United Arab Emirates, Pakistan, Philippines, Kazakhstan, South Korea, Kyrgyzstan, Cambodia, Qatar, Laos, Bangladesh, Myanmar, Nepal, Saudi Arabia, Tajikistan, Thailand, Turkey, Turkmenistan, Brunei, Uzbekistan, Singapore, Syria, Iran, Indonesia, Vietnam.
Africa	Ethiopia, Burundi, Ghana, Cameroon, Kenya, Mali, Morocco, Mozambique, Sudan, Nigeria, Senegal, Tanzania, Uganda, Zambia.
Europe	Albania, Austria, Poland, Russia, Czech Republic, Latvia, Lithuania, Luxembourg, Romania, Moldova, Serbia, Ukraine, Hungary, Italy.
North America	Panama, Costa Rica, Cuba, Nicaragua, Jamaica.
South America	Argentina, Brazil, Peru, Colombia, Guyana, Suriname, Venezuela, Uruguay, Chile.
Oceania	Fiji, Tonga, New Zealand.

4.2. Comprehensive evaluation of investment risk based on the CRITIC-TOPSIS method

Based on the established risk evaluation index system, this paper uses the CRITIC method and TOPSIS method to build a comprehensive evaluation model. CRITIC method is an objective weighting method, which can reasonably determine the weights of indexes by evaluating the variation degree and conflict among indexes, and avoid subjective deviation to a certain extent [19]. TOPSIS is a commonly used multi-criteria decision-making method. By constructing positive and negative ideal solutions and calculating the proximity of countries to ideal states, the risk ranking can be realized [20]. The specific steps are as follows:

(1) Construct evaluation matrix *X*.

For the evaluation of $n = 70$ countries, there are $m = 24$ indicators, x_{ij} represent the *jth* indicator value of the *ith* country and *X* is the evaluation matrix.

$$X = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \vdots & \vdots & x_{ij} & \vdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix} \quad (1)$$

(2) The normalized matrix is obtained by dimensionless processing, $Z = [z_{ij}]$.

For benefit indicators,

$$z_{ij} = x_{ij} - x_{imin} / x_{imax} - x_{imin} \quad (2)$$

For cost indicators,

$$z_{ij} = x_{imax} - x_{ij} / x_{imax} - x_{imin} \quad (3)$$

(3) Indicator variability.

$$\overline{z_j} = 1/m \sum_{i=1}^{m} z_{ij} \quad (4)$$

$$S_j = \sqrt{\sum_{i=1}^{m} \left(z_{ij} - \overline{z_j}\right)^2 / m - 1} \quad (5)$$

Where $\overline{z_j}$ is the average value of the *jth* index, S_j is the standard deviation of the *jth* index, reflecting the variability of the *jth* index.

(4) Indicator conflict.

$$r_{jk} = \frac{\sum_{i=1}^{m}\left(z_{ij} - \overline{z_j}\right)\left(z_{ik} - \overline{z_k}\right)}{\sqrt{\sum_{i=1}^{m}\left(z_{ij} - \overline{z_j}\right)^2}\sqrt{\sum_{i=1}^{m}\left(z_{ik} - \overline{z_k}\right)^2}} \tag{6}$$

$$R_j = \sum_{k=1}^{n}\left(1 - r_{jk}\right), k \neq j \tag{7}$$

Where r_{jk} is the correlation coefficient between index j and index k, R_j is the conflict of index.

(5) Index weight.

$$C_j = S_j \sum\nolimits_{k=1}^{n}\left(1 - r_{jk}\right) = S_j \times R_j \tag{8}$$

$$w_j = \frac{C_j}{\sum_{j=1}^{n} C_j} \tag{9}$$

Where C_j is the information amount of the *jth* index, w_j is the weight of the *jth* index.

(6) Standardized weighting matrix.

$$V = \left[v_{ij}\right]_{m\times n} = \left[z_{ij} \times w_j\right]_{m\times n} \tag{10}$$

(7) Positive and negative ideal solutions of the index.

$$v_j^+ = max\left\{v_{1j}, v_{2j}, v_{3j}, \ldots, v_{mj}\right\}, j = 1,2, \ldots, n \tag{11}$$

$$v_j^- = min\left\{v_{1j}, v_{2j}, v_{3j}, \ldots, v_{mj}\right\}, j = 1,2, \ldots, n \tag{12}$$

(8) Weighted Euclidean distances from countries to positive and negative ideal solutions.

$$D_i^+ = \sqrt{\sum_{j=1}^{n}\left(v_{ij} - v_j^+\right)^2} \tag{13}$$

$$D_i^- = \sqrt{\sum_{j=1}^{n}\left(v_{ij} - v_j^-\right)^2} \tag{14}$$

(9) Comprehensive evaluation index of investment risk.

$$G_i = \frac{D_i^-}{D_i^+ + D_i^-}, G_i \in [0,1] \tag{15}$$

Where the larger the G_i value, the closer the *ith* country is to the ideal value and the smaller the risk.

In this paper, MATLAB R2024b software was used to achieve comprehensive evaluation of cooperation risks in various countries, the risk evaluation results of each country are shown in **Table 3**.

Table 3. TOPSIS score results and rankings of countries

State	Score	Rank	State	Score	Rank
Venezuela	0.341	1	Laos	0.571	36
Suriname	0.401	2	Tajikistan	0.573	37
Nicaragua	0.402	3	Turkmenistan	0.574	38
Mozambique	0.406	4	Tanzania	0.575	39
Cameroon	0.408	5	Cuba	0.586	40
Burundi	0.412	6	Cambodia	0.591	41
Colombia	0.426	7	Guyana	0.593	42
Uganda	0.443	8	Kyrgyzstan	0.594	43
Senegal	0.451	9	Morocco	0.596	44
Costa Rica	0.451	10	Russia	0.601	45
Panama	0.454	11	Ghana	0.604	46
Brazil	0.456	12	Albania	0.605	47
Nepal	0.464	13	Uzbekistan	0.613	48
Zambia	0.474	14	Kazakhstan	0.624	49
Kenya	0.475	15	Uruguay	0.625	50
Syria	0.480	16	Peru	0.627	51
Sudan	0.492	17	Philippines	0.630	52
Serbia	0.492	18	Moldova	0.634	53
Brunei	0.495	19	Saudi Arabia	0.643	54
Tonga	0.496	20	Vietnam	0.647	55
Fiji	0.500	21	Indonesia	0.648	56
Chile	0.501	22	Thailand	0.654	57
Jamaica	0.502	23	Italy	0.662	58
Afghanistan	0.514	24	Qatar	0.663	59
Latvia	0.524	25	Romania	0.670	60
Iran	0.532	26	Hungary	0.670	61
Ethiopia	0.537	27	Lithuania	0.677	62
Ukraine	0.539	28	Poland	0.688	63
Nigeria	0.541	29	Luxembourg	0.695	64
Myanmar	0.548	30	Austria	0.700	65
Mali	0.550	31	Singapore	0.704	66
Bangladesh	0.554	32	UAE	0.705	67
Argentina	0.555	33	Korea	0.707	68
Turkey	0.568	34	Czech Republic	0.728	69
Pakistan	0.569	35	New Zealand	0.735	70

4.3. Classification of investment risk based on cluster analysis

In order to further identify the differences in the level of cooperation risks in different countries, this paper uses a hierarchical cluster analysis method to classify the risks of different countries. Based on the tree structure analysis of hierarchical clustering, the best cluster number is determined to be K = 3, and the clustering results are shown in **Table 4**.

Table 4. Results of cluster analysis

Risk level	Country
High risk	Venezuela, Suriname, Nicaragua, Mozambique, Cameroon, Burundi, Colombia, Uganda, Senegal, Costa Rica, Panama, Brazil, Nepal, Zambia, Kenya, Syria, Sudan, Serbia, Brunei, Tonga, Fiji, Chile, Jamaica.
Medium risk	Afghanistan, Latvia, Iran, Ethiopia, Ukraine, Nigeria, Myanmar, Mali, Bangladesh, Argentina, Turkey, Pakistan, Laos, Tajikistan, Turkmenistan, Tanzania, Cuba, Cambodia, Guyana, Kyrgyzstan, Morocco, Russia, Ghana, Albania, Uzbekistan.
Low risk	Kazakhstan, Uruguay, Peru, Philippines, Moldova, Saudi Arabia, Vietnam, Indonesia, Thailand, Italy, Qatar, Romania, Hungary, Lithuania, Poland, Luxembourg, Austria, Singapore, United Arab Emirates, South Korea, Czech Republic, New Zealand.

5. Results and discussion

According to the previous research results, the 70 countries are classified into three categories according to their risk levels: low-risk, medium-risk, and high-risk. Low-risk countries include Kazakhstan, Uruguay, Peru, the Philippines, Moldova, Saudi Arabia, and 16 other countries. Among them, Asian countries are mainly concentrated in Southeast Asia and West Asia. Most of these countries have close economic and trade exchanges with China under the Belt and Road Initiative framework, relatively stable political environments, and favorable policies, make them priority destinations for Chinese enterprises' transnational investments. European countries, such as Italy, Austria, Poland, the Czech Republic, etc., are mostly EU member States, with highly legalized market economic systems, high policy transparency, perfect social security, and mature labor systems, which are also important areas for enterprises to invest. As a developed country, New Zealand has a superior business environment, is friendly to foreign investment, and has a high degree of integration between the sports industry and culture, which can bring a higher value-added market to sporting goods manufacturers, and is one of the most attractive countries for transnational investment.

Medium-risk countries include Afghanistan, Latvia, Iran, Ethiopia, Ukraine, Nigeria, Myanmar, Mali, and 17 other countries, mainly distributed in Asia and Africa. Most of these countries are in the stage of institutional transition or development, and have certain investment potential, but they still face many challenges such as policy and economy. For example, Afghanistan, Iran, and Ukraine have had frequent geopolitical conflicts in recent years, with ongoing domestic political instability, which increases the uncertainty of investments. Nigeria and Ethiopia have imperfect legal systems and weak government supervision. For foreign-funded enterprises, weak legal frameworks and insufficient government oversight result in high risks for foreign enterprises in terms of contract enforcement and property rights protection. Countries like Ghana and Tajikistan suffer from underdeveloped infrastructure and high logistics costs, which reduce investment efficiency and returns. In addition, Cambodia, Uzbekistan, and other Southeast Asian and Central Asian countries maintain good relations with China under the Belt and Road Initiative. Significant differences in cultural identity and institutional environments, coupled with low levels of economic development and immature business environments, constrain enterprises in market entry and

operational management.

High-risk countries include Venezuela, Suriname, Nicaragua, Mozambique, Cameroon, Burundi, Colombia, Uganda, and 15 other countries, mainly distributed in Africa and Latin America. Mozambique, Cameroon, and other African countries have weak rule-of-law systems, poor governance capacity, and high levels of corruption, leaving foreign enterprises without effective legal remedies and subject to high institutional transaction costs. Venezuela, Zambia, and other American countries have been facing the influence of civil strife and extremist forces for a long time, with frequent regime changes, weak law enforcement, widespread economic risks such as hyperinflation and high foreign debt pressure, which have seriously affected the entry of foreign capital. Countries such as Nepal and Syria have undiversified economic structures, poor public security, and tense labor relations, which may threaten the personal safety of foreign enterprise staff. In some Pacific Island countries such as Tonga and Fiji, due to their limited market demand, obvious language and cultural barriers, it is difficult to localize sporting goods brands and expand the market, which constitutes the main obstacle for enterprises to invest.

6. Conclusion and policy recommendations

This paper constructed a risk evaluation index system including 5 first-level indicators and 24 second-level indicators. Based on the CRITIC method, the weighting results show that political and legal risk and socio-cultural risks are the two dimensions that have the greatest impact on enterprise investment. Among the secondary indicators, BIT signing status, business environment, diplomatic relations, social security, unemployment rate, inflation, and geopolitics have higher weights and warrant particular attention from enterprises. The comprehensive evaluation of investment risk in 70 Belt and Road countries using the TOPSIS method reveals that Asian and European countries generally exhibit lower investment risks. These countries typically maintain close trade ties with China, have relatively stable political environments, and higher levels of economic development. In contrast, some African and American countries show higher risks, mainly due to geopolitical instability, weak economic foundations, and poor public security.

Based on the above conclusions, this paper puts forward the risk prevention measures for Chinese sporting goods manufacturing investing in Belt and Road countries, from both the enterprises and government perspectives:

For enterprises, it is essential to enhance risk awareness and management capabilities. First, conduct comprehensive multidimensional risk assessments of the host country—including political, legal, economic, and socio-cultural aspects—prior to investment decisions, and select investment destinations scientifically based on their own resources and capabilities. Second, establish and improve the overseas investment risk management system, strengthen the ability of contract management and tax planning, and improve the level of coping with sudden risks such as exchange rate fluctuations and legal disputes.

For the government, it is necessary to optimize the external investment environment and support services. First, strengthen diplomatic coordination with countries along the route, promote more countries to sign bilateral investment agreements and other documents, and provide legal and institutional guarantees for overseas investment of enterprises. Second, establish and improve external investment service platforms, regularly release investment environment assessments and risk warning information for Belt and Road countries, and provide enterprises with timely and authoritative decision-making references.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Huang Y, 2016, Understanding China's Belt & Road Initiative: Motivation, Framework and Assessment. China Economic Review, 40: 314–321.

[2] Dunford M, 2021, China's Belt and Road Initiative and Its Implications for Global Development. Acta Via Serica, 6(1): 91–118.

[3] Duan F, Ji Q, Liu BY, et al., 2018, Energy Investment Risk Assessment for Nations along China's Belt & Road Initiative. Journal of Cleaner Production, 170: 535–547.

[4] Yuan J, Zeng Y, Guo X, et al., 2018, Electric Power Investment Risk Assessment for Belt and Road Initiative Nations. Sustainability, 10(9): 3119.

[5] Andrić JM, Wang J, Zou PXW, et al., 2019, Fuzzy Logic–Based Method for Risk Assessment of Belt and Road Infrastructure Projects. Journal of Construction Engineering and Management, 145(12): 04019082.

[6] Xiang Y, Zhang Q, Wang D, et al., 2022, Mining Investment Risk Assessment for Nations along the Belt and Road Initiative. Land, 11(8): 1287.

[7] Yang F, Gan Q, Guo L, 2023, Political Risks to China's Energy Infrastructure Investment in Countries along the Belt and Road. Energies, 16(18): 6461.

[8] Tang BJ, Ji CJ, Zheng YX, et al., 2024, Risk Assessment of Oil and Gas Investment Environment in Countries along the Belt and Road Initiative. Petroleum Science, 21(2): 1429–1443.

[9] Nikjow MA, Liang L, Xijing Q, et al., 2022, Risk Analysis of Belt and Road Infrastructure Projects Using Integrated ISM-MICMAC Approach. Journal of Modelling in Management, 17(4): 1410–1431.

[10] Jiang ZL, Jiang ML, 2022, Research on the Sustainability of China's Overseas Investment under the "Belt and Road" Initiative. On Economic Problems, (7): 35–43.

[11] Li T, Tang JQ, 2022, Research on the Influence of Financial Risks in the Countries Along the Belt and Road on China's OFDI. International Economics and Trade Research, 38(03): 36–50.

[12] Guo M, 2023, Research on Tax Risks of Enterprises' Overseas Investment under the New Situation of the Belt and Road Initiative. Communication of Finance and Accounting, (16): 131–136.

[13] Xiang PC, Liu SJ, Duan X, 2025, Research on Comprehensive Evaluation of Railway Investment Risk in Countries Along "the Belt and Road." Journal of Industrial Technology and Economy, 44(02): 139–149.

[14] Hou J, Li G, Ling J, et al., 2023, Mineral Investment Risk Assessment of Host Countries Based on a Cloud Matter-Element Model. Gospodarka Surowcami Mineralnymi, 39.

[15] Zhang M, Pang Z, Liu L, et al., 2024, Risk Assessment of China's Overseas Energy Investments Considering the Response Ability to Major Risk Events: A Case Study of COVID-19. Energy, 288: 129783.

[16] Jiang J, Ao L, 2023, Risk Evaluation and Prevention of China's Investment in Countries along the Belt and Road. Journal of Intelligent & Fuzzy Systems, 44(2): 1645–1659.

[17] Li B, 2022, Risk Assessment of OFDI for Technology-Based Enterprises under the Background of "One Belt One Road." Discrete Dynamics in Nature and Society, 2022(1): 6113930.

[18] Wu Y, Wang J, Ji S, et al., 2020, Renewable Energy Investment Risk Assessment for Nations along China's Belt & Road Initiative: An ANP-Cloud Model Method. Energy, 190: 116381.

[19] Diakoulaki D, Mavrotas G, Papayannakis L, 1995, Determining Objective Weights in Multiple Criteria Problems:

The Critic Method. Computers & Operations Research, 22(7): 763–770.

[20] Hwang CL, Yoon K, 1981, Methods for Multiple Attribute Decision Making. Multiple Attribute Decision Making: Methods and Applications a State-of-the-Art Survey, 1981: 58–191.

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Research on the Impact of Green Finance on Industrial Structure Optimization: Based on an Empirical Study of the Six Provinces in Central China

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Abstract: Green finance, as an important policy to promote high-quality economic development, has become a focus of attention in the academic and policy circles for its promotion of industrial structure optimization. Based on the data of six provinces in Central China from 2010 to 2023, this paper constructs a comprehensive index of green finance development by using entropy value method and empirically analyses the impact of green finance on industrial structure optimization. The results show that the level of green finance development has a significant contribution to the optimization of the industrial structure in the central region. Accordingly, this study provides suggestions for deepening green finance reform and accelerating industrial transformation and upgrading.

Keywords: Green finance; Industrial structure optimization; Green finance development index

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1. Introduction

Since the reform and opening up, China's economy has experienced rapid industrialization, with significant growth in economic output. However, this GDP-oriented development model has often neglected the sustainability of resources and the environment [1]. At present, the global promotion of green low-carbon development has become an unstoppable trend, and the green economy has become a new high ground for international industrial competition. Therefore, accelerating the transformation of the development mode, and promoting the formation of green and low-carbon production and lifestyle are of great significance.

The 20th Party Congress stressed that accelerating the promotion of industrial structure optimization is the key to green development. Therefore, the role of the financial sector cannot be ignored. However, there are significant differences in green finance development and industrial structure among different provinces in China. Based on this background, this paper selects the data of the six provinces of Central China (Shanxi, Anhui, Jiangxi, Henan, Hubei, Hunan Provinces) from 2010 to 2023 as the research object, makes an in-depth investigation of the relationship between green finance and the optimization of industrial structure, and provide suggestions for promoting the optimization of industrial structure with the help of the development of green finance, with a view to

providing theoretical support and practical reference for the sustainable development of the regional economy.

2. Literature review and research hypothesis

Green finance was first defined by Salazar (1998) as an innovative way for the financial industry to meet the financing needs of the industry, emphasising its importance in the economic development [2]. Scholars believe that green finance pays more attention to environmental factors in the economic growth by strengthening collaboration between the financial and environmental sectors, and by rationally allocating green financial resources to achieve sustainable development [3–5]. In China's green financial policy framework, green credit policy implementation is of high quality, which optimizes resource allocation, promotes economic restructuring, and industrial upgrading [6, 7].

Some scholars have proposed that industrial structural transformation can be subdivided into industrial rationalization and upgrading, and green finance has a key role in promoting structural transformation of industries in the central region [8]. Industrial structural adjustment involves the reallocation of production factors and changes in the proportion of production value among economic sectors, and relevant policies can promote the green transformation of industries and the sustainable development of the regional economy [9–11].

Regarding on the relationship between green finance and industrial structure, some scholars pay attention to the impact of green finance on industrial structural adjustment, pointing out that there is an interaction between the financial structure and industrial transformation [12–14]. Some studies show that green finance significantly promotes industrial transformation [15–16]. In addition, some studies have found that the synergistic effect of fintech and green finance is significant, and the green finance policy can promote the transformation and upgrading of industrial structure in pilot areas [17, 18]. Therefore, this paper puts forward the research hypothesis: The development of green finance can promote the optimization of industrial structure.

3. Research design

3.1. Research variables

3.1.1. Explained variables

This paper chooses the degree of optimization of industrial structure (ITR) as explained variables, including rationalization of industrial structure(theil), advancement of industrial structure (ais1) and upgrading of in industrial structure (ais2) [19, 20].

The Tel index takes the value of 0, it indicates that the resource allocation among industries reaches the optimal state; on the contrary, if the index deviates from 0, it reflects the existence of uncoordinated phenomenon of inter-industry development, the efficiency of resource allocation needs to be improved, and the industrial structure is unreasonable. The specific formula is as follows:

$$\mathrm{theil}_{i,t} = \Sigma_{m=1}^{3} y_{i,m,t} \ln\left(\frac{y_{i,m,t}}{l_{i,m,t}}\right), m = 1,2,3$$

The advancement of industrial structure is expressed by the industrial structure hierarchy coefficient, which denotes the proportion of industry *m* in region *i* to the regional GDP in period *t*. The specific calculation formula is as follows:

$$\mathrm{ais1}_{i,t} = \Sigma_{m=1}^{3} y_{i,m,t} \times m, m = 1,2,3$$

The upgrading of industrial structure adopts the ratio of output value between the secondary industry and the tertiary industry, and the specific calculation formula is:

$$ais2_{i,t} = y_{i,3,t}/y_{i,2,t}$$

Where, $y_{i,3,t}$ denotes the proportion of the tertiary industry in region *i* in period *t* in the GDP, $y_{i,2,t}$ denotes the proportion of the secondary industry in region *i* in period *t* in the GDP.

3.1.2. Explanatory variable

This paper selects green financial development level (GRFI) as the key explanatory variable. Green financial development involves five segments: green credit, green investment, green insurance, green securities, and carbon finance [21]. Further, entropy method is used to measure the weight of each indicator. The measures and the weights of each indicator are shown in **Table 1**.

Table 1. Green finance development level indicators and their weights

Variables	Measures	Weights
Green credit	Bank loans of A-share listed environmental protection enterprises/ Total loans of financial institutions	18.47 %
	Interest expenditure of six major energy-consuming industries/ Total industrial interest expenditure	3.57%
Green investment	Expenditure on energy saving and environmental protection/ General budget expenditure	8.07%
	Total investment in environmental pollution control/ GDP	31.43 %
Green insurance	Agricultural insurance payout expenditure/ Agricultural insurance revenue	5.52%
	Agricultural insurance expenditure/Total property insurance expenditure	7.19%
Green securities	A-share value of environmental protection enterprises/ A-share total market capitalization	13.56%
	Energy-consuming enterprises A stock market value/ A shares of total market capitalization	3.44%
Carbon finance	Carbon emission / Loan balance in local and foreign currency	8.77%

3.1.3. Control variables

The control variables include marketisation level (SCH) and the level of opening up to the outside world (OPE).

3.2. Data resources

In this paper, the data of six provinces in central China during 2010-2023 are obtained from Wind database, CEIC data network, EPS database, as well as China Statistical Yearbook, China Financial Statistical Yearbook, China Industrial Statistical Yearbook, China Insurance Statistical Yearbook, China Energy Statistical Yearbook, China Forestry and Grassland Yearbook, China Environmental Statistical Yearbook and provincial statistical yearbooks. For some of the missing values in the dataset, this paper adopts the linear interpolation method to fill them in.

3.3. Model setting

In order to analyze the impact of green finance on industrial structure optimization in six provinces in Central China, the model established in this paper is as follows:

$$ITR_{it} = \alpha_0 + \alpha_1 GRFI_{it} + \alpha_2 COTL_{it} + \varepsilon_{it}$$

Where: *i* and *t* denote the province and time variables respectively. ITR_{it} denotes the degree of optimization of industrial institutions in each province, specifically including rationalization of industrial structure (theil), the advancement of industrial structure (ais1) and upgrading of industrial structure (ais2). $GRFI_{it}$ denotes the level of green finance development in each province. $COTL_{it}$ denotes the control variables, specifically including the de-

gree of openness to the outside world (OPE) and the level of marketisation (SCH). denotes the random term.

4. Empirical analysis

4.1. Descriptive statistics

The mean value of theil is 0.156, indicating that the overall industrial structure of the six provinces is relatively balanced, but the maximum value (0.356) is about eight times as large as the minimum value (0.044), suggesting that there is a difference between the provinces. The mean value of ais1 is 2.340, indicating that the six central provinces are still dominated by the secondary industry. The mean value of of ais2 is 0.972, close to 1, indicating that the scale of the secondary industry and the tertiary industry as a whole is comparable, with a minimum value of 0.5 and a maximum value of 1.509, indicating that the differences between some provinces are significant. The mean value of GRFI is 0.226, and the maximum value (0.610) is 6.5 times of the minimum value (0.094), indicating that some provinces are significantly ahead in terms of green financial policies or market activity.

4.2. Analysis of basic regression results

This paper chooses the random effect regression model to analyze the relationship between the green financial development level (GRFI) and industrial structure optimization (ITR).

