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The Role of Big Data Analysis in Digital Currency Systems

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Abstract: In the contemporary era, characterized by the Internet and digitalization as fundamental features, the operation and application of digital currency have gradually developed into a comprehensive structural system. This system restores the essential characteristics of currency while providing auxiliary services related to the formation, circulation, storage, application, and promotion of digital currency. Compared to traditional currency management technologies, big data analysis technology, which is primarily embedded in digital currency systems, enables the rapid acquisition of information. This facilitates the identification of standard associations within currency data and provides technical support for the operational framework of digital currency.

Keywords: Big data; Digital currency; Computational methods; Transaction speed

1. Introduction

Big data technology primarily refers to the utilization of existing methods, theoretical frameworks, and specialized technical approaches to efficiently integrate and process digital currencies within a short timeframe. This technology offers distinct advantages, particularly in handling large volumes of data. In a global context, its effectiveness has been increasingly evident.

2. Digital currency characteristics

Compared to traditional currencies, digital currency is essentially a virtual currency based on Internet platforms and digital encryption methods. Its main features are reflected in the following aspects. Firstly, in terms of operation and application, digital currency primarily relies on open computational methods facilitated by the Internet. As a result, it does not have a central issuing authority, nor does it require any institution or organization to regulate its issuance. Secondly, because both the computational methods and results are predetermined, the overall supply of digital currency remains fixed. This fundamentally eliminates the risk of inflation caused by the uncontrolled issuance of virtual currencies. Thirdly, virtual currencies offer enhanced security in online

transactions, as they require verification from multiple nodes on the Internet platform [1].

2.1. Low cost

In comparison to traditional bank transfers, remittances, and other related methods, digital currency transactions do not require third-party service fees. Consequently, transaction costs are significantly lower. Additionally, digital currency provides greater flexibility and versatility in the selection of payment channels and methods [2].

2.2. Transaction speed

Digital currency transactions typically utilize blockchain technology, which enables decentralization. Since these transactions do not rely on any centralized clearing platform for data and information processing, they achieve higher efficiency, faster processing speeds, and greater convenience [3].

2.3. High privacy

In currency transactions, physical cash allows direct exchanges without intermediaries. Similarly, digital currency offers significant advantages in remote peer-to-peer payments, as transactions can be conducted without third-party platforms acting as intermediaries. This enables two parties—who may be complete strangers—to engage in financial transactions without the need to establish mutual trust. Consequently, digital currency ensures a high level of anonymity and effectively protects the privacy and security of both parties. However, the excessive flexibility of this transaction model also creates opportunities for illicit activities. Due to its anonymity, digital currency is highly susceptible to misuse in criminal activities.

3. Impact of digital currency
3.1. Monetary policy

The widespread adoption and promotion of digital currency, while enhancing the fundamental functions of money, may weaken the effectiveness of monetary policy. This poses challenges in the formulation and implementation of monetary development strategies. The core issue lies in the fact that digital currency issuance is typically not subject to the constraints and regulations of third-party supervisory platforms. As a result, currency creation occurs outside the traditional banking system, with the total supply dependent entirely on the issuing institutions' discretion. This leads to instability in the overall money supply. Additionally, the inability of third-party platforms to effectively monitor and regulate the base issuance and circulation of digital currencies prevents accurate assessments of economic conditions, industrial performance, and market trends. Consequently, this weakens the effectiveness of monetary policy and disrupts its implementation [4].

3.2. Financial markets

The widespread use of digital currencies and ledger-based technologies presents challenges to the existing financial market structure. Banks, as financial intermediaries, are responsible for monitoring and managing financial activities, particularly overseeing borrowers on behalf of depositors. Traditionally, banks facilitate highly liquid financial management operations that efficiently connect depositors with borrowers. However, if digital currencies and distributed ledger systems become widely adopted, the resulting disintermediation could significantly impact banks' ability to manage financial savings and lending operations.

3.3. Financial infrastructure

The application of digital currencies based on distributed ledger technology effectively transforms the financial

market infrastructure. At the same time, the distributed ledger management model introduces challenges to financial transactions, calculations, and management processes. By facilitating the disintermediation of traditional service providers across various financial sectors, these innovations and structural reforms will have a profound impact on the financial payments industry [5].

3.4. Security risks

Compared to traditional payment methods, digital currency is gaining public recognition due to its unique characteristics. If digital currency becomes widely used over an extended period, it could potentially replace traditional currencies. However, its high flexibility also increases the risk of cyberattacks, leading to security breaches and negative incidents affecting users. Furthermore, since digital currency systems based on blockchain technology are often controlled by a limited number of individuals, long-term use may result in significant security vulnerabilities and systemic risks.

4. Strategies for the application of big data analytics

4.1. Financial Sector

Big data technology primarily refers to the application of existing professional theories, methods, technical tools, and hardware equipment to rapidly perform data analysis, information processing, and related tasks. This ensures the effective integration of large volumes of data, particularly in the context of digital currency, where big data technology exhibits various distinct features and advantages [6].

In terms of data processing capacity, the total volume of data that can currently be processed using big data technology has far exceeded historical levels. With the continuous advancement and optimization of big data, processing efficiency has demonstrated exponential growth. Regarding the speed of digital currency transactions, data dissemination and propagation occur at significantly higher rates. Since big data technology enables the continuous flow of information across different timeframes, spaces, and fields, digital currency transactions exhibit unique fluidity. Moreover, due to the role of big data technology, the intrinsic value of data diminishes rapidly, increasing the computational and application capacity requirements.

From the perspective of data application value, as the scale of digital currency transactions expands, the underlying data also increases in value. At this stage, big data applications and computational methods are typically categorized into batch processing and stream processing. The batch processing method involves large-scale data storage, followed by centralized computation and processing of static data to improve accuracy and comprehensiveness. In contrast, stream processing cannot predefine the data flow direction or store all information. As a result, modern digital currency storage methods have largely moved away from this approach. Instead, real-time processing occurs directly within large-scale memory, although this method demands higher accuracy in data processing and is applicable in more flexible scenarios [7].

Currently, financial institutions employ batch processing for information and data management, creating corporate-level databases to facilitate internal structured processing. Big data technology not only supports these objectives but also enables business modeling to identify deeper connections between digital currencies, driving financial innovation and improvement.

4.2. Currency operation system

As the regulatory and operational authority of the currency system, monetary management organizations play a crucial role in developing financial infrastructure and implementing digital currency operational frameworks. Regulatory bodies must clearly define the fundamental responsibilities of digital currency systems and, within

the legal framework, actively promote the integration of big data technology and the structural design of digital currency. By leveraging the analytical capabilities of big data, monetary policies can be stabilized, currency system operations can be strengthened, and regulatory oversight can be maximized.

At present, global economic systems lack universally established legal standards for digital currency operations, making it difficult to conduct comprehensive empirical analysis. Therefore, theoretical exploration and predictive modeling remain the primary approaches for understanding its development. To address this, regulatory agencies should adopt a multi-perspective approach, integrating big data technology with digital currency characteristics for deeper analysis [8].

First, in the application of big data technology within digital currency systems, it is essential to adopt appropriate methods for refining core information related to issuance, circulation, exchange, storage, application, marketing, and recycling. Based on this information, relevant data models should be established, along with a structured simulation and analysis framework. From a spatial perspective, regulatory bodies should develop an operational structure map for digital currency, accurately tracking transaction scale, location, and time. This should include real-time coordinate data to ensure that authorities have a clear and comprehensive understanding of digital currency applications. In terms of system design, implementation teams must consider the scalability of big data applications and ensure that data structure and service layers are comprehensively analyzed to enhance the accuracy of analytical models.

Second, big data analysis should be applied to assess digital currency from multiple dimensions, including visibility, stability, and controllability. By evaluating key metrics such as the total supply index and price signal index, a deeper understanding of digital currency's economic impact can be achieved. Additionally, digital currency processing teams should utilize big data analysis techniques to monitor currency supply levels and structural changes within the financial system, enabling a thorough examination of internal financial asset trends. Moreover, attention should be given to analyzing digital currency transaction patterns, facilitating better demand forecasting for currency issuance and usage [9].

Regulatory agencies and implementation teams must also focus on monitoring the circulation velocity of digital currency and its fluctuations over time. By analyzing changes in transaction durations, liquidity speed, and other relevant factors, a detailed assessment of digital currency flows can be conducted. This enables the identification of trends in total currency supply, demonstrating that big data analytics plays a significant role in optimizing issuance volumes and frequency [10].

5. Conclusion

Digital currency, within the realm of economic transactions, presents both advantages and challenges. On one hand, this transaction model primarily relies on blockchain technology, effectively achieving decentralization. Its applications extend beyond digital currency itself to various other fields. On the other hand, the widespread adoption of digital currency significantly impacts monetary management policies, financial infrastructure, and financial markets, introducing both opportunities and regulatory challenges.

Disclosure statement

The author declares no conflict of interest.

References

[1] Huang S, Huang Z, Tang M, 2024, New Interest Accrual Design of Central Bank Digital Currency Under the Perspective of Personal Financial Data Revenue Sharing. Southeast Academic, 2025(5): 106–115.

[2] Han Y, 2024, Analysis of the Impact of Digital Currency on Traditional Economy. Industrial Innovation Research, 2024(15): 113–115.

[3] Wu Y, 2024, Legal Challenges and Responses to the Implementation of Central Bank Digital Currency. Qinghai Finance, 2024(7): 13–16.

[4] Cheng Y, 2024, Future Development Prospects of Commercial Banks in the Context of Central Bank Digital Currency: Change and Remodeling. Industrial Innovation Research, 2024(13): 119–121.

[5] Li W, 2024, Impact of Financial Technology and Digital Currency on Traditional Financial Industry. Mall Modernization, 2024(15): 155–157.

[6] Wu Y, 2024, Changes in Financial Market System and Innovation of Financial Instruments: The Risk and Response of Digital Currency as an Example. Journal of Henan College of Pastoral Economics, 37(3): 43–46.

[7] Hu X, Chen H, 2024, On the Regulation and Legal Regulation of Legal Digital Currency in China. Journal of Anhui University, 40(3): 69–75.

[8] Xie X, Li Y, Feng S, 2024, Liquidity Creation, Legal Tender, and Bank Risk Taking. Reform, 2024(5): 124–136.

[9] Guo J, 2024, Research on Legal Issues of Legal Digital Currency Issuance in China. Journal of Lvliang Institute of Education, 41(1): 124–128.

[10] Shi Z, Lu M, 2024, Research on the Influence Mechanism and Optimization Countermeasures of Digital RMB on the Development of Digital Finance Industry. Journal of Hebei Normal University (Philosophy and Social Science Edition), 47(2): 105–111.

Research on the Financial Performance Evaluation of Machinery Manufacturing Enterprises Based on the Entropy Value Method

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Abstract: As a key sector in advancing China's "carbon neutrality" goal, the machinery manufacturing industry has achieved remarkable development in recent years. Against this backdrop, the scientific and objective evaluation of the financial performance of machinery manufacturing enterprises has become a pressing issue in financial research. This topic is not only crucial for optimizing enterprise management and improving operational efficiency but also essential for enhancing overall industry performance and promoting sustainable development. This paper first introduces the concept of financial performance, followed by an analysis of related financial performance evaluation theories. It then focuses on the application of the entropy method in evaluating the financial performance of machinery manufacturing enterprises, detailing its analytical steps. Finally, a financial performance evaluation index system is constructed based on four dimensions: profitability, solvency, operational efficiency, and growth potential.

Keywords: Financial performance evaluation; Machinery manufacturing enterprises; Entropy value method; Enterprise management; Sustainable development

1. Introduction

The evaluation of enterprise financial performance is not only an internal requirement for business development but also an external necessity with far-reaching implications for social stakeholders. With the rapid expansion of the market economy, machinery manufacturing enterprises are encountering unprecedented growth opportunities, characterized by increasing market demand and a surge in the number of enterprises. Given the substantial and frequent capital flows in the daily operations of these enterprises, financial management capabilities play a decisive role in their long-term stability and success. In this context, selecting scientific and rational evaluation methods and establishing a comprehensive financial index system is of great significance for conducting in-depth financial performance assessments. This paper focuses on machinery manufacturing enterprises, providing a detailed analysis of evaluation methods and the construction of a financial index system, with the aim of offering a solid theoretical foundation for future enterprise financial assessments.

2. The concept of financial performance

Financial performance refers to the financial outcomes and achievements generated by an enterprise through its production and operational activities within a specific accounting period. It comprehensively reflects the enterprise's operating conditions, results, and overall efficiency. Financial performance is generally evaluated across four key dimensions: profitability, which measures income generation; operational efficiency, which assesses management effectiveness; solvency, which evaluates the enterprise's ability to meet short- and long-term debt obligations; and risk resilience, which reflects the capacity to withstand uncertainties. Analyzing financial performance provides insights into an enterprise's operational status, development trends, and potential challenges, serving as a valuable reference for decision-making. Therefore, financial performance is not only a quantitative representation of an enterprise's financial condition but also a crucial indicator of its actual standing and future potential.

3. Financial performance evaluation-related theories

3.1. Contingency theory

The term "contingency" refers to the ability to adapt flexibly to various situations. Contingency theory, originating from the Western empiricism school, emphasizes that each organization possesses unique characteristics, and even under similar external conditions, internal differences persist. As a result, a single theoretical approach cannot be universally applied to all organizations. Contingency theory highlights the importance of considering the diversity of market environments and internal enterprise conditions, underscoring the complexity of constructing a financial performance evaluation system that is universally applicable. Therefore, when developing a financial performance evaluation framework, machinery manufacturing enterprises should integrate industry-specific characteristics and the prevailing market environment to establish a system tailored to their operational needs.

3.2. Strategic management theory

The theory of strategic management has evolved from classical strategy theory to competitive strategy theory and, subsequently, to strategic ecology theory, forming a well-established theoretical framework. As a fundamental pillar of enterprise management, strategic management enables enterprises to identify their position in an increasingly dynamic market environment, strengthen their core competencies, and enhance their competitive advantage, thereby ensuring long-term sustainability in the industry. Financial performance evaluation, as a critical tool for assessing operational effectiveness, not only reflects an enterprise's economic benefits but also serves as a benchmark for evaluating the success of strategic management. Consequently, machinery manufacturing enterprises increasingly regard financial performance evaluation as an essential component of enterprise management.

4. Financial performance evaluation methods

4.1. Principal component analysis method

Principal component analysis (PCA) is a highly practical statistical method primarily used to simplify complex multivariate data sets. Through dimensionality reduction, PCA transforms multiple overlapping indicators into a few comprehensive indicators, with each principal component reflecting distinct information from the original data. Jia *et al.* applied PCA to reduce the dimensionality of 10 indicators, including the asset growth rate of 45 listed companies providing home-based care services, thereby effectively mitigating the overlap between indicators [1]. Similarly, Lareina *et al.* selected listed pharmaceutical companies and constructed a financial

performance evaluation system from multiple dimensions, using PCA to refine the evaluation indicators [2].

4.2. Entropy method

The entropy method is a valuable mathematical tool for evaluating financial performance. By selecting indicators, standardizing data, calculating information entropy, and determining weights, this method enables a more objective and accurate assessment of the importance and dispersion of each index. Cai selected listed logistics companies as samples and developed a performance evaluation system based on three dimensions: solvency, profitability, and growth potential, utilizing the entropy method [3]. Similarly, Hu conducted research on listed electric power companies and constructed a financial performance evaluation system comprising 15 indicators [4]. After applying the entropy method to determine the weight distribution, it was found that the indicators were well-balanced, with no objective data deficiencies, ensuring the accuracy and reliability of the evaluation results.

4.3. DuPont analysis method

DuPont analysis is a classic financial evaluation method that centers on return on net assets and integrates factors such as asset management, financial leverage, and profitability. This approach provides a comprehensive perspective for assessing a company's financial performance. Meng *et al.* conducted an empirical analysis of the financial performance of express delivery companies using the DuPont analysis method [5]. Additionally, Zhang enhanced the DuPont analysis framework and applied it to performance evaluation in reclassified business sectors [6].

5. Construction of a financial performance evaluation system for machinery manufacturing enterprises based on the entropy method

5.1. Rationale for choosing the entropy method

The financial performance indicators of machinery manufacturing enterprises are primarily quantitative, and the necessary financial data are relatively easy to collect and organize. Additionally, the correlation among indicators within each dimension is low, and the sample size is moderate. Given the potential for subjective judgment bias when dealing with qualitative indicators, selecting a method that minimizes subjective influence and ensures objectivity in evaluation is particularly important. The entropy method is well-suited for this purpose, as it effectively mitigates subjective interference associated with qualitative indicators and determines indicator weights through objective calculations. This enhances the reliability and objectivity of evaluation results while maintaining strong practical applicability. Based on these factors, the entropy method was selected as the approach for measuring financial performance.

5.2. Analysis process of the entropy method

(1) In the analysis of enterprise financial indicators, it is essential to fully consider industry-specific differences that may influence indicator assessment. Given the diversity of financial indicators, they are categorized into positive, negative, and moderate indicators. To ensure comparability across indicators, non-negative transformation and standardization are particularly important. The following section provides a detailed explanation of this process, with specific steps outlined in **Formulas 1–3**.

Positive indicators:

$$x_{ij} = \frac{X_{ij} - min(X_i)}{max(X_i) - min(X_i)} + 0.01 \tag{1}$$

Negative indicator:

$$x_{ij} = \frac{max(X_i) - X_{ij}}{max(X_i) - min(X_i)} + 0.01 \qquad (2)$$

Moderate index:

$$x_{ij} = 1 - \frac{|X_{ij} - X_0|}{max(|X_{ij} - X_0|)} + 0.01 \qquad (3)$$

where ij represents the standardized value, i denotes the enterprise, and j represents the index serial number. X_0 is the determined standard value, with general standard values set at 1 for the quick ratio, 1 for the equity ratio, and 0.5 for the asset-liability ratio. The addition of 0.01 in the formula prevents a zero-dimensional occurrence, thereby ensuring the smooth progression of subsequent steps.

(2) Calculate the proportion of the index value for the j-th indicator in year i, as shown in **Formula 4**:

$$y_{ij} = \frac{x_{ij}}{\sum_{i=1}^{m} x_{ij}} \qquad (4)$$

(3) Calculate the entropy value of the j-th indicator, with specific steps outlined in **Formula 5**:

$$e_j = -\frac{1}{ln(m)} \times \sum_{i=1}^{m} [y_{ij} \times ln(y_{ij})] \qquad (5)$$

(4) Calculate the coefficient of variation for the j-th indicator, as shown in **Formula 6**:

$$d_j = 1 - e_j \qquad (6)$$

(5) Determine the weight of each indicator, as shown in **Formula 7**:

$$w_j = \frac{d_j}{\sum_{j=1}^{n} d_j} \qquad (7)$$

(6) Compute the comprehensive score for each year, as shown in **Formula 8**:

$$U_i = \sum_{j=1}^{n} (y_{ij} w_{ij}) \qquad (8)$$

5.3. Design principles of the index system

When designing the financial performance evaluation index system, it is essential not only to carefully select performance indicators but also to balance the degree of integration among them. The following core principles should be followed to construct a suitable system:

(1) Prioritization of quantitative indicators, supplemented by qualitative indicators: Financial indicators are highly valued in both domestic and international enterprises due to their quantifiable nature. Quantitative indicators enable clear grading standards, ensuring that evaluation results remain objective and fair, and they are widely applied in various practices. In contrast, qualitative indicators are more susceptible to subjective influence, leading to ambiguous discrimination and lower reliability. Therefore, the index system should prioritize quantitative indicators. If qualitative indicators are introduced, they should be quantified using analytical tools to enhance evaluation objectivity.

(2) Testability principle: This principle requires that each indicator be measurable and practically applicable

in the evaluation process. The availability of indicator data must be assessed, and if data collection proves difficult or if indicators are unpredictable, they should be omitted in favor of more accessible alternatives. This ensures the effective implementation of the evaluation process.

(3) Goal consistency principle: This principle emphasizes that all indicators within the system should collectively support the same overarching performance objectives. Additionally, the selection of indicators should be comprehensive, fully reflecting the sub-goals of the evaluation subject across all dimensions to facilitate the achievement of the overall goal. Ensuring that the index system remains focused and all-encompassing provides a solid foundation for accurately assessing enterprise financial performance.

5.4. Selection of evaluation indicators

The selection of evaluation indicators is a crucial step in constructing a financial performance evaluation system, as it directly determines the accuracy and effectiveness of the system. Based on an extensive review of the literature, 14 financial indicators have been carefully selected across four key dimensions: solvency, operational capacity, profitability, and development ability. These indicators have been chosen in accordance with the financial characteristics and industry background of the machinery manufacturing sector to establish a comprehensive and scientific financial performance evaluation system, as shown in **Table 1**.

Table 1. Financial performance evaluation index system

Primary index	Secondary index	Indicator code
Solvency	Liquidity ratio	A1
	Quick ratio	A2
	Asset-liability ratio	A3
Operating capacity	Receivable turnover ratio	B1
	Inventory turnover	B2
	Turnover of total assets	B3
Profitability	Rate of return on total assets	C1
	Operating profit rate	C2
	Gross profit rate	C3
	Net profit rate	C4
Development ability	Total assets growth rate	D1
	Net assets growth rate	D2
	Operating income growth rate	D3
	Net profit growth rate	D4

The five categories of financial indicators are detailed below.

5.4.1. Solvency

Solvency is a key aspect of enterprise financial analysis and is typically divided into short-term and long-term solvency. To comprehensively evaluate an enterprise's financial stability and sustainable management capability, three representative financial indicators have been selected. In terms of short-term solvency, the current ratio and quick ratio are commonly used measures, while the asset-liability ratio is a key indicator for assessing long-term solvency. These three indicators provide a fundamental assessment of whether an enterprise is financially stable

and capable of sustained operations. They are considered moderate indicators, meaning their values should not be assessed simply as higher or lower but rather in a broader financial context. The calculation formulas for these indicators are presented in **Table 2**.

Table 2. Solvency indicators

Name	Calculation formula	Index property	Indicator code
Liquidity ratio	Current assets / Current liabilities	Appropriate	A1
Quick ratio	Quick assets / Current liabilities	Appropriate	A2
Asset-liability ratio	Total liabilities / Total assets	Appropriate	A3

5.4.2. Operational capacity

The analysis of operational capacity focuses on an enterprise's ability to generate profits through the effective utilization of its assets. This includes the turnover rates of current assets, fixed assets, and total assets. In this study, three key indicators have been selected: total asset turnover, accounts receivable turnover, and inventory turnover. These indicators provide insights into capital utilization and asset liquidity. Since all three are positive indicators, higher values indicate faster asset turnover, improved liquidity, and quicker conversion of assets into profits. The calculation formulas are shown in **Table 3**.

Table 3. Operational capacity indicators

Name	Calculation formula	Index property	Indicator code
Receivable turnover ratio	Net income from main business / Average accounts receivable balance	Forward direction	B1
Inventory turnover	Operating cost / Average inventory balance	Forward direction	B2
Turnover of total assets	Sales revenue / Total assets	Forward direction	B3

5.4.3. Profitability

Profitability is the fundamental measure of an enterprise's ability to generate earnings, which directly impacts its operations and future growth. Common indicators used to assess profitability include the net profit margin, gross profit margin, return on total assets, and return on net assets. In this study, four key indicators have been selected to evaluate an enterprise's profitability. These indicators reflect the firm's ability to generate revenue, its operational efficiency, and the overall profitability of its assets. Since they are all positive indicators, higher values generally indicate stronger profitability. The formulas for these indicators are provided in **Table 4**.

Table 4. Profitability indicators

Name	Calculation formula	Index property	Indicator code
Operating profit rate	Operating profit / Revenue	Forward direction	C1
Gross profit rate	Gross profit / Operating income	Forward direction	C2
Net profit rate	Net profit / Main business income	Forward direction	C3
Rate of return on total assets	Earnings before interest and tax / Average total assets	Forward direction	C4

5.4.4. Development ability

Development ability reflects an enterprise's capacity to expand its scale, accumulate resources, and sustain

long-term growth. This capability is essential for ensuring future value creation and competitiveness. Common indicators of development ability focus on asset growth, profit expansion, and revenue growth. Based on the characteristics of the machinery manufacturing industry and the ease of data collection, four widely used indicators have been selected: total assets growth rate, net assets growth rate, operating income growth rate, and net profit growth rate. The calculation formulas are presented in **Table 5**.

Table 5. Development ability indicators

Name	Calculation formula	Index property	Indicator code
Total assets growth rate	Asset growth this year / Total assets at the beginning of the year	Forward direction	D1
Net assets growth rate	Increase in current net assets / Total net assets in the previous period	Forward direction	D2
Operating income growth rate	Increase in operating income this year / Total operating income last year	Forward direction	D3
Net profit growth rate	Increase in current year's net profit / Last year's net profit	Forward direction	D4

6. Conclusion

To avoid the biased evaluation results associated with traditional analysis methods, a more comprehensive and objective approach—the entropy method—has been selected for comparison. The findings verify the feasibility of applying the entropy method to the comprehensive evaluation of financial performance. However, this study focuses solely on the machinery manufacturing industry, which may limit the generalizability of the results. Future research could expand the scope by analyzing other industries to explore broader, universally applicable principles.

Disclosure statement

The author declares no conflict of interest.

References

[1]   Jia H, Sun L, Sun C, 2021, Financial Performance Evaluation of Home Care Service Supply Chain Based on Principal Component Analysis. Journal of Qingdao University (Natural Science Edition), 34(4): 133–137.

[2]   Lareina C, Pu Q, Qiu Y, 2022, Research on Financial Performance Evaluation of Pharmaceutical Listed Companies Based on Principal Component Analysis. China Collective Economy, 2022(5): 147–148.