The regression analysis in **Table 2** shows that GRFI and Theil are significantly negatively correlated, with a regression coefficient of -0.270 ($p < 0.01$). This indicates that enhancing the development level of green finance can effectively optimize the allocation of regional factor resources and promote the upgrading of industrial structure. Additionally, there is a significant positive correlation between the GRFI and ais1, with a regression coefficient of 0.690 ($p < 0.01$), indicating that the development of green financial development can effectively promote the transformation of the industrial structure from the primary industry to the secondary and tertiary industries. Moreover, regression analysis shows that there is a significant positive correlation between GRFI and ais2, with a regression coefficient of 2.054 ($p < 0.01$). This indicates that the development of green finance can effectively promote the transformation and upgrading of industrial structure.

In summary, the hypothesis of this paper is established. The development of green finance can obviously promote the optimization of industrial structure.

Table 2. Regression results

Variable	(1) Theil	(2) ais1	(3) ais2
GRFI	-0.270***	0.690***	2.054***
	(0.055)	(0.082)	(0.262)
SCH	-0.502**	0.909***	0.749
	(0.217)	(0.208)	(0.666)
OPE	-1.080***	-9.53e-05	0.394
	(0.199)	(0.206)	(0.658)
Constant	0.444***	1.996***	0.308*
	(0.052)	(0.052)	(0.166)
Observations	84	84	84

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$, standard errors are in parentheses, similarly hereinafter.

4.3. Robustness test

In order to verify the above results, the following two methods were used. First, this paper lags one period of green financial development level (GRFI) and reconstructs the regression model. The robustness test results of (1)(2)(3) in **Table 3** show that GRFI with one lag period is significantly negatively correlated with theil, and significantly positively correlated with ais1 and ais2, and the regression coefficients are all significant at the 1% level. Second, this paper further selects the data from 2016–2023 and controls regional effects in the analysis. The results of (4)(5)(6) in **Table 3** show that GRFI is significantly negatively correlated with theil, and significantly positively correlated with ais1 and ais2. The above results not only confirm that the promotion of green finance on industrial structure optimization has a sustained effect, but also further verifies the robustness of the benchmark regression results.

Table 3. Robustness test results

Variables	(1) Theil	(2) ais1	(3) ais2	(4) Theil	(5) ais1	(6) ais2
L.GRFI	-0.283***	0.764***	2.247***			
	(0.067)	(0.102)	(0.328)			
GRFI				-0.085*	(0.201**)	0.863***
				(0.042)	(0.0794)	(0.287)
SCH	-0.422*	0.831***	1.079	-0.402*	0.906**	4.687***
	(0.231)	(0.220)	(0.838)	(0.209)	(0.379)	(1.370)
OPE	-1.136***	0.099	1.194	-0.902***	1.100***	4.520***
	(0.207)	(0.217)	(0.800)	(0.165)	(0.299)	(1.082)
Constant	0.430***	1.999***	0.147	0.342***	2.011***	-0.656*
	(0.058)	(0.060)	(0.218)	(0.053)	(0.096)	(0.346)
Area control				YES	YES	YES
Observations	78	78	78	48	48	48

5. Suggestions

In view of the inter-provincial differences in the development of green finance and industrial structure in the six provinces, it is recommended to implement a regional synergistic development strategy. Firstly, inter-provincial green industry investment funds and special bonds for green technology transformation can be established, focusing on supporting green infrastructure construction and low-carbon transformation of traditional industries in less developed areas. Secondly, a training base for green financial science and technology talents may provide a basis for labor force. Thirdly, a green financial science and technology innovation center can be set up in Hefei, Wuhan and other digital hub cities. Through the three-dimensional linkage of balanced allocation of material capital, quality improvement of human capital and in-depth empowerment of digital technology, the regional development gap will be effectively narrowed, and a solid foundation will be laid for green finance to promote the optimization and upgrading of industrial structure.

Regional synergy and a green finance-industry mechanism should be improved. It is recommended that the six provinces can establish a cross-regional green finance cooperation framework to promote mutual recognition of green finance standards, data sharing and policy synergy.

6. Conclusion

This paper selects the data of six provinces in Central China from 2010 to 2023, and systematically examines the impact of green finance on industrial structure optimization. The study finds that, firstly, the industrial structure of the six provinces in Central Chian and the development of green finance show significant differentiation characteristics. Secondly, the regression results show that green finance significantly promotes the transition from primary industry to secondary and tertiary industry by optimizing the allocation of resource factors, and directly increases the proportion of tertiary industry in the national economy, making the industrial structure more reasonable. Thirdly, after the robustness test, the findings remain stable.

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References

[1] Zhang T, Li Z, Cui J, 2022, Green Finance, Environmental Regulation and Industrial Structure Optimisation. Journal of Shanxi University of Finance and Economics (CSSCI), 44(06): 84–98.

[2] Salazar J, 1998, Environmental Finance: Linking Two Worlds. Presented at a Workshop on Financial Innovations for Biodiversity, 1998: 2–18.

[3] Ma J, 2015, On Building China's Green Financial System. Financial Forum, 20(5): 18–27.

[4] Su D, Lian L, 2018, Does Green Credit Affect the Investment and Financing Behaviour of Heavy Polluters. Financial Research, 2018(12): 123–137.

[5] Li R, Zhou H, 2023, Research on the Spatial Effect and Heterogeneity of Green Financial Development on Industrial Structure Transformation and Upgrading – Explanation Based on Spatial Durbin Model. Journal of Southwest University (Natural Science Edition), 45(03): 164–174.

[6] Du L, Zheng L, 2020, Research on the Evaluation of the Quality of China's Green Financial Policies. Journal of Wuhan University (Philosophy and Social Science Edition), 73(03): 115–129.

[7] Hu T, Tu Z, 2022, Green Finance and Enterprise High-Quality Development: Incentive Effect and Inhibition Effect. Financial Science, 2022(4): 133–148.

[8] Liu X, He P, 2019, Research on the Influence Effect of Green Finance in the Economic Development of Central Region. Industrial Technology Economy, 38(3): 76–84.

[9] Hu H, Lian S, 2021, China's Green Finance Development and Industrial Structure Change – A Multidimensional Perspective Based on Grey, Coupling and Spatial Linkage Network. Finance and Economy, 2021(09): 51–59.

[10] Zhang M, Zhao K, 2021, Research on the Relationship Between Green Finance and Enterprise Total Factor Productivity Based on Spatial Spillover Effect. Technical Economy, 40(5): 64–72.

[11] Li C, 2023, Impact of Green Finance on High-Quality Economic Development. Journal of Zhongnan University of Economics and Law, 2023(02): 65–77.

[12] Shaw ES, 1973, Financial Deepening in Economic Development. New York: Oxford University Press, 1973: 30–37.

[13] Weber O, 2005, Sustainability Benchmarking of European Banks and Financial Service Organizations. Corporate Social Responsibility and Environmental Management, 12(2): 73–87.

[14] Labatt S, White R, 2002, Environmental Finance: A Guide to Environmental Risk Assessment and Financial Products. Transplantation, 66(8): 405–409.

[15] Chen J, Jiang N, Li X, 2019, The Basic Logic, Optimal Boundary and Orientation Choice of "Green Finance". Reform, 2019(7): 32–36.

[16] Chen J, Zhang K, 2021, Research on Green Finance to Promote Industrial Upgrading and Development. Rural Economy and Technology, 2021(13): 106–108.

[17] Zhan S, Wang R, Liu Y, 2023, The Impact of Financial Technology and Green Finance Synergy on Industrial Structure Upgrading – Based on the Perspective of Heterogeneous Environmental Regulation. China Population-Resources and Environment, 33(11): 152–162.

[18] Chai S, Zhou Q, Wei W, 2025, Research on the Impact of Green Financial Policy on Industrial Structure Transformation and Upgrading – A Quasi-Natural Experiment Based on Green Financial Reform and Innovation Pilot Zone. Coal Economic Research, 45(03): 67–77. DOI:10.13202/j.cnki.cer.2025.03.007.

[19]Zhang X, Xie L, Xia J, 2024, Government Procurement, Digital Economy Development and Industrial Structure Upgrading. Contemporary Finance and Economics, 2024(03): 43–55. DOI:10.13676/j.cnki.cn36-1030/f.20231124.001.

[20] Yuan H, Zhu C, 2018, Have National High-Tech Zones Promoted the Transformation and Upgrading of China's Industrial Structure. China Industrial Economy, 2018(08): 60–77. doi:10.19581/j.cnki.ciejournal.2018.08.004.

[21] Liu J, Wang M, Li W, et al, 2024, Research on the Spatio-Temporal Coupling and Influencing Factors of Green Finance and Carbon Emission Efficiency. Zhejiang Finance, 2024(10): 43–54.

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Research on Optimization of Performance Management of Rural Commercial Bank Tellers

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Abstract: Amid the deepening implementation of rural revitalization strategies and rapid fintech development, rural commercial banks—core financial institutions serving agriculture, rural areas, and farmers (the "three rurals") and county economies—have seen their tellers' service quality and operational efficiency directly impact market competitiveness and sustainable development capabilities. This study examines teller performance management in rural commercial banks from a business management perspective. By analyzing structural issues in existing performance management systems and integrating theoretical frameworks with industry case studies, it proposes systematic optimization measures. The research aims to provide practical references for establishing scientific and efficient teller performance management systems in rural commercial banks, thereby enhancing service quality, strengthening talent support, and better serving the rural financial market.

Keywords: Rural commercial bank; Teller; Performance management; Optimization path; Business management

Online publication: September 9, 2025

1. Introduction

1.1. Research background

As the backbone of China's rural financial system, rural commercial banks play a pivotal role in advancing rural revitalization and serving county economies. Teller staff, serving as frontline service windows, directly shape customer experiences. Their performance directly impacts the bank's brand image and customer retention rates. With deepening interest rate liberalization reforms and digital finance challenges, rural commercial banks face dual pressures of "service decentralization" and "efficiency enhancement". The traditional teller performance management model centered on "transaction volume" has become inadequate for the new landscape. According to data from the China Banking Association, the average turnover rate for rural commercial bank tellers reached 18.7% in 2023, with 34.2% of departures attributed to "unfair performance evaluations", highlighting the urgent need for optimized performance management [1].

1.2. Research significance

Theoretically, this study concentrates on performance management within the grassroots positions of rural financial institutions, broadening the scope of performance management theory to encompass specific industries and roles. It offers a novel perspective for research into differentiated performance management within business administration. In practical terms, the results can directly inform rural commercial banks on how to refine their teller performance management systems, mitigate talent attrition, and improve service quality and efficiency for agriculture, rural areas, and farmers (commonly referred to as the "three rurals"), thereby showcasing substantial practical value.

1.3. Research methods

This study employs a mixed research methodology: Initially, a literature review method is used to systematically examine performance management theories and rural commercial bank management literature; secondly, a case study method is applied through in-depth investigations of three rural commercial banks of varying scales (a provincial-level institution in eastern China, a municipal-level institution in central China, and a county-level institution in western China); and thirdly, a questionnaire survey method is conducted by distributing questionnaires to 326 tellers across 12 rural commercial banks, with 289 valid responses collected, achieving an effective response rate of 88.65%.

2. Theoretical basis and literature review

2.1. Definition of core concepts

(1) Rural commercial bank tellers: This term specifically denotes the front-line operational and service personnel who are actively involved in a variety of essential tasks such as cash receipt and payment transactions, comprehensive account management, and providing detailed business consultations within the grassroots branches of rural commercial banks. These individuals play a pivotal role as they serve as the central and crucial nodes for direct and immediate interaction between the banking institution and its rural clientele. Their responsibilities are not only limited to routine financial transactions but also encompass a broader spectrum of customer service and advisory functions, making them indispensable in fostering a strong and trust-based relationship between the bank and its rural customers.

(2) Performance management: refers to the management process of achieving the coordination between individual goals and organizational strategic goals through closed-loop management of performance planning, coaching, evaluation, feedback, and improvement [2].

2.2. Theoretical support

(1) Motivation theory: Herzberg's two-factor theory points out that "health care factors" such as salary and welfare can eliminate dissatisfaction, while "motivation factors" such as achievement and recognition can enhance work enthusiasm, which provides a theoretical basis for performance incentive design [3].

(2) Strategic performance management theory: It emphasizes that the performance system should be deeply bound with the organizational strategy, and realize the implementation of the strategy through indicator decomposition, and guides rural commercial banks to integrate the "supporting agriculture and small businesses" strategy into the performance indicators of tellers [4].

(3) Service-profit chain theory: reveals the positive correlation between employee satisfaction, service quality,

and customer loyalty, and provides theoretical support for balancing "business indicators" and "service indicators" [5].

2.3. Literature review

Scholars worldwide have extensively studied performance management in the banking sector. Smith et al. discovered that over-quantified performance metrics in commercial banks lead to "goal substitution" —where employees prioritize meeting numerical targets over service quality [6]. In China, Zhang *et al.* identified two systemic issues: rural commercial banks 'tendency to prioritize short-term performance over compliance and their focus on immediate gains over long-term sustainability [7]. Chen's empirical research demonstrated that incorporating customer satisfaction metrics could enhance teller service quality by 23.5% [8]. While existing studies predominantly focus on macro-level system frameworks, micro-level optimization for teller positions remains underexplored. This paper conducts an in-depth investigation into this gap.

3. Current situation and problems of performance management of rural commercial bank tellers

3.1. Structural imbalance of performance indicator system

(1) Excessive emphasis on quantitative indicators: Research indicates that in 83.7% of rural commercial bank tellers' performance metrics, quantitative indicators such as "deposit completion rate" and "transaction volume" constitute over 70% of the weight, whereas qualitative indicators like "customer satisfaction" and "compliance operations" typically receive less than 20%. A county-level rural commercial bank even designated "adding 500,000 yuan in new deposits monthly" as a "veto item" in tellers' performance evaluations, resulting in an overzealous promotion of wealth management products and eliciting customer complaints.

(2) The indicators are not interconnected with the overarching strategy: A significant majority of banks fail to incorporate "rural revitalization service" into the performance evaluation metrics for their tellers. To illustrate this point, consider the scenario where a rural commercial bank located in the Western region of China was tasked with promoting the initiative of "whole village credit granting". Despite the importance of this initiative, the bank encountered a substantial delay in advancing the business promotion. This delay was primarily attributed to the fact that the performance assessment of the tellers was not aligned with, nor did it reflect, the progress or success of this specific rural revitalization effort. Consequently, the lack of direct correlation between the tellers' performance indicators and the strategic goal of rural revitalization hindered the timely execution and effectiveness of the program.

(3) Inadequate granularity of indicators: There is a lack of detailed standards for indicators such as "service quality". For example, "customer satisfaction" is simply defined by "no complaints", without distinguishing dimensions such as "proactive service" and "efficiency improvement" [9].

3.2. The performance evaluation mechanism lacks scientificity

(1) Single evaluation subject: A percentage of 91.2% of rural commercial banks still adopt the "one-way evaluation by branch directors" model, lacking diversified evaluation subjects such as customers and colleagues. A teller from a central China rural commercial bank reported that the "impression score of directors" has a greater impact on performance results than actual work performance, and there is a phenome-

non of "seniority-based promotion".

(2) Stiff evaluation cycle: The fixed cycle of "monthly assessment + annual excellence evaluation" is adopted, which does not match the seasonal demand of rural customers, "low peak during busy season and high peak during idle season", resulting in excessive workload of tellers in peak season but difficult to obtain immediate incentives.

(3) Data collection lags: A total of 76.5% of banks rely on manual input of performance data, and there are problems such as "data lag of 3–5 days" and "error rate of more than 5%", which affect the timeliness of evaluation.

3.3. The failure of performance feedback and application mechanism

(1) Formalized feedback: A total of 82.3% of the tellers said that "they only received performance scores, but did not get improvement suggestions", and the performance feedback became "score notification". A survey conducted by a rural commercial bank in western China showed that the proportion of branches carrying out performance interviews in the past year was less than 30%.

(2) Incentive "one size fits all": Performance pay is strongly bound to the position level, and weakly related to individual performance differences. For example, the biggest gap in the performance pay of a clerk in a municipal rural commercial bank is only 800 yuan/month, which fails to reflect "the more you work, the more you get".

(3) Results application narrowing: A sum of 90% of banks only use performance results for salary adjustment, ignoring the connection with training and promotion. Among the branch managers promoted in a provincial rural commercial bank in the past three years, 62% of their performance rankings did not enter the top 30%, reflecting the disconnection between promotion and performance [10].

4. Optimization path of performance management for tellers in rural commercial banks

4.1. Build a strategic performance indicator system

4.1.1. Three-dimensional index design

(1) Business efficiency dimension (40%): Including "basic business completion rate", "deposit task achievement rate", and "digital business promotion volume" (such as the number of mobile banking accounts opened), among which the weight of digital indicators is not less than 10% [11].

(2) Service quality dimension (30%): Subdivided into "customer satisfaction (third-party evaluation)", "service process standardization", and "number of services for special groups" (such as providing door-to-door service for the elderly).

(3) Compliance and growth dimension (30%): Covers "business error rate", "anti-money laundering task completion rate", "training pass rate" [12]. After a pilot system was launched by an eastern rural commercial bank, the customer complaint rate dropped by 42% and the proportion of digital business increased by 17 percentage points.

4.1.2. Weight of differentiated indicators

Increase the weight of "agricultural business indicators" (such as "assistance in handling farmer loans") for rural branch tellers, and strengthen the "small and micro enterprise service indicators" for urban branch tellers to reflect

regional characteristics [13].

4.1.3. Dynamic adjustment mechanism

Adjust indicators quarterly according to the bank's strategic priorities and market changes. For example, during the peak season of grain purchase, the "efficiency of settlement of agriculture-related funds" indicator is temporarily increased.

4.2. Improve the performance evaluation mechanism of multiple collaboration

4.2.1. 360-Degree evaluation subject

(1) Superior assessment (50%): The branch director evaluates business compliance and team collaboration;

(2) Customer evaluation (30%): Collect customer feedback through "service evaluator" and "monthly questionnaire", and conduct telephone return visits for the elderly.

(3) Peer evaluation (20%): Evaluate collaboration efficiency and timeliness of information sharing [14].

4.2.2. Flexible assessment cycle

"Monthly assessment + quarterly salary adjustment + annual general evaluation" is implemented. In peak seasons such as spring ploughing and autumn harvest, a "special incentive cycle" is added to reward the tellers who exceed the agricultural business [15].

4.2.3. Digital evaluation tool

Build a performance management system, connect with the business system to automatically collect data, realize "business processing is data recording", and control the data error rate within 1%.

4.3. Build a closed-loop performance feedback and application system

(1) Structured feedback interviews: Managers are required to conduct monthly interviews in three steps: "achievement affirmation, problem diagnosis, and improvement plan", form written records and track the improvement. A rural commercial bank in Western China has increased the performance improvement rate of its tellers by 28% through this mechanism.

(2) Step incentive design: The performance pay gap has widened to three to five times, and top tellers can receive a "star bonus". Special awards such as "Agricultural Pioneer Award" and "Service Star Award" will be set up, and the winners will have priority to participate in the training of provincial cooperative union [16].

(3) Application of the whole chain results: The performance outcomes are intricately linked to career advancement opportunities, ensuring a direct correlation between individual achievements and professional growth. For instance, individuals who consistently rank within the top 20% of performance metrics for two consecutive years become eligible to apply for the prestigious role of a customer manager, thereby opening doors to higher responsibilities and career progression. Additionally, those who demonstrate exceptional performance on an annual basis are systematically included in the reserve cadre pool, which serves as a talent repository for future leadership positions. This structured approach not only motivates employees to excel but also ensures a steady pipeline of qualified candidates ready to take on key roles within the organization.

5. Case verification: Optimization practice of a rural commercial bank

5.1. Bank profile

A provincial rural commercial bank in central China has 126 branches and a total of 893 tellers. In 2022, the average turnover rate of tellers was 19.3% and the customer satisfaction was 78.5 points (out of 100).

5.2. Optimization measures

(1) Reconstruct the index system: Increase the weight of "agricultural business processing volume" and "customer satisfaction" to 25% and 30%.

(2) Introduce customer evaluation: "Service evaluation" function is embedded in ATM and mobile banking, and the customer number of the counter is automatically associated.

(3) Implementing elastic incentives: The maximum gap of performance pay is up to 5,000 yuan/month, and a "special bonus for supporting agriculture" is set up.

5.3. Implementation effect

Data in 2023 show that customer satisfaction has increased to 89.2 points, the turnover rate of tellers has decreased to 11.5%, and the balance of agriculture-related loans has increased by 23.7% year on year, which verifies the effectiveness of the optimization measures.

6. Conclusion

To optimize performance management in rural commercial bank teller services, it is imperative to move beyond the conventional "business-centric, service-negligent" approach and to establish a novel framework that is distinguished by its "strategic alignment, multifaceted evaluation criteria, and comprehensive closed-loop application." Extensive research has demonstrated that the implementation of a scientifically designed performance management system can lead to a substantial enhancement in service quality, with improvements exceeding 30%, and can also significantly elevate customer retention rates by approximately 20%. Looking ahead, as artificial intelligence technology becomes increasingly integrated into the realm of rural finance, the methodologies employed for performance evaluations are poised to undergo a transformative shift towards more "real-time and context-specific" methodologies. For example, the utilization of AI-driven analysis of service interaction recordings can provide nuanced insights into the quality of communication, thereby substantially refining the accuracy and effectiveness of performance management practices. This evolution promises to not only streamline operational efficiencies but also to foster a more customer-centric service environment, ultimately contributing to the sustained growth and success of rural commercial banks.

Disclosure statement

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References

[1] China Banking Association, 2023, Development Report of Rural Commercial Banks in China. China Financial Publishing House, viewed on March 15, 2024.

[2] Armstrong M, Baron A, 2005, Performance Management: The New Realities. Kogan Page, viewed on December 18, 2024.

[3] Herzberg F, 1966, Work and the Nature of Man. World Publishing, viewed on January 16, 2025.

[4] Otley D, 1999, Performance Management Systems: A Review of Their Operation. International Journal of Management Reviews, 1(1): 3–28.

[5] Heskett JL, Jones TO, Loveman GW, et al., 1994, Putting the Service-Profit Chain to Work. Harvard Business Review, 72(2): 164–174.

[6] Smith J, 2018, Goal Displacement in Performance Management: Evidence from Banking. Journal of Management Studies, 55(7): 1210–1235.

[7] Zhang Q, 2020, Research on the Optimization of Performance Evaluation System for Rural Commercial Banks. Financial Research, 2020(4): 167–180.

[8] Chen Y, 2021, Research on the Relationship Between Service Quality and Performance of Rural Commercial Banks. Journal of Business Economics, 2021(8): 156–159.

[9] Liu X, 2021, Research on the Transformation and Development of Rural Commercial Banks. Journal of Finance and Economics, 2021(6): 34–45.

[10] Gao J, 2022, Pain Points and Countermeasures of Performance Management in Commercial Banks. Financial Forum, 2022(3): 45–52.

[11] Chen S, 2021, Pathways and Challenges of Digital Transformation in Commercial Banks. Financial Research, 2021(5): 1–15.

[12] Jiang J, 2020, Research on Management Innovation in Chinese Commercial Banks. Economic Research, 2020(12): 102–115.

[13] Wu X, 2020, Path Selection of Rural Financial Reform. Finance and Trade Economics, 2020(5): 5–18.

[14] Yang K, 2021, Risk Management and Performance Balancing in Commercial Banks. Banker, 2021(8): 23–26.

[15] Guo S, 2021, Practice and Reflections on Financial Support for Rural Revitalization. China Rural Finance, 2021(7): 10–13.

[16] Pan G, 2022, Reform and Development of China's Banking Industry in the New Era. China Finance, 2022(9): 18–21.

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Discussion on the Dilemmas and Optimization Strategies of Rural Economic Development under the Rural Revitalization Strategy

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Abstract: This article focuses on the challenges of rural economic development under the strategy of rural revitalization, and deeply analyzes the current situation of rural economic development. Research has found that although the rural revitalization strategy has achieved significant results in improving residents' quality of life, promoting agricultural modernization, it still faces challenges such as severe loss of human resources, insufficient agricultural technological innovation, and backward infrastructure construction. In response to these challenges, this paper proposes optimization strategies from three aspects: strengthening rural education and talent team construction, promoting agricultural technology innovation and achievement transformation, and increasing investment in rural infrastructure construction.

Keywords: Dilemmas and optimization strategies; Rural economic development; Rural revitalization strategy

Online publication: September 9, 2025

1. Introduction

In the process of comprehensively promoting rural revitalization, rural economic development serves as both a critical link and the fundamental underpinning for achieving comprehensive rural revitalization. However, the current development of rural economy in China still faces many challenges, and the limitations of traditional development models are becoming increasingly prominent, forming a stark contrast with the rapid development of the urban economy. Exploring the challenges of rural economic development under the strategy of rural revitalization and seeking practical and feasible optimization strategies is not only crucial for addressing the problems of rural economic development, but also represents an imperative requirement for promoting agricultural and rural modernization and achieving the grand goal of rural revitalization [1].