[3]   Cai W, 2021, Research on Financial Performance Evaluation of Listed Companies in Transportation Logistics Industry Based on Entropy Method. Logistics Engineering and Management, 43(9): 159–162.

[4]   Hu X, 2021, Evaluation of Financial Performance of Hydropower Enterprises Based on Entropy Method. Business News, 2021(22): 32–34.

[5]   Meng T, Zhu J, Yin X, 2020, Evaluation of Financial Performance of Backdoor Listed Companies in Express Delivery Industry Based on Entropy-TOPSIS. Journal of Jiujiang University (Natural Science Edition), 35(2): 51–57.

[6]   Zhang Y, Hu M, 2021, Research on DuPont System Based on the Division of Enterprise Activities: Empirical Evidence from Manufacturing Listed Companies. Friends of Accounting, 2021(7): 109–114.

The Impact of Digital Inclusive Finance on the Rural Economy in Anhui Province

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Abstract: Anhui Province is a major agricultural province in eastern China, and the development of rural economy plays an important role in improving the overall economic level of the province. In recent years, the extensive use of digital technologies and ongoing financial innovations have contributed to the rapid growth of digital inclusive finance in rural areas of Anhui, significantly reducing the lack of financial services in these regions. The main objective of this paper is to explore in depth how digital inclusive finance impacts the rural economy of Anhui Province and to provide practical policy recommendations based on these findings.

Keywords: Digital inclusive finance; Rural economic development in Anhui Province; Regression model

1. Introduction

As a major agricultural province in China, Anhui's unique geographical location, climate, land resources, agricultural history, and reforms in agriculture highlight the vital role of the rural economy in the overall economic development of the province. Rural economic development is crucial for the economic security and progress of Anhui [1]. The Chinese government has continuously strengthened its support for agriculture by implementing a series of pro-farmer policies, effectively promoting the overall improvement of the rural economy [2]. Despite these efforts, rural areas continue to lag behind urban regions in economic development due to the structural divide between urban and rural areas. As of 2023, rural residents in Anhui made up 39.85% of the total population. Despite their significant numbers, their contribution to economic growth is lower than that of urban residents. This trend highlights a continuing widening income gap between urban and rural populations [3].

In this context, the integration of digital technology and inclusive finance has given rise to the concept of "digital inclusive finance." This new concept leverages digital means to promote the development of inclusive finance, aiming to break the temporal and spatial limitations of traditional financial services [4]. Digital inclusive finance seeks to tap into the growth potential of the rural economy by providing more convenient consumption channels for rural residents, thereby driving healthy economic growth, improving living standards, and stimulating market vitality [5]. Ultimately, it lays a solid foundation for the long-term growth of China's economy [6].

Digital inclusive finance leverages digital technologies to transform traditional financial models, ensuring that equal and comprehensive financial services are available to disadvantaged groups. This includes rural populations, migrant workers who lack sufficient rights protection, and small to medium-sized enterprises that face financial challenges [7]. The core goal of digital inclusive finance is to reduce financial exclusion and provide inclusive services for all, enabling vulnerable groups to generate their own wealth [8].

2. Related work

While research on inclusive finance in China has progressed more slowly than in other countries, the nation has significantly emphasized developing this sector, proposing numerous related policy recommendations at key conferences. Additionally, many researchers in the field of economics have combined foreign research findings with China's actual conditions, conducting studies that are more aligned with China's national circumstances.

Currently, research on inclusive finance in China mainly focuses on the national and provincial levels, examining its measurement and influencing factors [9]. Du et al. discovered that the development of inclusive finance promotes economic growth when it is below a certain threshold. However, once it exceeds that threshold, it can hinder economic growth. This finding is based on their study of the relationship between inclusive finance and regional economic growth in the eastern, central, and western regions of China [10]. Song et al. used the "China Digital Inclusive Finance Index" to prove that digital inclusive finance can narrow the income gap between urban and rural areas [11]. Du et al. empirically showed that inclusive finance plays a significant role in optimizing resource allocation, improving social production efficiency, and contributing to economic development [12]. Chen demonstrated that inclusive finance contributes to regional economic growth and enhances regional economic stability [13]. Hao et al. used the system generalized method of moments (GMM) estimation method and found that inclusive finance significantly promotes inclusive economic growth [14]. Yi et al. empirically proved that digital inclusive finance significantly improves currency liquidity and facilitates resident payments, thereby promoting consumption [15]. Regarding the relationship between digital inclusive finance and economic growth, Hao et al. used a spatial autoregressive model to conduct an empirical study on inter-provincial panel data, proving that digital inclusive finance promotes economic growth but exhibits regional heterogeneity; they also demonstrated a nonlinear relationship between digital inclusive finance and economic growth [14]. Zhan also conducted an empirical study on inter-provincial panel data, using the dynamic panel SYS-GMM model to analyze the impact of digital inclusive finance on both the quantity and quality of economic growth. The results showed that digital inclusive finance suppressed the quantity of economic growth but promoted the quality of economic growth [16].

However, when inclusive finance develops to a certain stage, it inevitably competes with the real economy, squeezing the profit margins of enterprises and hindering the development of the real economy. Bai et al. discovered that the relationship between inclusive finance and regional economic development follows an inverted "U" shape. This means that up to a certain critical point, the growth of inclusive finance encourages regional economic development. However, beyond this critical point, further development of inclusive finance can negatively impact regional economic growth [17]. Liu et al. demonstrated that inclusive finance promotes economic growth by constructing a more inclusive financial system [18]. Jia used a mediation effect model to conduct empirical analysis and found that digital inclusive finance plays a significant role in narrowing the income gap between urban and rural areas, with the effect being more pronounced in regions with higher levels of education [19]. Zhang et al. believed that digital finance enhances entrepreneurial behavior among low-income households, thus increasing household income, especially among rural low-income groups [20].

In summary, there is still vast space and potential for research on inclusive finance, digital inclusive

finance, and their relationship with rural economies, which requires further exploration and study by more scholars and researchers.

This paper, based on the practical context of Anhui Province, focuses on digital inclusive finance, using reliable data from the Anhui Province Statistical Yearbook and the Digital Inclusive Finance Index. It conducts an empirical study on the relationship between digital inclusive finance and the rural economy of Anhui Province, further examining the mechanisms between the two. The paper also proposes feasible and targeted suggestions for the development of inclusive digital finance and the promotion of rural economic development in Anhui Province.

3. Research design

3.1. Data sources and selection

Based on the construction of the model, the content of this study, and the availability of relevant data, the data for this study was carefully selected. Considering data availability, data from 2013 to 2022 was selected, covering a total of 10 years. Second, based on Yang's research on the empirical study regarding the impact of digital inclusive finance on farmers' income in Shandong Province, the per capita disposable income of rural residents in Anhui Province was chosen as an indicator for measuring rural economic development [21]. Lastly, data from 16 prefecture-level cities in Anhui Province from 2013 to 2020 was selected as the sample. The Digital Inclusive Finance Index from 2013–2022 was sourced from Peking University's Digital Inclusive Finance Index, while the other data was obtained from the Anhui Provincial Statistical Yearbook and other relevant sources [22].

3.2. Selection of variables and descriptive statistical analysis

In the model, following the research of Yang Zewen on the Empirical Study regarding the Impact of Digital Inclusive Finance on Farmers' Income in Shandong Province, the income level of rural residents in Anhui Province was selected as the dependent variable, with a period from 2013 to 2022. The Digital Inclusive Finance Index was used as the independent variable, as it comprehensively reflects the development status of digital inclusive finance in Anhui Province. After reviewing numerous studies, this paper also introduces agricultural development level, government behavior, education level, and industrial structure as control variables. The selection of these control variables is based on their potential direct or indirect effects on rural residents' income. A detailed description of these variables is provided in **Table 1.**

Table 1. Variable selection

Variable type	Variable symbol	Variable name	Measurement method
Dependent variable	inc	Rural residents' income level	Per capita disposable income of rural residents
Independent variable	difi	Digital inclusive finance development level	Digital inclusive finance index
Control variable	agro	Agricultural development level	Logarithm of total agricultural output
	gov	Government behavior	Regional fiscal expenditure / Gross Domestic Product
	edu	Education level	Education expenditure / Fiscal expenditure
	is	Industrial structure	Primary industry added value / Gross Domestic Product

3.2.1. Dependent variable

Following the research of Yang Zewen on the Empirical Study regarding the Impact of Digital Inclusive Finance on Farmers' Income in Shandong Province, the per capita disposable income of rural residents in Anhui Province from 2013 to 2022 across 16 prefecture-level cities (denoted as **inc**) were selected as the measure of rural economic development. The disposable income of farmers intuitively reflects improvements in their living standards and serves as an indicator of rural economic growth.

3.2.2. Independent variable

The Digital Inclusive Finance Index of Anhui Province (**difi**) was selected as the core independent variable in the model. This index effectively reflects the level of digital inclusive finance development in Anhui Province.

3.2.3. Control variables

(1) **Agricultural development level (agro)**: The level of agricultural development is directly related to farmers' economic activities and production efficiency. It is represented by the logarithm of total agricultural output value.

(2) **Government behavior (gov)**: Government actions play a crucial role in resource allocation and policy support. This is represented by the ratio of local government expenditure to Gross Domestic Product (GDP) in Anhui Province on an annual basis.

(3) **Education level (edu)**: The education level influences farmers' labor skills and employment opportunities. It is represented by the percentage of education expenditure relative to the total government fiscal expenditure in a given year.

(4) **Industrial structure (is)**: Changes in industrial structure can have a profound impact on farmers' income sources and employment structure. It is represented by the percentage of the added value of the primary industry in the total GDP for the given year.

Table 2. Descriptive statistical analysis of variables

	N	Minimum	Maximum	Mean	Standard deviation
is	160	3.37	3.55	3.4423	0.06347
edu	160	15.93%	17.33%	16.6718%	0.40839%
agro	160	7.28	7.47	7.3630	0.06093
gov	160	0.66%	0.76%	0.7259%	0.02988%
inc	160	3.91	4.29	4.1230	0.12175
difi	160	2.18	2.59	2.4279	0.14307

3.3. Construction of the regression model

Following the approach used by Yang Zewen in the Empirical Study regarding the Impact of Digital Inclusive Finance on Farmers' Income in Shandong Province, his study selects rural residents' disposable income in Anhui Province from 2013 to 2022 as the dependent variable, with the Digital Inclusive Finance Index as the independent variable. After reviewing several research studies, this paper introduces agricultural development level, government behavior, education level, and industrial structure as control variables to construct the following model:

$$\text{inc}_{it} = \beta_0 + \beta_1 \text{difi}_{it} + \beta_2 X_{it} + \varphi_t + \varepsilon_{it}$$

Among them: *difi* represents the development level of digital inclusive finance in Anhui Province, inc represents rural residents' income level in Anhui Province, *X* includes the control variables: agricultural

development level (agro), government behavior (gov), education level (edu), and industrial structure (is), i represents the sequence number of each prefecture-level city in Anhui Province, t represents time, β_i represents the estimated parameters of the respective variables, φ represents time fixed effects, ε represents the random disturbance term.

3.4. Correlation analysis

When examining the relationships between the explanatory variables and control variables, data correlation is a critical consideration. By reviewing **Table 3**, it is observed that the maximum correlation coefficient among the variables is 0.991, which is very close to 1 in absolute value. This suggests a strong correlation between the explanatory and control variables. However, this correlation is not expected to negatively impact the regression results. Therefore, we can proceed with the regression analysis using these variables without concern for the interference of their correlation on the results.

Table 3. Correlation coefficient table between variables

	inc	difi	is	edu	agro	gov
inc	1					
difi	0.991**	1				
is	0.970**	0.939**	1			
edu	0.589	0.602	0.644*	1		
agro	0.976**	0.945**	0.984**	0.617	1	
gov	-0.611	-0.568	-0.653*	-0.667*	-0.704*	1

Note: *** and ** indicate significance at the 1% and 5% levels, respectively.

4. Empirical results and analyses

4.1. Overall regression results analysis

This section analyses the panel data selection model and conducts empirical analysis using a linear regression model in SPSS.

Without considering the control variables, the regression analysis results shown in **Table 4** indicate that the model's goodness of fit reaches 0.983, suggesting a very good fit. The variable representing the development of digital inclusive finance has a significant positive effect on rural residents' income levels. At the 1% significance level, the coefficient is 0.992. This implies that with each unit increase in the development of digital inclusive finance, rural residents' per capita disposable income increases by 0.992 units. It is clear that the higher the level of development of digital inclusive finance, the more pronounced its role in increasing rural residents' income.

Table 4. Regression analysis without control variables

Variable	R	R^2	Adjusted R^2	Beta	T	Significance
difi	0.992^2	0.985	0.983	0.992	22.781	0.000

After introducing the control variables, as shown in **Table 5**, the goodness of fit of the model reaches 0.996, indicating that the regression equation has a very good fit. The level of development of digital inclusive finance has a significant positive impact on rural residents' income levels. At the 5% significance level, the coefficient is 0.875. Although this coefficient is lower compared to the case without control variables, it still

indicates that the control variables have a certain effect on the relationship between the explanatory variable and the dependent variable. From this, we can conclude that for every one-unit increase in the development level of digital inclusive finance, the per capita disposable income of rural residents increases by 0.875 units. This confirms that improving the development of digital inclusive finance helps increase rural residents' income.

At the same time, the effects of the moderating variables, such as agricultural development, in the regression analysis were explored. The results show that the regression coefficient for government behavior is -0.075, which suggests that the government's support policies for rural residents and farmers in Anhui are not sufficiently comprehensive. The government's financial input has not been adequately focused on rural economic development. The regression coefficient for rural education level and income level is -0.106, which indicates a significant impact. However, there is still room for improvement in rural education. The government can focus on increasing investments in rural education. This would expand employment options and opportunities for rural residents. Furthermore, improving farmers' education levels would help them acquire more financial knowledge, enhance their financial literacy, and better accept financial products, ultimately increasing their income.

Table 5. Regression analysis after adding control variables

Variable	Beta	T	Significance
is	0.229	3.096	0.017
edu	-0.106	-2.450	0.092
agro	-0.074	-0.276	0.800
gov	-0.075	-1.273	0.293
difi	0.875	3.877	0.030
R		0.999²	
R^2		0.999	
Adjusted R^2		0.996	

4.2. Robustness test

This section conducts a robustness test to verify the regression results from the previous analysis, using an alternative dependent variable.

Residents' consumption is typically closely related to their income. The level of consumption often reflects residents' economic strength and quality of life. In rural areas, an increase in consumption not only signifies a clear indication of farmers escaping poverty but also reflects substantial improvements in their living standards. Here, we use the logarithm of per capita consumption expenditure of rural residents (denoted as *cons*) as the measurement indicator, instead of directly using income levels. The results are shown in **Table 6**. It is noteworthy that the regression coefficient for digital inclusive finance reaches 0.673, and this result is statistically significant at the 1% level. This finding strongly suggests that digital inclusive finance plays an active role in promoting the consumption level of rural residents. From this perspective, we can indirectly infer that the development of digital inclusive finance has a positive effect on increasing the income levels of rural residents.

Table 6. Robustness test results

Variable	Beta	*T*	Significance
difi	0.673	4.761	0.009
agro	-0.243	-0.678	0.535
is	0.498	1.689	0.167
edu	0.113	1.378	0.240
gov	-0.020	-0.196	0.854
R		0.996²	
R^2		0.991	
Adjusted R^2		0.981	

5. Conclusion and recommendations

5.1. Conclusion

Based on a review and summary of relevant domestic and international literature and theories, this study analyses the relationship between digital inclusive finance and rural economic development in Anhui Province. Using per capita disposable income of rural residents as an indicator of economic development in Anhui, this study analyzes panel data from 2013 to 2022 to investigate the impact of digital inclusive finance on farmers' income. The main conclusions of the research are as follows, firstly, regarding per capita disposable income of rural residents, the development of digital inclusive finance in Anhui Province has shown strong momentum, with its coverage and usage in rural areas continuously expanding. This trend provides strong financial support for rural economic development, promotes the optimization of rural industrial structures, and contributes to the increase in farmers' income.

Secondly, the impact of digital inclusive finance on the per capita disposable income of rural residents is significant. Since farmers' income is representative of the rural economy in Anhui, the widespread adoption and application of digital financial services can not only improve the financial accessibility in rural areas but also optimize the allocation of financial resources, promoting the diversified development of the rural economy.

Lastly, based on the results of the robustness test, the conclusions drawn in this study are highly reliable, providing strong empirical support for policymaking.

5.2. Recommendations

Based on the above conclusions, the following policy recommendations are made:

(1) Continue deepening the development of rural digital inclusive finance: Expand the scope and depth of financial service usage in rural areas. This includes strengthening rural digital infrastructure, enhancing farmers' digital financial literacy, and promoting operational innovation and service optimization in rural financial institutions.

(2) Fully leverage the advantages of digital inclusive finance to drive the upgrading and transformation of rural industrial structures: Optimize the allocation of fiscal resources to support the development of rural specialty industries, promote the integration of the primary, secondary, and tertiary industries in rural areas, and enhance the overall competitiveness of rural economies.

(3) Develop differentiated policies based on the nonlinear relationship between digital inclusive finance

and rural economic development: During the early stages of digital inclusive finance development, focus on strengthening infrastructure and financial knowledge dissemination. In the development stage, emphasize innovation and enhancement of financial service quality. In the mature stage, prioritize risk prevention and financial regulation.

(4) Strengthen policy coordination and interdepartmental cooperation: Form a collaborative effort to promote the development of digital inclusive finance. Stakeholders, including the government, financial institutions, and social organizations, should jointly participate in policy alignment to foster the healthy development of digital inclusive finance in rural areas.

In conclusion, digital inclusive finance plays a significant role in rural economic development. We should fully utilize its advantages and promote its deeper development in rural areas to provide strong financial support for sustainable rural economic growth.

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References

[1] Corrado G, Corrado L, 2017, Inclusive Finance for Inclusive Growth and Development. Current Opinion in Environmental Sustainability, 24(4): 19–23.

[2] Demirguc-Kunt A, Klapper L, Singer D, 2017, Financial Inclusion and Inclusive Growth: A Review of Recent Empirical Evidence. World Bank Policy Research Working Paper No. 8040: 1–27.

[3] Sahay R, Cihak M, N'Diaye P, et al., 2015, Financial Inclusion: Can It Meet Multiple Macroeconomic Goals? International Monetary Fund: 1–33.

[4] Kim D, Yu J, Hassan M, 2017, Financial Inclusion and Economic Growth in OIC Countries. Research in International Business and Finance, 43: 1–14.

[5] Chen D, Yao M, 2019, Empirical Analysis of the Impact of Digital Inclusive Finance on Rural Residents' Income. Shanghai Finance Research, 2019(6): 74–77.

[6] Guo F, Wang J, Wang F, et al., 2020, Measuring the Development of Digital Inclusive Finance in China: Index Construction and Spatial Characteristics. Economic Research (Quarterly), 19(4): 1401–1418.

[7] Li J, Peng Y, Ma S, 2020, Inclusive Finance and China's Economic Development: Multidimensional Connotations and Empirical Analysis. Economic Research, 19(4): 37–52.

[8] Tang Y, Long Y, Zheng Z, 2020, Research on the Inclusive Economic Growth Effect of Digital Inclusive Finance: An Empirical Analysis Based on 12 Provinces in Western China. Southwest Finance, 2020(9): 60–73.

[9] Xing Y, 2016, Inclusive Finance: A Basic Theoretical Framework. International Financial Research, 2016(9): 21–37.

[10] Du Q, Pan Y, 2016, Research on the Impact of Inclusive Finance on Regional Economic Development in China: An Empirical Analysis Based on Provincial Panel Data. Economic Issues Exploration, 2016(3): 178–184.

[11] Song X, 2017, Empirical Test of the Effect of Digital Inclusive Finance on Reducing the Urban-Rural Income Gap. Financial Science, 2017(6): 14–25.

[12] Du L, Pan X, 2017, Inclusive Finance, Financial Service Equalization, and Regional Economic Development: A Study Based on Provincial Panel Data in China. Journal of Social Sciences of Jilin University, 57(5): 37–44.

[13] Chen Y, 2017, Inclusive Finance, Supportive Policies, and Regional Economic Growth: Based on Spatial Panel Data from 30 Provincial Areas. Financial Economics, 18(26): 60–63.

[14] Hao Y, Lei H, Dong Y, 2018, Inclusive Finance and Inclusive Economic Growth: Empirical Evidence from Panel Data in Western China. Finance and Economics, 2018(5): 44–49.

[15] Yi X, Zhou L, 2018, Does the Development of Digital Inclusive Finance Significantly Affect Household Consumption: Micro Evidence from Chinese Households. Financial Research, 2018(11): 47–67.

[16] Zhan Y, 2018, The Effects of Digital Inclusive Finance on the Quantity and Quality of Economic Growth: A System GMM Estimation Based on Provincial Panel Data. Credit Information, 36(8): 51–58.

[17] Bai J, Zhang M, 2018, The Development of Inclusive Finance, Regional Convergence, and Inclusive Economic Growth: An Empirical Study Based on Data from 44 Counties (Cities/Districts) in Liaoning Province. Credit Information, 36(3): 20–26.

[18] Liu J, Bi Z, 2019, The Development of Inclusive Finance and Its Income Distribution Effects: A Dual Perspective of Economic Growth and Poverty Alleviation. Economic and Management Research, 40(4): 37–46.

[19] Jia J, 2019, "Digital Dividend" or "Digital Divide"?: Also Discussing How Digital Inclusive Finance Can Narrow the Income Gap. Regional Financial Research, 2019(12): 28.

[20] Zhang X, Wan G, Zhang J, et al., 2019, Digital Economy, Inclusive Finance, and Inclusive Growth. Economic Research, 54(8): 71–86.

[21] Yang Z, 2023, Empirical Study on the Impact of Digital Inclusive Finance on Farmers' Income in Shandong Province, thesis, Dalian Ocean University.

[22] Guo Q, Meng S, Mao Y, 2022, Can the Development of Digital Inclusive Finance Promote the Improvement of Employment Quality? Journal of Shanghai University of Finance and Economics: Philosophy and Social Sciences Edition, 24(1): 61–75.

Research on the Optimization of Human Resources Allocation in Public Hospitals Under the New Medical Reform

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Abstract: With the advancement of the new medical reform, public hospitals face numerous challenges and opportunities, making the optimization of human resource allocation a critical priority. This paper analyzes the requirements imposed by the new medical reform on human resource allocation in public hospitals, examines existing issues such as an unbalanced personnel structure, unscientific job design, and an inadequate talent mobility mechanism, and proposes corresponding optimization strategies. These strategies include improving the recruitment and selection process, scientifically planning job structures, and establishing a flexible talent mobility mechanism. The goal is to enhance the quality of medical services, improve hospital operational efficiency, and promote the sustainable development of public hospitals.

Keywords: New medical reform; Public hospitals; Human resource allocation; Optimization strategy

1. Introduction

The implementation of the new medical reform policy aims to address the challenges of "difficult and expensive medical treatment" while enhancing the accessibility and equity of healthcare services. As the cornerstone of China's healthcare system, public hospitals bear significant medical service responsibilities. Under the new medical reform, the rational allocation of human resources is directly linked to the quality, efficiency, and long-term sustainability of healthcare services. Optimizing human resource allocation can effectively mobilize medical personnel, strengthen hospitals' core competitiveness, and better meet the increasing healthcare demands of the population.

2. Requirements for human resource allocation in public hospitals under the new medical reform

2.1. Emphasizing the public welfare of medical services

The new medical reform mandates that public hospitals prioritize their public welfare function. Accordingly,

human resource allocation should focus on ensuring the provision of essential medical services by appropriately distributing medical, nursing, and administrative personnel. This approach enables hospitals to effectively control costs, enhance resource utilization efficiency, and maintain high-quality medical services [1].

2.2. Enhancing the quality of the talent pool

To meet the new medical reform's requirements for medical technology and service quality, public hospitals must cultivate a highly skilled and professional workforce [2]. This necessitates strengthening continuing education and training programs for existing personnel to improve their professional competencies and overall qualifications. Additionally, hospitals should actively recruit high-level and interdisciplinary talents to enhance their overall medical standards, as well as their research and innovation capabilities [3].

2.3. Promoting the rational flow of human resources

The new medical reform encourages the equitable distribution of medical talent across different healthcare institutions to achieve a more balanced allocation of medical resources. Public hospitals should establish and refine talent mobility mechanisms, remove institutional barriers to workforce movement, and create broader platforms for medical professionals to maximize their expertise. Facilitating the rational flow of human resources also contributes to strengthening the service capacity of primary healthcare institutions [4].

3. Existing problems in human resource allocation in public hospitals

3.1. Unreasonable personnel structure

3.1.1. Imbalance in professional composition

Some public hospitals experience an oversupply of medical professionals while facing shortages in nursing, rehabilitation, public health, and other specialized fields. For instance, in certain general hospitals, there is an excessive number of clinicians, whereas nursing staff levels fail to meet the appropriate nurse-to-patient ratio. This imbalance hinders improvements in nursing service quality and negatively impacts the patient experience. Furthermore, shortages of rehabilitation therapists and preventive healthcare professionals also impede the development of comprehensive medical services within hospitals [5].

3.1.2. Disproportionate title structure

An imbalance exists in the distribution of professional titles, with a concentration of senior professionals and a disproportionate number of mid-level and junior professionals. While senior professionals primarily engage in research, teaching, and the diagnosis and treatment of complex diseases, mid-level and junior professionals constitute the backbone of routine medical services [6]. If the number of mid-level and junior personnel is insufficient or if career advancement opportunities are limited, the hospital's daily operations and talent development structure may be adversely affected.