2. The promoting role of the rural revitalization strategy in rural economic development

2.1. Improving the quality of life for rural residents

In terms of enhancing the quality of life for rural residents, the rural revitalization strategy drives the coordinated improvement of farmers' income and quality of life through the dual engines of extending the industrial value chain and improving the living environment [2]. On one hand, it promotes the transformation of traditional agriculture into modern agriculture that is efficient and high-value, encouraging deep processing of agricultural products and the development of the entire industrial chain. Through diversified sales channels such as brand building and e-commerce platform expansion, farmers are transformed from mere producers of raw materials into beneficiaries who share in the profits along the industrial chain, significantly enhancing their income-generating capacity. On the other hand, the rural living environment improvement campaign comprehensively enhances infrastructure such as water supply, drainage, electricity, and communication in rural areas, narrowing the gap in basic public services between urban and rural areas. Meanwhile, housing construction and renovation projects fundamentally improve the living conditions of farmers, enabling rural residents to enjoy a more convenient and comfortable living environment alongside growing economic incomes, thereby genuinely enhancing their sense of well-being and fulfillment [3].

2.2. Promoting agricultural modernization

In terms of promoting agricultural modernization, the rural revitalization strategy takes the application of science and technology and innovation in production organization as dual drivers, driving a transformation in the quality and efficiency of agricultural development. On the one hand, the in-depth application of agricultural biotechnology, intelligent agricultural machinery, and precision agriculture technology has enabled precise control over the growth environment of crops and intelligent management of the production process. This not only significantly boosts per unit area yield and agricultural efficiency but also promotes the transformation of agricultural production towards green and low-carbon by reducing the use of chemical fertilizers and pesticides, thus establishing an environmentally friendly agricultural development model. On the other hand, policy support for new types of business entities such as rural cooperatives and family farms has broken through the limitations of traditional small-scale farming, facilitating the scaling up and intensification of agricultural production. This large-scale operation model enhances the organizational level of agricultural production, improving the market competitiveness and risk resistance of agricultural products. Meanwhile, intensive management optimizes the allocation of production factors, stimulating the intrinsic vitality of the agricultural economy to adapt to market demands [4].

3. Analysis of the dilemmas in rural economic development under the rural revitalization strategy

3.1. Severe loss of human resources

There is a significant gap in economic development between urban and rural areas. Due to the abundant employment opportunities and higher wages in industrialization and service industries, cities have led to a one-way flow of young and middle-aged labor into cities, constituting a primary driver for the loss of human resources. The rural industrial structure is single, and the traditional planting and breeding industry has low added value, making it difficult to cover essential expenditures such as education and healthcare, exacerbating labor outflow. At the same time, the rural social service system lags behind, high-quality educational resources are scarce, and grassroots

medical capabilities are insufficient, which weakens the attractiveness of rural areas to talents. This has led to an aging and low-skilled agricultural production, with a high proportion of elderly individuals engaged in farming and a low prevalence of modern agricultural machinery. The talent gap has led to a lack of intellectual support for rural industrial upgrading, and emerging agricultural operators find themselves at a disadvantage in market competition. In addition, the lack of social security for left behind groups, the increase in medical expenses for empty nest elderly, and the lack of education for left behind children represent long-term challenges on rural economic development [5].

3.2. Insufficient agricultural, scientific, and technological innovation

Due to the low proportion of agricultural research and development investment in agricultural GDP in China, key areas such as seed research and development and biotechnology breeding are constrained by dependence on foreign technologies. More than half of the high-end vegetable seeds are imported, and there is an imbalance in the distribution of research and development investment in the industrial chain, with a low proportion in the pre-production stage, such as agricultural machinery manufacturing, and limited breakthroughs in the post-production stage, such as deep processing technology. Moreover, there are deficiencies in the mechanism for the transformation of scientific and technological achievements, with serious information barriers between research institutions and production bases, and a low alignment between laboratory achievements and practical field demands. In addition, the weakening of the grassroots agricultural technology promotion system has led to a low proportion of highly qualified agricultural technicians in towns and townships across the country and a lack of continuous training opportunities, creating a “last mile” bottleneck. As a result, the contribution rate of agricultural scientific and technological progress has remained relatively low for a long time, with a significant gap compared to developed countries, which has further constrained the improvement of agricultural total factor productivity [6].

3.3. Backward infrastructure construction

In the promotion of the rural revitalization strategy, the backwardness of rural infrastructure construction has become a key constraint on economic development, and its lag exhibits significant spatial disparities. Rural road density in the central and Western regions is substantially lower than that in the Eastern region, and the poor condition and weak disaster resistance of county roads. The aging of water conservancy facilities, low effective utilization coefficient of irrigation water, and significant food losses caused by facility damage every year; Insufficient communication network coverage and low 4G coverage in remote areas hinder the development of new business models such as rural e-commerce. This “short board effect” reshapes the cost structure of the rural economy: the lack of technology in the transport sector leads to a high loss rate of agricultural products logistics, the information blockage makes the price fluctuation of agricultural products greater than the urban market, the deterioration of the investment environment causes the growth rate of rural fixed asset investment to be lower than the national average for a long time, and the willingness of social capital to invest in rural areas is low [7].

4. Optimization strategies for rural economic development under the rural revitalization strategy

4.1. Strengthening rural education and talent team building

4.1.1. Building a solid foundation for human capital

The state and local governments should establish a rigid mechanism for tilting educational resources towards ru-

ral areas. In terms of investment, the central government should formulate a special transfer payment system for rural education to ensure that the growth rate of per-student education expenditure is not lower than the national average, with a focus on improving digital teaching equipment, laboratory facilities, and library resources in rural schools. Local governments should establish a "Silver Teacher" introduction plan, attracting retired urban teachers and outstanding young teachers to teach in rural areas through policies such as housing subsidies and preferential treatment in professional title evaluation. At the same time, the "County-Managed School-Hired" management reform should be implemented to promote balanced allocation of teachers between urban and rural areas. Additionally, a rural education quality monitoring system should be established, incorporating indicators such as the consolidation rate of compulsory education and the rate of teachers meeting educational qualifications into local government performance evaluations, ensuring precise matching of education investment and demand at the institutional level [8].

4.1.2. Aligning with industrial development demands

Vocational training should restructure its curriculum system based on the "industry demand orientation". In response to the demands of agricultural modernization, develop training modules covering areas such as smart agriculture operation, quality and safety control of agricultural products, and green planting techniques. Aligned with the trend of rural industrial integration, add practical contents such as e-commerce operation of agricultural products, rural tourism services, and rural logistics management. In terms of implementation, establish a dual-track training system of "online + offline": online, rely on platforms such as the "Rural Revitalization College" of the Open University of China to develop standardized MOOC courses, and incorporate live Q&A sessions and online assessment features; offline, collaborate with leading agricultural enterprises and cooperatives to establish training bases, and implement a three-stage training model of "theoretical teaching + field practice + enterprise internship". At the same time, establish a training effect tracking mechanism, link farmers' vocational skills levels with industrial support policies, and form a virtuous cycle of "training–employment–income increase".

4.2. Promoting agricultural, scientific, and technological innovation and the transformation of achievements

4.2.1. Breaking through bottlenecks in key areas

Research funding allocation should be prioritized towards the entire chain from "basic research–applied research–industrial transformation". In the field of basic research, establish key special projects focusing on areas such as agricultural biotechnology and intelligent breeding, support universities and research institutes to carry out basic research on germplasm resource protection and crop stress resistance, and ensure that the proportion of basic research investment increases to more than 20% of the total agricultural research funds. At the applied research level, focus on supporting the domestic development of agricultural machinery, promote the development and adoption of lightweight and intelligent agricultural machinery in hilly and mountainous areas, and at the same time strengthen the technological research on deep processing of agricultural products, and develop high-value-added products such as functional foods and bio-based materials. In terms of the investment mechanism, establish a diversified investment system of "government guidance + enterprise subject + social participation", encourage leading agricultural enterprises to set up research and development centers, and offer a 150% super tax deduction for enterprise research and development investment [9].

4.2.2. Opening up the pathway from laboratory to field

Establish an integrated transformation network of "research institutions–production entities–extension system". Research institutions should establish a topic selection mechanism oriented towards market demand, and jointly tackle "bottleneck" technologies through the approach of "enterprises posing questions and research institutions answering them". At the production end, promote the joint construction of experimental demonstration bases by research institutes and new types of agricultural business entities, and directly transfer scientific research achievements to the production front line. Reforming the grassroots extension system should focus on "professionalization of the team + digitalization of services". On the one hand, improve the educational level of agricultural technicians through "targeted training + on-the-job training", ensuring that the proportion of those with a bachelor's degree or above in the township agricultural technician team reaches 40%. On the other hand, develop an "agricultural technology extension APP", integrate data such as soil moisture and pest and disease warnings, and provide precise technical guidance for farmers. At the same time, improve the incentive mechanism for the transformation of scientific and technological achievements, increase the share of income from the transformation of scientific and technological achievements allocated to researchers to over 70%, and stimulate innovation vitality.

4.3. Increase investment in rural infrastructure construction

4.3.1. Building a diversified investment pattern

Innovate in the utilization of fiscal funds, implement a combined allocation model of "factor method + project method", and allocate funds scientifically based on factors such as rural population size and infrastructure gap. At the same time, a competitive project approval mechanism can be implemented for major infrastructure projects. In terms of financing models, issue "rural revitalization special bonds", allowing local governments to use bond funds for rural roads, water conservancy and other public welfare projects; promote the PPP model, formulate the "Operation Guidelines for Rural Infrastructure PPP Projects", and clarify the return mechanism for social capital participation in rural water supply, logistics and other projects, such as ensuring reasonable returns through user fees and feasibility gap subsidies. In addition, establish a "rural infrastructure development fund" to attract long-term funds such as social security funds and pensions, and use "reward instead of subsidy" methods to encourage local governments to improve the efficiency of fund use [10].

4.3.2. Enhancing service delivery and guarantee capabilities

Infrastructure construction should follow the principle of "comprehensive planning- categorized advancement-moderate advancement". In terms of transportation facilities, implement the "Four Good Rural Roads" quality improvement project, focusing on building industrial roads and tourism roads, and simultaneously improve rural integrated passenger, freight, and postal service stations to reduce the cost of the "first mile" for agricultural products entering the city. For water conservancy facilities, promote the modernization transformation of medium-sized irrigation areas, establish efficient water-saving irrigation demonstration zones, and at the same time reinforce dilapidated and dangerous reservoirs and dredge river channels to enhance flood control and drought resistance capabilities. Digital infrastructure is a key breakthrough point. Implement the "Digital Village Construction Action", and building upon the achievement of full 4G network coverage in administrative village, gradually promote 5G networks and gigabit optical fiber access to households, and build rural e-commerce public service centers to provide support for the development of the digital economy.

5. Conclusion

This paper has systematically analyzed the current situation and challenges of rural economic development under the rural revitalization strategy and proposes targeted optimization strategies. The effective implementation of these strategies is expected to strongly promote the high-quality development of rural economy and contribute to the realization of the goals of the rural revitalization strategy. However, rural economic development constitutes a long-term and complex systemic undertaking. In the future, it is still necessary to continuously pay attention to new problems and new challenges, and continuously refine relevant policies and measures to adapt to the new requirements of economic and social development, thereby providing sustained impetus for the comprehensive revitalization of rural areas.

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References

[1] Zhan X, Zhang H, Zhao Y, et al., 2024, Assessment of Rural Sustainable Development and Analysis and Prediction of Obstacles and Coupled Coordinated Development: A Case Study of Zaozhuang City. Chinese Journal of Population, Resources and Environment, 22(3): 312–325.

[2] Tang H, 2024, Innovation Analysis of Rural Agricultural Economic Management Model in the Context of the Belt and Road Initiative. Asian Agricultural Research, 16(6): 11–12, 18.

[3] Deng J, Zhong Y, Lin X, 2024, Development of Rural Tourism Industry under the Background of New Rural Construction: A Case Study of Henghe of Boluo County in Huizhou City. Asian Agricultural Research, 16(3): 14–17.

[4] Wang R, 2025, The Role of Rural Revitalization Investment Funds in Advancing Common Prosperity: Mechanisms, Challenges, and Strategies. Proceedings of Business and Economic Studies, 8(1): 50–54.

[5] Zhang J, 2019, The Predicament of Rural Development under the Strategy of Rural Revitalization. Asian Agricultural Research, 11(11): 1–3, 8.

[6] Sun Z, Li D, Liu Z, 2024, Design Strategies for Rural Revitalization under the Background of Rural Revitalization: A Case Study of Baimaozhuang Village, Baodi District, Tianjin City. Journal of Landscape Research, 16(4): 44–46, 50.

[7] Zhong W, Zhao J, Zhang Y, et al., 2025, The Practical Logic and Optimization Path of Rural Human Settlement Environment Governance in Jiangsu Region of China from the Perspective of Cultural and Tourism Integration. Proceedings of Business and Economic Studies, 8(1): 119–126.

[8] Li X, Guo Z, Hu A, 2022, Research on the Development of Rural Tourism in the Context of Comprehensively Promoting Rural Revitalization: A Social-System-Based Approach. Contemporary Social Sciences, 7(5): 49–73.

[9] Wei H, 2022, China's Rural Development in the 14th Five-Year Plan Period. China Economist, 17(1): 2–11.

[10] Li L, Long Z, 2024, Development Level and Dynamic Analysis of the Integration of Three Rural Industries in the Context of Rural Revitalization. Asian Agricultural Research, 16(9): 1–6, 10.

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Psychoanalysis of the Attention Economy in the Era of Big Data: A Topological Interpretation Based on Lacan's Three Orders

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Abstract: In the era of Big Data, the attention economy has emerged as a core logic of capital accumulation, yet behavioral economic explanations fail to penetrate the unconscious drives and desire structures underlying attention investment. This paper adopts Lacan's topological framework of the three orders (the Real, the Symbolic, and the Imaginary) to conduct a psychoanalytic dissection of the attention economy. It argues that Big Data-driven attention mechanisms essentially manipulate desire across these three orders: algorithms, functioning as the "digital big Other," exploit the Real's traumatic surplus and the deferred structure of desire through infinite scroll and traumatic stimuli; regulate identity production in the Symbolic via visibility laws, social currency, and datafication; and construct narcissistic illusions in the Imaginary through filters, filter bubbles, and illusions of hyperconnection. Ultimately, the paper proposes an ethics of lucid attention, calling for critical algorithmic literacy, confrontation with the Real's lack, dismantling of Imaginary illusions, and reclaiming sovereignty over attention—essential for preserving subjective dignity and human freedom in the digital age.

Keywords: Attention economy; Big data; Lacan's Three Orders; Psychoanalysis; Algorithm

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1. Introduction

In the information-explosive era of Big Data (*Ère du Big Data*), the fundamental contradiction between the finitude of human cognition and the infinity of information supply has become ever more pronounced. Herbert A. Simon was among the first to point out that information abundance leads to attention scarcity, thus giving rise to what is now termed the "attention economy" [1]. Its core proposition is that attention is the key scarce resource in post-industrial society, and its capture, orchestration, and monetization have become the central logic of new forms of capital accumulation. Behavioral economics reveals the inherently irrational nature of human decision-making; phenomena such as the anchoring effect, loss aversion, and status quo bias are but a few examples of the cognitive biases that have become critical variables in economic models [2, 3].

However, explaining the mechanisms of the attention economy solely on the behavioral level presents significant limitations. It fails to probe the unconscious drives (*pulsions inconscientes*) and the structure of desire that propel individuals to continuously invest their attention. Lacan's psychoanalytic theory—especially his topological framework of the "three orders"—offers a profound philosophical-psychological perspective for understanding how the attention economy embeds itself within and reshapes the subject's psychic world. According to Lacan, the subject emerges within a topology composed of the "Real" (the unsymbolizable traumatic kernel), the "Symbolic" (the order of language, law, and the "big Other"), and the "Imaginary" (the domain of mirror identification and egoic illusions). Desire (*désir*) perpetually gravitates towards the "*objet petit a*"—a cause of desire that remains forever unattainable [4]. This paper argues that the attention economy in the era of Big Data is, in essence, an elaborate orchestration of desire manipulation enacted on the stage of Lacan's three orders, with algorithms assuming the role of the "digital big Other" (*l□Autre numérique*), systematically exploiting the subject's unconscious structures to achieve the efficient capture and commodification of attention.

2. The mechanisms of attention capture under the topology of the three orders: A psychoanalytic dissection

2.1.The intrusion of the Real and the algorithm's simulacral manipulation of the "*objet petit a*"

The "Real" is the domain that transcends symbolization (*hors-signifiance*), characterized by the traumatic kernel that resists integration into the symbolic order, manifesting through trauma (*Trauma*), anxiety (*Angoisse*), and the perpetual absence of the "*objet petit a*". Algorithmic systems in the attention economy deeply understand and systematically harness this very feature of the Real:

Infinite scroll, autoplay, and personalized recommendations ("You may also like") are designed to replicate the deferred structure of desire (*structure du différé du désir*). Each refresh or click yields a fleeting glimpse of the "*objet petit a*" (*aphanisis*), which immediately vanishes, triggering an even stronger desire to seek "just one more scroll." This is the ultimate application of intermittent reinforcement, a concept from behavioral economics that locks user behavior through unpredictable "rewards" [5].

(1) Traumatic stimuli and emotional arousal

Algorithms prioritize content with high emotional arousal, particularly negative, conflictual, catastrophic, or extreme information ("clickbait"). Such content functions as shards of the "Real" (*éclats du Réel*), penetrating the defenses of the everyday symbolic order with raw, unsymbolized impact, forcibly capturing attention [6]. User interactions generate the "behavioral surplus" that nourishes algorithmic systems [7].

(2) Data gaze and ontological anxiety

The totalized collection, analysis, and prediction of user data give rise to an algorithmic gaze. This gaze, emanating from an anonymous, systemic "digital big Other" (*l'Autre numérique*), claims to know—and even predict—the deepest, most inexpressible inclinations of the user (search histories, covert browsing). This induces a Lacanian anxiety (*Angoisse*): the subject senses that their innermost Real is being surveilled, defined, and manipulated, yet the source and logic of this gaze remain elusive, resulting in ontological insecurity.

2.2. Symbolic order: Regulation by the law of the Big Other and the production of identity

In Lacanian theory, the symbolic order is governed by the law of the big Other (Lacan, 1957). Within the attention economy, this order encompasses language (*langage*), law (*loi*), and the big Other (*l'Autre*). It is within this

symbolic structure that the subject is named, positioned, and regulated. Desire flows through a chain of signifiers (*chaîne signifiante*), yet remains constrained by the law of the "big Other" [8]. In the digital context, the symbolic order manifests through platform architectures, algorithmic governance, and embedded social norms—together forming a dominant regulatory structure that shapes identity and subjectivity online.

2.2.1. Algorithm as the embodiment of the Big Other

Platform algorithms (*Algorithm as l'Autre*) personify the big Other in the digital age. They enforce an invisible *Law of Visibility* (*Loi de Visibilité*), determining which content is seen (exposure) and which is silenced (*shadow banning*). They define value standards: likes, shares, comments, and follower counts become the key signifiers for measuring an individual's social worth and influence [9]. Users' desires for recognition, visibility, and influence must conform to algorithmic logic to be expressed and fulfilled. Concepts such as social preferences *and* identity utility from behavioral economics are precisely encoded within these algorithmic incentive structures.

2.2.2. Social currency and the circulation of signifiers

Within the Symbolic, the attention economy produces and circulates social currency (*Monnaie Sociale*)—likes, comments, shares, and follows [10]. These signifiers flow among users, constructing symbolic capital (*capital symbolique*) and digital identity (*identité numérique*). The accumulation, display, and exchange of these signifiers constitute the user's core digital labor [11]. The subject becomes ensnared in an endless pursuit of recognition by the big Other, channeling their attention toward carefully curated self-presentation (curated self) and performative engagement with others' content [12].

2.2.3. Datafication of the subject and taxonomic violence

At the heart of the symbolic order lies classification and naming. Algorithms build user profiles (*Profil Utilisateur*) from vast behavioral data, slotting individuals into predetermined taxonomies ("Gen Z," "urban middle class," "tech enthusiast"). Subjectivity is reduced through datafication and profiling, with the subject's complex, fluid inner experiences simplified, fixed, and regulated by the symbolic order's classificatory logic [13]. To receive "better" services—actually, more efficient attention capture—users actively or passively participate in constructing these datafied identities, accepting the big Other's definitions.

2.3. Imaginary order: Narcissistic mirrors and the fortress of the filter bubble

The Imaginary is rooted in the mirror stage (*stade du miroir*), where the subject forms an ego (*moi*) through identifying with a unified, idealized image, founded on misrecognition (*méconnaissance*) and narcissistic relations (*narcissisme*) [14]. The attention economy is an ideal site for constructing and sustaining the illusions of the Imaginary.

(1) Filters, beautification, and the digital mirror

Social media filters, editing tools, carefully curated angles, and content all construct a beautified, simplified digital self-image. Users project their Ideal Ego (*Idéal du Moi*) onto this image, gaining narcissistic satisfaction (*satisfaction narcissique*). However, this is a profound misrecognition, masking the messy, imperfect, and divided real self (*moi réel*). Maintaining this illusion demands continuous investment of attention—producing persona-consistent content, following and mimicking idealized influencers, and engaging in endless comparison [15].

(2) The filter bubble as a fortress of the imaginary

Algorithm-driven personalized feeds create filter bubbles (*Bulles de Filtres*) [16]. These bubbles operate as exclusive, homogenous strongholds within the Imaginary, immersing the user in content that reinforces existing beliefs and interests—" the world as I imagine it to be." They effectively block heterogeneous, disruptive voices from the Symbolic or Real, stunting the subject's exposure to information that could shatter egoic illusions, thereby producing cognitive narrowing, group polarization, and reality distortion.

(3) The illusion of hyperconnection and imaginary communities:

Digital technologies create the illusion of being always-on and globally connected. Users feel part of vast, possibility-laden digital communities. Yet Lacan reminds us that relations in the Imaginary are essentially narcissistic, based on projective identification with the other's image. Much digital interaction remains shallow, symbolic (emojis, brief comments), lacking the linguistic mediation and true recognition of otherness (*altérité*) that deeper Symbolic exchange requires [17]. This "connectedness" satisfies narcissistic needs (to be seen, acknowledged) but may obscure—or worsen—real loneliness and the poverty of genuine Symbolic dialogue.

3. Toward an ethics of lucid attention

Confronting the alienating predicament of the attention economy demands a lucid ethics of attention (*Éthique de l'attention lucide*) informed by Lacanian insights and behavioral economics:

3.1. Recognize the tricks of the "Big Other" and cognitive biases

(1) Critical algorithmic literacy: Understand how platforms, algorithms, and business models exploit the three orders to capture attention.

(2) Metacognitive monitoring: Apply behavioral economics knowledge to detect anchoring effects, loss aversion, confirmation bias, and cultivate cognitive resilience.

3.2. Confront lack and embrace the unknowability of the real

(1) Accept the eternal absence of the "*objet petit a*": Resist hoping for fulfillment through digital illusions (Imaginary) or data metrics (Symbolic).

(2) Tolerate uncertainty: View information overload, ambiguity, and the unknown as real dimensions of existence, not noise to be extinguished by endless input. Practice digital fasting to restore a sense of the Real.

3.3. Shatter the imaginary, seek symbolic exchange

(1) Burst the bubble: Intentionally access non-algorithmic sources, seek dissenting views and heterogeneous voices to break the Imaginary's fortress.

(2) Deep communication: Strive for Symbolic dialogue that transcends narcissistic image management and shallow symbolic exchange, recognizing and engaging otherness (*altérité*).

3.4. Reclaim sovereignty over attention and temporality

(1) Deliberate planning: Treat attention as a core resource for shaping self and world; proactively direct it toward self-defined goals and values rather than passively responding to algorithmic demands.

(2) Restore deep time: Create undisturbed deep time for sustained focus (reading, creating, contemplation,

deep dialogue), rebuilding continuity and depth of experience.

The attention economy of the Big Data era is not merely an issue of information filtering or market efficiency; it is a profound transformation of desire and subjectivity staged within Lacan's topological structure of the "Real, Symbolic, and Imaginary". Algorithmic systems, as the digital big Other, orchestrate the manipulation of the lack and anxiety of the Real, the rules and identity production of the Symbolic, and the illusions and narcissistic satisfactions of the Imaginary, achieving the efficient capture, commodification, and alienation of humanity's most precious cognitive resource—attention. The cognitive biases revealed by behavioral economics become levers for algorithmic exploitation, accelerating the psychic structure's fragmentation and the erosion of reflexivity.

4. Conclusion

This interdisciplinary analysis suggests that addressing this predicament demands more than technical optimization or individual self-discipline; it requires engagement at the level of the psychic structure itself. Constructing a lucid ethics of attention calls for recognizing the ruses of the "big Other" and the human cognitive limitations, courageously confronting the lack and uncertainty of the Real, dismantling the Imaginary's illusory mirrors, seeking genuine Symbolic dialogue, and ultimately reclaiming sovereignty over one's attention and temporal experience. This is not merely a path for maintaining mental health in the digital age but a necessary condition for preserving the subject's dignity (*dignité du sujet*) and the essence of human freedom (*essence de la liberté*). Future research should integrate empirical neuroscience (e.g., studies of attention and reward circuits) and platform ethnography to deepen our understanding of this complex psychic-economic formation.

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References

[1] Bucher T, 2018, If... Then: Algorithmic Power and Politics. Oxford University Press, UK.