3.2. Unscientific job positioning

3.2.1. Undefined job responsibilities

Some public hospitals fail to clearly define job responsibilities, authority, and role expectations, leading to overlapping duties and accountability issues [7]. For example, in the medical management department, multiple staff members from different positions may be involved in medical quality supervision. However, due to unclear role delineation, it becomes difficult to identify responsibility in the event of a problem, thereby reducing work efficiency and management effectiveness.

3.2.2. Lack of dynamic adjustment in job allocation

With advancements in medical technology and the expansion of hospital operations, job demands continue to evolve. However, some public hospitals do not adjust job allocations in a timely manner, resulting in underutilization in some positions while others experience excessive workloads. This imbalance affects employee motivation and reduces overall hospital efficiency [8].

3.3. Deficiencies in the talent flow mechanism
3.3.1. Restricted internal mobility

Personnel mobility between departments in public hospitals is often limited due to the absence of an effective internal talent flow mechanism. Employees are typically confined to career progression within their own departments, making cross-departmental job transitions difficult. This restriction limits career development opportunities and hinders the cultivation of multidisciplinary talent within hospitals [9].

3.3.2. Limited external talent exchange

Public hospitals face multiple barriers to talent exchange with external medical institutions. On one hand, concerns over workforce attrition lead hospitals to impose restrictive policies on personnel seeking further education and exchange opportunities. On the other hand, challenges in talent recruitment—such as administrative constraints and compensation limitations—make it difficult to attract outstanding external professionals, thereby weakening hospital workforce vitality and innovation capacity [10].

4. Optimization strategies for human resource allocation in public hospitals
4.1. Enhancing personnel recruitment and selection mechanisms
4.1.1. Developing a scientific recruitment plan

A comprehensive recruitment plan should be formulated based on the hospital's strategic development objectives and operational needs. The plan should clearly define job positions, required personnel numbers, professional qualifications, and educational requirements to ensure that newly recruited staff align with the hospital's actual demands across different roles [11]. The recruitment process should emphasize candidates' comprehensive qualities, professional skills, and ethical standards. A diversified recruitment strategy—combining campus recruitment, social recruitment, and online recruitment—should be adopted to expand hiring channels and enhance recruitment efficiency and quality [12].

4.1.2. Establishing a fair and equitable selection mechanism

A fair and transparent evaluation system should be implemented for the selection and promotion of internal personnel. Key assessment criteria should include work performance, professional competence, and ethical standards to ensure that promotion opportunities are granted based on merit, thereby fostering employee motivation and creativity. The selection process should be conducted with openness and transparency, allowing for staff supervision to enhance credibility and fairness [13].

4.2. Scientific planning of job positions
4.2.1. Defining job responsibilities and requirements

A detailed classification of hospital positions should be conducted to specify job responsibilities, tasks, authority, and the necessary professional knowledge, skills, and experience for each role. Comprehensive job descriptions

should be developed to provide employees with clear expectations regarding their roles while serving as a foundation for recruitment, training, and performance evaluation [14]. For instance, the job description for a clinician should outline specific duties related to outpatient care, inpatient management, surgical procedures, and the required medical expertise, clinical experience, and licensure [15].

4.2.2. Implementing dynamic job adjustments

A dynamic job adjustment mechanism should be established to periodically assess and modify job structures based on hospital development needs, technological advancements, and patient demand. Positions should be created or eliminated accordingly to optimize workforce distribution. For example, with the rise of telemedicine, public hospitals can establish positions dedicated to online consultations and remote medical services. Conversely, roles with significantly reduced workloads due to technological advancements may be consolidated or restructured [16].

4.3. Establishing a flexible talent flow mechanism
4.3.1. Facilitating internal talent mobility

Internal talent mobility policies should be developed to encourage job rotations and cross-departmental exchanges within hospitals. An internal talent marketplace or job exchange platform should be established to regularly publish job openings, allowing employees to apply for transfers based on their interests, abilities, and career aspirations. Hospitals should provide necessary training and support to ensure employees can quickly adapt to new positions. Enhancing internal talent mobility will help cultivate multidisciplinary skills among staff and optimize workforce allocation.

4.3.2. Strengthening external talent exchanges and collaborations

Hospitals should actively foster personnel exchange and cooperation with other medical institutions, universities, and research organizations. Outstanding employees should be selected for further training and academic exchange programs to broaden their expertise and enhance their professional and innovative capabilities [17]. Additionally, hospitals should attract high-level external professionals for part-time engagements, guest lectures, and research collaborations, introducing new perspectives, technologies, and management practices. In terms of talent recruitment, traditional staffing constraints should be reconsidered, and flexible employment mechanisms—such as contract-based and project-based hiring—should be adopted to enhance the hospital's attractiveness and competitiveness in talent acquisition [18].

5. Conclusion

Amid the ongoing medical reform, optimizing human resource allocation in public hospitals remains a long-term and challenging endeavor. By implementing strategies such as enhancing personnel recruitment and selection mechanisms, scientifically planning job positions, and establishing a flexible talent flow system, existing issues in human resource allocation can be effectively addressed, thereby improving hospital management and the quality of medical services [19]. Public hospitals should actively adapt to the requirements of the new medical reform, continuously explore and innovate human resource allocation models, and cultivate a high-quality, professional, and dynamic workforce. These efforts will contribute to safeguarding public health and promoting the advancement of medical and healthcare services [20]. Additionally, the government and relevant authorities should provide policy and financial support to foster a conducive external environment for optimizing human resource allocation in public hospitals.

Disclosure statement

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References

[1] Hao S, 2024, SWOT Analysis of Human Resource Management Information System Construction in Public Hospitals. Economic Outlook Around Bohai, 2024(10): 119–122.

[2] Su W, 2023, Analysis of Technical Efficiency and Health Resource Allocation Level of Public Hospitals in Guangdong Province from the Perspective of Time and Space, dissertation, Henan University.

[3] Wang L, 2022, Research on Problems and Countermeasures of Health Human Resources Allocation in Guangzhou Public Hospitals, dissertation, Guangdong University of Finance and Economics.

[4] Yang ZY, 2024, Research on Procurement Management Optimization of Public Hospitals From the Perspective of Financial and Accounting Supervision. Friends of Accounting, 2024(22): 56–63.

[5] Zhang Y, 2023, Optimizing Human Resource Allocation to Achieve High-Quality Development of Public Hospitals. China Business, 2023(6): 108–109.

[6] Dong Y, 2019, Study on Application and Practice of Intelligent Management in Hospital Material Management. Chinese Urban and Rural Enterprise Health, 38(11): 222–225.

[7] Chen F, Ge F, 2023, Research on Connotation and Key Path of High-Quality Development of Public Hospitals. Health Economics Research, 40(7): 55–57.

[8] Guo P, 2024, Application Research of Activity-Based Cost Management for Medical Service Projects in Public Hospitals. Friends of Accounting, 2024(22): 23–30.

[9] Li M, 2021, Discussion on Optimal Strategies of Human Resource Management in Public Hospitals. China Industry & Economics, 2021(20): 130–131.

[10] Guo P, 2020, Thinking on Optimization of Human Resource Management in Public Hospitals Under the Background of Medical Reform. Journal of Finance and Economics, 2020(7): 108–109.

[11] Li Y, 2020, Development Trend of Human Resource Performance Management in Public Hospitals. Human Resources, 2020(2): 88–89.

[12] Wang Y, 2023, Discussion on Innovative Countermeasures of Hospital Human Resource Management Under the Background of New Economy. Economic Research Guide, 2023(23): 104–106.

[13] Sun H, 2023, Discussion on Optimization Measures of Hospital Human Resource Management. Finance and Economics, 2023(35): 168–170.

[14] Huang A, 2024, Research on Internal Control of Medical Consumables Management in Public Hospitals: A Case Study of F Hospital. Friends of Accounting, 2024(22): 37–42.

[15] Li M, 2021, Effective Measures to Optimize the Allocation of Human Resources in Public Hospitals. Human Resources, 2021(14): 28–29.

[16] Yang R, 2021, Optimization Strategies of Human Resources Allocation in Public Hospitals. Human Resources Development, 2021(14): 25–26.

[17] Fang L, 2021, The Impact of Optimizing Human Resource Allocation on Hospital Economic Development. Human Resources Development, 2021(1): 40–41.

[18] Tang H, 2023, Discussion on the Information Construction of Hospital Financial Management Under the Development of Electronic Era. Financial News, 2023(24): 183–185.

[19] Hu G, 2023, Analysis of Human Resource Management Strategies in Public Hospitals from the Perspective of Fine Management. Human Resource Development, 2023(24): 70–72.

[20] Huang X, 2023, Research on Cadre Personnel File Management Under the Background of Smart Hospital

Construction. Journal of Lantai & Beyond, 2023(35): 10–12.

Research on Risk Management in the Decision-Making Stage of a Project Based on DPSIR

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Abstract: With the growth of the construction industry, risk management in construction projects has garnered significant attention from the academic community. Effective risk management during the decision-making stage can greatly enhance project management efficiency. This paper integrates the AHP-entropy value method and constructs a risk management model based on the DPSIR framework for construction projects. The model is applied to evaluate and analyze the risk level of the decision-making stage in a navigation and electricity hub project in Chongqing Municipality. The results demonstrate the scientific validity and effectiveness of the proposed model.

Keywords: DPSIR; Construction projects; Decision stage; Risk management; AHP-entropy method

1. Introduction

As the economy continues to grow, the construction industry is expanding rapidly [1]. However, construction projects are increasingly exposed to various risks [2]. Throughout a project's life cycle, economic losses resulting from potential natural disasters, accidents, and other unforeseen events are collectively referred to as engineering risks [3]. These risks not only lead to increased project costs and delays but may also impact the overall benefits and social reputation of the project. Therefore, effective risk management in construction projects is essential.

Risk management involves maximizing safety and security through economic and technical approaches, including risk identification, assessment, evaluation, and preventive measures [4]. In construction projects, risk management is typically implemented through risk analysis and the development of mitigation strategies. Managing risks during the decision-making stage enables early identification and assessment of potential risks, facilitating optimal resource allocation [5]. To ensure the smooth implementation of construction projects and the achievement of their intended objectives, this paper examines risk management in the decision-making stage.

Existing research on construction project risk management has explored various approaches. Zhou addressed cost risk in the construction stage by developing an AHP-DEMATEL model [6]. Hu *et al.* constructed a system dynamics (SD) risk model for prefabricated building projects under the PPP model by identifying potential risk factors at each stage of the project life cycle through a risk breakdown structure (RBS) [7]. Zhu applied a fuzzy risk

evaluation model to analyze the potential risks associated with green building applications from a construction perspective [8]. Xiang and Zhang processed dispersed risk evaluation data into different degrees of gray assessment values by analyzing the mutual influence of indicators [9]. Serpell *et al.* developed an organizational maturity model to effectively evaluate risk management capacity within construction organizations [10]. Cai proposed a fuzzy multilevel gray evaluation method for assessing the risks of green building design, integrating fuzzy Delphi hierarchical analysis and gray theory [11]. Zhao *et al.* assessed the risk management maturity of Singaporean construction firms using triangular fuzzy numbers [12].

Despite extensive research on construction project risk management, some studies overlook the interrelationships among influencing factors, failing to consider the complex interactions within the system. The DPSIR model provides a comprehensive framework for identifying and analyzing risk factors in the decision-making stage of construction projects, allowing for a systematic evaluation of their interdependencies and impacts [13-16]. By incorporating the DPSIR model into risk management at the decision-making stage, project managers can systematically analyze risk factors, gain a holistic understanding of their interactions, and develop more scientifically sound and effective risk management strategies. Therefore, this paper introduces the DPSIR model into risk management research for the decision-making stage of construction projects. By integrating the AHP-entropy value method, it constructs a DPSIR-based risk management model tailored to the decision-making stage of construction projects. This study aims to provide a valuable reference for improving risk management practices during the decision-making stage of construction projects.

2. Construction of an indicator system for risk management at the decision-making stage based on DPSIR

2.1. Selection of risk management indicators

Driving force indicators: Driving force indicators encompass natural, social, and policy factors, which serve as key drivers for effective decision-making in construction projects. First, natural risks represent a major challenge for construction projects, including environmental degradation, geological changes, force majeure events (e.g., earthquakes, floods), shifts in transportation conditions, and extreme weather, all of which can significantly impact project timelines, costs, and quality. Second, various social factors influence project implementation. Social risks include local security conditions, religious beliefs and customs, immigration, and relocation issues, all of which may affect the smooth progress of a project. Additionally, with China's construction industry experiencing steady development, changes in policies, laws, and regulations may introduce uncertainties and legal risks, thereby influencing project decision-making and execution.

Pressure indicators: Pressure indicators reflect the external forces that influence effective decision-making in construction projects. Since the decision-making stage involves cross-departmental collaboration and complex technical interfaces, these indicators primarily stem from challenges in interdepartmental coordination and professional ethics. Such risk factors can lead to mismanagement, ultimately affecting the overall efficiency and success of a project.

State indicators: State indicators assess the economic and technical risk factors affecting construction projects under the influence of external pressures. Economically, large-scale investments, exchange rate fluctuations, interest rate adjustments, material price changes, and labor market shifts can escalate project costs, thereby impacting economic efficiency. Technically, discrepancies between decision-making assumptions and actual conditions may arise. Factors such as the feasibility of key technical solutions, the rationality of construction organization design, and the appropriateness of major building arrangements can pose challenges to project implementation, ultimately affecting technical feasibility and safety.

Impact indicators: Impact indicators evaluate the societal effects of a construction project post-completion, as anticipated during the decision-making stage. The objective of a construction project extends beyond economic maximization to achieving a balance among economic, social, and environmental goals. Risks related to project objectives primarily concern the ability to manage these targets effectively. If not properly addressed, these risks may prevent the project from meeting its expected goals, thereby influencing its final outcomes.

Response indicators: Response indicators assess the societal response to a construction project, including its demonstrative role and operational effectiveness post-completion. These factors influence public acceptance and the project's long-term benefits.

2.2. Construction of a risk management indicator system

Based on the selected risk management indicators, this study organizes and synthesizes existing evaluation frameworks for construction project risk management. By refining and optimizing the initial selection of indicators, it ultimately establishes a comprehensive risk management evaluation system for construction projects based on the DPSIR model, as illustrated in **Table 1**.

Table 1. Evaluation index system of risk management in the decision-making stage of a construction project based on DPSIR model

Objective level	Criterion level	Indicator level
Evaluation of risk management at the decision-making stage of construction projects	Driving	Environmental Degradation (D_1), Geological Conditions (D_2), Force Majeure (D_3), Transportation Conditions Change (D_4), Abnormal Climate Conditions (D_5), Local Security Level (D_6), Religious Beliefs and Customs (D_7), Resettlement and Relocation (D_8), Environmental Policy Changes (D_9), Local Protectionism (D_{10}), War and Conflict (D_{11})
	Pressure	Interdepartmental Coordination Capability (P_1), Professional Ethics Level (P_2)
	State	Exchange Rate Fluctuation (S_1), Interest Rate Adjustment (S_2), Construction Material Price Fluctuation (S_3), Labor Market Changes (S_4), Feasibility of Key Technical Schemes (S_5), Rationality of Construction Organization Design (S_6), Rationality of Main Building Layout (S_7)
	Impact	Target Management Capability of Construction Projects (I_1)
	Response	Demonstrative Role of Construction Projects (R_1), Operational Performance After Project Completion (R_2)

As shown in **Table 1**, the evaluation system is structured into three levels: the objective level, the criterion level, and the indicator level. These levels are used to assess the risk management capability of construction projects during the decision-making stage, as well as to identify and analyze specific risk factors. This framework provides essential theoretical support for subsequent management analysis and evaluation based on the analytic hierarchy process–entropy value method.

3. Analysis and evaluation of construction project risk management based on AHP-entropy method

3.1. Determination of indicator weights

3.1.1. AHP method for determining subjective weights of indicators

The AHP method decomposes complex decision-making problems into multiple levels, enabling systematic analysis and comparison. This approach helps determine the relative importance of each risk factor in risk management. Based on the risk management evaluation index system for the decision-making stage of a construction project, the matrix elements a_{ij} are obtained through expert assessment using the Delphi method. A

discriminant matrix is then constructed, followed by normalization to derive the standard matrix.

$$A = \left(\overline{a_{ij}}\right)_{m \times n} \tag{1}$$

where $\overline{a_{ij}}$ denotes the matrix elements after normalization. Summing the matrix by rows yields:

$$\overline{w_i} = \sum_{j=1}^{n} \overline{a_{ij}} \tag{2}$$

After normalization, the subjective weight w_i of the indicator is determined and can be expressed as:

$$w_i = \frac{\overline{w_i}}{\sum_{j=1}^{n} \overline{w_i}} \tag{3}$$

3.1.2. Entropy value method for determining objective weights of indicators

The entropy value method is an objective weighting approach that evaluates the information entropy of indicators, effectively minimizing the influence of subjective factors on risk evaluation results. Based on the construction project risk management index system, this study applies the entropy value method to calculate the entropy values and corresponding weights of the data. The jth evaluator assesses the risk level of the ith indicator, resulting in b_{ij} and establishing the initial data matrix B:

$$B = \left(b_{ij}\right)_{m \times n} \tag{4}$$

The entropy value E_i of the ith indicator is calculated as:

$$E_i = -\frac{1}{\ln n} \sum_{j=1}^{m} \overline{b_{ij}} \ln \overline{b_{ij}} \tag{5}$$

where $\overline{b_{ij}}$ denotes the corrected matrix elements. Finally, the objective weight Q_i of the indicator is calculated as:

$$Q_i = \frac{1 - E_i}{\sum_{i=1}^{n} 1 - E_i} \tag{6}$$

3.1.3. Combined weight calculation based on hierarchical analysis-entropy value method

Subjective weights and objective weights are combined to get the combined weight vector. Comprehensively assign weights to the evaluation indicators to get the comprehensive weight W_i of the ith indicator as:

$$W_i = (1 - k)w_i + kQ_i \tag{7}$$

where k is the correction coefficient, taking the value between 0 and 1. To ensure that the evaluation results are objective and accurate, with reference to existing literature, this paper compromises the value of $k = 0.5$ [17]. Therefore, the comprehensive weight of the indicators is:

$$W_i = 0.5w_i + 0.5Q_i \tag{8}$$

3.2. Construction of the risk evaluation matrix

Since the evaluation indicators of risk management in the decision-making stage of the construction project are all qualitative indicators, this paper develops the risk level through expert scoring, and transforms the qualitative indicators of risk management into quantitative indicators. The experts are organized to score the indicators, and the score of the pth expert on the ith risk evaluation indicator is set as c_{pi}, and according to the scoring results of the mth expert, the evaluation sample matrix C is obtained as:

$$C = \begin{bmatrix} c_{11} & c_{12} & \cdots & c_{1n} \\ c_{21} & c_{22} & \cdots & c_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ c_{m1} & c_{m2} & \cdots & c_{mn} \end{bmatrix} \tag{9}$$

3.3. Gray evaluation

3.3.1. Determining the evaluation gray class whitening weight function

Based on the statistical data, five evaluation gray intervals are selected, and their order is e = 1, 2, 3, 4, 5. e denotes extremely low risk, low risk, medium risk, high risk, and extremely high risk, respectively. The whitening weight function $f_e(c_{pi})$ is defined as follows:

(a) Type 1 gray "extremely low risk" with gray number $\otimes$ 1$\in$ [0,1,2], i.e.:

$$f_1(c_{pi}) = \begin{cases} c_{pi}, c_{pi} \in [0,1]; \\ 2 - c_{pi}, c_{pi} \in (1,2]; \\ 0, c_{pi} \in (-\infty,0) \cup (2,\infty) \end{cases} \tag{10}$$

(b) Type 2 gray "low risk" with gray number $\otimes$ 2$\in$ [0,2,4], i.e.:

$$f_2(c_{pi}) = \begin{cases} \frac{c_{pi}}{2}, c_{pi} \in [0,2]; \\ \frac{4-c_{pi}}{2}, c_{pi} \in (2,4]; \\ 0, c_{pi} \in (-\infty,0) \cup (4,\infty) \end{cases} \tag{11}$$

(c) Type 3 gray "medium risk" with gray number $\otimes$ 3$\in$ [0,3,6], i.e.:

$$f_3(c_{pi}) = \begin{cases} \frac{c_{pi}}{3}, c_{pi} \in [0,3]; \\ \frac{(6-c_{pi})}{3}, c_{pi} \in (3,6]; \\ 0, c_{pi} \in (-\infty,0) \cup (6,\infty) \end{cases} \tag{12}$$

(d) Type 4 gray "high risk" with gray number $\otimes$ 4$\in$ [0,4,8], i.e.:

$$f_4(c_{pi}) = \begin{cases} \frac{c_{pi}}{4}, c_{pi} \in [0,4]; \\ \frac{8-c_{pi}}{4}, c_{pi} \in (4,8]; \\ 0, c_{pi} \in (-\infty,0) \cup (8,\infty) \end{cases} \tag{13}$$

(e) Type 5 gray "extremely high risk" with gray number $\otimes$ 5$\in$ [0,5,10], i.e.:

$$f_5(c_{pi}) = \begin{cases} \frac{c_{pi}}{5}, c_{pi} \in [0,5]; \\ \frac{10-c_{pi}}{5}, c_{pi} \in (5,10]; \\ 0, c_{pi} \in (-\infty,0) \cup (10,\infty) \end{cases} \tag{14}$$

3.3.2. Calculating the gray evaluation coefficient

The evaluation gray number of the indicator Gt belonging to category e evaluation gray category is:

$$X = \sum_{i=1}^{n} f_e(c_{pi}) \tag{15}$$

3.3.3. Calculating the gray evaluation weight vector and weight matrix

The gray evaluation weights of all experts claiming to belong to category e with respect to the evaluation indicator

Gt are:

$$r_e = \frac{X_e}{X} \qquad (16)$$

The gray evaluation weight vector $r_e = (r_1, r_2, r_3, r_4, r_5)$ is obtained as the gray evaluation weight matrix *R* as:

$$(17)$$

$$R = \begin{bmatrix} r_{g1} \\ r_{g2} \\ \vdots \\ r_{gt} \end{bmatrix} = \begin{bmatrix} r_{g11} & r_{g12} & r_{g13} & r_{g14} & r_{g15} \\ r_{g21} & r_{g22} & r_{g23} & r_{g24} & r_{g25} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ r_{gt1} & r_{gt2} & r_{gt3} & r_{gt4} & r_{gt5} \end{bmatrix}$$

3.3.4. Comprehensive evaluation

The weight of the indicator *Gt* with respect to the previous level indicator *G* is *U*. The evaluation result of *G* is denoted as *D*. Then we have:

$$D = U \times R = (d_{g1}, d_{g2}, d_{g3}, d_{g4}, d_{g5}) \qquad (18)$$

The matrix of indicator evaluation results *T* is obtained as:

$$(19)$$

$$T = \begin{bmatrix} B_1 \\ B_2 \\ \vdots \\ B_5 \end{bmatrix} = \begin{bmatrix} d_{11} & d_{12} & d_{13} & d_{14} & d_{15} \\ d_{21} & d_{22} & d_{23} & d_{24} & d_{25} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ d_{51} & d_{52} & d_{53} & d_{54} & d_{55} \end{bmatrix}$$

Comprehensive evaluation results are available:

$$Z = U \times T = (d_1, d_2, d_3, d_4, d_5) \qquad (20)$$

4. Case study

A navigation and power hub in Chongqing, China is a project that mainly focuses on shipping, combines navigation and power, and has comprehensive utilization of transportation, irrigation, water supply, and breeding. This research takes this navigation hub project as an example to analyze the scientific and effectiveness of the risk management evaluation index system for the decision-making stage of construction projects based on the DPSIR model.

4.1. Risk management evaluation process

The risk management indicators are categorized into five levels, i.e., V = {very low risk ∈ [0,2], low risk ∈ [2,4], medium risk ∈ [4,6], high risk ∈ [6,8], and very high risk ∈ [8,10]}, for the risk scenario of the project at the decision-making stage. Five experts from each of the construction unit and the investment unit, totaling 10 people, were invited to score the indicators of the indicator layer. The weights are calculated according to the hierarchical analysis and entropy value method, and the weights of each indicator are calculated in turn to get the weights of the indicators of each structural layer, and the results are shown in **Table 2**.

Table 2. Summary of weight values of risk management indicators in the decision-making stage of a navigation hub project

Criterion level	Weight value	Indicator level	AHP weight value	Entropy method weight value	Comprehensive weight value
		D_1	0.0411	0.0403	0.0407
		D_2	0.0483	0.0492	0.04875
		D_3	0.0468	0.0475	0.04715
		D_4	0.0424	0.0422	0.0423
		D_5	0.0468	0.0465	0.04665
D	0.4804	D_6	0.0422	0.0408	0.0415
		D_7	0.0412	0.0412	0.0412
		D_8	0.0471	0.0454	0.04625
		D_9	0.0421	0.0402	0.04115
		D_{10}	0.0466	0.0472	0.0469
		D_{11}	0.0375	0.0382	0.03785
P	0.0853	P_1	0.0423	0.0397	0.041
		P_2	0.0454	0.0432	0.0443
		S_1	0.0461	0.0464	0.04625
		S_2	0.0402	0.0407	0.04045
		S_3	0.0477	0.0452	0.04645
S	0.3082	S_4	0.0407	0.0402	0.04045
		S_5	0.0469	0.0468	0.04685
		S_6	0.0432	0.0441	0.04365
		S_7	0.0434	0.0448	0.0441
I	0.0436	I_1	0.0434	0.0438	0.0436
R	0.0825	R_1	0.0402	0.0429	0.04155
		R_2	0.0401	0.0418	0.04095

In the decision-making stage, a total of 10 experts with experience in similar engineering projects in technology, economy, and management were invited to score the comprehensive risk management indexes in the decision-making stage of this navigation hub project. Based on the five levels of risk evaluation, the corresponding gray whitening weight function is established, which is denoted as $f1, f2, f3, f4, f5$, and its graph is shown in **Figure 1**.
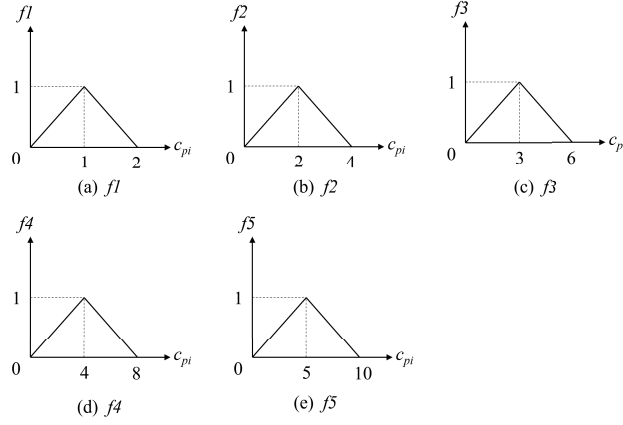
Figure 1. Whitening weight functions for various levels of risk

The evaluation coefficients are obtained according to the whitening weight function and the gray evaluation matrix is calculated as:

$$R = \begin{bmatrix} 0.1502 & 0.1137 & 0.1426 & 0.1477 & 0.2612 \\ 0.1713 & 0.2072 & 0.4131 & 0.1022 & 0.1420 \\ 0.1704 & 0.1542 & 0.2213 & 0.3104 & 0.2001 \\ 0.2911 & 0.4211 & 0.3072 & 0.1924 & 0.3002 \\ 0.2441 & 0.2043 & 0.2512 & 0.1076 & 0.1471 \end{bmatrix}$$

Based on Equation (18), the evaluation vector of the upper-level risk evaluation indicators can be calculated:

$$T = \begin{bmatrix} 0.0052 & 0.0061 & 0.0070 & 0.0067 & 0.0072 \\ 0.0022 & 0.0031 & 0.0041 & 0.0050 & 0.0021 \\ 0.0791 & 0.0962 & 0.0933 & 0.0062 & 0.0231 \\ 0.0182 & 0.0251 & 0.0270 & 0.0236 & 0.0023 \\ 0.1201 & 0.1102 & 0.4102 & 0.0109 & 0.0128 \end{bmatrix}$$

Based on Equation (20), the assessed value of the risk profile of this navigation hub project is obtained:

$$Z = (1.6237, 0.1022, 0.9245, 0.3926, 0.0901)^T$$

4.2. Analysis of results and recommendations

According to the assessment results, the main risks faced in the decision-making stage of the project include: risk of geological conditions D_2, abnormal climate D_5, force majeure D_3, rising prices of construction materials S_3, local protection D_{10}, exchange rate changes S_1, migration and relocation D_8, and infeasibility of key technical solutions S_5. In addition, there are some other risks, such as irrational arrangement of the main buildings S_7, risk of professional ethics P_2, and construction unreasonable organization design S_6, etc., which have smaller weights but still need to be handled with appropriate risk response measures.

Therefore, the primary risks at this stage stem from external drivers and decision-making uncertainties. Project risk managers should develop targeted countermeasures based on risk assessment results. It is crucial to implement effective risk management strategies, strictly enforce risk treatment plans, and conduct regular reporting and review.

For natural risks, environmental changes should be scientifically predicted and monitored, with contingency plans established accordingly. For example, designing adaptable building structures can help mitigate the impact

of extreme weather conditions. In terms of social risks, enhancing communication with local communities can facilitate smoother migration and relocation processes, ensuring social harmony during project implementation.

To address political and policy risks, close monitoring of policy changes is essential, allowing for timely adaptation to new regulations and minimizing uncertainties. Economic risks, such as exchange rate and interest rate fluctuations, can be managed using financial instruments, while procurement costs for construction materials should be carefully controlled. Technical risks can be mitigated through thorough feasibility studies and scientifically sound construction planning, including the rational design of construction organization and the arrangement of major buildings.

At the decision-making stage, risk factors should be categorized based on their impact, prioritizing high-risk elements without neglecting lower-risk ones. To manage operational risks, professional ethics training should be reinforced to enhance managerial responsibility and professionalism. Performance evaluation and progress monitoring can help ensure project goals are met, while regular assessments of operational effectiveness will ensure the project continues to provide value and benefits to society.

5. Conclusion

Based on the DPSIR model, this paper constructs a risk management index system for the decision-making stage of construction projects and applies the hierarchical analysis-entropy value method to determine the final risk management model. A case study is conducted on a navigation and electricity hub project in Chongqing. The results indicate that the proposed risk management model effectively reflects the risk level at each structural level, providing a scientific basis for decision-making in construction project risk management. However, a limitation of this study is that the hierarchical analysis method may struggle to assess interrelated elements within complex systems, particularly in large-scale construction projects influenced by numerous factors. Future research could develop more advanced management models to better address the complexities of large-scale construction projects.

Disclosure statement

The author declares no conflict of interest.

References

[1] Xu J, Qian Y, He B, et al., 2024, Measurement and Influencing Factors of the Coordinated Development of New Urbanization and the Construction Industry: A Case Study of Yunnan Province. Small Town Construction, 42(03): 60–68.
[2] Yu Y, 2022, Cost Control Work in Construction Project Management. Today's Fortune, (20): 49–51.
[3] Lou J, 2017, Cost Management and Risk Control of Construction Projects. Building Engineering Technology and Design, (13): 4024.
[4] Ma Y, Shi H, Zhang Y, 2000, Exploration of Safe Operation and Risk Management in Coal Enterprises. Coal Economic Research, 2000(11): 64–66.
[5] Qiao L, 2024, Construction and Improvement of the Risk Identification System for State-Owned Capital Investment. Finance and Accounting, (06): 70–71.
[6] Zhou H, 2022, Research on Cost Risk Management of Construction Projects at the Construction Stage Based on AHP-DEMATEL Model. Science & Technology Information, 20(12): 86–90.

[7]   Hu R, Wang Y, Leng B, et al., 2021, Research on Risk Management of Prefabricated Construction Projects Based on SD Model. Engineering Economics, 31(2): 60–66.

[8]   Zhu J, 2022, Research on Risk Management of Green Building Construction Based on Fuzzy Comprehensive Evaluation. Ceramics, 2022(10): 184–186.

[9]   Xiang Y, Zhang S, 2012, Risk Assessment of Construction Projects Based on Gray Clustering and Network Analysis. Statistics and Decision, 2012(1): 184–186.

[10] Serpell A, Ferrada X, Rubio L, et al., 2015, Evaluating Risk Management Practices in Construction Organizations. Procedia - Social and Behavioral Sciences, 194: 201–210.

[11] Cai J, 2015, Research on Risk Assessment of Green Building Design Based on Fuzzy Multi-level Gray Method. Journal of Hefei University of Technology: Natural Science Edition, 2015(7): 968–972, 983.

[12] Zhao X, Hwang BG, Sui PL, 2014, Investigating Enterprise Risk Management Maturity in Construction Firms. Journal of Construction Engineering and Management, 140(8): 1–10.

[13] Liu W, Xu J, Li M, 2022, Research on Maturity of Risk Management for Green Building Projects Based on DPSIR. Urban Construction Space, 29(S01): 138–139.

[14] Fang Y, Wu Y, Wang Q, et al., 2024, Resilience Evaluation and Influencing Factors of Urban Tourism Economy Based on DPSIR Model: A Case Study of the Yangtze River Delta Urban Agglomeration. Journal of Nanjing Normal University (Natural Science Edition), 47(02): 26–34.

[15] Hu Z, Zhao Z, Yu F, et al., 2024, Resilience Evaluation and Evolution Characteristics of Urban Ecology in Beijing Based on DPSIR Model. Ecological Economy, 40(06): 77–84.

[16] Ma Z, Gao Y, An T, et al., 2022, Research on the Measurement of Green Transportation Level in National Central Cities Based on DPSIR Model: A Case Study of Xi'an. Ecological Economy, 38(4): 85–93, 114.

[17] Li Q, Tao J, 2022, Research on Maturity of Risk Management for Green Building Projects Based on DPSIR. Journal of Civil Engineering and Management, 39(2): 70–78.

Legal Risks and Preventive Measures in Trademark Infringement of Co-Branded Products

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Abstract: Co-branding, as an innovative consumer model, is increasingly favored by "Generation Z" consumers and has become a preferred strategy for many brands to expand their market reach and achieve widespread recognition. However, with the rapid growth of the co-branding economy, trademark infringement issues related to co-branded products have become more prevalent, posing significant obstacles to the successful execution of co-branding marketing activities. Based on the different legal statuses of trademarks, this study systematically analyzes the various infringement risks that may arise in the use of trademarks within co-branding practices and explores corresponding risk prevention measures. The objective is to provide strong support for the healthy and sustainable development of the co-branding economy.

Keywords: Co-branding; Trademark infringement; Risk prevention

1. Background of the study on brand co-branding trademark infringement

Co-branding refers to the collaboration between two or more brands, commonly known in English as "co-branding." The term "brand" in this context encompasses the concept of a "trademark," which, in Chinese interpretation, includes the legal designation of a brand's identity [1]. The renowned American marketing expert Dr. Philip Kotler defines a brand as a name, term, symbol, or pattern—or a combination thereof—used to identify a product or service offered by a particular entity and to differentiate it from competitors' offerings [2].

A trademark, by contrast, is a distinct legal concept. According to Article 8 of the *Trademark Law of the People's Republic of China*, a trademark refers to any sign that distinguishes the goods of a natural person, legal entity, or other organization from those of others. This includes text, graphics, letters, and other elements presented individually or in combination. Therefore, in the co-branding process, the identification of the brand to which a co-branded product belongs inherently involves the use of that brand's trademark.

In recent years, the co-branding trend has gained significant traction in the market. For instance, the co-branded "Moutai Latte," a collaboration between Luckin Coffee and Moutai, sold 5.42 million cups on its launch day, successfully capturing widespread consumer attention. As co-branding continues to gain popularity, legal issues surrounding brand partnerships have increasingly come under public scrutiny. In September 2020, Semir's

"Shaolin Kungfu" clothing series faced allegations of trademark infringement after reportedly failing to obtain proper authorization from the exclusive rights holder of the "Shaolin Kungfu" registered trademark. The ensuing legal dispute raised questions regarding whether Semir had indeed committed trademark infringement and whether it had obtained the necessary authorization, though no clear resolution was publicly disclosed.

This uncertainty surrounding "co-branding disputes" has resulted in mixed consumer evaluations of the brands involved. However, it is evident that Semir, in its attempt to capitalize on the rising popularity of the "national style" and "national trend" movements, ultimately became entangled in a trademark infringement controversy, negatively impacting its brand reputation.

2. Trademark legal implications of co-branding

The essence of co-branding lies in the use of intellectual property licensing, which encompasses various forms such as trademark authorization co-branding, copyright authorization co-branding, and commercialization rights authorization co-branding (**Table 1**) [3]. Regardless of the specific co-branding strategy employed, trademarks are typically utilized in product design, packaging, marketing, and promotional activities. This is because both participating brands often opt to display their trademarks in marketing and publicity efforts to indicate the origin of the co-branded product. The use of a brand's trademark by another party in this process constitutes trademark use as defined in Article 48 of the *Trademark Law of the People's Republic of China*.

Table 1. Co-branding models and their associated intellectual property rights

Co-branding models	Joint intellectual property rights	Co-branding cases
Brand & Brand	Trademark right & Trademark right	Luckin Coffee × Kweichow Moutai
IP & Brand	Copyright & Trademark right	Black Myth: Wukong × Daoxiangcun
	Commercialization right & Trademark right	Harry Potter × Holiland

Given this, the legal issues arising from co-branding are closely linked to the *Trademark Law of the People's Republic of China*. Notably, trademark infringement is addressed under Article 57 of the current Trademark Law. To avoid legal disputes, as seen in the case of Samsung's co-branding with Supreme—where the actual co-branding partner was later found to be Supreme Italia—obtaining a valid trademark license is crucial. Moreover, it is essential to ensure that the licensee holds the exclusive right to use the trademark for marketing purposes. This is particularly important as co-branding primarily focuses on the marketing impact of collaborative efforts.

Accordingly, this study will analyze co-branding based on the different trademark statuses of the involved parties. The primary focus will be to identify actions that may lead to legal risks of trademark infringement under the trademark authorization model of joint branding and to propose corresponding preventive measures.

3. Legal risk analysis of co-branding trademark infringement

According to Articles 48 and 57 of the *Trademark Law of the People's Republic of China*, trademark infringement generally requires the fulfillment of two conditions: (1) the use of the trademark constitutes trademark use, and (2) the trademark in question is a registered trademark. In co-branding under the trademark authorization model, the use of a co-branding partner's trademark can be categorized into two forms: indicating the overall source of the goods or indicating the source of specific components. The risk of infringement varies depending on how the trademark is used in different contexts [4].

3.1. Use of registered trademarks in co-branding

3.1.1. Unauthorized use of a registered trademark

If a brand intends to use a registered trademark in co-branded products, the primary risk it faces is infringement disputes arising from failure to obtain authorization from the exclusive rights holder of the registered trademark. In the previously mentioned infringement case involving Semir and Shaolin Temple, Songshan Shaolin Temple held the exclusive right to use the registered trademark "Shaolin Kungfu" within Class 25 of trademarks, which includes clothing, children's apparel, and related products. Without obtaining a license, Semir used the "Shaolin Kungfu" trademark in clothing and promotional activities, creating the misleading impression of a "Semir × Shaolin Kungfu" collaboration. This unauthorized use constituted a clear violation of Article 57 of the *Trademark Law of the People's Republic of China*, and in cases where such use causes consumer confusion, the infringing brand is liable for damages [5].

Regardless of intent, the unauthorized use of a registered trademark in co-branding reflects a lack of awareness of intellectual property risks. Such actions not only result in potential legal consequences but also damage brand reputation, leading to losses that may be difficult for businesses to mitigate.

3.1.2. Licensed use of a registered trademark

Trademark licenses can be categorized into three types: exclusive, sole, and general. As a result, multiple parties may hold the right to use a registered trademark. When a trademark has multiple layers of licensing, brands must carefully examine the qualifications of the registered trademark holder and review relevant authorization documents to verify whether the co-branding party has the legal authority to license the trademark.

When a brand obtains a legitimate license to use a trademark, the risk of infringement is generally lower. However, co-branding differs from ordinary trademark licensing in that it relies on marketing synergy, requiring the involvement of a legitimate and recognizable brand partner. A well-known case highlighting the consequences of improper partner selection is Samsung's "co-branding own goal" incident. In December 2018, Samsung announced a collaboration with "Supreme" at a product launch event in Beijing, planning various cross-industry marketing activities. However, media outlets quickly discovered that the "Supreme" involved in this partnership was actually "Supreme Italia," a legally distinct entity unaffiliated with the well-known streetwear brand "Supreme New York." Although Samsung's co-branding was legally authorized, the lack of an authentic co-branding partner significantly diminished its appeal to consumers, resulting in negative publicity and unfavorable consumer perceptions.

3.1.3. Trademark revocation due to improper use or non-use for more than three years

As trademark squatting has become increasingly common in recent years, many brands have strengthened their trademark protection strategies by registering trademarks across multiple categories. While defensive trademark registration for commercial protection is legally acceptable, Article 49 of the *Trademark Law of the People's Republic of China* stipulates that any unit or individual may request the revocation of a registered trademark if it has been improperly used or remains unused for more than three years. This provision aims to prevent the malicious hoarding or unauthorized expansion of trademark use.

To avoid the risk of revocation, some brands may engage in co-branding activities within the scope of their defensive trademark registrations. However, if a brand discovers during the co-branding process that its partner's trademark is at risk of being revoked, it must carefully plan the duration of the co-branding collaboration. Failure to do so may result in the loss of trademark rights, potentially leading to infringement of third-party exclusive rights.

3.2. Use of unregistered trademarks in co-branding

In China, the acquisition of the exclusive right to use a trademark follows the principle of voluntary registration. The use of unregistered trademarks in co-branding generally does not constitute trademark infringement. However, if a well-known trademark is used in co-branding, Article 13(2) and Article 14(5) of the *Trademark Law of the People's Republic of China* provide that unregistered well-known trademarks are entitled to cross-class protection for identical or similar goods.

A typical example of such infringement is the trademark dispute between LEGO JURIS A/S and a domestic company [6]. LEGO, a globally renowned enterprise, discovered that the defendant had used the word "LEGO" in the sale and promotion of clothing without authorization, misleading consumers into believing that the clothing was co-branded with LEGO and thereby profiting from the unauthorized use. The court ruled that LEGO's registered trademark No. 10176179 was a well-known trademark. Even though LEGO had not registered the "LEGO" trademark under Class 25 (which covers clothing), the court held that, under the cross-class protection principle for well-known trademarks, the defendant's use of the "LEGO" trademark still constituted infringement. As a result, the defendant was ordered to pay 1.6 million Chinese yuan in damages.

This case demonstrates that using unregistered trademarks still carries a certain risk of infringement. Before engaging in co-branding, it is essential to carefully assess whether the co-branded trademark meets the criteria for recognition as a well-known trademark under Article 14(1) of the *Trademark Law of the People's Republic of China*. If the co-branded trademark remains unregistered but is widely recognized, has been deemed well-known in previous legal cases, or meets other conditions for well-known status, a thorough infringement risk assessment must be conducted in advance. Additionally, establishing cooperative agreements with co-branding partners is crucial to prevent conflicts with third-party trademark rights.

In summary, the risk of trademark infringement in co-branding varies depending on the trademark's legal status. When using registered trademarks, enterprises must ensure proper authorization and verify the actual ownership of the co-branding partner's trademark rights. When using unregistered trademarks, it is necessary to determine whether the co-branding partner's trademark could be recognized as a well-known trademark, which may be entitled to cross-class protection. Furthermore, co-branding activities involve additional risks, such as unauthorized use beyond the agreed scope and exceeding the authorization period, which also requires careful attention to avoid potential legal disputes.

4. Risk prevention measures for trademark infringement in co-branded partnerships

4.1. Conduct comprehensive trademark due diligence and rights confirmation

Thorough due diligence is essential in the early stages of a co-branding partnership to prevent collaboration with trademark owners who possess defective rights, reduce the risk of disputes with trademark squatters or infringers, and minimize legal risks associated with potential infringement claims. The primary objective of due diligence is to accurately determine the ownership and legal status of the trademarks involved in co-branded products, thereby mitigating both legal and marketing risks. Ensuring that both parties possess legitimate trademark rights helps brands secure reliable co-branding partners and avoid legal pitfalls.

Before initiating a co-branding partnership, a brand should systematically gather relevant information about the prospective partner to verify its legitimacy and ensure alignment with the intended marketing objectives. This step helps achieve the desired promotional effect while reducing the likelihood of brand misrepresentation.

Once a preliminary co-branding agreement has been reached, the brand should immediately verify the legal status of the trademarks involved. Relevant departments should review trademark registration details through official channels, assess the co-branding partner's legal qualifications, and confirm key information, including

trademark registration status, ownership, licensing arrangements, and whether the approved scope of use includes the co-branded products. Additionally, if the co-branding partner is not the registered owner, the brand must obtain valid authorization from the rightful trademark owner and meticulously review all authorization documents to ensure clear and undisputed ownership.

In accordance with Article 49 of the *Trademark Law of the People's Republic of China*, the brand should request the co-branding partner to provide evidence of the trademark's use over the past three years to mitigate the risk of trademark revocation during the collaboration. Furthermore, the licensing agreement should explicitly define liability for breach of contract in the event of trademark revocation, ensuring both parties are legally protected throughout the partnership.

4.2. Develop a comprehensive licensing agreement

Chinese law primarily regulates the licensing of registered trademarks under Article 43 of the *Trademark Law of the People's Republic of China*, which requires licensors to file a trademark usage license with the Trademark Office. However, the law does not mandate that the trademark usage license agreement be in written form or specify other formal requirements. In practice, disputes often arise due to ambiguous terms in trademark usage license agreements. For instance, in the trademark usage license dispute between Liuling Far East Co., Ltd. and Foshan Saturday Shoes Co., Ltd., uncertainties regarding the conditions for the agreement's validity led to legal complications [7].

Furthermore, if a co-branding agreement fails to define the scope, geographical region, duration, and intended purpose of the licensed trademark usage, the co-branding partner may engage in unauthorized use, potentially resulting in infringement disputes [8]. Therefore, after verifying trademark ownership and determining the usage method for co-branded products, it is essential for both parties to negotiate and draft a comprehensive licensing agreement.

First, the agreement should explicitly define the authorization method, scope, geographical coverage, and duration of the trademark usage for co-branded products. This ensures that unauthorized usage, which could lead to infringement claims involving either party or third parties, is effectively prevented. Additionally, the agreement should clearly outline the rights and obligations of both parties, as well as dispute resolution mechanisms.

Second, the agreement should anticipate and address issues such as the ownership of any new intellectual property created during the partnership, renewal procedures for co-branded trademark licenses upon expiration, and the management of any remaining co-branded products after the agreement's termination.

Finally, due to evolving market conditions, corporate developments, and regulatory policies, it is impossible to foresee all potential legal risks during the preparatory phase. To further safeguard trademark rights in co-branding partnerships, both parties should actively monitor actual trademark usage, newly developed intellectual property, product quality, and the reputation of the co-branding partner throughout the collaboration. This proactive approach enables timely intervention to mitigate risks that could impact the co-branding outcome.

5. Conclusion

The unique value of co-branding lies in its ability to generate marketing effects that are difficult for a single brand to achieve. Therefore, the legal status of the co-branded party's trademark is particularly crucial. Branding strategies are not limited to the two categories discussed in this article but also encompass the branding of commercialization rights and commercial sponsorships. These variations, due to their differing legal statuses, may infringe upon the exclusive right to use a trademark and thus warrant the attention of brand operators and their legal teams. At present, co-branding remains in its early stages; however, its sustainable and healthy development

cannot rely solely on the unilateral efforts of brand operators. A comprehensive and robust legal framework for the protection and regulation of trademark rights must be established as a foundation. In the future, co-branding is expected to thrive in a fairer and more transparent environment as laws and regulations continue to evolve and consumer awareness of brand intellectual property rights grows. This progress will not only provide consumers with higher-quality products and services but also drive continuous innovation and advancement across the entire industry.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Liang C, 2024, "Pork Ribs" and "Rice Cake" Co-Name Good Returns, but Need to Pay Attention to Legal Risks. Rule of Law Daily, 2024-01-21(005).

[2] Kotler P, Pfoertsch W, 2006, B2B Brand Management. Springer Science and Business Media, Berlin.

[3] Zheng S, 2024, Trademark Infringement Risks and Countermeasures in Brand Co-Branding from the Perspective of Co-Branding Event Organizers. Moyu, viewed November 6, 2024, https://mp.weixin.qq.com/s/uNWADR8si83V7ABUwqqFYA

[4] Gong Q, 2022, Trademark Legal Issues and Risk Tips Involved in Brand Co-Naming. China Trademark, 2022(2): 27–31.

[5] Du Y, 2020, Semir "Freeriding" with Shaolin Temple: Infringement or Publicity Stunt? China Newsweek, viewed November 7, 2024, https://mp.weixin.qq.com/s/9ME_u7EMt05CSJh5suzzoQ

[6] He Y, Xu M, 2024, Dunhe Case: The Pros and Cons of Cross-Industry Co-Branding: The "LEGO" Trademark Recognized as a Well-Known Trademark in Toys, Extended Cross-Class Protection to Apparel, with a Compensation Ruling of 1.6 Million Yuan. Dunhe Law Firm, viewed November 7, 2024, https://mp.weixin.qq.com/s/Ww6yyhpv-5BSk41kQL2IxA

[7] Guangdong Provincial Higher People's Court Civil Judgement, 2017, Guangdong Civil Final No. 271: Foshan Saturday Shoes Co., Ltd. Over a Trademark License Contract Dispute with Liuling Far East Co., Ltd.

[8] Bian X, 2024, Analysis of Trademark Licensor's Responsibility for Product Quality Supervision. Dispute Resolution, 10(2): 792–799.

Examining the Relationship Between Corporate Social Responsibility Performance and Stock Price Crash Risk

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Abstract: This paper selects the Corporate Social Responsibility (CSR) index from Hexun.com (2010–2020) and the stock price crash index of China's Shanghai and Shenzhen A-share listed companies from the China Stock Market & Accounting Research Database (CSMAR) for empirical analysis. By examining the impact of CSR performance on stock price crash risk, this study identifies key relationships and further investigates the moderating role of media promotion and communication as an intermediary to explore the transmission mechanisms and influence between the two. The empirical results indicate that CSR performance is significantly negatively correlated with stock price crash risk, suggesting that strong CSR performance can effectively reduce the likelihood of a stock price crash. Furthermore, additional analysis reveals that media plays a moderating role in the relationship between CSR performance and stock price crash risk. This study aims to contribute to the understanding of the formation mechanisms and analytical paradigms of factors influencing stock price crash risk while providing theoretical support and reference value for risk prevention strategies.

Keywords: Social responsibility information disclosure; Stock price crash risk; Information effect

1. Introduction

From the 1997 Asian financial crisis to the severe stock price crashes triggered by the COVID-19 outbreak in early 2020, stock market collapses have had widespread economic and social consequences. These events have led to investor wealth losses, weakened business investment and consumer confidence, financial system turmoil, increased pressure on employment and economic growth, and heightened political and public opinion concerns.

Several studies have indicated that CSR performance is closely related to corporate stability, investor confidence, and broader market fluctuations [1,2]. For instance, Fu categorized CSR into different components and found that the fulfillment of environmental and stakeholder responsibilities had a significant impact on reducing stock price crash risk, whereas charitable donations did not significantly mitigate such risks [3].