[2] Cheney-Lippold J, 2017, We Are Data: Algorithms and the Making of Our Digital Selves. NYU Press, New York.

[3] Citton Y, 2017, The Ecology of Attention. Polity Press, UK.

[4] Crary J, 2013, 24/7: Late Capitalism and the Ends of Sleep. Verso Books, New York.

[5] Davenport TH, Beck JC, 2001, The Attention Economy: Understanding the New Currency of Business. Harvard Business Press, Massachusetts.

[6] Fuchs C, 2014, Digital Labour and Karl Marx. Routledge, UK.

[7] Gerlitz C, Helmond A, 2013, The Like Economy: Social Buttons and the Data-Intensive Web. New Media & Society, 15(8): 1348–1365.

[8] Han BC, 2015, The Burnout Society. Stanford University Press, California.

[9] Hogan B, 2010, The Presentation of Self in the Age of Social Media: Distinguishing Performances and Exhibitions Online. Bulletin of Science, Technology & Society, 30(6): 377–386.

[10] Kahneman D, 2011, Thinking, Fast and Slow. Farrar, Straus and Giroux, New York.

[11] Lacan J, 1949, The Mirror Stage as Formative of the I Function as Revealed in Psychoanalytic Experience. In Écrits, 1949: 75–81.

[12] Lacan J, 1957, The Agency of the Letter in the Unconscious or Reason Since Freud. In Écrits, 1957: 146–178.

[13] Lacan J, 1966, Écrits: The First Complete Edition in English. W. W. Norton & Company, New York.

[14] Pariser E, 2011, The Filter Bubble: What the Internet is Hiding from You. Penguin UK, UK.

[15] Schüll ND, 2012, Addiction by Design: Machine Gambling in Las Vegas. Princeton University Press, New Jersey.

[16] Stiegler B, 2010, For a New Critique of Political Economy. Polity, UK.

[17] Thaler RH, Sunstein CR, 2008, Nudge: Improving Decisions About Health, Wealth, and Happiness. Yale University Press, Connecticut.

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Decision Framework for Reverse Logistics Models of Decommissioned Wind Turbine Blades

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Abstract: To address the recycling challenges posed by the global peak of wind turbine blade retirement, this study aims to establish a decision-making model for reverse logistics modes of decommissioned blades, resolving the multi-agent collaborative optimization problem under ultra-high logistics cost constraints. Based on the characteristics of centralized sourcing and determinable elements in blade reverse logistics, we developed three models dominated by wind power equipment manufacturers, operators, and third-party enterprises, respectively. The research analyzes influencing factors on reverse logistics mode selection and proposes a threshold decision mechanism for mode selection. Key findings reveal: technological strength serves as the core driver for manufacturer-dominated models; channel efficiency determines the applicability of operator-led models; insufficient economies of scale may hinder third-party model development. This study provides decision-making foundations for the resource utilization of decommissioned blades.

Keywords: Wind blade recycling; Reverse logistics mode; Network optimization

Online publication: September 9, 2025

1. Introduction

Amidst the global energy transition, wind energy stands as one of the most promising green energy sources [1]. With the rapid growth of global wind power installed capacity, the volume of decommissioned wind power equipment has surged significantly in recent years. Projections indicate that the global peak in wind turbine retirement will occur within the next decade, generating vast quantities of end-of-life wind turbine blades. Due to their oversized and ultra-heavy characteristics, these blades pose immense challenges for disposal and recycling. China possesses exceptional geographical conditions and ranks among the world's leaders in wind energy resources [2]. By the end of 2023, its cumulative grid-connected wind power installed capacity reached 440,000 MW [3]. In 2025, the first wave of large-scale wind turbine retirements will emerge, with aging wind farms exceeding 20 years of operation, surpassing 1.2 million kW in scale [4]. By 2026, decommissioned wind turbine blades are projected to total 8,000 tonnes [5]. This raises the critical question of how to manage such large-scale end-of-life blade waste. Globally, policies for handling decommissioned blades vary significantly. European Union nations, governed by

stringent environmental regulations, largely prohibit direct landfilling of turbine blades. Countries like China and the United States have also gradually tightened restrictions on incineration and on-site landfilling of blade waste [6]. Studies confirm that recycling end-of-life blades generates higher economic returns and superior environmental benefits [7]. Consequently, recycling costs must be addressed: the oversized characteristics and low stacking density of blades result in logistics costs substantially exceeding those of conventional industrial goods. For a 200-km transport distance, transportation costs alone reach ¥1,200–1,500 per tonne [8].

2. Characteristics of decommissioned wind turbine blades

2.1. Reverse logistics features

According to China's definition, reverse logistics in the narrow sense comprises recovery logistics and waste logistics [9]. While sharing similarities with forward logistics (e.g., handling, transportation), reverse logistics exhibits distinct features:

(1) Reverse flow direction: The core characteristic where goods move opposite to forward logistics—from consumers/end-users back to manufacturers, suppliers, or recycling centers.

(2) Decentralization (Unpredictability): Reverse logistics lacks predictability in timing, location, quantity, and quality of returned products. Transport routes often deviate from conventional patterns, contrasting sharply with the planned, centralized flows of forward logistics.

(3) Gradual accumulation: Initial stages involve diverse but low-volume recoverables, hindering economies of scale. Prolonged accumulation phases reduce stakeholder engagement. Post-collection, complex sorting/reprocessing further extends cycles, limiting responsiveness to demand.

(4) Complexity:Remanufacturing(cleaning,testing,disassembly,refurbishment,reassembly) regenerates value. Diverse treatment methods yield significantly variable resource recovery outcomes.

2.2. Unique features of blade reverse logistics

Decommissioned blade reverse logistics diverges from traditional models, anchored in source concentration and determinable key factors, enabling stable network design:

2.2.1. Geographic concentration

Sources are fixed at onshore/offshore wind farms—spatially identifiable versus random origins in conventional systems.

2.2.2. Predictable drivers

(1) Retirement window: Around 20–25-year lifespan allows accurate long-term forecasting.

(2) Retirement volume: Blade counts per wind farm are pre-determinable.

(3) Material properties: Dimensional ranges and compositions (GFRP/CFRP composites) are well-defined.

2.3. Reverse logistics network typologies

China's blade recycling sector remains nascent, with three dominant models exhibiting distinct advantages and limitations:

(1) Manufacturer-dominated model: Driven by resource circularity mandates and policy compliance, manufacturers recover blades for remanufacturing. This reduces production costs, enhances product value, and

strengthens market competitiveness.

(2) Operator-dominated model: Operators/investors leverage direct source coordination for efficiency—minimizing transport costs while generating revenue streams from retirement demand.

(3) Third-party-dominated model: Specialized logistics providers handle recovery, allowing supply chain actors to focus on core operations and mitigate operational risks associated with reverse flows.

3. Research on reverse logistics models for decommissioned wind turbine blades

3.1. Model formulation

The selection of reverse logistics models for decommissioned wind turbine blades is critically important, as economic returns for participating entities vary significantly across different models. This study focuses on three manufacturer-, operator-, and third-party-dominated frameworks. Based on the operational workflow of collection → assessment → cascading utilization or material recycling pathways, mathematical models with profit maximization as the optimization objective are developed to establish a decision-making framework for optimal model selection.

3.2. Model notation and assumptions

3.2.1. Model symbols

The symbols and their meanings in the model are shown in **Table 1** below:

Table 1. Symbol model and meaning description

Symbols	Definition
k	Reverse logistics model type:k=M(manufacturer-dominated),k=O(operator-dominated),k=T(third-party-dominated)
p_k	Representing the recycling price of the recycling party under k reverse logistics modes, k=M, O, T
Q_k	The amount of retired wind turbine blades recovered under the k-th reverse logistics mode, k=M, O, T
Q_0	Recycling amount of retired wind turbine blade foundations
a	Sensitivity coefficient of the market to the price of blade recycling
λ_k	Reuse rate of retired wind turbine blades under the k-th reverse logistics mode
λ_0	Utilization rate of retired wind turbine blade foundation
β	Design efficiency coefficient
r_u	Benefits from reusing retired wind turbine blades
r_r	Renewable income from retired wind turbine blades
B	Processing scale coefficient
I_k	Investment cost under the k-th reverse logistics mode, k=M, O, T
γ	Transportation cost of retired wind turbine blades
s	Green design level
d_k	The average transportation distance under the k-th reverse logistics mode, k=M, O, T
η_k	Scale efficiency coefficient under the k-th reverse logistics mode, k=M, O, T
π_k^M	Manufacturer's total profit under model k
π_k^O	Operator's total profit under model k
π_k^T	Third-party recycler's total profit under model k

3.2.2. Model assumptions

(1) All recycling entities operate under symmetric information conditions and function as risk-neutral decision-makers.

(2) The collection volume of decommissioned wind turbine blades Q^k is assumed to follow a linear relationship with the collection price, expressed as: $Q^k = Q^0 + ap^k$, where Q^0 denotes the baseline collection volume and a represents the price sensitivity coefficient.

(3)Material recycling revenue: Units unsuitable for cascading utilization or re-decommissioned after such use generate revenue r^r per unit through recycling processes (e.g., shredding, material recovery), with $r^r < r^\mu$ where r^μ signifies the value per unit derived from cascading utilization, confirming its superior economic benefit.

(4) Investment cost differentials among recycling entities: Recycling entities (denoted I^k, where k=M for wind equipment manufacturers, k=O for operators, and k=T for third-party recyclers) incur distinct average investment costs per unit collected, satisfying $I^0 < I^M < I^T$. This hierarchy arises because: operators (O) leverage their geographically dispersed wind farm O&M networks and spare parts warehouses for collection, minimizing investment; manufacturers (M) utilize existing sales/service networks or OEM channel resources, resulting in moderate costs; third-party recyclers (T) require dedicated infrastructure investments (transportation, storage sites, preprocessing facilities), incurring the highest costs.

3.3. Model and construction of reverse logistics mode selection

3.3.1. Reverse logistics model managed by wind power equipment manufacturers

Under the manufacturer-dominated reverse logistics model, the manufacturer handles both blade collection and processing. Its benefit function incorporates sales revenue from cascading utilization and material recycling, offset by collection costs, investment costs, eco-design expenditures, and processing costs. Thus, the comprehensive benefit function for the wind equipment manufacturer is derived as:

$$\pi_M^M = \eta_M[r_u\lambda_M Q_M + r_r(1-\lambda_M)Q_M] - (p_M + I_M)Q_M - Bs_M^2 - \gamma d_M Q_M \quad (1)$$

$$\text{constraints:}\begin{cases} Q_M = Q_0 + ap_M \\ \lambda_M = \lambda_0 + \beta s_M \end{cases} \quad (2)$$

Equation (1) is about the p_M function. By substituting the constraint conditions, the first-order partial derivative is obtained, and the partial derivative is set to 0, to obtain the optimal recycling price of retired wind turbine blades in M-mode.

$$\frac{\delta\pi_M^M}{\delta p_M} = 0 \Rightarrow p_M^* = \frac{\eta_M[(r_u - r_r)(\lambda_0 + \beta s_M) + r_r] - I_M - \gamma d_M}{2} - \frac{Q_0}{2a} \quad (3)$$

3.3.2. Reverse logistics model managed by wind power equipment operators

Under the operator-dominated reverse logistics model, decision-making is centralized: the operator exclusively controls blade collection pricing, with no manufacturer involvement or transfer payments. Its benefit function incorporates sales revenue from cascading utilization and material recycling, offset by collection, investment, and processing costs. Thus, the operator's comprehensive benefit function is derived as:

$$\pi_O^O = \eta_O[r_u\lambda_O Q_O + r_r(1-\lambda_O)Q_O] - (p_O + I_O)Q_O - \gamma d_O Q_O \quad (4)$$

$$\text{constraints:}\begin{cases} Q_O = Q_0 + ap_O \\ \lambda_O = \lambda_0 + \beta s_O \\ s_O = s_{fix}(CV) \end{cases} \quad (5)$$

Equation (4) is about the p_0 function. By substituting the constraint conditions, the first-order partial derivative is obtained, and the partial derivative is set to 0, to obtain the optimal recycling price of retired wind turbine blades in O-mode.

$$\frac{\delta\pi_O^0}{\delta p_O} = 0 \Rightarrow p_O^* = \frac{\eta_O[r_u\lambda_O + r_r(1-\lambda_O)] - I_O - \gamma d_O}{2} - \frac{Q_0}{2a} \quad (6)$$

3.3.3. Reverse logistics mode in the charge of third-party recycling enterprises

Under third-party-dominated reverse logistics, decision-making is centralized: the third-party entity holds exclusive pricing control for blade collection, with no manufacturer involvement or transfer payments. The enterprise integrates full-chain resources to autonomously set prices for profit maximization. Its benefit function comprises material recycling revenue (excluding cascading utilization), minus collection, investment, and processing costs. Thus, the comprehensive benefit function for the third-party recycler is derived as:

$$\pi_T^T = \eta_T[r_T Q_T] - (p_T + I_T)Q_T - \gamma d_T Q_T \quad (7)$$

$$\text{constraints:} Q_T = Q_0 + ap_T \quad (8)$$

Equation (7) is about the p_T function. By substituting the constraint conditions, the first-order partial derivative is obtained, and the partial derivative is set to 0, to obtain the optimal recycling price of retired wind turbine blades in T-mode.

$$p_T^* = \frac{\eta_T r_T - I_T - \gamma d_T}{2} - \frac{Q_0}{2a} \quad (9)$$

3.3.4. Comparative analysis of three mode equilibrium solutions

As shown in **Table 2**, the optimal solution under three different models contains different parameter sets, and each uncertain parameter has different effects on the optimization results. Therefore, it is necessary to analyze how these parameters affect the selection of reverse logistics model for retired fan blades.

Table 2. Optimal solution of M-mode, O-mode, and T-mode

index	M-mode	O-mode	T-mode
Recycling price	$p_M^* = \frac{\eta_M[(r_u - r_r)(\lambda_0 + \beta s_M) + r_r] - I_M - \gamma d_M}{2} - \frac{Q_0}{2a}$	$p_O^* = \frac{\eta_O[r_u\lambda_O + r_r(1-\lambda_O)] - I_O - \gamma d_O}{2} - \frac{Q_0}{2a}$	$p_T^* = \frac{\eta_T r_T - I_T - \gamma d_T}{2} - \frac{Q_0}{2a}$
Reuse rate	$\lambda_M = \lambda_0 + \beta s_M$	$\lambda_O = \lambda_0 + \beta s_{fix}$	$\lambda_T = 0$
Recovery amount	$Q_M = Q_0 + ap_M$	$Q_O = Q_0 + ap_O$	$Q_T = Q_0 + ap_T$

4. Conclusion

Wind turbine blade recycling constitutes a critical link in the green closed-loop industrial chain of renewable energy. This study, operating under three fundamental constraints—no manufacturer take-back obligations, exclusion of environmental policy variables, and distinct model advantage differentiation—reveals systemic patterns in

decommissioned blade recovery through multi-agent game-theoretic modeling and a threshold decision framework. Technological superiority, channel efficiency, and economies of scale collectively form a three-dimensional coordinate for model selection. Research indicates that regional resource endowments and entity capabilities necessitate differentiated recycling pathways: the manufacturer-dominated model proves irreplaceable for high-value blade processing, the operator-dominated model demonstrates significant advantages in short-distance transport scenarios, while third-party models rely entirely on scale effects derived from concentrated wind farm clusters.

The industry's core challenge stems from the structural imbalance between recycling costs and material recovery value, requiring multi-tiered solutions: policy interventions must establish economic incentive mechanisms, technological advancements should drive eco-design innovations, and logistics systems require optimized regional consolidation networks. Future research should explore dynamic techno-economic equilibrium mechanisms and advance nationwide recycled material circulation systems. Ultimately, the green renaissance of wind turbine blades will be illuminated by technological innovation, lighting the path toward resource circularity in humanity's carbon-neutrality journey.

Disclosure statement

The author declares no conflict of interest.

References

[1] Barthelmie RJ, Pryor SC, 2014, Potential Contribution of Wind Energy to Climate Change Mitigation. Nature Climate Change, 4(8): 684–688. DOI:10.1038/nclimate2269.

[2] Feng Y, Lin H, Ho SL, et al., 2015, Overview of Wind Power Generation in China: Status and Development. Renewable & Sustainable Energy Reviews, 50: 847–858. DOI:10.1016/j.rser.2015.05.005.

[3] Xia Y, 2024, Overview of Wind Power Development and Utilization in Some Countries and Regions of the World in 2023. Wind Energy, 2024(2): 60–62. DOI:10.3969/j.issn.1674-9219.2024.02.012.

[4] Teng Y, 2023, Wind Power Photovoltaic Equipment Ushered in the Tide of 'Retirement'. Environmental Economy, 2023(17): 36–37.

[5] Chen YY, Zhang X, Chen Y, et al., 2024, [Title not provided]. Chinese Journal of Environmental Engineering, 18(5): 1415.

[6] Liu P, Meng F, Barlow CY, 2022, Wind Turbine Blade End-of-Life Options: An Economic Comparison. Resources, Conservation and Recycling, 180: 106202. DOI:10.1016/j.resconrec.2022.106202.

[7] Nagle AJ, Mullally G, Leahy PG, et al., 2022, Life Cycle Assessment of the Use of Decommissioned Wind Blades in Second Life Applications. Journal of Environmental Management, 302: 113994.

[8] Xiong X, Zhang Y, Zhang J, et al., 2024, Organic Solid Waste Experiment of Boiler Coupling Combustion of Decommissioned Wind Power Based on Settling Furnace. Chemical Progress, 43(z1): 555–563. DOI:10.16085/j.issn.1000-6613.2024-0998.

[9] Liu Y, 2016, Research on Automobile Reverse Logistics. Enterprise Reform and Management, 2016(12): 180.

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Research on the Construction and Application of Intelligent Financial Decision-Making Model Driven by Generative Artificial Intelligence

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Abstract: This study focuses on the construction and application of intelligent financial decision-making models driven by generative artificial intelligence (AI). It analyzes the mechanisms by which generative AI empowers financial decision-making within a dual framework of dynamic knowledge evolution and risk control. The research reveals that generative AI, with its superior data processing, pattern recognition, and autonomous learning capabilities, can transcend the limitations of traditional decision-making models, facilitating a significant shift from causal inference to probabilistic creation in decision-making paradigms. By systematically constructing an intelligent financial decision-making model that includes data governance, core engine, and decision output layers, the study clarifies the functional roles and collaborative mechanisms of each layer. Additionally, it addresses key challenges in technology application, institutional adaptation, and organizational transformation by proposing systematic strategies for technical risk management, institutional innovation, and organizational capability enhancement, aiming to provide robust theoretical support and practical guidance for the intelligent transformation of corporate financial decision-making.

Keywords: Generative artificial intelligence; Intelligent financial decision making; Decision model; Risk control

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1. Introduction

In the era of rapid digital economic development, the environment for corporate financial decision-making is undergoing profound changes. On one hand, as businesses diversify and globalize, and with the widespread use of Internet and IoT technologies, the volume of financial data generated both internally and externally by companies is growing exponentially. The types of data are becoming increasingly complex, including structured financial reports, semi-structured transaction records, and unstructured market sentiments and policy documents. On the other hand, the uncertainty in the global economic landscape has increased, market competition has intensified, and the economic relationships faced by companies have become more intricate. The limitations of traditional financial

decision-making models, which rely on fixed rules, historical experience, and static analysis frameworks, have become more apparent. Traditional models lack the ability to efficiently parse and integrate large volumes of unstructured data. In a dynamic economic environment, these models also fall short in risk prediction and adaptive adjustment mechanisms, making it difficult to meet the demands of detailed management and strategic decision-making.

Although research on the application of artificial intelligence (AI) technology in finance has made some progress, most existing studies focus on the localized use of individual technologies or the simple adaptation of general AI techniques. There is a significant gap in developing a systematic model that integrates deep integration and generative AI features with the practical needs of financial decision-making. Additionally, there is no well-established theoretical framework or practical solution for achieving continuous updates of dynamic knowledge and effective risk control during the financial decision-making process. As a cutting-edge technology in AI, generative AI excels in data analysis, pattern generation, and prediction. Its unique technical capabilities offer new possibilities and directions for the innovation of financial decision-making. A deeper exploration of intelligent financial decision-making models driven by generative AI can not only fill the gaps in current theoretical research and further refine the theoretical framework of intelligent financial decision-making, but also promote the transformation and upgrading of corporate financial decision-making towards intelligence and precision from a practical perspective. This can significantly enhance the risk management and decision-making scientificity of enterprises in complex economic environments, which is crucial for enhancing core competitiveness and driving digital transformation in the financial sector.

2. The mechanism of financial decision-making enabled by generative AI

2.1. Technical characteristic adaptability

Generative artificial intelligence, leveraging deep learning algorithms, demonstrates high adaptability in financial decision-making scenarios. Its capability to process multi-source data overcomes the data barriers of traditional financial analysis. It can analyze unstructured texts like policy documents and news articles using natural language processing technology, and handle image data such as invoices and vouchers with image recognition technology. These data are then efficiently integrated with the structured data from the company's internal financial system. In terms of autonomous learning and pattern recognition, generative AI, through extensive training on years of financial data, industry historical fluctuations, and macroeconomic indicators, can uncover hidden nonlinear relationships between financial metrics, such as the potential link between R&D investment and future three-year earnings, and the impact of supply chain fluctuations on cash flow. Particularly, its generative capabilities enable the creation of financial data simulation models for hundreds of market scenarios using techniques like Monte Carlo simulation and reinforcement learning, providing comprehensive data support for investment and financing decisions and cost control scheme evaluations. This technical feature aligns well with the core needs of financial decision-making, including deep data mining, dynamic risk assessment, and forward-looking validation of plans, thereby providing innovative momentum for intelligent financial decision-making at the technical level.

2.2. Comparison with traditional decision models

As shown in **Table 1**, compared with traditional financial decision-making models, the generative AI-driven intelligent financial decision model demonstrates significant advantages in data-handling capacity, decision basis, risk prediction, and decision plan generation.

Table 1. Comparison with traditional decision models

Compare dimensions	Traditional financial decision-making model	Intelligent financial decision model driven by generative AI
data-handling capacity	It mainly relies on manual collection and input of structured data, and a large amount of manual transformation is required for the processing of unstructured data [1]. The efficiency of data cleaning and integration is low, and the processing cycle can last several weeks when facing TB-level data.	Through the API interface, it can automatically connect to ERP, CRM, and other systems to capture structured data in real time; NLP and OCR technology can be used to realize second-level processing of unstructured data, with data cleaning accuracy of more than 98%, and support parallel computing of PB-level data.
Decision basis	Based on historical financial ratio analysis and fixed formula calculation (such as DuPont analysis method), the parameters of the decision-making model are solidified for a long time, which makes it difficult to adapt to external shocks such as sudden changes in economic policies and technological innovation in industries.	The machine learning model with dynamic parameters is built and the training data is updated daily. The decision weight can be adjusted in real time according to the adjustment of the Federal Reserve interest rate and the change of industry standards, so as to ensure the timeliness and accuracy of the decision basis.
Risk prediction ability	Subjective evaluation methods such as Delphi method and scenario analysis method are adopted, and the risk identification dimension is limited to abnormal financial indicators, while the early warning of non-financial risks, such as supply chain fracture and public opinion crisis lags behind.	By integrating multi-source information such as public opinion monitoring, supply chain data, and satellite remote sensing data (such as port freight volume), the algorithm of correlation rule mining can identify systemic risks 6–12 months in advance, and the error rate of risk quantification is reduced by 40% compared with traditional methods.
Decision plan generation	Relying on the experience of financial personnel to formulate 3–5 conventional schemes, the scheme comparison is only based on static data measurement, and lacks dynamic simulation of the implementation process of the scheme.	More than 20 kinds of differentiated decision-making schemes are automatically generated, and the probability distribution chart of the implementation effect of the scheme is output by simulating the market feedback and the chain reaction, such as the adjustment of competitors' strategies after the implementation of the scheme through the generative adversarial network (GAN) [2].

2.3. Core breakthroughs

Generative AI is driving a paradigm shift in financial decision-making from "causal inference" to "probability creation." Traditional financial decisions are based on linear causal logic, such as predicting future revenue through historical sales growth rates, which makes it difficult to handle black swan events and sudden variables. In contrast, generative AI, using architectures like Transformers, can perform unsupervised learning on millions of economic data points. This enables it to break free from the constraints of causal frameworks and generate probability distributions for financial data under various scenarios, such as macroeconomic fluctuations and changes in industry competition over the next 3–5 years, providing decision-makers with more forward-looking decision maps. To balance the explainability of the decision-making process and black box risks, SHAP (Shapley Additive Explanations) value analysis and LIME (Local Interpretable Model-Agnostic Explanations) algorithms are used to break down the logic of model decisions, converting complex neural network computations into metrics that financial personnel can understand. Additionally, a dual verification system is established to validate AI outputs using traditional financial analysis methods and to manually intervene in abnormal decision recommendations by incorporating expert experience. This ensures that while leveraging the powerful decision-making capabilities of generative AI, the decision-making process remains transparent and controllable.

3. Construction of intelligent financial decision-making model

3.1. Data governance layer

The data governance layer, serving as the foundation of the intelligent financial decision-making model, is responsible for managing multi-source data throughout its entire lifecycle. In the data collection phase, this layer establishes a standardized data access platform, using API interfaces to seamlessly integrate with the company's internal ERP and CRM systems, as well as production management systems, to obtain real-time business data such as financial accounting, sales orders, and inventory management [3]. Additionally, it uses web crawling and data interface protocols to gather macroeconomic indicators, industry trends, and market sentiment from external sources like government economic databases, industry research institutions, and social media platforms. Once the collected data enters the cleaning stage, data deduplication algorithms are used to eliminate duplicate records, anomaly detection algorithms are employed to identify and correct erroneous data, and multiple methods, such as imputation and predictive modeling, are applied to fill in missing data, ensuring the accuracy and completeness of the data. In the data annotation and classification phase, natural language processing technology is used to analyze unstructured text data for semantic analysis and keyword extraction, and machine learning algorithms are applied to automatically classify the data into structured formats. Furthermore, the data governance layer has established a robust data security system, using data encryption technology to securely store and transmit sensitive data, implementing access control mechanisms to strictly limit data access permissions for different users, and setting up data audit logs to monitor data operations in real time, thereby ensuring comprehensive data privacy and security, and providing a reliable data foundation for subsequent model training and decision-making analysis [4].

3.2. Core engine layer

The core engine layer, serving as the central hub of the intelligent financial decision-making model, deeply integrates generative artificial intelligence algorithms with professional financial decision analysis models. In data processing and analysis, this layer employs advanced algorithms such as natural language processing, deep learning, and reinforcement learning to deeply mine the standardized data from the data governance layer. A financial risk assessment model is constructed, which uses convolutional neural networks (CNNs) to extract the temporal features of financial data and recurrent neural networks (RNNs) to analyze the dynamic evolution patterns of the data, achieving precise identification and quantitative assessment of various financial risks, including credit risk, market risk, and liquidity risk. Using a Transformer architecture, it learns from historical financial data and related influencing factors to predict the future trends of key financial indicators such as revenue, profit, and cash flow. In decision plan generation, the core engine layer utilizes generative adversarial networks (GANs) and variational autoencoders (VAEs) to simulate changes in financial data under different economic scenarios, market environments, and corporate strategies, generating multiple decision scenarios and corresponding financial data simulation results to provide rich reference for decision-makers. Additionally, the core engine layer has strong dynamic learning capabilities, automatically updating model parameters based on new data, continuously optimizing the model structure, and enhancing the model's ability to analyze financial decision-making issues and improve decision accuracy, ensuring the model remains adaptable and effective in complex and changing financial environments [5].

3.3. Decision output layer

The decision output layer serves as a crucial bridge between the analysis results of the intelligent financial decision-making model and the enterprise's decision-makers. Its primary task is to transform complex data analysis

results into intuitive, understandable, and user-friendly decision information. In terms of text report generation, the decision output layer employs natural language generation technology to automatically summarize and refine the conclusions derived from model analysis. This process provides a clear, accurate, and standardized textual description that details the basis for financial decisions, current financial status analysis, potential risk warnings, and specific decision recommendations, enabling decision-makers to quickly grasp the key points of the decision. For visual presentation, this layer utilizes professional data visualization tools to present financial data, risk assessment results, and comparison of decision options through various visual elements such as bar charts, line graphs, pie charts, dashboards, heat maps, and Sankey diagrams. These visual elements intuitively illustrate the relationships, trends, and comparative advantages and disadvantages among different options, helping decision-makers better understand the underlying data. Additionally, the decision output layer supports robust human-computer interaction features, allowing decision-makers to adjust decision parameters, switch analysis dimensions, and view detailed data according to their needs and concerns [6]. This enables them to obtain personalized decision plans and analysis reports, integrating the intelligent decision-making system with human experience, thereby enhancing the scientific and rational nature of financial decisions [7].

4. Implementation challenges and response paths

4.1. Technical risk control

Generative AI technology faces multiple technical risks and challenges in financial decision-making applications. Algorithm bias risks arise from issues such as sample selection biases and data labeling errors in training data, which can lead to systematic biases in model outputs. For instance, in credit risk assessments, these biases can result in discriminatory judgments against specific industries or types of enterprises. Data privacy breaches are also a significant concern, as financial data contains core business secrets and sensitive information. If security measures are inadequate during data collection, transmission, storage, and use, data breaches can occur, causing significant losses to companies [8]. Additionally, the black-box nature of generative AI models makes their decision-making processes difficult to understand and interpret, increasing decision-making risks and regulatory challenges. To address these risks, companies need to establish robust algorithm review mechanisms, regularly assess and optimize model algorithms, and test the fairness and accuracy of models through cross-validation and A/B testing. They should also enhance data security systems by using federated learning technology for collaborative analysis without leaving local data and employing homomorphic encryption to ensure data is processed in an encrypted state, thus securing data privacy from a technical standpoint. Furthermore, companies should actively develop and apply explainable AI technologies, such as causal inference and visual analytics, to increase the transparency of model decision-making logic and reduce the risks associated with technology application.

4.2. Institutional adaptation and innovation

Traditional financial management systems struggle to meet the demands of generative AI-driven intelligent financial decision-making. In terms of data usage, traditional systems lack clear guidelines on new data sources, data sharing scopes, and data usage permissions, leading to inefficient data circulation within companies and failing to fully realize their value. The traditional hierarchical and approval-based decision-making processes are cumbersome and do not meet the time-sensitive requirements of intelligent financial decisions, and they lack effective support for data-driven decision-making. Regarding the division of responsibilities, intelligent financial decisions

involve multiple departments, including finance, technology, and business [9]. Under the traditional system, unclear departmental responsibilities can lead to buck-passing, affecting decision-making efficiency and quality. Therefore, companies need to innovate their financial management systems comprehensively, establish specific data usage standards, clarify the standards and permissions for data collection, storage, sharing, and use, and build a data sharing platform to facilitate data circulation. They should also optimize decision-making processes, develop a data-driven agile decision-making mechanism, reduce unnecessary approval steps, and improve decision-making efficiency. Additionally, they should redefine the responsibilities and permissions of each department in intelligent financial decision-making, establish a cross-departmental collaboration mechanism, and enhance inter-departmental communication and cooperation [10]. Furthermore, companies should integrate generative AI technology into their internal control systems, implement corresponding risk prevention measures and supervision mechanisms, and ensure that the intelligent financial decision-making process is compliant and controllable.

4.3. Restructuring of organizational capabilities

Enterprises face significant challenges in implementing intelligent financial decision-making models due to organizational capabilities. From a personnel skills perspective, traditional financial staff primarily focus on financial accounting theories and regulations, often lacking knowledge and skills in data analysis and artificial intelligence technology. This makes it difficult for them to effectively operate and apply these models, thus failing to fully leverage their advantages. In terms of organizational culture, traditional companies tend to have a conservative and experience-focused culture, with low acceptance of new technologies and methods. Employees often resist change, which significantly hinders the promotion and application of intelligent financial decision-making models. Additionally, the current organizational structure is typically divided by function, leading to poor communication and collaboration between departments, making it challenging to meet the cross-departmental and cross-domain needs of intelligent financial decision-making. To address these challenges, enterprises should enhance talent development and recruitment by offering internal training, external professional training, and collaborating with universities to improve financial staff's skills in data processing, analysis, and AI application. They should also actively recruit composite talents who are proficient in both finance and technology. Organizational culture should be transformed through publicity, guidance, setting innovation role models, and establishing incentive mechanisms to foster an open, innovative, and adventurous cultural environment, thereby enhancing employees' acceptance and recognition of new technologies. The organizational structure should be optimized by breaking down departmental barriers and forming project-oriented cross-departmental teams, building agile organizational structures and work models that support intelligent financial decision-making, and achieving a comprehensive restructuring and enhancement of organizational capabilities.

5. Conclusion

This study systematically explores the construction and application of intelligent financial decision-making models driven by generative artificial intelligence. Based on a dual framework of dynamic knowledge evolution and risk control, it delves into the mechanisms by which generative AI empowers financial decision-making. It constructs an intelligent financial decision-making model that includes data governance, core engine, and decision output layers. The study also proposes targeted strategies to address technical, institutional, and organizational challenges encountered during implementation. The research provides a comprehensive theoretical framework and practical

guidance for the intelligent transformation of corporate financial decision-making. However, as generative AI technology continues to evolve and innovate, and the corporate financial decision-making environment remains dynamic, further in-depth research is needed to explore the deep integration of technology and financial operations, aiming to develop more efficient, secure, and intelligent financial decision-making models. For example, how to integrate generative AI with blockchain technology to achieve credible sharing and traceability of financial data; and how to use generative AI to better address the impact of global risks such as climate change and geopolitical conflicts on corporate financial decision-making. Through ongoing research and practice, the aim is to continuously drive digital innovation and development in the financial sector, providing robust support for companies to achieve sustainable development in a complex and ever-changing market environment.

Disclosure statement

The author declares no conflict of interest.

References

[1] Feng Q, 2025, New Paradigm of Management Accounting Research Driven by Artificial Intelligence. Finance and Accounting Monthly, 46(11): 31–40.

[2] Xue L, Jiang L, 2025, Generative AI Drives the Paradigm Change of Future Industrial Innovation. Journal of the Chinese Academy of Sciences, 40(05): 820–827.

[3] Zhao J, Dou Z, Yang H, et al., 2025, The Impact of Artificial Intelligence Technologies Represented by DeepSeek on Discipline Development: Tool Innovation and Method Integration. Journal of Beihang University (Social Sciences Edition), 38(03): 36–51.

[4] Jiang H, Zeng W, 2025, Generative Artificial Intelligence Drives the Transformation of Educational Evaluation. Chinese Journal of Education, 2025(08): 41–48.

[5] Wang H, Ding S, 2025, Research Progress on the Economic Impact of Generative Artificial Intelligence. Economic Dynamics, 2025: 1–18.

[6] Liang L, Song M, 2025, Exploration of Agile Audit Mode Transformation and Practice Framework Driven by Digital Intelligence Technology. Finance and Accounting Monthly, 46(15):91–96.

[7] Wang W, Deng Y, 2025, The Symbiotic Logic and Practical Path of Human–Machine Composite Educators. Journal of Central China Normal University (Humanities and Social Sciences Edition), 64(04): 90–99.

[8] Tang L, Xu Y, 2025, Research on the Efficient Development Path of China's Generative Artificial Intelligence Industry: Configuration Analysis Based on TOE Framework. Scientific Research, 2025: 1–13.

[9] Zong S, Yang F, Long L, et al, 2025, Promote or Inhibit? The Double-Edged Sword Effect of Adopting Generative Artificial Intelligence on Creativity. Advances in Psychological Science, 33(06): 905–915.

[10] Zheng Y, Wang Y, 2025, How Generative Artificial Intelligence Empowers High Quality Development of Science Education. Science and Society, 15(01): 18–21.

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Revenge or Rationality? Investigating Post-Pandemic Luxury Purchase Intentions in Guangzhou Through an Extended TPB Framework

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Abstract: This study examines whether post-pandemic luxury purchase intentions in Guangzhou are primarily driven by emotional compensation ("revenge consumption") or rational deliberation. Based on an extended Theory of Planned Behavior (TPB) model—incorporating brand trust and digital engagement—the analysis uses SEM on 412 consumer responses. Findings indicate that core TPB constructs significantly predict intention, and additional variables enhance explanatory power. Interaction effects suggest that emotional and cognitive mechanisms jointly shape behavior, forming a continuum. The study offers empirical insights into evolving consumer psychology in digitally mediated luxury markets.

Keywords: Theory of Planned Behavior; Luxury consumption; Post-pandemic behavior; Brand trust; Digital engagement; Consumer psychology

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1. Introduction

1.1. Research background

The COVID-19 pandemic triggered significant shifts in luxury consumption. In China, a rapid post-crisis rebound was evident, notably in Guangzhou. Two psychological trends emerged: emotional "revenge consumption" and rational, value-conscious spending. Bain & Company (2024) reported a 12% year-on-year growth in China's luxury market, while McKinsey & Company highlighted a shift toward responsible and identity-aligned purchases [1]. Guangzhou, with its affluent, digitally connected consumer base, offers a pertinent context to examine whether luxury purchases reflect compensatory impulses or rational discernment in a post-pandemic economy.

1.2. Research problem and research questions

In the aftermath of the COVID-19 pandemic, luxury consumption behaviors in urban China have evolved beyond short-lived "revenge spending." While many studies emphasized immediate consumption rebounds, fewer

addressed longer-term shifts toward rational, digitally influenced, and ethically aware purchasing. Existing TPB frameworks often omit key drivers such as brand trust and digital engagement, leaving explanatory gaps.

This study addresses these limitations by investigating: Whether luxury purchase intentions are primarily emotional or rational; How extended TPB variables—brand trust, digital engagement, and cultural values—influence these intentions; The moderating effects of demographic factors. Focusing on Guangzhou as a representative tier-one city, this research seeks to contribute to a deeper understanding of post-pandemic luxury behavior within a digitalized and socially dynamic environment.

1.3. Theoretical framework and conceptual model

The Theory of Planned Behavior (TPB) explains behavioral intention through attitude (ATT), subjective norms (SN), and perceived behavioral control (PBC) (Ajzen, 1991)[2]. While effective in various consumption studies, traditional TPB lacks sensitivity to post-pandemic shifts in luxury purchasing.

This study incorporates three context-specific constructs into the TPB framework:

(1) Brand trust (BT): Reflecting confidence in brand authenticity and value consistency under economic uncertainty.

(2) Digital engagement (DE): Capturing the influence of social media and online interactions on luxury perception.

(3) Cultural value orientation (CVO): Addressing the influence of social identity, status aspiration, and collectivist norms.

Together, these variables enhance TPB's explanatory capacity by capturing both emotional and rational elements of post-pandemic luxury decisions. The resulting extended model forms the conceptual basis for hypothesis development and empirical testing.

1.4. Significance of the study

This study contributes theoretically by extending the Theory of Planned Behavior (TPB) to include brand trust, digital engagement, and cultural value orientation—factors increasingly relevant in post-pandemic luxury consumption. This enriched model responds to calls for adapting TPB to evolving market and psychological contexts, particularly in non-Western, digitally embedded societies like urban China.

Practically, distinguishing between emotional and rational consumption patterns enables luxury brands to calibrate marketing strategies. Emotion-driven consumers may respond to exclusivity and identity narratives, while rational consumers prioritize trust, value, and sustainability.

Socio-culturally, the research sheds light on shifting values among China's urban middle class. Findings offer implications for consumer policy, ethical marketing, and domestic brand development, particularly as post-crisis consumption increasingly reflects a blend of self-expression and calculated discernment.

2. Literature review

2.1. Theoretical foundation: Extended TPB perspective

The Theory of Planned Behavior (TPB), developed by Ajzen (1991), posits that behavioral intentions are shaped by attitude, subjective norms, and perceived behavioral control. While widely applied in consumer behavior studies, TPB's standard constructs have limitations in explaining luxury consumption, particularly in post-crisis contexts where emotional, symbolic, and social drivers intensify.

This study extends TPB by incorporating brand trust, digital engagement, and cultural value orientation—contextual variables reflective of China's evolving luxury landscape. These additions enhance the model's capacity to account for both rational deliberation and emotionally charged decisions, positioning the extended TPB as a more context-sensitive framework.

2.2 Emotional versus rational motives in luxury consumption

Luxury consumption is shaped by both affective and cognitive mechanisms. Emotional drivers—such as self-reward, stress relief, and identity signaling—have gained salience in the post-pandemic context, particularly in the form of "revenge consumption." Concurrently, rational considerations, including price–value assessment, brand credibility, and long-term utility, have become more prominent amid economic uncertainty.

This duality reflects a shift from traditional conspicuous consumption to a more nuanced behavioral spectrum. Recent studies in urban China suggest that consumers increasingly balance symbolic gratification with calculated judgment. Hence, a comprehensive analysis must account for the interaction between emotion and rationality rather than treat them as mutually exclusive forces.

2.3. Evolving patterns of luxury consumption in post-pandemic China

The COVID-19 pandemic accelerated structural shifts in China's luxury market. While early stages saw an upsurge in emotionally driven "revenge buying," this trend has gradually transitioned into more deliberate consumption patterns. Urban consumers increasingly emphasize brand authenticity, ethical sourcing, and alignment with personal values.

Furthermore, digital platforms now play a pivotal role in shaping luxury preferences, not only by expanding access but also by facilitating peer influence and curated identity expression. As consumers recalibrate their priorities amid economic ambiguity, luxury purchases are becoming expressions of both emotional recuperation and rationalized self-investment.

2.4. Extending TPB: Incorporating brand trust, digital engagement, and cultural values

To enhance the predictive capacity of TPB in luxury consumption, this study incorporates three contextually salient variables. Brand trust captures consumers' reliance on perceived authenticity and credibility, which moderates impulsive buying tendencies in uncertain times. Digital engagement reflects how social media and virtual interaction influence behavioral intention through curated brand narratives and peer validation. Cultural value orientation accounts for collective norms, status signaling, and identity expression prevalent in Chinese society. These additions allow for a more comprehensive understanding of how emotional and rational motivations coalesce in shaping post-pandemic luxury consumption.

2.5. Conceptual model and hypotheses

Building upon the extended TPB framework, this study proposes that attitude (ATT), subjective norms (SN), and perceived behavioral control (PBC) significantly predict luxury purchase intention. Further, brand trust (BT) and digital engagement (DE) are posited to moderate the effects of ATT and SN, respectively.

The following hypotheses are formulated:

(1) H1: ATT positively influences luxury purchase intention.

(2) H2: SN positively influences luxury purchase intention.

(3) H3: PBC positively influences luxury purchase intention.

(4) H4: BT moderates the ATT–intention relationship.

(5) H5: DE moderates the SN–intention relationship.

The conceptual model integrates these relationships, capturing both rational and affective dimensions influencing luxury consumption in the post-pandemic era.

3. Research methodology

3.1. Research design

This study adopts a quantitative research design to examine the applicability of an extended Theory of Planned Behavior (TPB) framework in explaining post-pandemic luxury purchase intentions in Guangzhou. Structural equation modeling (SEM) was selected due to its capacity to estimate complex relationships between latent constructs and account for moderating effects. A cross-sectional survey method was employed to collect primary data, enabling both confirmatory factor analysis (CFA) and structural path modeling to assess reliability, validity, and hypothesis testing within a unified empirical structure.

3.2. Conceptual framework and hypotheses

The conceptual model builds upon Ajzen's (1991) TPB, encompassing the original constructs of attitude (ATT), subjective norm (SN), and perceived behavioral control (PBC), and is extended by incorporating brand trust (BT), digital engagement (DE), and cultural value orientation (CVO). Interaction terms (e.g., ATT × BT, SN × DE) are included to reflect the interdependence of rational and emotional pathways in luxury decision-making.

The following hypotheses were formulated:

(1) H1: Attitude positively influences luxury purchase intention.

(2) H2: Subjective norm positively influences purchase intention.

(3) H3: Perceived behavioral control positively influences purchase intention.

(4) H4: Brand trust positively moderates the relationship between attitude and purchase intention.

(5) H5: Digital engagement positively moderates the relationship between subjective norm and purchase intention.

(6) H6: Cultural value orientation has a direct positive effect on purchase intention.\

This extended model provides an integrated framework for capturing both utilitarian and expressive dimensions of luxury consumption behavior in a post-pandemic context.

3.3. Sampling and data collection

Given the study's focus on luxury consumers in post-pandemic Guangzhou, the target population comprised urban residents with a history or intent of luxury purchases. A non-probability purposive sampling strategy was employed to ensure that respondents possessed adequate exposure to luxury consumption and digital platforms. This approach was suitable for theory-driven modeling where generalizability is secondary to construct validation.

The survey instrument was distributed online via major Chinese platforms (WeChat, Wenjuanxing), and screened for completion, consistency, and eligibility. Respondents had to be over 18 years of age, reside in Guangzhou, and demonstrate awareness of luxury brands. Data were collected in April 2025 over a two-week period, yielding 412 valid responses after screening.

This sample size exceeded the minimum threshold for SEM analysis, as guided by Krejcie & Morgan (1970)

and supported by Hair *et al.* (2019), which recommends a minimum of 10 responses per estimated parameter [3, 4]. The final dataset allowed for robust estimation of the extended TPB model with multiple moderators.

3.4. Measurement instrument and operationalization of variables

The questionnaire was developed based on validated scales adapted to the context of luxury consumption in China. Each construct was measured using multi-item Likert-type scales ranging from 1 ("Strongly Disagree") to 7 ("Strongly Agree").

(1) Attitude (ATT), Subjective Norm (SN), and Perceived Behavioral Control (PBC) were operationalized following Ajzen's (1991) original TPB specifications.

(2) Brand Trust (BT) was measured using items from Delgado-Ballester and Munuera-Alemán (2005)[5], emphasizing reliability and integrity perceptions.

(3) Digital Engagement (DE) was captured via adapted scales reflecting social media influence, online interaction, and digital exposure, aligned with Kapferer and Bastien (2021) [6].

(4) Cultural Value Orientation (CVO) encompassed status motivation, collectivism, and identity signaling, adapted from Zhang and Kim (2023) [7].

(5) Purchase Intention (PI) was measured using three items assessing the likelihood of purchasing luxury goods in the near term.

A pre-test involving 30 Guangzhou-based consumers was conducted to ensure content validity and linguistic clarity. Minor adjustments were made based on feedback, ensuring cultural relevance and psychometric adequacy.

3.5. Data analysis methods

Data were analyzed using a two-stage approach. First, Confirmatory Factor Analysis (CFA) was employed to assess the reliability and validity of the measurement model, using indices such as Cronbach's alpha (α), composite reliability (CR), average variance extracted (AVE), and model fit indicators (e.g., CFI, RMSEA).

Second, Structural Equation Modeling (SEM) was applied to test hypothesized relationships among latent variables, consistent with the extended Theory of Planned Behavior framework. Moderation effects (e.g., BT × ATT, DE × SN) were examined via interaction terms.

The software packages SPSS 26.0 and AMOS 24.0 were used for statistical analysis. Demographic variables were included as controls to account for heterogeneity in age, gender, income, and education.

This methodological strategy ensured robust testing of both direct and interaction effects while accounting for measurement error and latent construct interdependencies.

3.6. Common method bias control

To minimize common method bias (CMB), both procedural and statistical remedies were employed. Procedurally, anonymity was ensured, question wording was refined to reduce social desirability, and measurement items were psychologically separated.

Statistically, Harman's single-factor test was conducted; the first factor accounted for less than 40% of the total variance, suggesting that CMB was not a serious concern. Additionally, a marker variable approach was applied, using an unrelated variable to confirm the robustness of relationships among theoretical constructs. These measures collectively ensured the validity of self-reported responses and enhanced the credibility of structural

modeling outcomes.

4. Results and discussion

4.1. Descriptive statistics

A total of 412 valid responses were retained for analysis. The demographic profile of the respondents indicated a balanced distribution across gender, age, and income, with a substantial representation of digitally active consumers in urban Guangzhou. **Table 1** summarizes the key demographic characteristics.

Table 1. Demographic profile of respondents (N = 412)

Demographic variable	Category	Frequency (n)	Percentage (%)
Gender	Male	183	44.4%
	Female	229	55.6%
Age	18–25	94	22.8%
	26–35	167	40.5%
	36–45	93	22.6%
	46+	58	14.1%
Monthly Income	< RMB 8,000	49	11.9%
	RMB 8,000–15,000	154	37.4%
	RMB 15,001–25,000	131	31.8%
	> RMB 25,000	78	18.9%
Education	Undergraduate or below	219	53.2%
	Postgraduate or above	193	46.8%
Luxury Purchase Freq.	Once/year or less	109	26.5%
	2–3 times/year	187	45.4%
	More than 3 times/year	116	28.2%

Descriptive statistics of the latent constructs (e.g., ATT, SN, PBC, BT, DE) confirmed sufficient variability and absence of extreme outliers. Skewness and kurtosis values were within acceptable thresholds, supporting the assumption of multivariate normality for SEM analysis.

4.2. Measurement model assessment

Confirmatory Factor Analysis (CFA) was conducted to validate the reliability and validity of the measurement model. Standardized factor loadings for all observed variables exceeded the 0.6 threshold, indicating satisfactory indicator reliability. Cronbach's alpha and Composite Reliability (CR) values were above 0.7 across constructs, confirming internal consistency.

Table 2. Reliability and validity assessment

Construct	Cronbach's α	CR	AVE
ATT	0.82	0.86	0.67
SN	0.79	0.84	0.64
PBC	0.76	0.82	0.61
BT	0.85	0.88	0.69
DE	0.83	0.87	0.68

Average Variance Extracted (AVE) values surpassed the 0.5 benchmark, establishing convergent validity. Discriminant validity was confirmed as the square root of AVE for each construct exceeded inter-construct correlations (Fornell & Larcker, 1981) [8]. Model fit indices for CFA indicated satisfactory fit: $\chi^2/df = 2.14$, CFI = 0.948, TLI = 0.936, RMSEA = 0.053, SRMR = 0.042—within recommended thresholds (Hu & Bentler, 1999) [9]. These results validate the robustness of the measurement model and its suitability for structural equation modeling.