In addition to CSR, shareholder behavior is considered a critical factor influencing stock price crash risk [4-6].

For example, Jiang and Xu demonstrated that excessive corporate investment significantly increases the likelihood of future stock price crashes, with long-term effects that firms are often unable to predict [7].

2. Study hypothesis

Based on the aforementioned research, the disclosure of the CSR index may theoretically reduce stock price crash risk by increasing transparency. However, it may also serve as a tool for corporate management to conceal negative information, thereby exacerbating the risk of a stock price crash. Therefore, the first hypothesis to be tested in this study is as follows:

H1A: When enterprises fulfill greater social responsibilities, the risk of a stock price crash is relatively moderate or reduced.

H1B: When enterprises fulfill greater social responsibilities, the risk of a stock price crash in the future increases.

3. Research and design

3.1. Sample selection and model design

3.1.1. Sample selection

In this study, Shanghai and Shenzhen A-share listed companies in China from 2010 to 2020 were selected as the initial research samples, resulting in a total of 25,812 annual sample observations.

3.1.2. Model design

To verify hypotheses H1A and H1B, the following model is designed:

$$Risk_{i,t} = \alpha_0 + \alpha_1 CSR_{i,t} + \sum_{i=2}^{12} \alpha_i Control\ Variables_{i,t} + Year + IND + \varepsilon_{i,t} \quad (1)$$

3.2. Variable definition

3.2.1. Explained variable: Stock price crash risk

This variable draws on the design used by Kim [8] and Ye and Wang [9] in the existing literature. It is measured using the negative return skew coefficient (NCSKEW) and the rate of up-and-down volatility (DUVOL).

3.2.2. Explanatory variable: CSR performance

CSR performance is measured using the scoring results from the professional evaluation system of social responsibility reports of listed companies on Hexun.com.

3.2.3. Control variables

Control variables are defined and measured based on existing literature, such as Chen *et al.* [10] and Song [11]. The specific definitions and measurements of the control variables are shown in **Table 1**.

Table 1. Definition of variables

Variable type	Variable name	Variable symbol	Variable measure
Explained variable	Stock Price Cash Risk	NCSKE, DUVOL	The negative skew of NSK stock's weekly return, upward volatility of weekly return of DUV stocks
Explanatory variable	CSR Performance	CSR Index	CSR Index release by Hexun
Mediating variable	MEDIA Publicity and Promotion	Log of media mentions	Logarithm of the number of news articles mentioning the company on the Internet and in newspapers
Control variables	Company Size	SIZE	Company's total assets
	Corporate Financial Leverage	LEV	Corporate asset-liability ratio
	Return on Total Assets	ROA	Percentage of return on total assets of the enterprise
	Book-to-Market Ratio	BM	The book-to-market ratio of the enterprise
	Growth Rate of Operating Income	GROWTH	The growth rate of the enterprise's main business income
	Equity Nature	Equity_Nature	Whether the enterprise is state-owned (1 if state-owned, 0 otherwise)
	Audit Quality	BIG4	Whether the enterprise is audited by one of the Big Four accounting firms (1 if audited, 0 otherwise)
	Listing Years	ListAge	Number of years since the enterprise was listed
	Board Size	Board	Number of directors in the enterprise
	Dual Chairman and General Manager	Dual	1 if the chairman and general manager are the same person, 0 otherwise
	Proportion of Largest Shareholder	Top1	Number of shares held by the largest shareholder / total number of shares

4. Empirical results

4.1. Descriptive statistics

Table 2. Descriptive statistics of key variables

Variable names	N	Mean	SD	Min	Median	Max
NSK	25812	-0.296	0.709	-2.413	-0.254	1.639
DUV	25812	-0.194	0.473	-1.349	-0.194	1.023
CSR	25812	20.048	15.322	-3.250	21.960	74.270
Size	25812	22.195	1.288	19.940	22.010	26.209
Lev	25812	0.424	0.206	0.053	0.417	0.892
ROA	25812	0.043	0.061	-0.218	0.040	0.216
BM	25812	1.031	1.109	0.094	0.665	6.674
SmallGrowth	25812	0.002	0.004	-0.005	0.001	0.024
SOE	25812	0.370	0.483	0.000	0.000	1.000
Big4	25812	0.060	0.237	0.000	0.000	1.000
ListAge	25812	2.109	0.838	0.000	2.303	3.296
Board	25812	2.134	0.197	1.609	2.197	2.708
Dual	25812	0.269	0.443	0.000	0.000	1.000
Top1	25812	34.784	14.909	8.803	32.770	74.824
ln_Media	25812	5.692	0.963	3.497	5.656	8.460

As shown in **Table 2**, the mean values for the stock price crash risk indicators NSK and DUV are -0.296 and -0.194, respectively, which are consistent with the descriptive statistical results from Shen [12]. The standard deviations are 0.709 and 0.473, respectively, aligning with the research findings of Huang *et al.* [13], Qin [14], and Zhou *et al.* [15].

The mean value for the CSR index is 20.048, with the maximum, minimum, and median values being 74.270, -3.250, and 21.960, respectively, indicating significant variability among enterprises in terms of CSR performance. The difference between the minimum and maximum values is 77.520, suggesting the presence of extreme values in CSR performance across different enterprises and years. Additionally, the standard deviations of the other variables are relatively small, indicating that the descriptive statistical results in this study are acceptable.

4.2. Main effect regression results

Table 3. Main effect regression analysis results

	NSK	DUV
CSR	-0.002***	-0.001***
	(-4.650)	(-4.159)
Control	Yes	Yes
_cons	0.264**	0.540***
	(2.337)	(7.196)
N	25812	25812
adj. R2	0.020	0.026

Note: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 3 reveals that the CSR coefficients are -0.002 and -0.001 for NSK and DUV, respectively, and both are significant at the 1% level. This supports the establishment of hypothesis H1A, which suggests that an increase in CSR performance can effectively reduce the agency's cost of management, improve corporate transparency, enable investors to better understand the actual business conditions, and ultimately reduce the risk of a stock price crash.

4.3. Test of mediating effect of media reports

To examine the moderating effect of media reports on the relationship between CSR performance and stock price crash risk, a cross-variable method is employed. The results are presented in **Table 4**.

Table 4. Testing the moderating effect of media reports

	NSK	DUV
CSR	-0.010***	-0.007***
	(-5.920)	(-5.977)
ln_Media	-0.045***	-0.034***
	(-4.997)	(-5.696)
Iteration	0.001***	0.001***
	(5.143)	(5.433)
Control	yes	yes
N	25812	25812

Note: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

The iteration regression coefficients for both NSK and DUV are 0.001, and they are significantly positive at the 1% level. This reflects that increased media coverage strengthens the positive effect of CSR performance on reducing stock price crash risk. In other words, media coverage moderates the relationship between CSR performance and stock price crash risk.

5. Conclusion

This paper investigates the relationship between CSR performance and stock price crash risk, considering media coverage as a moderating variable. The empirical results reveal a significant negative correlation between stock price crash risk and CSR performance, indicating that better CSR performance is associated with a reduced risk of stock price crashes.

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References

[1] Zeng A, Wei Z, Zhang C, et al., 2020, Corporate Social Responsibility: "Sincerity" or "Pretense"? – A Study Based on the Perspective of Executive Insider Trading. Journal of Financial Research, 2020(9): 154–171.

[2] Tao C, Yang S, Lin W, 2015, Corporate Governance, Corporate Social Responsibility, and Stock Price Crash Risk. Journal of Xiangtan University (Philosophy and Social Sciences), 39(6): 50–56.

[3] Fu Y, 2020, Research on the Impact of Corporate Social Responsibility on Stock Price Crash Risk of Listed Companies, dissertation, Jiangnan University.

[4] Hutton AP, Marcus AJ, Tehranian H, 2009, Opaque Financial Reports, R^2, and Crash Risk. Journal of Financial Economics, 94(1): 67–86. https://doi.org/10.1016/j.jfineco.2008.10.003

[5] Li D, Ye J, Lu S, et al., 2018, Management Overconfidence, Property Rights, and Goodwill in M&A. Accounting Research, 2018(10): 8.

[6] Tian K, Sun Y, 2015, Inefficient Investment, Audit Supervision, and Stock Price Crash Risk. Audit and Economics Research, 2015(2): 9.

[7] Jiang XY, Xu NX, 2015, Overinvestment of Enterprises and the Risk of Stock Price Collapse. Financial Research, 2015(8): 141–158.

[8] Kim Y, Li H, 2014, Corporate Social Responsibility and Stock Price Crash Risk. Journal of Banking and Finance, 43(6): 1–13.

[9] Wang K, Cao F, Gao S, et al., 2014, Investor Protection and Stock Price Crash Risk. Journal of Finance and Economics, 2014(10): 73–82.

[10] Chen J, Hong H, Stein JC, 2011, Forecasting Crashes: Trading Volume, Past Returns, and Conditional Skewness in Stock Prices. Journal of Financial Economics, 21: 345–381.

[11] Song X, Yu T, 2017, Audit Industry Expertise and Stock Price Crash Risk: From the Perspective of Client Importance and Internal Control Level. Journal of Hunan University (Social Sciences Edition), 31(4): 64–70.

[12] Shen K, 2020, The Impact of Corporate Social Responsibility on Stock Price Crash Risk, dissertation, Shanghai University of Finance and Economics.

[13] Huang J, Chen L, Ding J, 2022, Corporate Social Responsibility, Media Report, and Stock Price Crash Risk. China Management Science, 30(3): 1–12.

[14] Qin N, 2023, A Study on the Impact of Corporate Social Responsibility on Stock Price Crash Risk: Mediating Effect Based on Investor Concern, dissertation, Jilin University of Finance and Economics.

[15] Zhou M, Zhang Q, Yang D, 2017, Innovation Input and Market Performance of GEM Listed Companies Based on Internal and External Perspectives. Economic Research Journal, 52(11): 135–149.

The Role of Rural Revitalization Investment Funds in Advancing Common Prosperity: Mechanisms, Challenges, and Strategies

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Abstract: The Rural Revitalization Investment Fund serves as a crucial financial instrument for advancing rural revitalization and promoting common prosperity. It aims to address financing and land-use challenges faced by rural industries through financial support while fostering coordinated industrial development. The fund primarily operates through equity direct investment and the "mother fund + direct investment" model, with an increasing emphasis on combining government guidance with social capital participation. However, challenges persist, including a shortage of professional talent, insufficient institutional innovation, and weak industrial foundations in rural areas. To enhance the fund's effectiveness, it is recommended to strengthen professional team management, clearly define its strategic positioning, implement strict supervision, innovate operational mechanisms, and prioritize environmental and social responsibility. These measures will ensure that the fund contributes to rural revitalization while promoting sustainable development and common prosperity.

Keywords: Rural revitalization investment fund; Financial support; Common prosperity

1. Background and nature of rural revitalization funds

In his article *Emphasizing the Priority of Addressing Issues Relating to Agriculture, Rural Areas, and Farmers, and Mobilizing the Whole Party and Society to Promote Rural Revitalization*, the current President of the People's Republic of China stated, "To develop rural industries, we must ensure that farmers have work to do and money to earn [1]. We should establish a pattern of complementary advantages and cooperative division of labor within the industrial chain between enterprises and farmers, allowing farmers to share more of the value-added benefits of the industry." The article also highlighted that "many policy obstacles and pain points have been widely reported in the development of rural industries, with the most prominent being difficulties in acquiring land and obtaining loans."

Rural revitalization cannot be achieved without strong financial support [2]. Fully promoting rural revitalization and facilitating integrated urban-rural development is not only a key political responsibility for the

financial industry in supporting national strategies but also a crucial opportunity for the industry to achieve high-quality development.

As a new approach to integrating industry and finance, rural revitalization investment funds serve as medium- and long-term equity capital that facilitates the two-way flow and equal exchange of talent, land, and capital between urban and rural areas, thereby stimulating endogenous drivers of rural revitalization. These funds effectively address widespread capital shortages and land acquisition difficulties encountered by governments, market entities, and industrial capital in advancing rural industries in China [3].

In implementing rural revitalization funds, government guidance plays a central role while also leveraging market-based resource allocation. Government finance serves as an essential catalyst by offering policy concessions and tolerating a degree of risk. Additionally, by establishing a "safety cushion" for potential risks and optimizing fund operation platforms [4], the government can effectively encourage private capital to participate in rural development projects.

Regarding industrial development, the investment scope of rural revitalization funds extends beyond agriculture. From a broader perspective of promoting comprehensive rural industrial prosperity, these funds facilitate close linkages and coordinated development among the primary, secondary, and tertiary industries in rural areas [5].

2. Current development status of rural revitalization investment funds in China

In recent years, rural revitalization investment funds have demonstrated continuous growth. According to statistical data from Agriculture Intelligence, as of the end of 2023, the total management scale of rural revitalization funds nationwide had reached 164.239 billion Chinese yuan, reflecting a year-on-year increase of 12.80% [6]. Currently, 177 rural revitalization funds have been established across 25 provincial administrative regions, with Guangdong, Jiangsu, Anhui, Shandong, and Sichuan ranking among the top five provinces in terms of the number of funds. Among these, Guangdong, Guizhou, and Shandong have fund management scales exceeding 20 billion Chinese yuan, with Guangdong approaching 40 billion Chinese yuan [7]. These funds have played a crucial role in alleviating financing difficulties in rural areas, promoting agricultural development, and increasing farmers' incomes. Additionally, they provide valuable insights for other developing countries seeking to adjust their policy frameworks.

The issuance of rural revitalization industrial funds is primarily concentrated in economically developed regions such as Guangdong and Jiangsu [8]. The eastern coastal areas, characterized by strong government finances, well-developed rural infrastructure, and rapid economic growth, are more conducive to the establishment of such funds. Despite recent growth, the overall number of issuances remains relatively low, with most funds being government-led [9]. Moreover, regional enthusiasm for regulating the establishment and operation of these funds is limited, with only a few provinces, such as Jiangsu and Zhejiang, having introduced specific management measures.

In practice, the model of government guidance combined with social capital participation has gained increasing attention [10]. However, social capital faces several challenges, including fundraising difficulties, high financing costs, and a scarcity of high-quality projects. These challenges are particularly pronounced in the agricultural sector, where long investment cycles, slow returns, and high risks reduce its attractiveness to investors [11]. Amid growing economic downward pressure and the increasing flow of capital toward high-return industries, rural revitalization funds continue to face significant obstacles.

3. Operational mechanism of rural revitalization investment funds

The primary investment method of rural revitalization investment funds is direct equity investment, with funds raised through the issuance of fund shares and allocated specifically for investments in agricultural enterprises or projects. Fund managers are responsible for the operation and management of these funds [12].

China's rural revitalization funds typically adopt the "mother fund + direct investment" model. Under this structure, the mother fund collaborates with local governments, township governments, and private capital to establish sub-funds. Direct equity investment, in contrast, involves investing in companies with the potential for future public listing [13].

On one hand, by partnering with leading domestic fund managers through the mother fund, these funds leverage external resources and information advantages to mitigate investment risks while enhancing the stability of returns. Furthermore, by providing comprehensive support to collaborating fund managers and fostering mutual empowerment, the investment ecosystem can be continuously expanded to access higher-quality industrial investment opportunities [14]. On the other hand, by selecting high-growth and highly innovative companies for direct investment, transaction costs can be effectively reduced, thereby improving overall fund returns. Simultaneously, this approach facilitates the development of a fund management team characterized by strong focus, market sensitivity, and professional expertise.

4. Issues in the development of rural revitalization funds

4.1. Lack of professional talent

Rural industrial investment requires professionals with specialized expertise in fund management. These individuals must possess not only strong financial knowledge but also a deep understanding of agriculture and related industries. Moreover, the fund platform must integrate various industrial, human, and marketing resources to ensure that industry personnel can quickly adapt to the development trends of emerging sectors.

4.2. Insufficient innovation in systems and mechanisms

Rural industrial investment typically follows a limited partnership model, such as joint ventures between industrial funds and local government investment platforms responsible for industry introduction and operation. As companies develop, industrial funds eventually exit. Although this model provides flexibility, for enterprises with long-term development potential, predetermined exit periods may pose higher risks, preventing investors from benefiting from future growth [15]. The limitations and potential risks of the financial system are also closely linked to the dominant role of the government and state-owned enterprises in government-guided funds. Therefore, fostering industrial fund development requires appropriate policy support for private capital while allowing for controlled innovation in fund operation mechanisms.

4.3. Weak foundation for rural industrial development

Compared to urban areas, rural regions face constraints in investment and business environments. Projects supported by industrial funds often encounter challenges such as lower educational levels among personnel and difficulties in process implementation, increasing management complexity and affecting product quality and output. Additionally, rural industries primarily rely on left-behind labor forces, which acquire skills at a slower pace, further impacting industrial efficiency. The success of rural revitalization funds largely depends on their alignment with local needs, the robustness of governance structures, and their integration with broader rural development policies. Therefore, strengthening the rural industrial foundation remains a key priority.

5. Suggestions for leveraging rural revitalization funds

Firstly, professional team management should foster a sense of local attachment and responsibility. The effective management and operation of rural revitalization investment funds require localized and highly skilled professionals with expertise in finance, agriculture, services, and various industries. These individuals should possess a strong connection to local communities, respect for farmers' willingness to cooperate, and the ability to translate their commitment into practical actions. Since rural revitalization depends heavily on human capital, enhancing financial literacy and investing in financial education in rural areas is essential.

Secondly, the strategic positioning of these funds should be clearly defined to maximize their guiding role. The primary objective of rural revitalization investment funds is to stimulate endogenous growth and support the high-quality development of the rural industrial system. By offering return concessions and implementing error correction mechanisms, the government can encourage fund innovation, enabling social capital to focus on the investment value and potential returns of projects while mitigating concerns about investment risks.

Thirdly, strict regulatory oversight is essential. The entire process of fund-raising, investment, management, and withdrawal must adhere to relevant laws and regulations, ensuring clear ownership structures and preventing illegal or non-compliant activities. Additionally, targeted mechanism innovations can be explored, such as profit distribution models based on principles like "withdrawal and distribution" or "return of capital before profit distribution," fostering a virtuous cycle between industrial foundations and industrial development. At the same time, excessive administrative intervention by local governments in the investment activities of rural revitalization funds should be avoided, granting fund managers greater autonomy in decision-making.

Lastly, environmental and social responsibilities should be prioritized. During the selection of investment projects, environmental, social, and governance (ESG) factors should serve as key evaluation criteria to ensure that investments contribute not only to economic development but also to environmental sustainability and social well-being, thereby promoting long-term rural development.

Disclosure statement

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References

[1] Yan H, Li K, Jing J, 2023, Research on Financial Support from Banking Financial Institutions in China for Rural Revitalization. Reform and Opening-up, 2023(16): 12–20.

[2] An S, 2024, Rural Revitalization Fund is Rapidly "Heating Up". China Cooperative Economy, 2024(4): 5–8.

[3] Wang X, 2023, Thoughts on Financial Support for Rural Industrial Development and Public Infrastructure Construction – From the Perspective of Rural Revitalization Investment Funds. Fujian Finance, 2023(9): 39–43.

[4] Chang Y, 2019, Research on Development Strategies of Rural Revitalization Industrial Funds. Economic Outlook Around Bohai Sea Rim, 2019(10): 44–45.

[5] Li J, Liu H, Chang WY, 2024, Evaluating the Effect of Fiscal Support for Agriculture on Three-Industry Integration in Rural China. Agriculture, 14(6): 912. https://doi.org/10.3390/agriculture14060912

[6] Bhati S, Dadhich M, Shukla A, et al., 2024, Analysis of Rural Microfinance Sustainability: Does Local Insight-Driven Governance Work? RESEARCH REVIEW International Journal of Multidisciplinary, 9(4): 209–222. https://doi.org/10.31305/rrijm.2024.v09.n04.024

[7] Jiao H, Gao F, 2022, Why Rural Revitalization Industrial Funds Have Emerged as a New Force. Farmers' Daily, 2022-06-22(007).

[8]   Ni B, 2019, Economic Effects and Policy Suggestions of Industrial Investment Fund Operation in the Process of Rural Revitalization – A Case Study of Henan Province. Henan Social Sciences, 27(10): 57–63.

[9]   Zhu X, 2009, Research on the Establishment of Agricultural Industrial Investment Funds in Henan Province. Finance Theory and Practice, 2009(8): 75–78.

[10]   Senna D, 2008, Global Financial Talent Shortage. Corporate Finance Review, 13(3): 5–6 + 8–10.

[11]   Pan F, Zhang F, Wu F, 2021, State-led Financialization in China: The Case of the Government-guided Investment Fund. The China Quarterly, 247: 749–772. https://doi.org/10.1017/S0305741020000880

[12]   Xiao Y, 2023, Research on the Organization and Operation Mode of State-owned Rural Revitalization Funds – Taking a Regional Rural Revitalization Fund in Guangdong as an Example. Economic Outlook Around Bohai Sea Rim, 2023(12): 136–138.

[13]   Scarlet J, 2024, Sustainable Investment Strategies for Rural Development. International Journal of Developing Country Studies, 6(3): 1–14. https://doi.org/10.47941/ijdcs.2172

[14]   Shen Y, Hu G, 2024, How Does Digital Inclusive Finance Improve Rural Economic Resilience? Evidence from China. Digital Economy and Sustainable Development, 2(1): 12. https://doi.org/10.1007/s44265-024-00035-4

[15]   Gerard B, 2019, ESG and Socially Responsible Investment: A Critical Review. Beta, 33(1): 61–83. https://doi.org/10.18261/issn.1504-3134-2019-01-05

A Review of Content Marketing's Influence on Consumers' Purchase Intention in Live-streaming E-commerce

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Abstract: In the contemporary digital landscape, the proliferation of information has led to an increasing diversity of channels through which consumers obtain information, resulting in a gradual transformation of shopping habits. Consumers now frequently rely on external sources to make well-informed purchasing decisions, leading to the emergence of live shopping as a prominent avenue for gathering product information and completing transactions. E-commerce live streaming has experienced rapid growth, leveraging its ability to generate traffic and capture consumer attention. The integration of content and live streaming not only meets users' psychological needs but also facilitates seamless communication between buyers and sellers. From the perspective of content marketing typologies, this paper examines content marketing across three key dimensions: informational content, entertainment content, and emotional content. It further explores the impact of content marketing on consumers' purchase intentions within the context of e-commerce live streaming.

Keywords: Content marketing; E-commerce live streaming; Consumer purchase intention

1. Introduction

E-commerce live streaming has emerged as an innovative and transformative extension of the "live +" paradigm within the broader e-commerce landscape. It has fundamentally reshaped traditional sales models by dismantling the long-standing unidirectional approach that previously characterized interactions between consumers and products. In this dynamic model, the anchor assumes the role of the central marketing entity, while content marketing serves as the essential medium driving engagement. This integrated approach seamlessly combines consumption with service and experiential elements, creating an immersive and interactive shopping ecosystem.

The "live +" model effectively addresses several shortcomings inherent in traditional online sales. Through key features such as real-time interaction—allowing consumers to ask questions and receive immediate responses from anchors or fellow viewers—enhanced visualization, which presents products more vividly than static images, and integrated purchasing functionalities, this approach caters to consumers' demand for high-quality products

while delivering an engaging shopping experience.

The rapid expansion of e-commerce live streaming has unlocked significant opportunities for content marketing. Unlike the static nature of text and images, live streaming enables information to be conveyed in a dynamic, engaging, and interactive manner, making products more tangible and appealing. E-commerce live-streaming platforms also serve as crucial channels for directing consumer traffic toward merchants, acting as virtual marketplaces where users engage with content and products.

However, as the e-commerce landscape evolves, several challenges have emerged. The cost of customer acquisition has been steadily increasing, while conversion rates have declined, indicating that attracting customers has become more difficult and less effective. Additionally, the traffic dividend, once a primary driver of growth, has reached its peak, limiting the potential for expansion through increased traffic alone. The market has also become saturated with homogeneous marketing content, where numerous live streams feature similar and unoriginal presentations, further contributing to persistently low purchase conversion rates.

In this highly competitive environment, high-quality content marketing has become a crucial factor for success. Effective content marketing enhances live streaming sessions by delivering valuable information, entertainment, and emotional connections that sustain consumer interest and foster brand loyalty. By providing unique, engaging, and relevant content, e-commerce enterprises can distinguish themselves in the market and optimize marketing outcomes. As consumer expectations continue to rise, content remains an indispensable element in attracting audiences, expanding traffic, and improving conversion rates. The mastery of content marketing strategies will determine success in the evolving e-commerce live-streaming landscape.

2. The influence of informational content marketing on consumers' purchase intention

Informational content serves as the foundation of content marketing, primarily providing consumers with detailed insights into the functional attributes of products. By delivering relevant and valuable information, it enables consumers to make informed decisions, fostering a stronger inclination to purchase. However, the effectiveness of informational content is not determined solely by its volume but by its utility and ability to address consumers' specific needs [1]. Content that aligns precisely with consumer demands enhances shopping motivation and engagement.

Informational content is distinguished by its intuitiveness, usability, and credibility. It must present product details in an accurate and transparent manner, facilitating a comprehensive understanding of the product and other relevant information. Some scholars suggest that the value of communication content plays a crucial role in determining the effectiveness of content marketing [2]. Specifically, the more effective the content delivered through marketing strategies, the greater its impact on consumers' purchase intention. For example, in the technology sector, when promoting a new smartphone, detailed informational content about its advanced camera features, processing power, and battery life can significantly enhance consumers' understanding and interest, ultimately strengthening their purchase intention [3].

3. The influence of entertainment content marketing on consumers' purchase intention

Entertainment content within the domain of content marketing is designed to capture consumers' attention through its engaging and captivating nature. In a market saturated with marketing stimuli, consumers often develop indifference toward repetitive and mundane content. Therefore, incorporating intriguing and interactive elements is essential. Such content has the potential to provide consumers with an enjoyable entertainment experience, thereby enhancing their psychological and emotional states and ultimately influencing their purchasing decisions [4].