4.3. Structural model results

The structural model was tested using SEM to evaluate hypothesized relationships. Fit indices confirmed good model adequacy ($\chi^2/df = 2.09$, CFI = 0.951, TLI = 0.939, RMSEA = 0.051, SRMR = 0.045).

Based on **Table 3**, all three core TPB predictors had significant positive effects on luxury purchase intention: Attitude ($\beta = 0.37$, $p < 0.001$); Subjective Norms ($\beta = 0.29$, $p < 0.001$); Perceived Behavioral Control ($\beta = 0.26$, $p < 0.001$). The extended constructs also showed strong effects: Brand Trust ($\beta = 0.31$, $p < 0.001$); Digital Engagement ($\beta = 0.27$, $p < 0.001$); Interaction analysis revealed two significant moderating effects: ATT × BT ($\beta = 0.15$, $p < 0.01$) and SN × DE ($\beta = 0.18$, $p < 0.01$). These findings underscore that consumer intention is shaped by both internal beliefs and contextual factors such as trust and digital exposure, validating the extended TPB model's applicability.

Table 3. Structural model path coefficients

Path	β	*p*-value
ATT → PI	0.37	< 0.001
SN → PI	0.29	< 0.001
PBC → PI	0.26	< 0.001
BT → PI	0.31	< 0.001
DE → PI	0.27	< 0.001
ATT × BT → PI	0.15	< 0.01
SN × DE → PI	0.18	< 0.01

4.4 Comparative Motivation Analysis: Revenge vs. Rationality

This section examines whether luxury purchase intention in post-pandemic Guangzhou reflects revenge-driven impulses or rational deliberation. Descriptive comparison and interaction analysis reveal a hybrid pattern rather than a binary outcome.

Consumers scoring high on brand trust and perceived behavioral control tend to exhibit calculated decision-

making, aligning with rational consumption. In contrast, individuals highly engaged with digital platforms—particularly those exposed to luxury content and influencer marketing—demonstrate stronger affective motivations, indicating traits of revenge consumption.

Multigroup analysis by age and income further supports this segmentation. Younger, digitally active respondents showed a higher susceptibility to emotional cues, while older, high-income consumers emphasized durability, investment value, and brand legacy. This distinction illustrates a continuum of motivations, shaped by demographic and contextual factors (**Figure 1**).

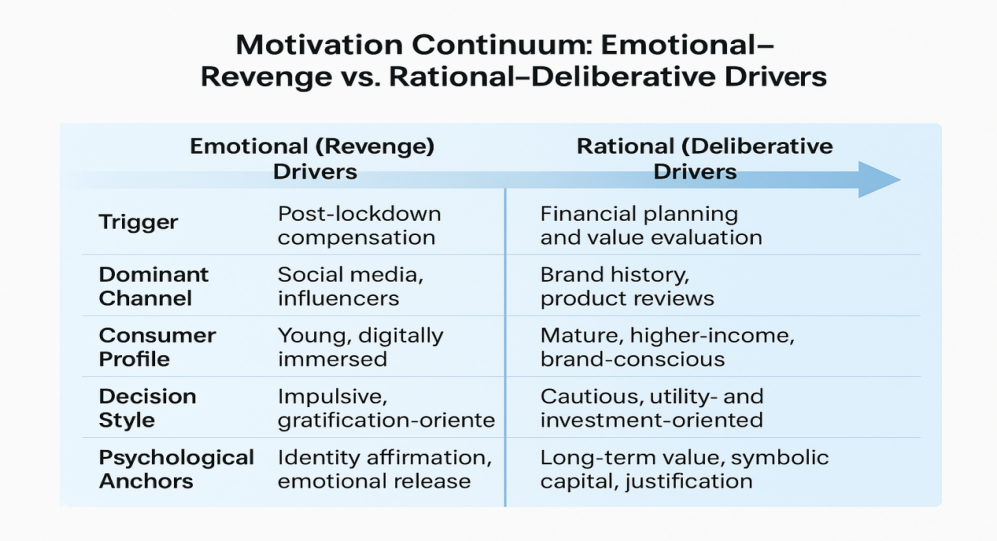

Figure 1. Motivation continuum: Emotional-revenge vs. Rational-deliberative drivers

Rather than viewing revenge and rationality as mutually exclusive, findings support an integrative perspective: luxury consumption decisions are dynamically shaped by affective impulses and cognitive justifications in response to evolving post-pandemic realities.

5. Conclusion and implications

5.1. Summary of key findings

This study employed an extended Theory of Planned Behavior (TPB) to examine luxury consumption intentions in post-pandemic Guangzhou. SEM results confirm the significance of core predictors—attitude, subjective norm, and perceived behavioral control—while also highlighting the role of brand trust and digital engagement as key contextual moderators. Rather than discrete motivations, the findings reveal a dynamic continuum blending emotional gratification and rational evaluation.

5.2. Theoretical contributions

First, the integration of brand trust and digital engagement enriches TPB, extending its relevance to emotionally complex, digitally mediated consumption. Second, the study supports a dual-process mechanism, wherein affective impulses interact with rational appraisals. Third, the research underscores the influence of cultural and collective norms, reinforcing the social embeddedness of purchase intention in urban China.

5.3. Managerial implications

Brand managers should segment audiences by motivational orientation. Younger, digitally immersed consumers respond to immersive campaigns and influencer narratives. Older consumers value consistency, authenticity, and heritage. Cultivating brand trust through transparency and ethical branding is vital, especially in a market sensitive to credibility. Rational framing—such as trial opportunities, digital previews, or post-purchase assurances—can legitimize consumption under perceived risk.

5.4. Limitations and future research

The study's geographic focus on Guangzhou may limit generalizability to broader Chinese or global luxury markets. Cross-sectional data constrain longitudinal inferences. Future studies should pursue mixed-method and longitudinal designs, explore emerging domains such as digital or sustainable luxury, and examine psychological rationalizations—such as virtue signaling—as mechanisms reconciling indulgence and pragmatism.

5.5. Concluding remarks

Luxury consumption in post-COVID China reflects a hybrid psychological process—emotional desires strategically justified through cognitive framing. This synthesis, captured through an enriched TPB model, offers a nuanced framework for understanding consumer behavior amid volatility and digital acceleration. Scholars and practitioners alike must recognize that today's luxury consumption is neither purely hedonic nor strictly calculated, but a negotiated act within evolving socio-cultural and economic realities.

Disclosure statement

The authors declare no conflict of interest.

Author contributions

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References

[1] McKinsey & Company, 2024, State of the Consumer 2024: What's Now and What's Next. https://www.mckinseysolutions.com/industries/consumer-packaged-goods/our-insights/state-of-consumer.

[2] Ajzen I, 1991, The Theory of Planned Behavior. Organizational Behavior and Human Decision Processes, 50(2): 179–211. https://doi.org/10.1016/0749-5978(91)90020-T

[3] Krejcie RV, Morgan DW, 1970, Determining Sample Size for Research Activities. Educational and Psychological Measurement, 30(3): 607–610. https://doi.org/10.1177/001316447003000308

[4] Hair JF, Black WC, Babin BJ, et al., 2019, Multivariate Data Analysis (8th ed.). Cengage, Massachusetts.

[5] Delgado-Ballester E, Munuera-Alemán JL, 2005, Does Brand Trust Matter to Brand Equity? Journal of Product & Brand Management, 14(3): 187–196. https://doi.org/10.1108/10610420510601058

[6] Kapferer JN, Bastien V, 2021, The Luxury Strategy: Break the Rules of Marketing to Build Luxury Brands (3rd ed.). Kogan Page, UK.

[7] Zhang L, Kim HJ, 2023, Cultural Value Orientation and Luxury Consumption in China. Journal of Consumer Behaviour, 22(1): 97–113. https://doi.org/10.1002/cb.2010

[8] Fornell C, Larcker DF, 1981, Evaluating Structural Equation Models with Unobservable Variables and Measurement Error. Journal of Marketing Research, 18(1): 39–50. https://doi.org/10.1177/002224378101800104

[9] Hu LT, Bentler PM, 1999, Cutoff Criteria for Fit Indexes in Covariance Structure Analysis: Conventional Criteria Versus New Alternatives. Structural Equation Modeling, 6(1): 1–55. https://doi.org/10.1080/10705519909540118

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Research on the Impact of Supply Chain Finance on Enterprises' ESG Performance

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Abstract: With the continuous increase in global attention to Environmental, Social, and Governance (ESG) issues, an enterprise's ESG performance has become an important indicator for measuring its comprehensive competitiveness. As an innovative financial model that integrates the industrial chain and financial resources, supply chain finance not only improves the capital liquidity and resource allocation efficiency of enterprises but also plays a positive role in promoting the sustainable development of enterprises. Based on the operational characteristics and internal mechanisms of supply chain finance, this paper systematically analyzes its impact pathways on enterprises' ESG performance, aiming to provide theoretical support and practical references for enterprises to improve their sustainable development strategies and for the government to optimize policy-making.

Keywords: Supply chain finance; ESG performance; Enterprise management

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1. Introduction

Against the backdrop of accelerating globalization and deepening sustainable development concepts, an enterprise's competitive advantage is not only reflected in its internal operating efficiency but also closely related to its position and responsibilities within the supply chain system. Supply chain finance, as an innovative financial model that integrates logistics, information flow, and capital flow, has become an important tool for enterprises to optimize resource allocation, improve operating efficiency, and enhance risk-resistance capabilities. At the same time, Environmental, Social, and Governance (ESG) have gradually become key indicators for measuring an enterprise's comprehensive performance and sustainable development capabilities [1].

Currently, China is in a crucial stage of high-quality economic development. The guiding role of the ESG concept in enterprise operations is becoming increasingly prominent, prompting enterprises to pay more attention to fulfilling social responsibilities and choosing green development paths while pursuing economic benefits. Excellent ESG performance not only helps to enhance an enterprise's reputation and social recognition but also

strengthens its financing capabilities and market competitiveness, serving as an important support for enterprises to achieve long-term value creation [2].

In this context, more and more enterprises are incorporating ESG into their core strategic plans and promoting its integration into the entire process of operation and management. Exploring the impact of supply chain finance on enterprises' ESG performance not only has important theoretical research value but also provides practical references and path guidance for the government to improve the policy system and for enterprises to promote sustainable development practices.

2. Overview of supply chain finance

2.1. Definition of supply chain finance

Supply chain finance refers to the coordinated management of financial institutions, core enterprises, or third-party platforms around the upstream and downstream enterprises of a supply chain in terms of goods flow, capital flow, and information flow, providing systematic and customized financial service solutions, relying on the core enterprise of the supply chain. This model is based on the credit guarantee of the core enterprise. By effectively controlling the real trade background, it transforms the risk exposure of a single enterprise in traditional finance into the overall management of the risks of all participants in the entire supply chain system, achieving effective risk diversification and control [3].

The core goal of supply chain finance is to improve the overall capital allocation efficiency of the supply chain, enhance the liquidity and transparency of the operation process, and thus improve the stability and competitiveness of the supply chain system [4]. In short, supply chain finance does not merely provide financing support to a single enterprise. Instead, relying on the credit advantages of the core enterprise, it integrates the resources of the industrial chain and offers a package of comprehensive financial services to upstream and downstream small and medium-sized enterprises, including financing, settlement, credit assessment, accounts receivable management, warehouse financing, order financing, etc., to promote the coordinated development and sustainable operation of the supply chain system [5].

2.2. Main characteristics of supply chain finance

2.2.1. Controllable risk

Supply chain finance uses the credit of the core enterprise as a fulcrum. Relying on its stable trading relationships and operating capabilities, it effectively reduces the default risk faced by financial institutions during the credit-granting process. By participating in the capital flow and logistics of each link of the supply chain, financial institutions can have a more comprehensive understanding of the trading background and credit status of enterprises, realizing a transformation from traditional single-risk control to systematic risk management [6].

2.2.2. Transparent information

Supported by digital platforms, supply chain finance enables the sharing of information among the upstream and downstream of the supply chain. With the help of the business data mastered by the core enterprise, financial institutions can obtain real-time information on the order fulfillment status, inventory turnover rate, and transaction records of small and medium-sized enterprises, thereby improving the accuracy of credit assessment and the scientific nature of financing decisions [7].

2.2.3. Based on real trade background

Supply chain finance emphasizes that all financing activities must be based on real transactions [8]. Financial institutions ensure that financing behaviors have a clear trade background and capital use purpose by reviewing purchase orders, invoices, logistics documents, etc., and establish a "self-liquidating" financing mechanism to reduce the risk of financial fraud and ensure the predictability of closed-loop capital operation and repayment sources [9].

2.2.4. Stable cooperative relationship

Core enterprises usually have strong bargaining and control power over their upstream and downstream supply chain enterprises. Within the supply chain system, member enterprises establish stable relationships based on long-term cooperation and benefit-sharing, which provides a continuous and reliable basis for risk assessment by financial institutions and enhances the continuity and stability of financial services [10].

2.2.5. Shift in credit-granting logic

Compared with the credit-granting logic of traditional finance, which focuses on enterprise financial statements, supply chain finance pays more attention to the credit transmission mechanism in the transaction chain. Financial institutions usually grant credit to core enterprises, and then the core enterprises extend their credit to upstream and downstream enterprises, achieving indirect credit-granting to small and medium-sized enterprises. This simplifies the risk control process, improves financing efficiency, and reduces credit risk exposure.

2.2.6. Meeting multi-level financing needs

Supply chain finance can cover the diversified financing needs of enterprises in various links, from raw material procurement, production and processing, logistics and warehousing to sales and payment collection. Its financial products are rich in variety and flexible in form, capable of providing customized services to enterprises and alleviating practical problems such as difficult and expensive financing [11].

2.2.7. Closed-loop capital operation

Supply chain finance emphasizes the full-process controllability and traceability of capital flows. Through the unified management of capital flow, logistics, and information flow, it realizes closed-loop control of links such as financing applications, capital disbursement, and recovery. Financial institutions strengthen post-loan management through item-by-item review and dynamic supervision, effectively preventing systematic risks and achieving pre-emptive risk management.

2.3. Functions of supply chain finance

As a product of the deep integration of modern financial services and supply chain management, the value of supply chain finance is not only reflected in alleviating enterprise financing difficulties but also in promoting the overall optimization and upgrading of the supply chain. Its main functions can be elaborated from the following four aspects [12].

2.3.1. Optimizing capital flow efficiency

Supply chain finance helps enterprises convert idle assets into working capital through tools such as accounts receivable financing and inventory pledge, alleviating the capital pressure in each link. Enterprises can extend

payment terms through credit purchases while accelerating the collection of accounts receivable, shortening the turnover cycle, and improving operating efficiency. Compared with traditional financing, supply chain finance focuses on the overall liquidity and coordination of the supply chain, promoting inventory structure optimization, order response acceleration, and data-driven dynamic management, achieving precise capital allocation and maximizing the use efficiency.

2.3.2. Reducing financing costs

Relying on information sharing and digital technology, supply chain finance effectively alleviates the problems of "difficult and expensive financing" for small and medium-sized enterprises. Financial institutions reduce information asymmetry and risk premiums with the credit endorsement of core enterprises and data-based risk control. At the same time, diverse financing products such as order financing and warehouse receipt financing can accurately match enterprise needs, avoiding financing mismatches. The introduction of digital platforms also simplifies processes, reduces costs, and improves efficiency.

2.3.3. Enhancing supply chain stability

Supply chain finance provides financial guarantees for small and medium-sized enterprises, enhancing the performance capabilities of each link and reducing the risk of supply chain disruptions. Relying on the credit transmission and coordination mechanism of core enterprises, it achieves risk-sharing and improves the overall resilience. Information sharing and transparent management improve response speed and scheduling efficiency, promoting the establishment of long-term and stable cooperative relationships between upstream and downstream enterprises and enhancing the internal stability of the supply chain structure.

2.3.4. Improving enterprises' comprehensive competitiveness

Supply chain finance provides flexible financial support, improving enterprises' capital security and market response capabilities, enhancing customer satisfaction and delivery efficiency. Enterprises can concentrate resources on innovation, market expansion, and brand building, strengthening their core competitiveness. At the same time, through a stable financial cooperation mechanism, enterprises can achieve resource sharing and complementary advantages, improving their bargaining power and strategic position in the supply chain and facilitating high-quality development and sustainable operation.

3. Impact of supply chain finance on enterprises' ESG performance

Against the backdrop of the increasingly strengthened "Dual-carbon" strategy and high-quality development orientation, ESG has become an important indicator for measuring an enterprise's comprehensive competitiveness. As a bridge connecting all parties in the industrial chain and financial resources, supply chain finance not only improves the resource allocation efficiency of enterprises but also profoundly affects environmental performance, social responsibility, and governance levels [13].

3.1. Promoting the improvement of environmental performance

Supply chain finance guides enterprises to adopt environmentally friendly raw materials and low-carbon production methods through the green credit mechanism. Financial institutions can implement incentives such as preferential interest rates and green credit lines for green enterprises, promoting green procurement,

energy conservation, emission reduction, and constructing a sustainable supply chain. At the same time, the environmental risk assessment mechanism prompts enterprises to improve compliance systems and reduce the risk of environmental violations. In addition, green financing helps enterprises accelerate technological innovation and energy-saving transformations, and the information disclosure mechanism improves the efficiency of environmental risk identification and response, overall enhancing the green management levels of enterprises and their upstream and downstream partners.

3.2. Strengthening the fulfillment of corporate social responsibility

Supply chain finance provides financing channels such as accounts receivable and prepayment financing for small and medium-sized enterprises, alleviating financial strain, protecting employees' rights and interests, and promoting employment stability. Financial institutions are also gradually incorporating social responsibility evaluations, covering aspects such as labor treatment and supply chain compliance, into their due diligence investigations, strengthening corporate responsibility constraints. At the same time, enterprises tend to choose partners with strong responsibility-fulfilling capabilities, driving a responsibility-oriented cooperation mechanism. Through methods such as issuing social responsibility bonds and establishing sustainable funds, capital further flows into public welfare fields such as education, healthcare, and poverty alleviation, expanding the social influence of enterprises.

3.3. Optimizing the corporate governance structure

Supply chain finance improves enterprises' financial transparency and risk management capabilities, promoting the improvement of their internal financial control, budgeting, and audit mechanisms. The requirements for financing information disclosure also prompt management to improve governance efficiency and transparency. To meet risk control standards, enterprises need to strengthen internal control construction and improve their governance structures, forming a modern management system.

In addition, enterprises with strong governance capabilities are more likely to obtain financial support and cooperation preferences, forming a "reverse screening" mechanism that drives the synchronous improvement of the governance levels of the entire supply chain. The continuous supervision of financial institutions also strengthens the compliance and governance stability of enterprises.

In summary, supply chain finance is not only a financing innovation but also a financial means to promote enterprises to fulfill their ESG responsibilities and achieve sustainable development. Through its green incentive, responsibility-oriented, and information-transparent systems, it is increasingly becoming an important support for enterprises to achieve the coordinated improvement of the environment, society, and governance.

4. Conclusion

This paper systematically explores the impact mechanism of supply chain finance on enterprises' ESG performance. The research shows that supply chain finance not only helps to optimize enterprise capital flow, improve operating efficiency, and enhance competitiveness but also plays a significant role in promoting environmental performance, fulfilling social responsibilities, and optimizing corporate governance. Through its green incentive mechanism, information-sharing, and transparent governance system, it guides enterprises to accelerate their sustainable development transformation and helps to build a responsible and resilient supply chain

system.

To further unleash the potential of supply chain finance in enhancing ESG performance, the following suggestions are put forward: At the enterprise level, deepen the strategic deployment of supply chain finance. Enterprises should actively introduce the concept of supply chain finance, incorporate it into their strategies and operation systems, and improve their collaborative management capabilities with upstream and downstream enterprises. By integrating financial resources, they can optimize the supply chain structure, enhance resource integration and environmental management capabilities, and form an internal driving force for sustainable development [14]. At the risk control level, improve the ESG-oriented supply chain management mechanism. Enterprises should establish an ESG-oriented risk assessment and control system, pay attention to risks related to environmental compliance, social responsibility fulfillment, and governance structure, achieve the dual improvement of supply chain stability and corporate responsibilities, and promote the coordinated integration of business goals and sustainable development goals.

At the policy and financial support level, promote institutional innovation and diverse financial supply. The government and financial institutions should strengthen top-level design and improve the policy framework for green supply chain finance. Encourage the innovation of financial products, promote the implementation of green credit, responsible investment, and ESG evaluation tools, and guide financial resources to gather towards environmentally friendly and socially responsible enterprises, providing institutional and financial support for the improvement of enterprises' ESG performance [15].

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References

[1] Qiu J, Cui M, Pan A, 2025, Supply Chain Finance and Enterprise Sustainable Development – Empirical Evidence from ESG Performance. Nankai Business Review 2025: 1–32. http://kns.cnki.net/kcms/detail/12.1288.f.20250321.1116.003.html

[2] Lei R, Zhang X, Li N, et al., 2025, Supply Chain Finance and Enterprises' ESG Performance – Based on the Mediating Roles of the Financing Effect and the Relationship Effect. Journal of Chongqing Technology and Business University (Social Science Edition), 42(1): 110–126.

[3] Wang Y, 2024, An Analysis of the Impact of Supply Chain Finance on Enterprises' ESG Performance. China Circulation Economy, 2024(14): 164–168.DOI:10.16834/j.cnki.issn1009-5292.2024.14.003.

[4] Jian G, Bai F, 2024, Can Supply Chain Finance Promote Enterprises' ESG Performance? – Based on the Synergy Theory and Information Asymmetry Theory. Finance and Accounting Monthly, 45(12): 71–78. DOI:10.19641/j.cnki.42-1290/f.2024.12.011.

[5] Sun Y, 2023, Digital Transformation and Enterprises' ESG Performance – Based on the Empirical Data of Private

Listed Enterprises. Productivity Research, 2023(9): 100–105.

[6] Wu C, Dong H, 2023, Digital Transformation, High-Quality Development Level, and Enterprises' ESG Performance – Based on the Empirical Data of Listed Manufacturing Companies in the Yangtze River Delta. Journal of Dalian Minzu University, 25(6): 507–517. DOI:10.13744/j.cnki.cn21-1431/g4.2023.06.015.

[7] Li M, Tao T, Bao H, 2025, The Impact and Mechanism of Digital Transformation on Enterprises' ESG Performance – Based on the Empirical Data of Chinese A-Share Listed Companies. Market Outlook, 2025(4): 10–13.

[8] Meng Q, 2023, An Analysis of the Impact of Supply Chain Finance on Enterprise Performance From the Perspective of the Digital Economy. Marketing World, 2023(2): 47–49.

[9] Zhang W, Liu K, 2012, Can the Development of Supply Chain Finance Reduce the Financing Constraints of Small and Medium-Sized Enterprises? – An Empirical Analysis Based on Small and Medium-Sized Listed Companies. Economic Science, 2012(3): 108–118.

[10] Wang B, Guo H, Zheng J, et al., 2022, Supply Chain Finance and the Financing Efficiency of Science-and-Technology-Based Small and Medium-Sized Enterprises. Finance and Economy, 2022(12): 88–96.

[11] Fan H, Wu T, He S, 2023, Research on the Industrial Chain Linkage Effect of Enterprise Digitalization. China Industrial Economics, 420(3): 115–132.

[12] Liu F, Wu Y, 2024, The Impact and Mechanism of Digital Transformation on Enterprises' ESG Responsibility Performance Under the "Dual-carbon" Goals. Science & Technology Progress and Policy, 41(5): 40–49.

[13] Zhao C, 2022, Research on the Impact of Digital Transformation on Corporate Social Responsibility. Contemporary Economic Science, 44(2): 109–116.

[14] Zhang W, Liu K, 2012, Can the Development of Supply Chain Finance Reduce the Financing Constraints of Small and Medium-Sized Enterprises? – An Empirical Analysis Based on Small and Medium-Sized Listed Companies. Economic Science, 2012(3): 108–118.

[15] Zhou M, Tang P, 2024, The Mitigating Effect of Supply Chain Finance on the Financing Constraints of Small and Medium-Sized Enterprises – Based on the Moderating Effect of the Digital Economy. Financial Development Review, 2024(2): 65–80.

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Research on Empowering Small and Medium-sized Enterprises with Artificial Intelligence for Financial Decision Optimization

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Abstract: With the acceleration of the iterative process of artificial intelligence technology, small and medium-sized enterprises have encountered innovative solutions in the field of financial decision-making, significantly enhancing their dynamic response capabilities to complex and changing market environments. This article summarizes the specific application scenarios and development trends of artificial intelligence in the financial management practice of small and medium-sized enterprises, and explores the path and positive impact of artificial intelligence on the optimization of financial decision-making in small and medium-sized enterprises from the current application status of artificial intelligence in financial decision-making, the unique challenges of financial management in small and medium-sized enterprises and the impact of AI technology on it, the application of artificial intelligence in financial decision-making optimization, and prospects.

Keywords: Artificial intelligence; Small and medium-sized enterprises; Financial decision optimization

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1. Introduction

Against the backdrop of profound changes in the global economic landscape, small and medium-sized enterprises, as one of the core forces driving market development, are facing severe challenges. Traditional financial management systems are significantly ineffective in dealing with market fluctuations and uncertainties. The factors that constrain the development of enterprises include poor information flow, limited resource conditions, and a lack of decision-making tools. Therefore, it is urgent to establish a new type of decision support mechanism. At present, the booming development of intelligent technology has opened up an innovative path for enterprises to achieve transformation and upgrading.

1.1. Data modeling and analysis

Technological breakthroughs in data modeling and analysis have endowed intelligent systems with two distinct advantages: massive information processing capabilities and risk prediction capabilities. Compared to traditional manual analysis models, machine learning-powered decision architectures leverage deep analysis of multidimensional data to accurately capture market signals and potential risks. At the technological level, this advancement has undergone iterative development, not only reconstructing financial information processing models but also enabling synergistic decision-making in resource allocation, cost optimization, and risk prevention.

1.2. Industrial development

From the perspective of industrial development, building an intelligent financial decision-making system has dual value. On the one hand, it is very important for promoting the development of enterprises in the digital age and has become a core key link in the digital transformation of enterprises. On the other hand, it has laid a solid technological foundation for enterprises to cultivate sustainable competitiveness. This innovative practice path that integrates multiple elements is rewriting the survival and development model of small and medium-sized enterprises, enabling them to form a new development trend in the complex and ever-changing market environment.

2. Current state of AI applications in financial decision-making

2.1. Fundamental concepts of AI technology

AI technology is a key domain of the technological revolution, encompassing machine learning, deep neural networks, and other branches. Leveraging its powerful data analysis and automated decision-making capabilities, AI has expanded its applications across various fields. With significant improvements in computing power, increasingly robust big data systems, and the growing adoption of intelligent algorithms in industrial applications, breakthroughs have been achieved in both resource allocation efficiency and decision-making accuracy [1].

2.2. Development of AI technology

Firstly, the profound impact of intelligent technology is driving a comprehensive reform of the financial governance system for small and medium-sized enterprises. In the traditional financial governance model, the contradiction between the bottleneck in information processing and the dynamic changes in the market environment has become increasingly apparent. Unlike the common cases of slow response in manual analysis, intelligent systems can provide real-time analysis of massive data through algorithm models, greatly resolving the problem of information asymmetry. This intelligent technology endows enterprises with significantly enhanced risk warning capabilities, and optimizes financial decision-making processes through pattern recognition technology, providing strategic support to market entities from multiple dimensions.

Secondly, by using deep learning methods to construct predictive models, financial indicators of enterprises can be dynamically monitored, and future trends can also be inferred. This model extracts features from historical data, and also carries out pattern learning. Using data-driven analysis strategy, it can broaden the confidence interval of prediction results and shorten the time period required for information processing [2].

Thirdly, driven by continuous technological evolution and institutional innovation, intelligent algorithms are developing into a new type of infrastructure in the value creation process for small and medium-sized enterprises.

As cutting-edge technologies such as edge computing and federated learning are used in business, financial decision systems have more obvious real-time response capabilities. These characteristics can effectively assist enterprises in achieving sustainable value growth goals in dynamic and uncertain market environments, providing solid guarantees for the long-term stable development of enterprises.

3. The unique challenges of financial management for small and medium-sized enterprises and the impact of AI technology on them

Small and medium-sized enterprises have encountered a series of unique challenges in the field of financial management, mainly manifested as insufficient capital reserves, a lack of professional talent, and a weak ability to cope with market fluctuations.

3.1. Intelligent analysis technology enhances the ability of small and medium-sized enterprises to cope with market fluctuations

The traditional financial management model is limited by data processing capabilities, which often leads to delays in grasping market dynamics. This lag can easily lead to decision-making biases. In the current market environment where multiple complex factors interact, this issue is particularly evident. In this situation, the introduction of intelligent analysis technology has brought a new solution to the problem of reforming financial management systems for small and medium-sized enterprises. By using data cleaning algorithms and risk modeling frameworks, asset allocation mechanisms and crisis warning systems can be optimized. Meanwhile, through deep neural network technology, enterprises can construct multidimensional financial indicator analysis models, greatly improving the adaptability of business decisions in different time and spatial dimensions [3].

3.2. Intelligent decision systems mitigate talent shortages

The deployment of intelligent decision-making systems has effectively alleviated the adverse effects of the shortage of professional accounting talents in enterprises to some extent. Build an automated report generation mechanism and cash flow forecasting model to enable enterprises to obtain accurate financial diagnostic reports even with limited human resources.

3.3. Intelligent financial tools enhance value creation

In the process of enterprise development, the use of intelligent financial tools not only enhances the company's ability to create value but also builds a systematic and comprehensive risk control barrier for the company. Small and medium-sized enterprises can build a dynamic and adaptable financial management system by continuously optimizing algorithm models and continuously improving digital infrastructure. This system has helped small and medium-sized enterprises achieve stable and sustainable development in a complex and ever-changing market environment.

In short, intelligent financial systems have many advantages, but their implementation is hindered by practical factors such as limited completeness of digital infrastructure, slow technological updates, insufficient funding, and varying levels of digital literacy among personnel. Therefore, it is urgent to rely on hierarchical and step-by-step policy support to solve this difficulty [4].

4. Application pathways for AI in decision optimization

4.1. Data analysis and predictive modeling

With the continuous advancement of artificial intelligence technology, data analysis systems are gradually demonstrating their core supporting role in the financial decision-making architecture of small and medium-sized enterprises.

Firstly, the current prediction tools mainly rely on massive data mining techniques and intelligent algorithm systems for construction. The application of this model has greatly improved the accuracy of market trend analysis, consumption characteristics analysis, and capital risk warning. By utilizing a composite technological path, enterprises can anticipate the dynamic changes in capital flows, predict market trends, and dynamically adjust resource allocation plans and risk control strategies.

Secondly, when building a system, the most crucial thing is to establish a clear data processing framework. In the initial stage, it is necessary to utilize multi-source heterogeneous data interfaces to comprehensively integrate various information flows such as business reports, industry indicators, and user profiles. This step is to aggregate data scattered across different sources and structures, laying the foundation for subsequent processing. Next, the deployed purification module will perform standardized filtering operations on the raw data signal. The core of this operation is to effectively remove outliers and duplicate records from the data, preventing these interfering factors from having adverse effects on subsequent data processing steps. After completing the above data cleaning work, a structured dataset is obtained, and the machine learning engine uses this dataset for pattern recognition and result derivation. By running machine learning algorithms, potential patterns and patterns in data can be explored, providing strong support for system decision-making and applications [5].

Thirdly, in the implementation phase, model operability and continuous optimization of system performance are core tasks in the technical implementation process. Specifically, combining K-fold cross-validation with a grid search strategy can effectively enhance the algorithm's adaptability to new samples. This method divides and validates the dataset multiple times, and then systematically searches for parameters, so that the algorithm can better handle different sample data and improve generalization ability.

Fourthly, the main obstacle when deploying predictive tools is the conflict between information confidentiality requirements and algorithmic black box attributes. The key to ensuring the security of sensitive information is to implement homomorphic encryption protocols and dynamic privacy protection algorithms. Related studies have shown that using a visual decision tree framework, combined with a SHAP value interpretation system, can clearly present the nonlinear interaction paths between variables. This mechanism that makes the decision-making process transparent greatly increases the trust level of the decision-making layer in the predicted results. The intelligent analysis system can organically combine the above series of technologies to measure the stability and reliability in practical application scenarios [6].

4.2. Design of intelligent decision support systems

The key to improving financial management efficiency for small and medium-sized enterprises is to efficiently and reasonably apply intelligent decision support systems. Firstly, to build this system, it is necessary to deeply integrate artificial intelligence technology with the operational characteristics of the enterprise itself, to achieve the automation upgrade and intelligent optimization of the decision-making process. In the constantly changing market environment, the system architecture needs to establish a real-time data update mechanism to ensure timely decision-making. By utilizing this mechanism, financial information flow can be synchronized in real-time,

providing an accurate and reliable basis for strategic adjustments of enterprises [7].

Secondly, the foundation of decision quality lies in the accuracy of analysis, which requires the use of algorithms such as deep learning to construct predictive models. Integrating various technologies with deep learning algorithms can not only optimize the calculation results of data but also greatly improve the ability to predict financial development trends. When promoting the practical application of the system, the user-friendly design of the human-computer interaction interface is a key factor, which can optimize the operation logic and improve the visual presentation effect. This not only reduces the threshold requirements for professional knowledge in financial work, but also improves the response efficiency of decision-making terminals.

Thirdly, in the system development process, building a comprehensive data protection system is crucial. Specifically, it is best to adopt a combination of end-to-end encryption and distributed storage to ensure high security of trade secrets in various stages of digital transformation. The widespread adoption of the system is mainly driven by two core factors: policy support and technological innovation. On the one hand, relying on systems to effectively stimulate the transformation drive of enterprises. On the other hand, constantly breaking through key technological bottlenecks. Only by simultaneously meeting these two requirements can we accelerate the process of digitizing financial management [8].

In summary, through comprehensive and multidimensional technology integration and architecture optimization, the system can ultimately build a precise and efficient decision support network. This network can help small and medium-sized enterprises build and consolidate sustainable competitive advantages in complex and ever-changing market environments.

5. Future prospects for financial decision optimization

5.1. Potential impact of technological advances on financial management

With the rapid advancement of artificial intelligence technology, the financial management landscape of small and medium-sized enterprises has undergone profound changes, especially in areas such as information analysis and strategic assistance, which are particularly significant. The computing power has been constantly improving, and the models have been continuously optimized. There has been a qualitative leap in information processing efficiency and analysis accuracy, and market entities can deeply mine and extract massive financial information in a short period of time. This development has significantly improved the timeliness and credibility of economic decision-making in the time dimension, and has also established a multidimensional risk warning system. With the help of machine learning architecture and deep neural network models, market entities can accurately grasp the volatility characteristics and potential crisis signals of business cycles, thereby optimizing asset allocation and decision-making processes, enhancing their ability to respond and competitiveness in complex market environments [9, 10].

However, with the rapid development of technology, emerging risk matrices have become significant, such as issues related to defining information sovereignty and privacy protection mechanisms. This requires us to build a multidimensional defense system. The adoption of dynamic encryption protocols and heterogeneous authentication mechanisms can be organized to ensure security and maximize technological potential, promoting the continuous development of financial management systems towards adaptive modes.

5.2. Policy recommendations

Government departments and industry organizations need to work together to introduce special support policies so that artificial intelligence can be effectively applied to the financial decision-making of small and medium-sized enterprises. The urgent task is to establish a standard system for artificial intelligence financial management, starting from the formulation of technical guidelines, data encryption methods, and other aspects, to build a solid information security protection barrier. When small and medium-sized enterprises introduce technology, if there are special funding support, tax and fee reductions, and other incentive measures, the financial burden can be reduced in the initial stage, making the enterprise more active and proactive in research and development investment [11].

5.3. Implementation pathways

Industry institutions should play a leading role, build platforms for technological empowerment, and regularly organize specialized training activities. It aims to help practitioners proficiently master the operating points and core skills of intelligent financial tools. This knowledge dissemination mechanism can, on the one hand, enhance the awareness and understanding of digitalization among the decision-making level of enterprises. On the other hand, utilizing the shared model of case databases can promote the exchange and interaction of cross-enterprise experiences, thereby stimulating the vitality and motivation of collaborative innovation.

Small and medium-sized enterprises need to develop a phased intelligent transformation strategy based on their own business characteristics. Integrating machine learning algorithms into the budget management process can improve the accuracy of financial warnings. In the specific implementation, special attention should be paid to the reconstruction of business processes to ensure that technological innovation can be effectively transformed into a powerful driving factor for reducing costs and improving efficiency. In the era of digital transformation, the ability of enterprises to resist risks will be strengthened, and the high-quality development of regional economy will also usher in a new source of power [12].

6. Conclusion

This article outlines the practical models of artificial intelligence technology in the field of financial decision-making for small and medium-sized enterprises. Intelligent tools can solve the problems of information barriers and resource allocation, and are an important supporting force for small and medium-sized enterprises to break through development bottlenecks. It has high efficiency in multidimensional data analysis and has a decision support mechanism, which can effectively improve the efficiency of enterprise financial management and make decisions more accurate.

Looking ahead to the future, in-depth research on the adaptation rules of intelligent systems in various segmented industries and different enterprise sizes will be conducted, improving privacy protection mechanisms, and building algorithm security systems. To achieve wider value dissemination and deep penetration in the ecosystem of small and medium-sized enterprises, intelligent decision-making systems need to coordinate effective policy guidance and core algorithm innovation in order to have broader value.

Disclosure statement

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References

[1] Liu X, 2025, From the Perspective of Integrating Industry and Finance, How Private Enterprises Can Optimize Financial Decision-Making. Chinese Businessman, 2025(3): 150–151.

[2] Yin H, 2024, Research on the Implementation Path and Economic Consequences of Lean Digitalization Empowering Specialized, Refined, Unique and New "Little Giants", thesis, Jiangxi University of Finance and Economics. DOI: 10.27175/d.cnki.gjxcu.2024.00077.

[3] Zhao Y, 2024, Digital Transformation Path of SMEs in the Perspective of AI and Industrial Internet Integration. China Broadband, 20(7): 121–123. DOI: 10.20167/j.cnki.ISSN1673-7911.2024.07.41

[4] Dey PK, Chowdhury S, Abadie A, et al., 2024, Artificial Intelligence-Driven Supply Chain Resilience in Vietnamese Manufacturing Small-and Medium-Sized Enterprises. International Journal of Production Research, 62(15): 5417–5456.

[5] Khan AA, Laghari AA, Li P, et al., 2023, The Collaborative Role of Blockchain, Artificial Intelligence, and Industrial Internet of Things in Digitalization of Small and Medium-Size Enterprises. Scientific Reports, 13(1): 1656.

[6] Nagy M, Lăzăroiu G, Valaskova K, 2023, Machine Intelligence and Autonomous Robotic Technologies in the Corporate Context of SMEs: Deep Learning and Virtual Simulation Algorithms, Cyber-Physical Production Networks, and Industry 4.0-Based Manufacturing Systems. Applied Sciences, 13(3): 1681.

[7] Ren S, 2022, Optimization of Enterprise Financial Management and Decision-Making Systems Based on Big Data. Journal of Mathematics, 2022(1): 1708506.

[8] Sun W, 2022, Financial Technology, Debt Financing, and Corporate Strategic Progress, thesis, Southwest University of Finance and Economics, DOI: 10.27412/d.cnki.gxncu.2022.003380.

[9] Soni G, Kumar S, Mahto R V, et al., 2022, A Decision-Making Framework for Industry 4.0 Technology Implementation: The Case of FinTech and Sustainable Supply Chain Finance for SMEs. Technological Forecasting and Social Change, 180: 121686.

[10] Shang X,2022, Research on the Impact of Digital Transformation on Enterprise Performance. Guangzhou University. DOI: 10.27040/d.cnki.ggzdu.2022.001656.

[11] Wen X, 2021, Exploration of Innovation and Development of Finance for Small and Medium-Sized Enterprises Based on the Perspective of Artificial Intelligence. Finance and Economics, 2021(32): 115–116.

[12] Žigienė G, Rybakovas E, Alzbutas R, 2019, Artificial Intelligence-Based Commercial Risk Management Framework for SMEs. Sustainability, 11(16): 4501.

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Research on the Development Direction of Commercial Banks' Corporate Business— Taking A Commercial Bank as an Example

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Abstract: Against the backdrop of the gradual deepening of interest rate liberalization, the decline in effective credit demand, the intensification of competitive involution among commercial banks, and the complex international economic and trade situation, commercial banks in mainland China have entered a stage of low interest rates and narrow interest margins. Coupled with the continuous exposure of risks in retail customer groups and small and micro enterprises, many commercial banks have chosen to phase in expanding and strengthening their corporate business segments to smoothly navigate economic cycles and enhance operational resilience and sustainability. How the corporate business segment optimizes its asset-liability structure through asset allocation to achieve high-quality development is a major issue worthy of consideration by the entire industry. From the perspective of a medium-sized national commercial bank, this paper explores and proposes four key basic customer groups, six asset allocation models, and fourteen key industries for layout, for reference, and research.

Keywords: Corporate credit; Asset allocation; Business transformation; High-quality development

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1. Introduction

Against the backdrop of profound changes in the current financial market, the process of interest rate liberalization has continued to deepen, effective credit demand has shown a downward trend, competition among commercial banks has become increasingly fierce, and the international economic and trade situation has become complex and changeable. These factors have put pressure on commercial banks' net interest margin management and asset quality management, thereby affecting their operational sustainability. At the same time, risks in retail customer groups and small and micro enterprises have been continuously exposed. In the external operating environment of "low interest rates, narrow interest margins, and high risks", many commercial banks have chosen to phase in expanding and strengthening their corporate business segments, hoping to smoothly navigate the economic cycle

and enhance their operational resilience and sustainable development capabilities [1].

2. Strengthening four key customer groups to identify business focus

2.1. State-owned enterprise customer group

The report to the 20th National Congress of the Communist Party of China points out: Deepen the reform of state-owned assets and state-owned enterprises, accelerate the optimization and structural adjustment of the layout of the state-owned economy, promote the strengthening, optimization, and expansion of state-owned capital and state-owned enterprises, and enhance the core competitiveness of enterprises. In 2024, the total revenue of state-owned enterprises was 84.72 trillion yuan, accounting for 63% of GDP. The state-owned enterprise customer group has a large market scale and can be regarded as a key direction for asset allocation. Following the pace of state-owned enterprise reform, Commercial Bank A has innovatively launched "state-owned enterprise special bonds" for their major infrastructure and industrial upgrading projects to help enterprises reduce financing costs; it has also joined hands with financial technology companies to build a dedicated treasury management platform for state-owned enterprises, realizing intelligent management and allocation of funds [2]. At the same time, a dynamic risk assessment model for state-owned enterprises has been established, focusing on the impact of industry policy changes on enterprise operations. Through regular risk investigations and bank-enterprise communication, potential risks are resolved in advance to achieve long-term and stable cooperation.

2.2. Medium-sized private manufacturing company customer group

Following the concept of "low risk, uniform return", based on full identification and asset inventory, for medium-sized enterprises with "revenue below 1 billion yuan and financing scale below 500 million yuan", the business cooperation model of "strong guarantee + main settlement bank + lead bank" is adopted. By using the enterprise's core assets as collateral to enhance credit, the lead bank increases cooperation efforts, reduces the risk of being replaced by other banks, consolidates the customer base, and builds loyal customers. At the same time, adhering to the business philosophy of "customer-centric", bank-enterprise cooperation is strengthened. Through comprehensive financial services such as credit, online banking, salary payment, and private banking services, customer stickiness is enhanced, striving to become the main settlement bank and further improving asset returns. Commercial Bank A has developed the "Intelligent Manufacturing Quick Loan" product to simplify the approval process and provide rapid financial support for enterprise technological transformation; combined with enterprise export needs, it provides one-stop services such as export tax rebate financing and cross-border settlement. In addition, regular industry salons and management training are held to help enterprises improve their operational capabilities; through the establishment of a customer hierarchical management system, for high-quality customers, combined with the historical cooperation situation between the bank and the enterprise, differentiated interest rate preferences and credit line increase support policies are given to enhance customer stickiness and consolidate market share [3].

2.3. (Prospective) Listed company customer group

Seize the market opportunity of the registration system in the capital market. The science and technology innovation financial customer group can be seized and strengthen the resource allocation of authorizations, credit policies, and performance appraisals for prospective listed enterprises, cultivate future customers, and lay a solid customer base. At the same time, increase credit investment in listed companies and actively expand

business opportunities such as asset mergers and acquisitions and new projects. Commercial Bank A has formed a professional listing service team to provide full-process guidance for prospective listed enterprises from share reform to IPO, and participates in enterprise Pre-IPO investments through the establishment of special funds [4]. For listed companies, it has launched "market value-linked loans", which dynamically adjust credit lines based on stock price performance; it deeply participates in enterprise mergers and acquisitions and reorganizations, providing financing and advisory services. Financial technology is used to real-time monitor enterprise stock prices, performance, and other indicators, and a risk early warning system is built to ensure that business risks are under control and share the dividends of the capital market.

2.4. Overseas-oriented enterprise customer group

The trend of Chinese enterprises growing from weak to strong and moving from China to the world is an irresistible trend. Since the international economic and trade frictions, it has been quite obvious that some manufacturing enterprises have taken the initiative to transfer their production bases overseas to avoid policy risks. It is recommended to focus on domestic high-quality entities and expand their cross-border business financing needs. Commercial Bank A has improved its global service network and joined hands with overseas institutions to provide localized financial services for overseas-oriented enterprises, such as cross-border M&A loans and international syndicated financing. It has optimized the cross-border payment system to achieve real-time settlement in multiple currencies; launched a portfolio of exchange rate hedging products to help enterprises avoid exchange rate fluctuation risks; established a compliance review mechanism for overseas businesses, carried out regular risk assessments [5]; strengthened cooperation with international law firms to provide legal support for enterprises' overseas investments, escorting enterprises to "go global" and achieving the steady development of cross-border businesses.

3. Expanding six asset allocation models to cultivate business growth points

3.1. Layout of medium-to-long-term assets such as project financing

Problems such as the shortage of assets and insufficient effective market demand will continue. It is recommended to increase the allocation of medium-to-long-term assets such as project financing and M&A loans. At the same time, when investing in medium-to-long-term assets, grasp the enterprise's core assets, negotiate with the enterprise on the comprehensive return requirements of the assets, and thicken the return. For capital-intensive fields such as infrastructure and new energy, Commercial Bank A has designed a "full-cycle project financing plan", combining construction period loans with operational period revenue right pledges, matching project cash flow characteristics, reasonably determining credit lines and repayment terms to match enterprise operational needs; established a "project white list" management mechanism, giving priority to supporting key projects included in national plans, dispersing risks through syndicated loans, and at the same time embedding account supervision, closed-loop fund operation and other clauses to strengthen risk control and ensure that returns are fully realized [6–8].

3.2. Strengthening regional featured industries and making localized operations a new growth pole

With branches as the main body, actively explore the risk evolution and customer structure of featured industries in the branch region, seize opportunities to carry out a batch of businesses, and form phased competitive advantages.

At the same time, the head office should strengthen enabling support, and do a good job in supporting facilities such as credit policies, operational resources, joint research, and differentiated authorizations, and implement them one by one when mature. Commercial Bank A has laid out integrated circuit industry clusters in the Yangtze River Delta and focused on electronic information manufacturing in the Pearl River Delta, formulating regional featured industry credit guidelines through "one branch, one policy". At the head office level, it has explored the establishment of a special risk compensation fund to provide risk mitigation support for featured industry projects carried out by branches, and at the same time built a regional industry database to provide branches with precise enabling, such as industry dynamics and customer maps.

3.3. Strengthening mature interbank business models and replicating and promoting batch business development

For mature business opportunities that have been explored by local leading banks, we can, on the basis of strengthening regional interbank research, refer to interbank models to explore market opportunities. For example, the Nanning Branch, for the state-owned forest farm customer group with a large number of interbank credit lines, has carried out batch expansion of provincial forest farm business opportunities on the basis of strengthening regional research. Commercial Bank A has established a closed-loop mechanism of "interbank model research - localized adaptation - batch promotion", such as learning from a certain bank's "forestry carbon sink loan" model and developing exclusive products combined with regional forestry resource endowments; transforming the management organization, establishing cross-departmental interbank business teams, regularly tracking interbank innovation trends in the region, and quickly forming differentiated competitive advantages through "introduction-digestion-improvement" to avoid homogeneous involution [9].

3.4. Seizing asset appreciation expectations and carrying out business opportunities under collateral and pledge

Under the continuous and substantial growth of M2, asset appreciation is an inevitable trend. With the continued rapid growth of M2 and the downward trend of interest rates driven by interest rate liberalization, the appreciation expectations of core assets will become more obvious. We can focus on exploring businesses under core assets (such as real estate in first-tier and strong second-tier cities, industrial plants in the Yangtze River Delta/ Pearl River Delta, equity of high-quality listed companies, equity of financial institutions, etc.). Commercial Bank A has built a dynamic valuation system for core assets, introduced AI valuation models for collateral such as real estate and industrial plants, and real-time monitors market price fluctuations [10]. For listed company equity pledge businesses, it has set up an intelligent control mechanism of "early warning line + liquidation line", dynamically adjusts the pledge rate combined with stock price volatility, and at the same time explores a dual credit enhancement model of "equity + cash flow" to enhance risk mitigation capabilities.

3.5. Accurately capturing "small cycle" business opportunities in the "big trend"

The big trend means big opportunities, but at the specific operational level, attention should be paid to the fluctuations of small cycles. For example, regarding the development trend of the real estate industry, the evolution from "urbanization" to "metropolitanization" should be observed and actively grasp the real estate market opportunities in the Yangtze River Delta, Pearl River Delta, Beijing-Tianjin-Hebei, and Chengdu-Chongqing economic circles. In the event of short-term fluctuations, consider extending the business term to provide tools for

enterprise fund recovery and lock in high-quality assets at the underlying level.