In the field of Internet advertising research, scholars have identified that the entertainment value of content significantly impacts consumers' perceptions and engagement with advertisements. It not only increases their interest but also strengthens their purchase intention. Moreover, this type of content can foster positive attitudes and behaviors among consumers by evoking feelings of pleasure or fascination, alleviating stress, and exerting a favorable influence on their final purchasing decisions. The effectiveness of content marketing relies on both value and entertainment; the absence of either element can hinder the achievement of desired marketing outcomes [5].

Empirical research has demonstrated that engaging online content receives higher levels of recognition, acceptance, and comprehension, as it effectively captures consumers' attention and contributes to the development of a positive brand and product image. This, in turn, facilitates an increase in consumers' purchase intention. For instance, in a popular beauty livestream, the host incorporates entertaining elements such as makeup challenges and humorous anecdotes, which not only sustain audience engagement but also heighten interest in the promoted products [6].

4. The influence of emotional content marketing on consumers' purchase intention

In this context, emotion refers to the affective response elicited when an individual's subjective experience aligns with objective needs. In content marketing, the emotional resonance evoked by content serves as an indicator of consumers' identification with brands and products. When content marketing successfully conveys an emotional appeal that resonates with customers, it fosters a deeper connection with the product, thereby enhancing their intention to take action. Once consumers establish an emotional bond, it becomes easier to cultivate their trust, ultimately leading to emotional resonance [7].

In product advertising and packaging, the strategic integration of emotional elements is essential in fulfilling consumers' psychological needs and achieving overarching marketing objectives. The emotions elicited by content are perceived by consumers as an emotional commitment, which serves as a powerful driver of purchase intention [8]. This emotional commitment positively influences consumer behavior, and its effects have been validated in various contexts. Some scholars have proposed a three-dimensional structure of brand association, emphasizing the core concept of relationships, particularly highlighting the significant role of emotion in purchase intention [9].

Furthermore, research has demonstrated that the specific emotional tone of brand communication content can lead to varying consumer behaviors. Notably, positive emotional content has been found to be more effective in driving user engagement and purchase behavior. In e-commerce live streaming, emotional content that reflects real-life experiences and evokes consumer empathy may include narratives about product usage that inspire nostalgia or stories illustrating how a particular product has improved individuals' quality of life [10].

5. Conclusion and suggestions

5.1. Research conclusion

This comprehensive and meticulously designed study has unequivocally established that content marketing—encompassing the three critical dimensions of informational, entertainment, and emotional content—exerts a significantly positive influence on consumers' purchase intention. Through an in-depth analysis of extensive data and a series of well-structured experiments, it has become evident that these different types of content collectively shape consumers' decision-making processes.

Informational content, by providing detailed insights into product features, specifications, and usage instructions, equips consumers with the essential knowledge required to make informed purchasing decisions.

Entertainment content, in contrast, introduces an element of enjoyment and engagement into the shopping experience, capturing consumers' attention and enhancing their overall interaction with the brand. Emotional content, by appealing to consumers' deeper feelings and aspirations, fosters a stronger connection between them and the product or brand on a personal level.

This underscores the significance of strategically implementing content marketing strategies within the dynamic and rapidly evolving live-streaming ecosystem to enhance consumers' purchase propensity. By carefully tailoring content to align with the interests and needs of the target audience, live streamers can create a more immersive and persuasive shopping environment.

Anchors, as central figures and key facilitators in this process, play a crucial role in maximizing consumers' perception and receptivity to these diverse content dimensions. Leveraging their communication skills, charisma, and product knowledge, they can present content in a compelling and engaging manner. Through vivid descriptions, live demonstrations, and interactive engagement with the audience, they can effectively bring products to life, ensuring that the content resonates deeply with consumers.

By skillfully implementing these strategies and techniques, anchors can successfully stimulate consumers' latent purchase desires, leading to increased sales and heightened customer satisfaction. This, in turn, drives the overall success and growth of e-commerce live streaming. As the industry continues to expand and mature, the importance of content marketing—and the role of anchors in leveraging its potential—will only continue to grow, shaping the future landscape of e-commerce.

5.2. Suggestions

In the increasingly competitive business landscape of the future, while surface-level competition may appear to revolve around traffic acquisition, the fundamental essence lies in the contest for high-quality content. The current internet traffic is highly fragmented, with significant concentrations not only on mainstream e-commerce live-streaming platforms but also dispersed across content-driven platforms such as Douyin, Kuaishou, and XiaoHongshu. To succeed in this environment, enterprises should leverage e-commerce live streaming as a strategic tool to refine their product and service offerings. They must ensure a seamless integration of live stream content with brand and product identities while meticulously curating and disseminating a diverse range of marketing content. This requires an in-depth and nuanced understanding of consumer needs to foster a stronger connection with the target audience.

During the live broadcast content marketing process, enterprises should prioritize the dissemination of comprehensive informational content, including detailed specifications regarding product functionality, appearance, and operation methods. By providing clear and reliable information, they can effectively mitigate consumers' concerns regarding perceived risks and uncertainties, thereby enhancing their confidence in purchasing decisions. Furthermore, enterprises should actively explore innovative and interactive entertainment modalities. Through continuous advancements in live-streaming formats, they can offer novel and engaging viewing experiences to e-commerce live-stream audiences, thereby improving content dissemination and promotional effectiveness.

Additionally, it is essential to strategically integrate different content types. Beyond accurately conveying informational content to elucidate product details, enterprises should also master the marketing techniques associated with emotional and entertainment content. Special emphasis should be placed on optimizing the presentation and delivery of these content forms to maximize their impact on consumers. By carefully balancing these elements, enterprises can enhance audience engagement, strengthen brand affinity, and ultimately drive higher conversion rates in e-commerce live streaming.

Disclosure statement

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References

[1] Lieb R, 2012, Content Marketing: Think Like a Publisher – How to Use Content to Market Online and in Social Media. Que Publishing, Seattle.

[2] Hardey M, 2011, Generation C: Content, Creation, Connections and Choice. International Journal of Market Research, 53(6): 749–770. https://doi.org/10.2501/IJMR-53-6-749-770

[3] Rose R, Pulizzi J, 2011, Managing Content Marketing: The Real-world Guide for Creating Passionate Subscribers to Your Brand. CMI Books, New York.

[4] Chen Y, 2020, Study on the Influence of Content Marketing in New Game Industry on Consumers' Purchase Intention, dissertation, Harbin Institute of Technology.

[5] McMillan SJ, Hwang JS, Lee G, 2003, Effects of Structural and Perceptual Factors on Attitudes toward the Website. Journal of Advertising Research, 43(4): 400–409. https://doi.org/10.1017/S0021849903030393

[6] Chen Q, Rodgers S, He Y, 2008, A Critical Review of the E-Satisfaction Literature. American Behavioral Scientist, 52(1): 38–59. https://doi.org/10.1177/0002764208321340

[7] Wongkitrungrueng A, Assarut N, 2020, The Role of Live Streaming in Building Consumer Trust and Engagement with Social Commerce Sellers. Journal of Business Research, 117: 543–556. https://doi.org/10.1016/j.jbusres.2018.08.032

[8] Wiertz C, de Ruyter K, 2007, Beyond the Call of Duty: Why Customers Contribute to Firm-hosted Commercial Online Communities. Organization Studies, 28(3): 347–376. https://doi.org/10.1177/0170840607076003

[9] Zhou Z, 2004, An Empirical Study on the Three-Dimensional Structure of Brand Relationship. Journal of Shenzhen University (Humanities and Social Sciences Edition), 21(5): 66–70.

[10] Berger J, Milkman KL, 2012, What Makes Online Content Viral? Journal of Marketing Research, 49(2): 192–205. https://doi.org/10.1509/jmr.10.0353

AI-Driven Forecasting in Management Accounting: Model Construction and Implementation for Strategic Decision Support

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Abstract: In today's rapidly evolving business environment, enterprises face unprecedented competitive pressures and complexities, necessitating efficient and precise strategic decision-making capabilities. Management accounting, as the core of internal corporate management, plays a critical role in optimizing resource allocation, long-term planning, and formulating market competition strategies. This paper explores the application of Artificial Intelligence (AI) in management accounting, aiming to analyze the current state of AI in management accounting, examine its role in supporting external strategic decisions, and develop an AI-driven strategic forecasting and analysis model. The findings indicate that AI technology, through its advanced data processing and analytical capabilities, significantly enhances the efficiency and accuracy of management accounting, optimizes internal resource allocation, and strengthens enterprises' market competitiveness.

Keywords: AI and management accounting; Strategic decision-making; Strategic forecasting and analysis model

1. The integration of artificial intelligence and management accounting

1.1. Core functions of management accounting

The primary functions of management accounting involve collecting, analyzing, and reporting a company's financial information to support managerial decision-making. It not only focuses on daily operations and cost control but also emphasizes long-term development and market competition strategies. By conducting in-depth financial data analysis, management accounting provides insights into a company's profitability, cost control, and operational efficiency, offering strategic recommendations on resource allocation, investment decisions, and risk management. This decision-support information is crucial for enterprises to maintain competitive advantages in a complex and dynamic market environment [1].

1.2. The rise of artificial intelligence in financial management

With continuous advancements in technologies such as big data, cloud computing, and machine learning, artificial

intelligence (AI) applications in financial management have become increasingly widespread. AI possesses robust capabilities in pattern recognition, predictive analysis, and real-time optimization, making it an integral component of modern financial management. AI can process and analyze vast amounts of financial data, identify patterns and trends, and provide management with more accurate and timely decision-making support. Additionally, AI can automatically adjust financial strategies in response to market fluctuations and competitive dynamics, ensuring that a company's financial objectives remain aligned with the evolving business environment [2].

1.3. Research objectives and methods

This paper aims to explore the application of AI in management accounting, particularly the use of AI algorithms to analyze corporate financial data for strategic decision support. The research objectives include assessing the current state of AI implementation in management accounting, investigating AI's role in facilitating external strategic decisions, and constructing an AI-driven strategic forecasting and analysis model. To achieve these objectives, this study employs methodologies such as literature review, case analysis, and empirical research.

2. The current application status of AI in management accounting

2.1. AI applications in global enterprises

Globally, an increasing number of enterprises are integrating AI technology into management accounting. AI has been applied across various domains, including cost management, budget forecasting, and risk management. However, despite the progress in AI adoption, its application in external strategic decision-making remains limited. There is still significant potential for further expansion and advancement in the use of AI for management accounting [3].

2.2. Advantages of AI-driven strategic management

Firstly, AI leverages big data and machine learning algorithms to predict and analyze market trends. By collecting and processing vast amounts of market data, AI identifies patterns and trends, providing a scientific basis for corporate strategic decisions. For instance, Amazon analyzes consumer shopping data to detect emerging market demands, enabling swift adjustments to its supply chain and facilitating rapid business growth.

Secondly, AI enhances customer segmentation and insights. By analyzing unstructured data, such as consumer purchase behavior and social media sentiment, AI provides a deeper understanding of customer preferences, allowing enterprises to develop personalized marketing strategies. For example, Starbucks employs AI to improve customer retention rates among loyalty program members by optimizing marketing activities through refined data analysis, ultimately enhancing customer satisfaction and business growth [4].

2.3. Challenges and technical barriers

Despite AI's numerous advantages in management accounting, several challenges and technical barriers hinder its practical implementation. First, the integration of external data remains a significant challenge. Due to the scattered and inconsistent nature of external data, enterprises often struggle to gather comprehensive and accurate information. Second, privacy concerns pose a critical issue in AI-driven management accounting. The collection and analysis of external data may lead to potential privacy breaches, increasing the risk of non-compliance with regulatory requirements. Lastly, the complexity and technical expertise required for AI implementation continues to limit its widespread adoption in management accounting [5].

3. The role of AI in supporting external strategic decision-making

3.1. Market trend forecasting and industry competition analysis

AI, with its robust data processing and analytical capabilities, has become an essential tool for enterprises in forecasting market trends and gaining insights into industry competition patterns. By integrating historical data, real-time market intelligence, and unstructured information—such as social media—AI can construct highly accurate predictive models, enabling enterprises to stay attuned to industry developments.

In the realm of industry competition analysis, AI examines competitors' market performance, product innovations, and marketing strategies, providing enterprises with comprehensive and in-depth competitive intelligence. For instance, Tesla leverages AI technology to analyze global competitor dynamics, successfully identifying rapid growth trends in the electric vehicle market. As a result, the company has accelerated its research and development efforts as well as its marketing strategies accordingly.

3.2. Customer insights and precision marketing

In an era where consumer sovereignty is increasingly prominent, a deep understanding of customer needs and the provision of personalized products and services have become critical for enterprises seeking to maintain a competitive edge. AI technology analyzes multi-dimensional data, including customers' purchase histories, social media behaviors, and online reviews, to accurately construct customer profiles and uncover underlying consumption preferences and needs. This deep level of customer insight provides enterprises with valuable support in formulating personalized marketing strategies. For example, Disney employs AI to analyze global market demand, enabling it to strategically launch movies and related merchandise with precision [6].

3.3. Dynamic risk control and resource optimization

In the increasingly globalized and digitized business environment, enterprises face complex and rapidly evolving risks. AI technology, through real-time monitoring of macroeconomic indicators, industry trends, competitor activities, and regulatory changes, can provide early warnings of potential market risks, offering enterprises timely decision support. For instance, in the financial industry, Citadel utilizes AI and machine learning to continuously assess risks associated with its investments, anticipate market fluctuations, and adjust trading strategies accordingly, thereby safeguarding its portfolio from unforeseen downturns.

In terms of resource optimization, AI technology enables intelligent scheduling and allocation of enterprise resources, facilitating cross-market and cross-departmental coordination for enhanced efficiency. By leveraging AI-driven optimization models, enterprises can streamline operations and ensure the effective utilization of resources [7].

4. Building AI-driven strategic forecasting and analysis models

4.1. External data collection and processing

The foundational step in constructing AI-driven strategic forecasting and analysis models is the collection and processing of vast amounts of external data. This data spans multiple dimensions, including market information, competitor dynamics, consumer behavior, and macroeconomic indicators. To ensure accuracy and completeness, enterprises must establish a comprehensive data collection mechanism that incorporates processes such as data scraping, data cleaning, and data integration.

4.2. Selection and optimization of AI algorithms

Selecting the appropriate AI algorithm is critical to building effective strategic forecasting and analysis models.

Different algorithms are suited to different data characteristics and prediction objectives. For example, time series models are ideal for predicting industry trends and consumer behavior patterns that exhibit temporal characteristics. Clustering algorithms are effective in customer segmentation and market classification scenarios, while deep learning algorithms excel at analyzing complex market relationships and predicting consumer preferences.

4.3. Model function and technical architecture design

Developing AI-driven strategic forecasting and analysis models requires not only the selection of suitable algorithms but also the design of robust functional and technical architectures. Functionally, the model must incorporate core capabilities such as real-time market monitoring, dynamic customer analysis, and external risk early warning. These functionalities enable enterprises to track market dynamics in real time, gain deeper insights into customer needs, and promptly identify potential risks, thereby providing strong support for strategic decision-making [8].

From a technical perspective, enterprises should adopt advanced technologies such as distributed computing and cloud computing to ensure that the model can efficiently process large-scale data, deliver rapid responses, and facilitate high-performance computations.

5. Key steps for implementing AI-driven management accounting

5.1. Collaboration between technical and financial teams

The successful implementation of AI-driven management accounting depends on close collaboration between technical and financial teams. These teams possess distinct expertise: the technical team specializes in algorithm development, data processing, and technical architecture design, while the financial team has a deep understanding of the enterprise's financial status, business needs, and strategic direction. To ensure that AI development aligns with the organization's strategic objectives, both teams must establish regular communication mechanisms, collaboratively formulate project plans, determine priorities, and continuously refine and optimize the implementation process.

5.2. Data quality management and security assurance

As data forms the foundation of AI technology, ensuring high-quality data management and robust security measures is essential for implementing AI-driven management accounting. Enterprises can adopt various strategies to enhance data quality. For instance, they may establish a data governance committee responsible for defining data management policies and standards, introduce advanced data cleaning tools to automate the detection and correction of errors, duplicates, and missing values, and collaborate with third-party data providers to obtain comprehensive and accurate market data.

In terms of security assurance, enterprises should implement encryption technologies to protect sensitive data, establish access control mechanisms, and enforce audit protocols to ensure that only authorized personnel can access and process critical information [9].

5.3. Feedback mechanism and continuous optimization

Given the rapid evolution of AI technology and the constantly changing market environment, the implementation of AI-driven management accounting must incorporate a continuous feedback and optimization process. This involves regularly evaluating AI model performance, gathering user feedback and business requirements, and making necessary adjustments to enhance efficiency and effectiveness.

To establish an effective feedback mechanism, enterprises can adopt several measures. These include forming a dedicated AI project management office responsible for monitoring model performance and collecting user feedback, implementing cross-departmental collaboration mechanisms to ensure seamless cooperation among technical, financial, and business teams, and utilizing agile development methodologies to accelerate model iteration and enhance adaptability to evolving market conditions [10].

By adopting these key steps, enterprises can systematically develop an AI-driven management accounting system that enhances the scientific rigor and accuracy of strategic decision-making. However, this marks only the beginning. As AI technology continues to advance and market dynamics evolve, enterprises must persist in exploration and innovation to effectively navigate future challenges and seize emerging opportunities [11].

6. Future trends and development directions
6.1. More intelligent market prediction tools
Market prediction serves as a crucial foundation for enterprises in formulating strategic decisions. With the continuous advancement of AI technology, particularly breakthroughs in Natural Language Processing (NLP), future market prediction tools are expected to become more intelligent and automated.

NLP technology enables the processing and comprehension of unstructured data, such as news reports and social media comments, which often contain valuable market insights and consumer sentiments. By integrating NLP technology with AI algorithms, enterprises can develop more precise and comprehensive market prediction models [12].

6.2. Deep customization of industry applications
Different industries possess distinct business characteristics and requirements. In the future, as AI technology continues to mature and its application scenarios expand, its role in management accounting is expected to become more in-depth and tailored to specific industry needs.

To achieve deep customization of industry applications, enterprises must establish close collaborations with AI technology providers to jointly explore and develop AI-driven solutions tailored to their industries. Additionally, organizations should cultivate a multidisciplinary team with expertise in both AI technology and industry knowledge to ensure the seamless implementation and continuous optimization of AI applications [13].

6.3. Integration of intelligent decision support platforms
As enterprises accelerate digital transformation, AI-driven management accounting is expected to integrate more closely with other enterprise information systems, forming an intelligent decision-support platform that provides end-to-end strategic planning and implementation support [14].

On such a platform, AI will seamlessly integrate with systems such as Enterprise Resource Planning (ERP) and Customer Relationship Management (CRM). To facilitate this integration, enterprises must undertake several measures. First, they should establish standardized data protocols and interface specifications to ensure smooth data flow and interoperability between different systems. Second, the adoption of advanced integration technologies and tools, such as API management and microservices architecture, is essential to achieving seamless connectivity and collaborative functionality across systems. Finally, organizations should implement cross-departmental collaboration mechanisms and processes to ensure that all departments contribute to the development and optimization of intelligent decision-support platforms [15].

7. Conclusion and recommendations

7.1. Summary

This study outlines the key steps for implementing AI-driven transformation by constructing a strategic prediction analysis model. These steps include data collection and processing, algorithm selection and optimization, model functionality, and technical architecture design. The findings provide valuable guidance for enterprises in practical operations.

7.2. Recommendations for enterprises

When implementing AI-driven transformation in management accounting, enterprises should prioritize both technology adoption and team development. From a technological perspective, organizations should actively integrate advanced AI technologies and tools, such as machine learning and deep learning, to enhance data processing and analytical capabilities. Regarding team development, enterprises should cultivate and recruit multidisciplinary professionals with expertise in both AI technology and management accounting to facilitate the seamless implementation of this transformation.

7.3. Prospects for subsequent research

With the continuous advancement and widespread adoption of AI technology, its application in management accounting is expected to become increasingly extensive and sophisticated. Future research can further explore additional application scenarios and models of AI technology in management accounting, such as intelligent auditing and automated reporting. Additionally, subsequent studies may focus on the integration of AI with other emerging technologies, such as blockchain and the Internet of Things, to further improve the efficiency and accuracy of management accounting. Furthermore, interdisciplinary research collaboration should be strengthened by integrating knowledge and methodologies from fields such as management science, computer science, and statistics to drive the innovative application and development of AI technology in management accounting.

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References

[1] Ge Y, 2024, Combined Application of Management Accounting and Infrastructure Financial Management. Fortune Today, 2024(14): 146–148.
[2] Li K, 2023, Research on the Combination of Corporate Financial Accounting and Management Accounting in the New Situation. China Market, 2023(8): 158–160.
[3] Zhang J, 2024, Exploration of the Integration and Application Strategies of Financial Accounting and Management Accounting in the Era of Artificial Intelligence. Market Outlook, 2024(9): 89–91.
[4] Li Y, 2024, A Brief Discussion on the Transformation from Financial Accounting to Management Accounting in the Era of Artificial Intelligence. Fortune Today, 2024(10): 110–112.
[5] Zhou Y, 2023, Thoughts on the Transformation from Financial Accounting to Management Accounting in the Context of Artificial Intelligence. China Small & Medium Enterprises, 2023(10): 159–161.
[6] Wang F, 2023, Research on the Transformation from Financial Accounting to Management Accounting in the Era of Artificial Intelligence. Quality & Market, 2023(11): 181–183.
[7] Zhao J, 2022, Research on the Integration and Application of Financial Accounting and Management Accounting in

the Era of Artificial Intelligence. Accounting of Township Enterprises in China, 2022(9): 175–177.

[8] Liu G, Gan S, 2022, Intelligent Management Accounting Reports in the Context of the New Economy – Based on Digital Skills of "Blockchain + Artificial Intelligence". Finance and Accounting Monthly, 2022(14): 79–85.

[9] Ni X, 2022, A Brief Analysis of the Integration of Financial Accounting and Management Accounting in the Context of Artificial Intelligence. China Management Informationization, 25(6): 67–69.

[10] Jiang L, 2021, Discussion on the Issues of the Transformation from Financial Accounting to Management Accounting in the Era of Artificial Intelligence. Tax Paying, 15(25): 60–62.

[11] Wang L, 2021, Thoughts on the Transformation from Financial Accounting to Management Accounting in the Era of Artificial Intelligence. Modern Business, 2021(13): 169–171.

[12] Yang X, 2021, Discussion on the Problems and Countermeasures of the Transformation from Financial Accounting to Management Accounting in the Era of Artificial Intelligence. Enterprise Reform and Management, 2021(3): 132–133.

[13] Wu S, 2020, The Transformation of Corporate Accounting to Management Accounting in the Context of Artificial Intelligence. Foreign Investment in China, 2020(18): 41–42.

[14] Yao X, 2020, Countermeasures for the Transformation from Financial Accounting to Management Accounting in the Era of Artificial Intelligence. Economy and Management Digest, 2020(13): 130–131.

[15] Yue Y, 2020, Review and Prospects of Research on the Transformation from Financial Accounting to Management Accounting in the Era of Artificial Intelligence. Modern Salt and Chemical Industry, 47(3): 92–93 + 99.

Countermeasures for Chinese Foreign Trade Enterprises Amid the "Full Custody Wave" in Cross-Border E-Commerce

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Abstract: With the acceleration of global economic integration and the rapid development of cross-border e-commerce, an increasing number of foreign trade enterprises are encountering new market opportunities and challenges. In recent years, the "full custody" model has gradually emerged, providing one-stop service support for cross-border e-commerce enterprises. While this model reduces operational difficulties, it also introduces new requirements for the business models of Chinese foreign trade enterprises. This paper examines how foreign trade enterprises can respond to the opportunities and challenges presented by the full custody model from five key perspectives: background analysis, business layout adjustments, marketing channel innovation, digital and intelligent empowerment, and flexible operational strategies. The findings aim to provide insights into the sustainable development of foreign trade enterprises within the cross-border e-commerce ecosystem.

Keywords: Cross-border e-commerce; Full custody model; Foreign trade enterprises; Digital and intelligent transformation

1. Introduction

With the rapid expansion of the cross-border e-commerce industry in recent years, many Chinese enterprises have shifted their focus to overseas markets in pursuit of new growth opportunities. The industry is currently experiencing a favorable period for global expansion, presenting Chinese enterprises with unprecedented prospects for international market exploration. According to data from Frost & Sullivan, the global cross-border e-commerce transaction volume increased from approximately 2.3 trillion in 2018 to an estimated 7.7 trillion in 2028, with a compound annual growth rate (CAGR) of 9.8% from 2023 to 2028. The rapid development of cross-border e-commerce has created a vast market space for enterprises, particularly as strong consumer demand in emerging economies has opened new growth channels for Chinese foreign trade enterprises [1].

Over the past two years, the full custody model in cross-border e-commerce has experienced significant growth, quickly becoming the dominant model in China's cross-border e-commerce export sector. This model restructures the cross-border e-commerce value chain, exerting a profound and far-reaching influence on China's

foreign trade ecosystem. While it offers enterprises greater convenience in accessing overseas markets and has fueled the rapid expansion of China's cross-border e-commerce exports, it also presents notable challenges. The model significantly reduces enterprises' marketing autonomy, compresses profit margins, and intensifies price competition, leading to mixed industry reactions. To navigate these challenges, foreign trade enterprises must promptly adjust their business layouts and product development strategies, innovate marketing channels, leverage digital and intelligent technologies, and accelerate digital transformation and upgrading. These measures will enable enterprises to mitigate the negative impacts of the full custody model, turn challenges into competitive advantages, and achieve high-quality foreign trade development [2].