3.6. Strengthening research to improve the competitiveness of new fields and new product businesses

For industries or business models that have just emerged in the market, timely follow up and strengthen research, carry out special training, enhance risk control capabilities, and take the initiative to explore business market opportunities. Strive to create the first national order to form a demonstration effect. Commercial Bank A has formed research teams for strategic emerging industries such as new energy and biomedicine, and jointly released industry white papers with securities firms and consulting institutions to identify potential high-quality customers in advance; established an "innovation business incubator", and for cutting-edge fields such as hydrogen energy infrastructure and commercial aerospace, encourages grassroots exploration through mechanisms such as "forward-looking risk provision + special assessment" to create industry benchmark cases.

4. Layout of fourteen key industries, continuously researching and adjusting access standards

4.1. Wind power

Focusing on the wind power operation subsidiaries of the "Five Major and Six Small" central enterprise power generation groups, provincial energy groups, and leading complete machine manufacturers, as well as domestic wind power equipment complete machine manufacturers ranking among the top ten in market share, focus on expanding supply chain business and investment banking business.

4.2. Photovoltaic

Implement the credit strategy of "following the mainstream, seizing the leading enterprises, and controlling risks", and focus on expanding the silicon material and centralized photovoltaic power generation industries, as well as enterprises that have achieved integration of the silicon wafer and module industries.

4.3. Hydropower

Focus on intervening in various types of traditional hydropower projects with investment by large central and state-owned hydropower enterprises and their subsidiaries and confirmed grid access, as well as pumped storage projects approved by the development and reform commissions of provinces and municipalities directly under the Central Government, mainly through liquidity support products.

4.4. Hospitals

Focus on intervening in tertiary and above hospitals, and select public hospitals, private hospitals with good reputation and good profitability, and local hospitals with high market share as the customer group, mainly through liquidity support products.

4.5. Pharmaceuticals

Focus on expanding project loan opportunities such as bond issuance, new projects, renovations and expansion, and M&A of large and medium-sized pharmaceutical enterprises and high-quality listed companies. For market segment leaders or small and medium-sized enterprises specializing in characteristic drugs, the products are

mainly liquidity support.

4.6. Medical devices

Focus on products such as asset pools, receivables chains, and ultra-short loans to intervene in medical equipment and medical consumables companies with technological advantages, as well as market leaders in niche areas of in vitro diagnostics. Medical equipment enterprises can also be intervened through the channels of financial leasing companies.

4.7. Iron and steel smelting

In terms of region, focus on expanding customers in East China and South China, or enterprises located near coastal (river) ports, railway trunk lines, or mines (iron ore, coal mines) with obvious transportation cost advantages. In terms of customer selection, priority should be given to expanding cooperation with central and state-owned enterprises, leading private general steel enterprises, and competitive small and medium-sized private special steel enterprises operating in niche segments. Strictly control the access of small and medium-sized private steel enterprises in regions with severe supply and demand imbalance.

4.8. Education

Focus on expanding ordinary undergraduate and private undergraduate and junior college schools in the higher education stage, with products mainly including working capital loans, project loans, and M&A loans; select and intervene in high-quality private schools in key cities at the high school, secondary vocational, and compulsory education stages. Prohibit intervention in new school projects with diversified group investments and organizers without educational experience.

4.9. Warehousing and logistics

Focus on expanding state-owned petroleum warehousing enterprises in coastal areas, state-owned and leading private petroleum warehousing enterprises along the river region. State-owned enterprises with certain competitive advantages and private enterprises with chemical vessel transportation capabilities. High-standard warehouse businesses in cities with spillover demand from core logistics cities in economically developed regions such as the Yangtze River Delta, Greater Bay Area, and Bohai Rim.

4.10. Vehicle manufacturing

Continue to implement the list system management, focus on expanding mainstream vehicle manufacturers with obvious competitive advantages and strong brand influence, and focus on the six major industrial cluster regions such as the Yangtze River Delta cluster led by SAIC Group, the Pearl River Delta cluster led by Guangzhou Automobile, the Liaoning-Jilin cluster led by FAW Group, the Beijing-Tianjin cluster led by Beijing Automobile, the Hubei central cluster led by Dongfeng Motor, and the Chengdu-Chongqing cluster led by Changan Automobile.

4.11. Auto parts

Focus on expanding the top 100 national auto parts enterprises (groups), subsidiaries in China of the global top 100 auto parts enterprises, auto parts manufacturing enterprises subordinate to world's top 500 or domestic leading vehicle manufacturing enterprises, and first-level parts suppliers of leading mainstream vehicle enterprises.

4.12. Coal

Continue to implement the list system management, "first access, then credit", maintain reasonable and appropriate credit investment, focus on expanding large coal groups ranking among the top 30 in national coal production capacity, groups with resource advantages, main coal types of better quality, and enterprises with a combined annual coal production of 15 million tons and above. Strictly prohibit entry into backward and eliminated coal mines and coal enterprises listed in the local government's capacity reduction list.

4.13. Dairy products

The focus is on supply chain business, expanding upstream breeding and midstream dairy product processing enterprises. The downstream mainly relies on supply chain finance to expand sales of well-known brands among distributors and agents; in terms of industry segmentation, it can focus on expanding low-temperature milk, high-end fermented milk, and dried dairy products, etc. Actively introduce policy guarantee companies, local agricultural industrial funds, insurance institutions, etc., to play a role in risk mitigation.

4.14. Home furnishings

In the major household appliance industry, focus is directed on expanding leading enterprises, as well as upstream enterprises of leading enterprises and OEM manufacturing enterprises that provide OEM services to leading enterprises; in the small household appliance industry, focus is put on expanding enterprises with market shares in the top three in niche areas. In the furniture industry, expanding enterprises should focus that have a certain brand recognition and distinctive products in specialized fields.

5. Conclusion

To sum up, taking Commercial Bank A as an example, this paper has carried out in-depth research on the development direction of commercial banks' corporate business. It proposes to strengthen the four key customer groups of state-owned enterprises, medium-sized private manufacturing companies, (prospective) listed companies, and overseas-oriented enterprises to identify business focus points; expand six asset allocation models such as medium-to-long-term assets including project financing, strengthening regional featured industries, and replicating and promoting mature interbank business models to cultivate business growth points; at the same time, layout fourteen key industries such as wind power, photovoltaic, and hydropower, and continuously research and adjust access standards. The proposal of these development directions is of great practical significance for Commercial Bank A to optimize its asset-liability structure, enhance its operational resilience, and promote its own high-quality development in a complex financial environment. In the process of implementing these development strategies, commercial banks need to pay close attention to changes in the macroeconomic situation, adjustments in policy orientation, and dynamic evolutions in market demand, continuously strengthen the application of financial technology, improve risk control capabilities, and optimize service models to better meet customer needs, gain a favorable position in fierce market competition, promote the sustained, healthy, and stable development of commercial banks, and continuously create long-term value.

Disclosure statement

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References

[1] Zheng H, 2024, The Development Model of Commercial Bank Business from the Perspective of Green Finance. Popular Investment Guide, 2024(31): 70–72.

[2] Yuan Y, 2024, Research on the Development of Rural Commercial Bank Business under the Background of Rural Revitalization Strategy. Today's Fortune, 2024(10): 38–40.

[3] Zhang J, 2024, Analysis of the Relationship between Financial Innovation and Commercial Bank Business Development. Modern Business, 2024(6): 142–145.

[4] Xu Y, 2024, The Transformation of Regional Industrial Structure and the Reform of Commercial Bank Corporate Business Development System. Hebei Finance, 2024(1): 24–29.

[5] Zhu Y, 2023, Analysis on the Promotion of Digital Management to Commercial Bank Business Development. Modern Business Research, 2023(10): 65–67.

[6] Wang Y, 2022, Discussion on the Development of Rural Commercial Bank Business in Rural Revitalization. China Market, 2022(16): 44–46.

[7] Liu S, 2022, Research on the Development Countermeasures of Rural Commercial Bank Corporate Business, thesis, Dongbei University of Finance and Economics.

[8] Li J, 2021, Analysis on the Development Countermeasures of Commercial Bank Corporate Intermediate Business. Modern Business, 2021(27): 113–115.

[9] Jia F, 2020, Analysis on the Development of Internet Banking Business of Commercial Banks in China. Northern Finance, 2020(9): 43–46.

[10] Wan X, 2020, Problems and Countermeasures in the Development of Commercial Bank Investment Banking Business. Today's Fortune (China Intellectual Property), 2020(8): 71–73.

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Research on the Problem of Smart Public Transport for the Elderly

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Abstract: Intelligent transportation systems integrate numerous advanced technologies such as the Internet of Things, artificial intelligence, and cloud services, thereby forming a comprehensive and intelligent transportation service platform. Although this platform has brought great convenience to people's daily travel, it is insufficient in terms of adaptability for the elderly group. Based on this, the author will conduct an in-depth analysis of the current problems in the aging-friendly construction of smart public transportation in this paper and propose corresponding solutions, hoping to provide some references and help for readers.

Keywords: Smart public transportation; Aging-friendly; Urban construction

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1. Introduction

With the intensification of the global population aging trend, the contradiction between the travel needs of the elderly group and the supply of social public transportation services has become increasingly prominent. According to data from the United Nations, the global population aged 60 and above is expected to exceed 1.2 billion in 2025. Among them, China, as one of the countries with the fastest aging speed, has seen the proportion of elderly population exceed 18%. Against this background, how to build an intelligent transportation system that adapts to the needs of an aging society through technological innovation and optimization of public services has become an important issue in urban governance and people's livelihood projects. As the main reliance for the elderly in their daily travel, the aging-friendly transformation of public transportation is not only related to social equity, but also a key indicator to measure the degree of urban civilization and humanistic care.

2. Problems in the age-friendly construction of smart public transport

2.1. Technical-level problems

At the technical level of building age-friendly smart public transport, hardware facilities, as the physical carrier of age-friendly services, their degree of improvement directly affects the travel experience of the elderly. Currently,

the coverage rate of barrier-free facilities in China's public transport vehicles is still insufficient. Age-friendly configurations such as low-floor designs and barrier-free ramps have not been popularized, which makes it extremely difficult for wheelchair users or elderly people with mobility difficulties to get on and off the vehicles. Platform facilities also have shortcomings: the lack of barrier-free passages, such as ramps and tactile paving, as well as insufficient anti-slip floors and sunshade facilities, all increase the travel risks for elderly passengers. In addition, the age-friendly design of in-vehicle hardware facilities needs to be strengthened urgently. Issues such as excessively narrow seat spacing and insufficient anti-slip performance of handrails may pose threats to the safety of elderly passengers [1].

In terms of software services, although age-friendly apps have launched an "elderly mode", their operational complexity still needs to be further simplified. Operations such as multiple clicks and swipes still have a learning threshold for the elderly. Moreover, some functions like real-time public transport inquiries and QR code payments may lead to operational errors in actual use due to unintuitive interface designs. As an important part of intelligent services, voice interaction has also exposed limitations in age-friendly scenarios. Problems such as low recognition rates of dialects and lack of offline functions greatly reduce the effectiveness of voice assistants in weak signal or noisy environments, making it difficult to meet the actual needs of elderly passengers.

What is more severe is that the problem of data barriers has become increasingly prominent in the age-friendly construction of smart public transport. Insufficient cross-departmental data sharing leads to lagging analysis of the elderly's travel needs, and there is a lack of accurate basis for route optimization and capacity allocation. On the one hand, internal data of the public transport system, such as passenger flow and vehicle operation status, cannot be effectively integrated with external data from medical institutions, communities, etc., making it difficult to form a comprehensive insight into the travel needs of elderly passengers. On the other hand, problems such as untimely data updates and insufficient accuracy also restrict the precise delivery and dynamic adjustment of age-friendly services in smart public transport [2].

2.2. Issues at the management level

Currently, there is a lack of unified standards for the design, construction, and acceptance of age-friendly public transport vehicles and platforms, resulting in uneven quality of renovations. When promoting age-friendly transformations, some cities, due to the absence of clear regulatory guidance, often have to rely on local experience or enterprise standards. This not only increases the blindness of the transformation but also makes it difficult to guarantee the effectiveness of the renovation. At the same time, the gap in the evaluation mechanism also restricts the quantification and improvement of the effect of age-friendly services. Due to the lack of a scientific evaluation system, it is difficult to objectively assess the actual effect of age-friendly services, thus failing to provide a strong basis for policy adjustment and optimization [3].

In addition, the weakness in operation and maintenance management is also a major challenge at the management level. In practice, some cities have the phenomenon of "emphasizing construction over operation". They excessively pursue the coverage rate of intelligent equipment while neglecting the later operation and maintenance management. This leads to high equipment failure rates and short service life, which not only affects the travel experience of elderly passengers but also increases operating costs. Furthermore, insufficient personnel training also restricts the improvement of the quality of age-friendly services. Frontline service personnel, such as drivers and platform staff lack special training in age-friendly services, fail to respond timely to the needs of elderly passengers, and even have problems such as poor service attitude, which seriously damages the travel

rights and interests of elderly passengers [4].

Finally, the lack of a supervision mechanism is also a major hidden danger at the management level. In the process of age-friendly services, due to the lack of an effective supervision mechanism, it is difficult to conduct real-time monitoring and evaluation of service quality. This leads to problems such as substandard service quality and even illegal operations among some service providers, which seriously damage the legitimate rights and interests of elderly passengers. Moreover, the insufficient public participation also restricts the continuous improvement of age-friendly services. Due to the lack of effective public participation channels and feedback mechanisms, it is difficult to timely understand the needs and opinions of elderly passengers, thus unable to make targeted improvements and optimizations to the services.

2.3. Issues at the social level

In the eyes of some members of the public, aging-friendly renovations are seen as a form of "special care," and some even consider them a "waste" of public resources. This cognitive bias stems from an underestimation of the importance of the travel needs of the elderly population and a neglect of the social value of aging-friendly services. In fact, aging-friendly renovations are not only a necessary measure to safeguard the travel rights and interests of the elderly but also an important manifestation of building an inclusive society and achieving social equity. However, this cognitive bias has led to many obstacles in the promotion of aging-friendly services, such as difficulties in raising funds and ineffective policy implementation. In addition, with the continuous development of smart public transportation technology, intelligent devices have gradually become standard in travel services. For the elderly group, however, these devices often become barriers to their travel. Due to restrictions such as age and educational background, some elderly people are not proficient in operating smart devices such as smartphones and apps, and some even have a resistant attitude. This digital divide not only limits the elderly's access to the convenience of smart public transportation services but also exacerbates their sense of isolation and helplessness during travel.

Aging-friendly services require the joint participation of multiple parties, such as the government, enterprises, and communities, to form a synergy. However, in practice, there are often problems such as insufficient government investment, low enthusiasm of enterprises to participate, and inadequate community services. This lack of social support has caused many difficulties in the promotion of aging-friendly services, such as slow progress in facility renovation and uneven service quality.

In the process of building aging-friendly smart public transportation, the younger generation often plays the roles of designers and promoters. However, due to differences in age and life experience, the younger generation often finds it difficult to fully understand the travel needs and pain points of the elderly group. This intergenerational communication barrier leads to a situation where aging-friendly services are often designed based on "assumptions," making it difficult to truly meet the actual needs of the elderly [5].

Finally, the needs of elderly groups for aging-friendly services may vary across different regions and cultural backgrounds. For example, in some rural areas, the elderly may be more accustomed to traditional travel methods and have a lower acceptance of intelligent devices. Therefore, in the construction of aging-friendly smart public transportation, it is necessary to fully consider cultural differences and formulate service plans in accordance with local conditions.

3. Optimization strategies for aging-friendly construction of smart public transport

3.1. Accessibility upgrading of hardware facilities

Hardware facilities form the foundation of aging-friendly smart public transport. Through systematic renovation and upgrading, a safer and more convenient travel environment can be created for the elderly.

In terms of vehicle modification for the elderly, efforts should be made to promote low-floor and low-step buses to reduce the height difference between the vehicle and the platform, making it easier for the elderly to get on and off. For example, Xingyi City in Qianxinan Prefecture has deployed low-floor vehicles on hospital-specific lines, greatly facilitating the elderly's travel for medical treatment. The interior of the vehicles should be equipped with anti-slip floors, and the density and height of handrails should be increased to ensure that the elderly can grip them stably. Adjustable seats should also be installed to facilitate getting up. Meanwhile, priority seats for "the elderly, weak, sick, disabled, and pregnant" should be equipped with eye-catching signs and seat belts [6].

The aging-friendly construction of bus stops and hubs is equally crucial. Smart waiting pavilions should integrate large-font electronic stop signs with voice broadcast functions, allowing the elderly to clearly know vehicle information. Spacious, comfortable seats with backrests should be provided for the elderly to rest while waiting. Barrier-free passages and ramps are also necessary to facilitate the movement of wheelchair users. For the "last kilometer" from communities to bus stops, feeder bus services can be increased, and community transfer stations can be added to reduce the walking distance for the elderly. In addition, clear and prominent guiding signs should be set up in hub transfer areas, and staff or volunteers should be arranged at key nodes to guide the elderly, helping them transfer smoothly. Through the comprehensive upgrading of hardware facilities, the mobility threshold for the elderly to take buses can be effectively reduced, and their travel experience can be improved.

3.2. Humanized innovation in service modes

Humanized innovation in service modes is key to enhancing the elderly-friendly level of smart public transportation. Therefore, local governments should launch special routes for respecting and caring for the elderly. For example, Haikou has introduced 15 such special routes, where everything from vehicle configuration to in-car layout is designed around the elderly group. These routes are equipped with supplies like love kits and first-aid kits, and eye-catching and warm reminders are posted to create a cozy riding atmosphere. At the same time, driver training should be strengthened, and service standards should be standardized. Drivers are required to take the initiative to help elderly people with mobility difficulties get on and off the bus, patiently answer their questions, drive steadily during the trip, and reduce discomfort caused by sudden braking and sharp turns. For instance, Changzhi City has carried out special elderly-friendly service training for drivers of the No. 15 special route.

In addition, improving the emergency guarantee mechanism is also an indispensable and important link. Emergency call buttons should be installed in the bus, with clear and easy-to-understand instructions next to them, so that the elderly can contact the driver for help in the first place in case of sudden discomfort, loss of items, etc. Drivers need to pay real-time attention to the status of elderly passengers through rearview mirrors and in-car monitors during driving and promptly detect abnormalities. Moreover, an emergency response system linked with communities and hospitals should be built. When an emergency occurs, it can quickly contact the elderly's relatives and arrange medical assistance [7].

To meet the diverse needs of the elderly, reservation services can also be launched. For example, "fixed time and fixed point" pick-up and drop-off services can be provided to facilitate the elderly to participate in regular activities. For high-frequency travel scenarios such as medical treatment and shopping, route designs should be

optimized, and direct trips should be set up. Through these humanized innovations in service modes, meticulous care is integrated into the entire process of smart public transportation services, effectively enhancing the sense of security and happiness of the elderly in travel.

3.3. Adaptation of intelligent technologies for the elderly

The adaptation of intelligent technologies for the elderly aims to eliminate the "digital divide" faced by the elderly, enabling smart public transportation to truly serve the elderly group. In simplifying digital service processes, on the one hand, traditional payment methods such as cash and elderly cards are retained; on the other hand, convenient functions like "one-click ride-hailing" and "voice ride-hailing" are promoted. For example, the Haikou 95128 taxi-calling hotline and the service to be promoted in Jinzhou allow elderly people who are not familiar with smartphones to easily book buses. At the same time, develop aging-friendly APPs with oversized fonts, high-contrast interfaces, and simplified operation steps. Integrate functions such as real-time bus inquiry, route planning, and station navigation on the homepage, just like the "Changzhi Public Transport" APP, enabling elderly users to access core services with one click [8].

In terms of strengthening barrier-free information transmission, smart bus stops should not only display vehicle arrival information in large fonts but also have a voice broadcast function with a moderate speaking speed and clear content, so that elderly people with poor eyesight or illiteracy can also obtain information. The in-vehicle broadcasting system needs to be upgraded. In addition to regular station announcements, targeted reminders such as "There are steps at the next stop, please stand firm and hold on" are added, and safety reminders and service guidance are given in easy-to-understand language. In addition, intelligent wearable devices are linked with the public transportation system. For example, elderly people wear bracelets with positioning and emergency call functions. In case of emergencies, bus drivers and background systems can quickly obtain location information and provide help. Through these adaptation measures, intelligent technologies will no longer be an obstacle but a powerful assistant for the elderly to enjoy the convenience of smart public transportation, effectively improving their travel experience [9].

3.4. Policy support and social coordination

Policy support and social coordination form a solid foundation for the elderly-friendly transformation of smart public transportation, requiring multi-party collaboration among the government, enterprises, and communities to establish a long-term guarantee mechanism. First, the government should strengthen policy guidance by incorporating the elderly-friendly renovation of public transportation into local people's livelihood projects and transportation development plans. It should strictly implement policies on free or discounted rides for the elderly. For example, Xingyi City provides free rides for seniors aged 70 and above, effectively reducing the travel burden on the elderly. Meanwhile, it should increase financial input by setting up special renovation funds for vehicle purchases, platform upgrades, and installation of intelligent devices. Local governments should be encouraged to explore innovative subsidy models to attract social capital participation. A case in point is Shenzhen, where a partnership between the government and Gaode Taxi (a ride-hailing platform) has created elderly-friendly pick-up points, achieving complementary resource integration between the government and enterprises.

At the enterprise level, public transportation operators must take the initiative to assume social responsibilities by integrating elderly-friendly services into their performance evaluation systems and establishing incentive mechanisms to reward drivers who provide high-quality services. Tech enterprises should leverage their

technological strengths to collaborate with public transportation departments in developing elderly-friendly intelligent systems, lowering the threshold for elderly users. Communities serve as a crucial link between policies and the elderly. They can join hands with social organizations to carry out training programs on intelligent technologies, helping the elderly master skills such as using public transportation apps and scanning codes for rides through "one-on-one" assistance and regular lectures. Additionally, communities can organize volunteers to be stationed at bus stops during morning and evening rush hours to assist the elderly in boarding/alighting and answer their questions. Furthermore, the media should strengthen public awareness and guidance. Through public service advertisements, special reports, and other forms, they can promote the ethos of respecting and assisting the elderly, raise public attention and participation in elderly-friendly public transportation initiatives, and foster a positive social atmosphere where the whole society supports and participates in these efforts. This will drive the continuous deepening of the elderly-friendly transformation of smart public transportation [10].

4. Conclusion

In summary, the construction of age-friendly smart public transportation is a systematic and comprehensive project related to people's livelihood. During the construction process, it is necessary to lay a solid foundation for aging adaptation through barrier-free upgrades of hardware facilities and convey warmth through innovations in humanized services. In the future, with the continuous advancement of aging-friendly transformations, smart public transportation will truly become a warm link connecting cities and the elderly group, inject more humanistic care and development momentum into an aging society, and help achieve the dual goals of transportation inclusiveness and social equity.

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References

[1] Chen Y, 2024, "Smart Brain" Empowers Online Hailing-style Public Transport and Driverless Buses as New Explorations for Urban Public Transport Paths. China Business Journal, China. DOI: 10.38300/n.cnki.nzgjy.2024.002962.

[2] Duan K, 2024, Research on the Evaluation of Age-friendly Public Transport Services in the Context of Smart Transportation. China Venture Capital, 2024(32): 32–34.

[3] Luo J, Shi Y, Wu L, et al., 2024, Research on the Exploration of Smart Public Transport Service Operation Modes in Urban Low-passenger-flow Areas. In: Urban Transport Planning Committee of China Urban Planning Society. Green Digital Intelligence, Improving Quality and Efficiency: Proceedings of the 2024 China Urban Transport Planning

Annual Conference. Shenzhen Urban Transport Planning & Design Institute Co., Ltd., 2116–2123. DOI: 10.26914/c.cnkihy.2024.038717.

[4] Zhang Y, 2024, Research on the Problems of Age-friendly Construction of Smart Public Transport in Xi'an, thesis, Beijing University of Posts and Telecommunications.

[5] Li X, Jia Z, 2024, Research on the Evaluation of Age-friendly Public Transport Services in the Context of Smart Transportation. Logistics Sci-Tech, 47(08): 76–82. DOI: 10.13714/j.cnki.1002-3100.2024.08.021.

[6] Li X, 2024, Research on the Evaluation of Age-friendly Public Transport Services in Taiyuan from the Perspective of Smart Transportation, thesis, Taiyuan University of Science and Technology. DOI: 10.27721/d.cnki.gyzjc.2024.000266.

[7] Yu Z, Lü C, 2024, "Green + Smart" Opens a New Experience of Public Transport Travel. Xi'an Daily, China. DOI: 10.28843/n.cnki.nxarb.2024.000061.

[8] Ding C, Huang X, 2023, Smart Technology Empowers Green Travel, and Integrated Parking and Charging Helps a Better Life. People's Public Transport, 2023(11): 38–40. DOI: 10.16857/j.cnki.cn11-5903/u.2023.11.004.

[9] Han J, 2023, Application of Service Design Thinking in the Design of Urban Smart Bus Stops. Smart China, 2023(10): 77–78.

[10] Bo L, 2023, Digital Empowerment, Smart Public Transport Changes Life. People's Public Transport, 2023(07): 26–27. DOI: 10.16857/j.cnki.cn11-5903/u.2023.07.043.

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