Thus, in the context of globalization, the rapid rise of cross-border e-commerce presents Chinese foreign trade enterprises with both opportunities for international expansion and the necessity to adapt their business strategies to emerging challenges. This paper explores how enterprises can effectively respond to the "full custody wave" through adjustments in business layout, marketing innovation, digital and intelligent empowerment, and flexible operational strategies, providing valuable insights for the sustainable development of Chinese foreign trade enterprises.

2. Adjusting business layout and product development concepts

Under the full custody model, Chinese foreign trade enterprises must flexibly adjust their business layout and product development strategies in response to global market changes and consumer demands to enhance their market competitiveness.

2.1. Precise target market positioning

The deepening of globalization and the widespread adoption of digital technologies have led to increasingly refined market segmentation. Foreign trade enterprises should fully utilize big data analysis to gain a comprehensive understanding of the consumption preferences, cultural habits, and purchasing power of target markets [3]. For instance, in European and North American markets, high-end consumers prioritize product quality and brand value, prompting enterprises to focus on design innovation and sustainability. In contrast, in Southeast Asian and African markets, where demand for cost-effective products is high, enterprises should emphasize price advantages and practicality. Through differentiated market positioning, foreign trade enterprises can accurately align with regional consumption demands and enhance market penetration.

2.2. Dynamic adjustment of product structure

Given the rapid evolution of consumer preferences and market trends, foreign trade enterprises must improve product development efficiency and responsiveness. Under the full custody model, data feedback from platforms enables enterprises to swiftly identify popular products and areas requiring improvement [4]. For example, clothing manufacturers can adjust sizes and styles based on consumer reviews, while electronics companies can refine functional designs through data monitoring, launching upgraded products that meet market demands. Additionally, foreign trade enterprises should diversify their product lines to mitigate the risks of over-reliance on a single category or market. For instance, some Chinese manufacturers have shifted their focus from low-value-added products to emerging sectors such as high-value-added smart home devices and wearable technology. By optimizing product structures, enterprises can strengthen their competitiveness in the international market.

2.3. Strengthening brand building

Under the full custody model, platform brands often become the focal point for consumers, potentially diminishing

the visibility of independent enterprise brands. To address this challenge, Chinese foreign trade enterprises must reinforce brand building and establish international influence through differentiated branding strategies. For example, localized marketing approaches can help enterprises earn the trust of overseas consumers. In European and North American markets, emphasizing product sustainability and high-end design can enhance brand appeal, whereas in Southeast Asian markets, highlighting affordability and practicality can be more effective. Additionally, enterprises can enhance brand image through social media engagement, content marketing, and word-of-mouth promotion. Collaborating with influencers on platforms such as Instagram and TikTok can increase brand exposure, while interactive activities can foster consumer loyalty.

2.4. Building a global supply chain network

To meet the demands of global cross-border e-commerce, enterprises must establish an efficient supply chain system, encompassing overseas warehouse networks, logistics optimization, and localized after-sales services. This approach not only shortens delivery cycles and improves customer satisfaction but also reduces operational costs through flexible inventory management. Under the full custody model, close collaboration with platform supply chain networks is essential to ensure the efficient delivery of products.

3. Innovating marketing channels

Under the full custody model, innovating marketing channels has become a crucial strategy for foreign trade enterprises to overcome market limitations and expand brand influence. With the widespread application of digital technologies, diversified marketing approaches have become key to attracting global consumers.

3.1. Deepening the use of social media marketing

Social media has become a major traffic source for cross-border e-commerce. Platforms such as Facebook, Instagram, TikTok, and YouTube attract vast numbers of global consumers. Foreign trade enterprises can engage target audiences by precisely placing advertisements, collaborating with influencers for product promotions, and organizing interactive brand activities. For example, partnering with prominent TikTok influencers allows enterprises to showcase product usage scenarios and core features through short videos, quickly capturing consumer attention.

Social media also provides cost-effective advertising tools. Through advanced algorithm-driven targeting, enterprises can deliver personalized advertisements to specific user groups, maximizing conversion rates. Data indicates that by 2024, approximately 70% of cross-border e-commerce enterprises have experienced significant growth through social media advertising, solidifying social media as a primary channel for brand promotion [5].

3.2. Utilizing live streaming marketing and interactive experiences

Live streaming marketing has emerged as a significant trend in cross-border e-commerce. Supported by the full custody model, live streaming sales integrate product demonstrations, real-time consumer interaction, and direct purchasing functions, providing enterprises with a powerful marketing tool. Foreign trade enterprises can conduct brand promotions through live streaming tools provided by cross-border e-commerce platforms or attract consumers via third-party platforms such as TikTok Live and YouTube Live.

Live streaming also enhances consumer trust by showcasing product features in real-life scenarios, effectively reducing return rates. By demonstrating the functionality and quality of products in an interactive manner, enterprises can strengthen consumer confidence and drive sales.

3.3. Implementing localized marketing strategies

To expand into international markets, foreign trade enterprises must adopt localized marketing strategies tailored to the needs of regional consumers. For instance, in European and North American markets, consumers place high value on corporate social responsibility and environmental sustainability. Enterprises can enhance their reputation by promoting eco-friendly products. Meanwhile, in Southeast Asian markets, festival promotions and group-buying campaigns are more effective in attracting consumers.

Localization efforts should also extend to advertising design, language optimization, and payment method adaptation to foster consumer engagement. For example, when targeting Southeast Asian markets, enterprises can use local languages in advertisements and integrate culturally relevant visual elements, such as holiday-themed designs. These strategies effectively enhance brand affinity and market recognition.

3.4. Building brand stories through content marketing

Content marketing is a powerful tool for strengthening brand loyalty. Through mediums such as blogs, videos, and images, enterprises can communicate brand values and product narratives to consumers. For example, sharing behind-the-scenes videos of the product manufacturing process or inviting customers to participate in brand storytelling initiatives can foster emotional connections with consumers.

Under the full custody model, enterprises can leverage platform-provided data to analyze consumer preferences and develop customized content tailored to different audience segments, increasing brand appeal. Some Chinese enterprises on Amazon have successfully cultivated a loyal consumer base by offering detailed product tutorial videos and interactive Q&A content.

4. Attaching importance to digital and intelligent empowerment

Amid the full custody wave in cross-border e-commerce, digital and intelligent transformation has become essential for foreign trade enterprises to reduce costs, enhance efficiency, and strengthen competitiveness. The widespread application of technologies such as big data, artificial intelligence (AI), and cloud computing enables enterprises to optimize business processes, improve decision-making capabilities, and gain a competitive edge in the market.

4.1. Promoting the development of digital infrastructure

Digital infrastructure serves as the foundation for digital and intelligent empowerment. Foreign trade enterprises must establish efficient order management systems, warehousing management systems, and logistics tracking platforms to meet the operational requirements of the full custody model. For instance, automated order management systems facilitate seamless order processing from placement to delivery, while logistics tracking systems provide real-time updates on package status, thereby enhancing customer satisfaction.

Cross-border e-commerce platforms often offer comprehensive digital tools to support business operations. For example, Amazon's Seller Central and Alibaba.com's digital operation tools assist enterprises in optimizing supply chain management and marketing strategies. Leveraging digital tools enables enterprises to improve resource utilization efficiency, reduce labor costs, and minimize error rates.

4.2. Utilizing big data to optimize business decisions

Big data provides foreign trade enterprises with valuable market insights and a solid foundation for decision-making. Under the full custody model, platforms generate vast amounts of data related to consumer behavior, sales trends, and market demand. Enterprises can refine business operations by analyzing these datasets. For instance,

tracking popular products and user reviews allows enterprises to adjust inventory levels in a timely manner, preventing both overstocking and shortages.

Big data analytics also enhances precision marketing and product development. By examining consumer demographics and preferences in target markets, enterprises can design marketing campaigns and develop customized products that align with consumer needs.

4.3. Leveraging artificial intelligence to enhance operational efficiency

AI is increasingly integrated into cross-border e-commerce, offering intelligent solutions to improve operational efficiency. For example, AI-driven customer service systems provide 24/7 automated support, handling common inquiries and significantly reducing labor costs. AI-powered recommendation algorithms analyze consumers' browsing and purchase histories to deliver personalized product suggestions, thereby increasing conversion rates.

In logistics, AI technology optimizes transportation routes, predicts order demand, and manages inventory. For instance, Amazon's intelligent warehousing system utilizes AI algorithms to streamline goods sorting and distribution, thereby improving logistics efficiency.

5. Flexible and diverse operation strategies

The rise of the full custody model provides foreign trade enterprises with a wide range of operational tools and resources but also intensifies market competition. In this context, enterprises must adopt flexible and diverse operation strategies to better meet consumer needs and enhance market competitiveness.

5.1. Customized marketing plans

The full custody model equips enterprises with advanced marketing tools and extensive data resources, enabling them to formulate highly targeted and customized marketing plans. By accurately analyzing consumers' purchasing preferences, browsing habits, and historical data, enterprises can design personalized promotional activities. For instance, offering differentiated discounts, gift packages, or customized services to specific consumer groups can enhance customer retention and increase repurchase rates. Additionally, enterprises can launch time-limited promotional campaigns aligned with seasonal trends and major shopping festivals to create a sense of urgency and stimulate purchases. For example, leveraging global sales events such as "Black Friday" and "Double 11" to offer special discounts or bundled promotions can drive long-term sales growth through short-term marketing surges.

5.2. Diversified payment channels

The convenience of payment methods significantly impacts the conversion rate of cross-border e-commerce. With the support of the full custody model, foreign trade enterprises can offer diversified payment options tailored to the preferences of different markets. For example, in the European and American markets, credit cards and PayPal are the primary payment methods, whereas in Southeast Asia, cash-on-delivery and e-wallets are more widely used. With the advancement of cross-border payment technology, an increasing number of platforms now support multi-currency transactions and real-time exchange rate conversions. By integrating these payment tools, enterprises can provide consumers with a seamless payment experience and minimize order losses caused by inconvenient payment processes.

5.3. Optimizing the after-sales service system

High-quality after-sales service is crucial for enhancing customer satisfaction and loyalty. Under the full custody model, enterprises can leverage platform-provided after-sales service functions, such as streamlined return and

exchange processes, prompt customer support, and real-time logistics tracking. Enterprises should proactively collect customer feedback and improve their products and services accordingly. For instance, some enterprises gather consumer opinions on product quality and service efficiency through email surveys or questionnaires and make timely adjustments. This proactive approach to customer service can significantly enhance customer satisfaction and strengthen brand reputation.

5.4. Dynamically adjusting inventory and logistics strategies

While the full custody model simplifies logistics and inventory management, enterprises must continuously optimize these aspects to maintain efficiency. For instance, adjusting inventory distribution in overseas warehouses based on market demand fluctuations ensures the timely supply of popular products while preventing stockouts or overstocking. Additionally, enterprises can flexibly utilize platform logistics services to provide customers with multiple delivery options. During peak shopping seasons, such as holidays, enterprises can improve delivery efficiency and reduce operational costs by stocking up in advance and optimizing logistics routes.

5.5. Providing value-added services to enhance customer retention

Amid increasing market competition, offering value-added services has become a key strategy for attracting and retaining customers. For example, providing extended product warranties, free trials, or complimentary gifts can effectively boost consumers' purchasing willingness. Moreover, enterprises can enhance the shopping experience by offering personalized packaging or customized gift services, thereby increasing perceived value and fostering customer loyalty.

6. Conclusion

The emergence of the full custody model has brought a significant transformation to the cross-border e-commerce industry. By reducing operational complexity, it offers foreign trade enterprises a more accessible means of participating in the international market. However, this model also imposes higher demands on enterprises' core competitiveness. Only those who can adapt flexibly to market changes, continuously refine their business strategies, and maintain a long-term development focus will gain a competitive edge in this evolving landscape.

To navigate these challenges effectively, enterprises must adopt a multi-faceted approach. This includes optimizing business structures and product development strategies to ensure alignment with market demands, utilizing innovative marketing channels to overcome geographical limitations and enhance global brand influence, and leveraging digital and intelligent technologies to enable precise operations and efficient decision-making. Additionally, flexible and diversified operational strategies are essential to meeting the evolving needs of consumers. Such measures not only facilitate a proactive response to the full custody model but also contribute to a comprehensive enhancement of enterprises' overall competitiveness in the context of globalization.

Looking ahead, as cross-border e-commerce continues to evolve, foreign trade enterprises must remain committed to exploring new technologies, business models, and market opportunities. By capitalizing on policy incentives and strengthening internal capabilities, they can sustain long-term growth and remain competitive in the dynamic global marketplace.

Disclosure statement

The author declares no conflict of interest.

References

[1] Sihan Industrial Research Institute, 2024, Policies, Demands, and Infrastructure Resonate, and the Cross-Border E-Commerce Development Momentum is Strong.

[2] Huang X, 2024, Countermeasures of Chinese Foreign Trade Enterprises Under the Background of the "Full Custody Wave" in Cross-Border E-Commerce. Journal of Western Studies, 2024(13): 145–149.

[3] Dong Y, 2022, Research on the Current Development Status of China's Cross-Border E-Commerce Logistics Industry in the Context of the "Internet +" Era. Logistics Engineering and Management, 44(12): 60–62.

[4] Chen J, Lin W, 2023, Analysis of the Full Custody Model of Cross-Border E-Commerce Platforms. China Circulation Economy, 2023(22): 40–43.

[5] Liu H, Men J, Xu F, 2024, Research on the Overseas Operation Strategies of Cross-Border E-Commerce Enterprises: Taking the Temu Platform as an Example. Time-Honored Brand Marketing, 2024(14): 113–116.

Enhancing Customer Loyalty in Jewelry Enterprises: An Analysis Based on the ABC Attitude Model

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Abstract: The jewelry industry faces intense competition, making customer loyalty essential for sustained success. This paper examines customer loyalty through the lens of the ABC attitude model, which encompasses cognitive, affective, and behavioral dimensions. Cognitive factors, such as perceived quality and brand reputation, establish the foundation of trust, while affective factors, including emotional attachment and trust, strengthen customer relationships. Behavioral factors, such as repeat purchases and advocacy, reflect observable loyalty actions. The study proposes strategies to enhance loyalty, including delivering superior products and services, strengthening customer relationship management, and leveraging word-of-mouth and digital marketing. These approaches provide actionable insights for building long-term customer relationships in a competitive market. Future research could explore emerging technologies and cultural influences to further refine loyalty strategies. This research highlights the multidimensional nature of customer loyalty and offers practical recommendations for jewelry enterprises.

Keywords: Customer loyalty; ABC attitude model; Jewelry industry

1. Introduction

The jewelry industry is characterized by intense competition and rapid shifts in consumer preferences, influenced by evolving social and economic trends. In this highly competitive market, customer loyalty plays a pivotal role in sustaining business growth and profitability. Loyal customers not only provide a stable revenue stream through repeat purchases but also enhance a company's brand reputation by serving as advocates and sharing positive experiences. This underscores the importance of understanding and strengthening customer loyalty, particularly in the jewelry industry, where emotional value and symbolic meaning often take precedence over functional considerations [1].

This study examines customer loyalty through the framework of the ABC attitude model, which provides a comprehensive approach to analyzing customer behavior. The model encompasses three key dimensions: affective, behavioral, and cognitive. The jewelry industry, known for its high involvement and personalized purchasing decisions, serves as an ideal context for applying this model. Consumers assess jewelry purchases based on

cognitive factors such as perceived quality, emotional connections to a brand, and behavioral tendencies like repeat purchases or resistance to competitors.

By exploring these dimensions, this study aims to provide actionable insights to help jewelry enterprises strengthen customer relationships. Addressing loyalty in this sector not only aids in customer retention but also enhances brand competitiveness in an increasingly globalized market.

2. Theoretical foundation

The ABC attitude model provides a robust theoretical framework for examining customer loyalty, particularly in industries such as jewelry, where purchasing decisions are influenced by complex psychological and emotional factors. This model integrates three interconnected components—affective, behavioral, and cognitive—which collectively shape an individual's attitude and guide decision-making. Understanding these dimensions is essential for jewelry enterprises seeking to foster long-term customer relationships.

The affective dimension refers to the emotional connections and feelings that customers associate with a brand. In the jewelry industry, where purchases often hold symbolic value, emotions such as trust, admiration, and attachment significantly influence customer loyalty. A positive emotional experience—whether through exceptional service or meaningful interactions—can create a lasting bond with the brand.

The behavioral dimension focuses on observable actions, such as repeat purchases, word-of-mouth advocacy, and resistance to competitor offerings. Behavioral loyalty is particularly important for jewelry businesses, as loyal customers frequently return for future purchases, such as anniversaries, gifts, or personal milestones. These actions not only indicate customer loyalty but also provide valuable insights for businesses to assess the effectiveness of their strategies.

The cognitive dimension encompasses the beliefs and perceptions customers hold about a brand, including evaluations of product quality, brand reputation, and perceived value. Given the high cost and emotional significance of jewelry, cognitive factors play a central role in loyalty formation. Customers who perceive a brand as reliable and offering high-quality products at a reasonable value are more likely to develop and sustain long-term loyalty.

By applying the ABC attitude model, businesses can gain a comprehensive understanding of customer loyalty. This model enables jewelry enterprises to identify areas of strength and address potential gaps, allowing them to design targeted strategies that align with customers' emotional, cognitive, and behavioral needs. The ABC model is particularly well-suited to the jewelry sector, where brand identity, personal significance, and customer experience play a critical role in shaping loyalty.

3. Research methodology
3.1. Research design
This study employs a mixed-methods approach to comprehensively investigate the factors influencing customer loyalty in the jewelry industry. By integrating quantitative and qualitative methodologies, the research provides a multidimensional understanding of customer loyalty within the framework of the ABC attitude model.

The quantitative component involves the administration of structured surveys designed to systematically collect data on cognitive, affective, and behavioral factors. These surveys generate measurable insights into how customers evaluate, connect with, and engage with jewelry brands.

Complementing this, the qualitative component consists of in-depth interviews with customers, exploring the emotional and experiential dimensions of loyalty. These interviews capture subjective nuances often overlooked

by quantitative measures [2]. The combined approach ensures a balanced exploration of customer loyalty, addressing both observable patterns and underlying motivations. This design is particularly well-suited to the high-involvement nature of jewelry purchases, where decisions often reflect both rational evaluations and emotional connections.

3.2. Sampling framework and data collection

The target population consists of customers who have made purchases from jewelry retailers within the past two years, ensuring the collection of recent and relevant data. Stratified random sampling is employed to ensure diversity in demographic characteristics such as age, gender, income level, and purchase intent.

To maximize reach and representation, the survey is distributed through both online and offline channels. Online distribution includes customer email lists and social media platforms, while offline distribution takes place in retail stores. To enhance validity and reliability, the survey questions undergo pretesting with a small sample, followed by necessary adjustments to improve clarity and relevance.

Additionally, in-depth interviews were conducted with 15 participants, selected based on purchasing frequency and brand engagement. These qualitative insights further enrich the dataset, offering a deeper understanding of customer experiences and perceptions.

3.3. Analytical techniques

A range of analytical techniques is applied to ensure comprehensive insights.

(1) Quantitative data is analyzed using robust statistical methods, including regression analysis, factor analysis, and structural equation modeling (SEM).

    (a) Regression analysis identifies the strength and direction of relationships between loyalty dimensions and overall loyalty scores.

    (b) Factor analysis uncovers latent variables within cognitive, affective, and behavioral factors.

    (c) SEM provides a comprehensive framework for understanding their interplay.

(2) Qualitative data is analyzed using thematic analysis to identify recurring themes and patterns in customer experiences. Key themes include trust in brand authenticity, the symbolic meaning of jewelry, and the impact of personalized service, offering deeper insights into the emotional and experiential aspects of loyalty.

By integrating quantitative and qualitative findings, this study presents a holistic view of customer loyalty in the jewelry industry. These insights form the foundation for practical strategies aimed at enhancing customer retention, brand advocacy, and long-term success in a competitive market.

4. Data collection and analysis

4.1. Data collection process

A structured approach was adopted to collect both quantitative and qualitative data, ensuring a comprehensive and balanced understanding of customer loyalty in the jewelry industry. A survey questionnaire was designed based on the ABC attitude model, addressing three key dimensions:

    (1) Cognitive (e.g., perceived product quality, brand reputation)

    (2) Affective (e.g., emotional attachment, trust)

    (3) Behavioral (e.g., repeat purchases, brand advocacy)

The questionnaire consisted of 20 items measured on a 5-point Likert scale, ranging from "strongly disagree" to "strongly agree."

The target respondents comprised customers who had purchased jewelry within the past 12 months. To ensure diverse customer representation, 100 questionnaires were distributed through both online channels (e.g., social media, email campaigns) and offline channels (e.g., in-store). After excluding incomplete responses, 90 valid responses were obtained, resulting in a high response rate of 90%.

In addition to the survey, three in-depth interviews were conducted with participants representing different purchasing behaviors, including frequent buyers, first-time buyers, and those purchasing jewelry primarily as gifts. Each interview lasted approximately 30–40 minutes, focusing on the emotional and experiential aspects of customer loyalty. These interviews provided rich qualitative insights, complementing the quantitative findings.

4.2. Data analysis techniques

The collected data was analyzed using both descriptive and inferential statistical methods to ensure a thorough examination of customer loyalty factors.

(1) Descriptive statistics summarized key demographic characteristics, such as gender distribution (60% female) and purchasing intent.

(2) Regression analysis was employed to examine the relationships between cognitive, affective, and behavioral dimensions and overall customer loyalty. Results indicated that emotional attachment (affective) and perceived quality (cognitive) were the most influential factors, together accounting for 58% of the variance in loyalty scores.

The qualitative data from interviews was analyzed using thematic analysis to identify recurring patterns and key themes. Three dominant themes emerged:

(1) The importance of personalized service

(2) Trust in brand authenticity

(3) The symbolic significance of jewelry

These findings provided deeper insights into how customers emotionally connect with jewelry brands, enriching the statistical analysis.

By integrating quantitative and qualitative findings, this study ensures a comprehensive and actionable understanding of customer loyalty dynamics in the jewelry industry (see **Table 1** for a summary of key analysis techniques and findings).

Table 1. Summary of data analysis techniques and key findings

Analysis technique	Purpose	Key findings	Contribution to research
Descriptive statistics	Summarize demographic data and overall trends.	60% of respondents were female; the majority purchased jewelry for personal use.	Provides an overview of the respondent profile and highlights the general context of the jewelry market.
Regression analysis	Identify relationships between dimensions of loyalty and overall loyalty scores.	Emotional attachment (affective) and perceived quality (cognitive) accounted for 58% of loyalty variance.	Quantifies the impact of affective and cognitive dimensions on loyalty, highlighting their relative importance.
Thematic analysis	Analyze qualitative data to identify recurring themes.	Key themes: personalized service, trust in brand authenticity, and symbolic value of jewelry.	Adds depth to the findings by revealing emotional and experiential factors that influence loyalty.
Integrated analysis	Combine quantitative and qualitative insights.	Statistical findings supported by qualitative themes, ensuring robust conclusions.	Provides a holistic understanding of customer loyalty by integrating measurable and experiential aspects.

5. Analysis of customer loyalty factors

5.1. Cognitive factors: Perceived quality and brand reputation

Cognitive factors play a crucial role in shaping customer loyalty, as they influence how customers evaluate a brand's offerings. In the jewelry industry, perceived quality is a primary determinant of loyalty. Customers often associate high quality with superior craftsmanship, the use of authentic materials, and meticulous attention to detail [3]. Brands that transparently communicate the sourcing of precious metals and gemstones, along with their commitment to quality assurance, are more likely to earn customer trust and long-term loyalty.

Brand reputation is another critical cognitive factor. Customers tend to remain loyal to jewelry brands that have established themselves as trustworthy, reliable, and socially responsible. This reputation is built through a consistent track record of ethical practices in material sourcing and manufacturing, positive public relations, and high levels of customer satisfaction. Additionally, clear, consistent, and transparent marketing and communication efforts further enhance customer perceptions, reinforcing brand credibility. Together, these cognitive factors serve as the foundation of customer loyalty, influencing both initial purchase decisions and long-term engagement with the brand.

5.2. Affective factors: Emotional attachment and trust

Affective factors, particularly the emotional bonds between customers and brands, play a pivotal role in fostering loyalty within the jewelry industry. Emotional attachment often arises from deeply personal experiences, such as a memorable purchase or exceptional customer service. Jewelry, being highly symbolic and frequently associated with significant life events—such as engagements, weddings, and anniversaries—naturally fosters strong emotional connections. These occasions imbue purchases with profound sentimental value, reinforcing customers' emotional ties to the brand [4].

Trust is another fundamental element of emotional loyalty. Customers who perceive a brand as reliable and ethical are more inclined to remain loyal. This trust is strengthened when brands consistently deliver on their promises regarding product authenticity, ethical sourcing, and transparent customer service policies. For example, offering lifetime warranties, hassle-free return policies, or detailed product certifications reassures customers of a brand's commitment to quality and integrity. By fostering trust, jewelry brands not only encourage repeat purchases but also establish a deeper sense of belonging and alignment with the brand's values. Emotional loyalty extends beyond transactional interactions, creating lasting relationships that secure long-term customer allegiance.

5.3. Behavioral factors: Repeat purchases and advocacy

Behavioral factors represent the observable manifestations of customer loyalty, including repeat purchases and brand advocacy. In the jewelry industry, repeat purchases are primarily driven by consistently positive experiences. These may include satisfaction with product quality, personalized service during the buying process, and seamless after-sales support. Customers who feel valued and well-served are more likely to return to the same brand for future purchases, whether to commemorate milestones, replace items, or expand their jewelry collection [5]. Loyalty programs, exclusive discounts, and tailored recommendations further reinforce this behavior by incentivizing continued engagement.

Advocacy is an extension of behavioral loyalty, wherein satisfied customers actively promote the brand through word-of-mouth recommendations and online reviews. Jewelry brands that cultivate strong customer advocacy benefit from enhanced credibility, as potential buyers tend to trust personal recommendations over traditional advertising. Behavioral loyalty not only drives revenue through repeat business but also amplifies a brand's reputation and market presence.

6. Strategies for enhancing customer loyalty

6.1. Delivering superior products and services

Customer loyalty in the jewelry industry is fundamentally built on delivering high-quality products and exceptional service. Customers value jewelry that meets or exceeds their expectations in craftsmanship, material authenticity, and design innovation. To achieve this, brands must implement rigorous quality control measures, including certified sourcing of precious materials and transparent manufacturing processes. Ensuring product authenticity and durability fosters trust and strengthens long-term customer commitment.

Beyond product quality, exceptional service is a critical component of customer loyalty. Personalized experiences, such as tailored consultations and bespoke jewelry design options, address customers' emotional needs and enhance brand affinity. Additionally, offering comprehensive after-sales services—such as cleaning, resizing, and repairs—further enriches the overall customer experience. These efforts collectively demonstrate a brand's dedication to customer satisfaction, reinforcing loyalty.

6.2. Strengthening customer relationship management

Effective customer relationship management (CRM) is essential for fostering deeper connections and encouraging repeat purchases. Jewelry brands can leverage CRM tools to collect and analyze customer data, allowing them to understand preferences, purchase histories, and behavioral patterns. This data-driven approach enables brands to provide targeted recommendations, personalized marketing messages, and exclusive offers tailored to individual customers.

Building strong relationships also requires consistent and meaningful communication. Regular follow-ups through email newsletters, SMS updates, and social media engagement keep customers informed about new collections, promotions, and events. For high-value customers, exclusive invitations to VIP events or membership in loyalty programs can further strengthen their emotional and behavioral connection to the brand. CRM strategies that emphasize trust, transparency, and personalization contribute to higher customer satisfaction and long-term loyalty.

6.3. Leveraging word-of-mouth and digital marketing

Word-of-mouth marketing is a powerful tool for enhancing customer loyalty and expanding brand reach. Satisfied customers often share positive experiences with friends and family, serving as credible endorsements that attract new customers. To encourage this, jewelry brands can establish referral programs that reward both the referrer and the new customer, incentivizing advocacy while reinforcing existing customer relationships.

In the digital era, online platforms play a crucial role in customer loyalty strategies. Brands can leverage social media to showcase collections, share behind-the-scenes content, and engage directly with customers. User-generated content, such as customer testimonials and photos of purchased jewelry, adds authenticity and strengthens brand trust. Additionally, online reviews and ratings on platforms such as Google and Yelp influence potential customers' purchasing decisions, making it imperative for brands to actively manage their digital reputation.

7. Conclusion and future outlook

Customer loyalty is a critical determinant of long-term success in the highly competitive jewelry industry. By applying the ABC attitude model, this paper underscores the significance of cognitive, affective, and behavioral dimensions in shaping customer loyalty. Cognitive factors, such as perceived quality and brand reputation, establish the foundation for trust and satisfaction, while affective factors, including emotional attachment and trust,

strengthen the bond between customers and brands. Behavioral expressions of loyalty—such as repeat purchases and advocacy—serve as tangible indicators of a brand's ability to retain customers.

The proposed strategies emphasize delivering high-quality products and services, enhancing customer relationship management, and leveraging word-of-mouth and digital marketing to foster sustainable loyalty. These approaches not only address immediate challenges but also position jewelry brands for long-term competitiveness.

Looking ahead, the evolving consumer landscape and advancements in technology present new opportunities for further exploration. Future research could examine the impact of emerging technologies, such as AI-driven personalization and virtual try-on experiences, on customer loyalty. Additionally, investigating cultural and generational influences on loyalty behaviors could provide valuable insights for tailoring strategies to diverse customer segments. By continuously adapting and innovating, jewelry enterprises can cultivate enduring customer loyalty in an increasingly dynamic market.

Disclosure statement

The author declares no conflict of interest.

References

[1] Yuan J, Shahzad MF, Waheed A, et al., 2023, Sustainable Development in Brand Loyalty: Exploring the Dynamics of Corporate Social Responsibility, Customer Attitudes, and Emotional Contagion. Corporate Social Responsibility & Environmental Management, 31(2): 1042–1051. https://doi.org/10.1002/csr.2621

[2] Tajeddini K, Gamage T, Hameed W, et al., 2022, How Self-Gratification and Social Values Shape Revisit Intention and Customer Loyalty of Airbnb Customers. International Journal of Hospitality Management, 100: 103093. https://doi.org/10.1016/j.ijhm.2021.103093

[3] Rakhmawati H, Tuti M, 2023, Brand Experience Affects Brand Attitude, Brand Attachment, Brand Satisfaction, and Brand Loyalty on Customer Make Over. Jurnal Dinamika Manajemen, 14(1): 41488. https://doi.org/10.15294/jdm.v14i1.41488

[4] Lau MM, Ng PML, Chan EAH, et al., 2023, Examining Purchase Intention for Luxury Fashion: Integrating Theory of Reasoned Action, with Affect-Behavior-Cognition (ABC) Model, Identity and Social Identity Theories. Young Consumers, 24(1): 114–131. https://doi.org/10.1108/YC-07-2022-1557

[5] Edy IC, Riyanto, Marsono S, et al., 2021, The Application of the ABC Attitude Model to Online Purchasing Decisions (Study on E-Commerce Fashion Consumers in Indonesia). Technium Social Sciences Journal, 26(1): 616–635.

The Impact of the Carbon Sink Market on the Sustainable Development of the Forestry Economy

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Abstract: As a vital component of the national economic system, the forestry economy plays a significant role in promoting economic and social development. With the increasing emphasis on green and sustainable development, the carbon sink market has gained widespread attention and experienced rapid expansion, exerting a profound impact on the sustainable development of the forestry economy. In this new stage, deepening the relationship between the carbon sink market and the forestry economy is of great practical significance for enhancing forest coverage, advancing forestry economic growth, and fostering green ecological development. This paper analyzes the impact of the carbon sink market on the sustainable development of the forestry economy and explores specific strategies for its advancement.

Keywords: Forestry economy; Sustainable development; Carbon sink markets

1. Introduction

With the growing urgency of ecological and environmental challenges, forestry-based carbon sequestration has garnered significant attention. Carbon sinks primarily include trees, climate, soil, and oceans, functioning through the absorption of atmospheric carbon dioxide via photosynthesis and its fixation within the carbon sink system, thereby reducing greenhouse gas concentrations. Carbon sinks are characterized by convenience, sustainability, and efficiency. By selecting appropriate tree species and optimizing environmental conditions, the carbon sequestration capacity of forests can be significantly enhanced, playing a crucial role in forestry economic development.

Furthermore, amid increasingly severe climate and ecological crises, the implementation of green development strategies and ecological conservation efforts not only enhances the efficiency of forestry carbon sinks but also effectively mitigates environmental pollution. Additionally, the continuous development of forestry carbon sinks can expand economic opportunities, strengthen the foundation for sustainable forestry development, and maximize economic benefits.

2. The role of the carbon sink market in the sustainable development of the forestry economy

2.1. Contribution to increasing forest coverage

The forestry carbon sink mechanism promotes the development and implementation of vegetation protection, forest management, and tree conservation activities, which maximize forest expansion and increase carbon dioxide sequestration. Due to its inherent carbon sink function, forestry development aligns with the principles of the economic cycle. The efficient growth of forestry not only enhances the ecological environment by reducing soil erosion and maintaining biodiversity but also generates significant low-carbon benefits. In this regard, the continuous expansion of forestry carbon sink initiatives plays a crucial role in fostering economic growth, improving ecological conditions, and promoting environmental sustainability.

Against this backdrop, the advancement of the carbon sink market can stimulate a diverse range of carbon sink projects while garnering extensive support and recognition from various sectors of society. This support facilitates a systematic and comprehensive enhancement of forestry development, contributing to long-term sustainability [1]. As carbon sink projects continue to develop, both forest area and forest coverage rates are expected to increase significantly.

2.2. Enhancement of economic benefits in forestry

The establishment and expansion of the carbon sink market have had a profound impact on the forestry economy. The continuous growth of carbon sink initiatives has significantly improved the economic benefits of the forestry sector. From an economic perspective, large-scale afforestation projects not only stabilize the ecological balance but also optimize resource utilization, providing a foundation for social and economic stability.

Furthermore, the development of carbon sink projects enhances plant photosynthesis, thereby reducing the concentration of harmful gases in the atmosphere. Given the strong externalities associated with forestry resources, the large-scale planting of trees—considering factors such as regional temperature, soil conditions, and water quality—can provide abundant resources for the carbon sink market. This, in turn, contributes to the overall economic benefits of the forestry sector by increasing revenue streams and ensuring long-term profitability.

2.3. Promotion of ecological conservation and sustainability

With the rapid expansion of the carbon sink market, an increasing number of enterprises are investing in carbon sink projects and engaging in large-scale afforestation, ecological restoration of degraded land, efficient utilization of idle land, and the conversion of farmland into forests. These initiatives have significantly increased forest coverage and overall forest area, contributing to ecological conservation and the implementation of sustainable development strategies.

The carbon sink market plays a vital role in optimizing the ecological environment by enhancing landscape aesthetics, regulating climate conditions, maintaining soil and water balance, and preserving biodiversity. The continuous expansion of carbon sink initiatives has provided new momentum for the development of the forestry economy. On one hand, these initiatives facilitate the sustainable development of the forestry sector, and on the other, they maximize the benefits across various industries while supporting broader ecological conservation efforts.

3. The negative impact of the carbon sink market on the forestry economy

The impact of the carbon sink market on the development of the forestry economy is twofold. On one hand, the expansion of carbon sink projects can increase forest coverage, enhance the economic efficiency of the forestry sector, and promote ecological conservation. On the other hand, as the carbon sink market grows, the likelihood

of pest infestations and plant diseases also increases, placing additional strain on resource inputs [2]. Furthermore, inadequate awareness of forest fire prevention in certain regions and enterprises has led to a rising incidence of forest fires, adversely affecting social harmony, the ecological environment, and economic sustainability.

In the process of forestry economic development, some individuals and enterprises fail to consider the relationship between carbon sink market expansion and ecological balance. In pursuit of personal or corporate interests, some entities engage in large-scale deforestation, causing severe environmental degradation and disrupting ecological equilibrium. Consequently, while the carbon sink market contributes to forestry development, it also presents significant challenges.

At this new stage of development, achieving efficient and sustainable growth in the forestry economy requires relevant authorities to conduct in-depth research on the dynamics of the carbon sink market. By doing so, they can ensure the integration of carbon sink market expansion with forestry economic development, fostering a balanced and sustainable approach.

4. Strategies for promoting the sustainable development of the forestry economy through the carbon sink market

4.1. Establishing a robust development mechanism to enhance the efficiency of carbon sink initiatives

With the growing emphasis on sustainable development, higher standards have been set for the forestry economy. Establishing a well-structured development mechanism is essential to laying a strong foundation for its advancement. The carbon sink market is characterized by a high degree of professionalism, comprehensiveness, and complexity [3]. Therefore, in the process of developing the carbon sink market, relevant authorities must provide enterprises with reliable and effective carbon credit platforms. Currently, the carbon sink market is expanding rapidly. From a global perspective, some countries and enterprises comply with the Kyoto Protocol and have effectively met emission reduction targets. However, on a national scale, aside from conventional industries, certain emerging industries contribute significantly to carbon dioxide emissions, further exacerbating environmental pollution.

First, a carbon credit platform should be established. Under the Kyoto Protocol, developed nations and enterprises that successfully meet emission reduction requirements should be encouraged to participate in the development of carbon credit platforms. This includes domestic high-emission industries, particularly those with high pollution levels, which should adopt the principle of "pollution control and mitigation as a unified objective." Providing sufficient financial resources for forestry carbon sink projects is crucial. To address this, relevant authorities should introduce tax incentives, capital subsidies, and other policy measures to encourage enterprises to participate in carbon sink projects at an early stage, thereby alleviating the pressure of emission reduction.

Second, an early warning mechanism should be implemented, allowing enterprises to allocate resources to support carbon sequestration in exchange for carbon dioxide emission allowances. This mechanism would enable regulatory bodies to monitor corporate carbon emissions in real time, promptly identify potential risks of excessive emissions, and take preventive measures. Additionally, enterprises should engage in carbon sink projects based on their development needs and actual emission reduction performance, ensuring a strong foundation for future ecological initiatives. By actively participating in these projects, enterprises can gain comprehensive knowledge of carbon credit indicators and the operational processes of the carbon sink market.

Finally, a well-established legal framework is essential for the effective development of the forestry economy and carbon trading market. In building the carbon sink market, the government must play an active role in macroeconomic regulation, guiding policy implementation and overseeing market activities to ensure sustainable

growth. Furthermore, relevant authorities should formulate and refine the legal and regulatory framework governing forestry carbon sink trading, clearly defining trading rules, regulatory responsibilities, and legal obligations. Strengthening these legal foundations will contribute to the efficient and transparent operation of the carbon sink market.

4.2. Promoting the integration of carbon sink and finance to facilitate financial development

As a contemporary economic instrument with distinct economic benefits, the carbon sink market maximizes the financial potential of the forestry sector while accelerating financial development. It not only incentivizes enterprises to actively participate in emission reduction and carbon sink projects but also provides financial support for the sustainable development of the forestry economy. Forestry carbon sink projects exhibit strong sustainability, economic viability, efficiency, and growth potential. As these projects continue to expand, the financialization of the forestry carbon sink sector serves as a crucial driver for the prosperity and advancement of the forestry economy [4].

On the one hand, due to external constraints such as the relatively short establishment period and the underdeveloped nature of forestry carbon sink initiatives, the sector faces significant cost and operational challenges. One of the most common issues is that China's forestry carbon sink market remains in its early stages, with unclear development goals and themes, leading to disruptions in financial support for carbon credit platforms. To address this, the government should enhance financial assistance for the forestry carbon sink market by establishing dedicated funds and offering tax incentives to reduce the costs incurred by enterprises participating in forestry carbon sink projects. Additionally, a structured subsidy system should be introduced and refined to provide financial incentives to enterprises and individuals actively engaging in forestry carbon sink trading, thereby stimulating market activity. Furthermore, relevant authorities should establish clear subsidy standards and procedures to ensure the transparency and accountability of financial transactions, preventing resource misallocation and inefficiencies.

On the other hand, in the development of the carbon sink market, regulatory authorities must strengthen supervision and oversight to ensure safe, environmentally sustainable, and transparent market operations. Specifically, in the context of rapid carbon sink market expansion, green initiatives not only attract widespread corporate participation in project implementation but also facilitate the orderly execution of emission reduction measures. To effectively manage forestry carbon sink funds, enterprises require robust financial support to guarantee the successful execution of afforestation, forest management, and conservation projects, further advancing the growth of forestry carbon sink initiatives. Additionally, collaboration with commercial banks, insurance companies, and other financial institutions should be reinforced. Financial institutions can provide funding and risk management services to mitigate the operational risks associated with forestry carbon sink projects. This integrated approach effectively fosters synergy between forestry and finance, ensuring the successful implementation of forestry carbon sink projects, the smooth operation of carbon sink market transactions, and sustained financial support for the development of the forestry economy.

4.3. Strengthening internal control to foster a supportive environment for forestry development

From a structural perspective, the carbon trading market serves as a primary channel for optimizing carbon transactions, possessing both internal and external characteristics. A comprehensive analysis of carbon sink mechanisms reveals that the development of the forestry economy and the carbon sink market is influenced by various external factors, affecting the efficiency of carbon sink resource utilization and potentially hindering the overall growth of the forestry economy. In the context of modern economic and environmental challenges, the

externalities associated with forestry carbon sinks have become a significant concern for forestry development. Therefore, relevant authorities must conduct an in-depth analysis of the specific factors influencing forestry carbon sinks, leverage market structures to transform externality issues into internal control challenges and ensure the effective development of the forestry economy while maximizing internal benefits.

First, the clear delineation of property rights is essential for ensuring the maximization of economic benefits. In the development of forestry carbon sink projects, it is crucial to establish well-defined property rights to guarantee that forestry-acquired carbon sink rights align with practical needs and contribute to the stable development of the carbon sink market. As a tradable commodity, forestry carbon sink property rights are widely circulated in the market, facilitating the implementation of forestry carbon sink projects and attracting capital investment. It should be emphasized that property rights serve as a key mechanism for internalizing forestry's external resources. To ensure the legitimacy and efficiency of forestry carbon sink property rights, authorities should reinforce internal property rights control, establish a robust property rights framework, and ensure that the system supports the sustainable development of forestry capital and the carbon sink market. This approach will help create a stable and conducive environment for forestry economic growth.

Second, the integration of forestry resources involves the effective consolidation of available resources, including social, ecological, and market resources, to foster a pattern of complementary advantages and coordinated development [5]. This integration not only enhances the overall utilization efficiency of forestry resources but also strengthens the competitiveness and long-term viability of carbon sink projects. In the current stage of forestry resource integration, efforts should be made to explore synergies between forestry and sectors such as tourism, education, and scientific research. Additionally, diversified forestry carbon sequestration products and services should be developed to maximize economic and environmental benefits.

Third, the implementation of carbon sequestration projects plays a crucial role in transforming external environmental benefits into internal economic gains. Effective management of carbon sink projects requires a comprehensive approach encompassing project decision-making, financial investment, program design, project promotion, economic benefit realization, evaluation, and continuous improvement. Through meticulous project execution, optimal allocation of forestry resources can be achieved, enhancing the overall efficiency and sustainability of the forestry economy.

Finally, in managing forestry carbon sink projects, regulatory measures such as imposing carbon dioxide emission taxes can enhance precision in environmental management. To this end, relevant authorities should strengthen oversight of polluting enterprises, ensuring compliance with emission reduction requirements and promoting the growth of the forestry carbon sink sector. By enforcing stricter regulations and fostering collaboration across industries, a more supportive environment for forestry development can be established, ultimately contributing to sustainable economic and ecological progress.

4.4. Enhancing system management to promote the comprehensive development of the carbon sink market

From an international perspective, the advancement of the forestry economy is closely linked to the current status and challenges of forestry carbon sink development. In this context, establishing a robust regulatory and security system is of great practical significance for the sustainable growth of the carbon sink market.

On one hand, international regulations serve as the foundation and guiding framework for advancing low-carbon initiatives across countries. To foster the development of the forestry economy, China should conduct a thorough analysis of the rules and emerging trends in the global forestry carbon sink market. Based on this analysis, China should establish specific implementation systems and procedures that align with international standards. This approach would help safeguard the rights and interests of China's forestry carbon sink sector

in international cooperation and negotiations, effectively address complex challenges, and prevent potential disadvantages in global partnerships.

On the other hand, under the guidance of green, low-carbon principles and the theory of sustainable development, China should formulate a comprehensive regulatory framework that adheres to international standards while addressing the country's specific carbon emission conditions. Additionally, in the process of project development, ensuring the authenticity and effectiveness of initiatives is paramount. External advantages should be strategically transformed into internal strengths, and various measures should be implemented in a systematic and orderly manner.

Moreover, in constructing a comprehensive management system, innovation in project management models plays a crucial role. The interrelationship between economic development and innovative projects should be holistically considered to achieve optimal resource allocation and coordinated development across multiple industries. Establishing a sound regulatory framework would provide a solid foundation for the carbon sink market, fostering the growth and prosperity of the forestry carbon sink sector while simultaneously driving economic advancement and social progress.

5. Conclusion

In conclusion, the carbon sink market has a dual impact on the sustainable development of the forestry economy. A comprehensive understanding of the various factors influencing the development of the carbon sink market is essential for innovating implementation strategies in practical projects and enhancing overall economic benefits. In the process of carbon sink market development, establishing a robust regulatory framework, promoting the integration of carbon sink initiatives with financial mechanisms, strengthening internal control, and enhancing institutional management can facilitate the optimal allocation and coordinated development of forestry resources. These measures collectively contribute to the long-term sustainability of the forestry economy.

Disclosure statement

The author declares no conflict of interest.

References

[1] Zhu M, Liu W, Tan B, et al., 2024, Research on the Impact of Carbon Sink Market on Forestry Economic Development – A Case Study of Guangxi. Fortune Today, 2024(23): 14–16.

[2] Ke A, 2024, The Regulatory Dilemma of Forestry Carbon Sink Market and Its Improvement Path, dissertation, Zhejiang A&F University.

[3] Zhang D, Hou M, Li Y, 2022, The Development Strategy of Forestry Economy in Hunan Under the Goal of "Dual Carbon". Forest Products Industry, 59(8): 58–61.

[4] Cao FL, 2021, National Strategy of Promoting Carbon Neutrality by Marketization of Forestry Carbon Sink – Review of Operation, Price and Financing Mechanism of Forestry Carbon Sink. Forestry Economy, 43(11): 5–11.

[5] Wang X, Qi C, Ding S, 2020, An Evolutionary Game Analysis of Tripartite Interests Behavior in Regional Forestry Carbon Sink Market Based on System Dynamics. China Forestry Economy, 2020(2): 33–36.

Factors Influencing Merchants' Willingness to Participate in E-commerce Marketing in Digital Africa: A Case Study of Lagos, Nigeria

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Abstract: This study examines the current state of merchants' participation in e-commerce marketing within the context of the digital economy, focusing on merchants in Lagos, Nigeria. It explores the impact of behavioral attitudes, subjective norms, perceived behavioral control, and traditional transaction costs on their willingness to engage in e-commerce marketing. Grounded in the Theory of Planned Behavior (TPB) and employing a questionnaire survey, the study utilizes SPSS 23.0 and AMOS 22.0 for data analysis. The findings confirm the significant positive effects of behavioral attitudes, subjective norms, and perceived behavioral control on merchants' willingness, as well as the significant negative effect of traditional transaction costs. The results indicate that the advancement of digital economy policies has lowered participation barriers for merchants, with factors such as behavioral attitudes, social support, and digital skills playing crucial roles in decision-making. This paper recommends enhancing the usability of e-commerce platforms, improving infrastructure, and optimizing policy support. These suggestions provide theoretical insights and practical guidance for promoting Nigeria's digital economy and advancing research on merchants' e-commerce behavior.

Keywords: Digital economy; E-commerce marketing; Theory of Planned Behavior; Merchants' willingness to participate; Lagos; Nigeria

1. Introduction

This study examines the current state of merchants' participation in e-commerce marketing within the digital economy, analyzing its development background and influencing factors. The objective is to provide a reference for advancing research and practice in this field.

In recent years, Nigeria has implemented a series of policy measures to promote digital economic development. In August 2019, the country launched the National e-Government Master Plan and, in October of the same year, renamed the Ministry of Communications to the Ministry of Communications and Digital Economy, underscoring its commitment to digital transformation. In March 2020, Nigeria initiated the "National Broadband Plan" [1], recognizing telecommunications infrastructure as critical national infrastructure. In June

2022, President Muhammadu Buhari announced the establishment of the "Presidential Council on Digital Economy and e-Government" to enhance the adoption of digital technologies, improve governmental efficiency and transparency, and foster a more business-friendly environment.

The Nigerian government considers big data a key driver of the digital economy, advocating the idea that "data is the new oil." This vision aims to facilitate economic transformation and reduce the country's over-reliance on oil. At the macro level, the digital economy has become a new engine for high-quality development and a crucial strategy for Nigeria's economic diversification. Its rapid growth not only enhances service efficiency and drives technological innovation but also generates employment and business opportunities, thereby significantly improving living standards. These developments have encouraged merchants to actively engage in e-commerce marketing.

In 2023, Nigeria's e-commerce sector continued to expand, with both traditional and emerging forms of e-commerce contributing significantly to economic development. During the COVID-19 pandemic in 2020, e-commerce marketing played a vital role, gradually becoming an integral part of daily life for both merchants and consumers. As online services have advanced, entry barriers to e-commerce marketing have steadily decreased, alleviating merchants' concerns about adopting new technologies. Merchants now benefit from the efficiency and convenience of e-commerce, fostering trust and recognition of this business model. It is estimated that by 2025, Nigeria's e-commerce penetration rate will reach 52.5%, with the number of e-commerce users surpassing 122.5 million, the highest in Africa. This robust growth underscores the critical role of e-commerce marketing in driving merchant participation.

The Nigerian government continues to accelerate the development of the digital economy. For instance, in March 2023, the implementation of a cashless policy in Lagos significantly increased the adoption of electronic payment systems, further integrating merchants into the digital economy. By participating in e-commerce marketing, merchants not only improve their economic standing and quality of life but also contribute to the expansion of digital commerce, attracting more talent to the sector and fostering high-quality industrial development.

Despite these advancements, academic research on the factors influencing merchants' participation in e-commerce marketing within the context of "Digital Africa" remains limited. In particular, there is a lack of systematic analyses of merchants' e-commerce behavior and the mechanisms underlying their decision-making processes. This study focuses on merchants in Lagos, Nigeria, using a questionnaire survey to examine the effects of behavioral attitudes, subjective norms, perceived behavioral control, and traditional transaction costs on their willingness to engage in e-commerce marketing. Additionally, it explores secondary and tertiary variables influencing merchant behavior, offering theoretical insights and practical guidance for future research in this field.

2. Literature review

2.1. Studies on the African e-commerce market

Recent research on the African e-commerce market has primarily focused on its development potential and associated challenges. Peprah *et al.* analyzed how Jumia, one of Africa's leading e-commerce companies, has employed non-market strategies to navigate institutional voids, thereby enhancing its legitimacy and operations [2]. Similarly, Chun and Ogwal examined the localization strategies of Canadian multinational enterprises entering African markets, underscoring the importance of adapting to local cultural and market dynamics [3].

The proliferation of mobile payments and the rise of a young, tech-savvy population in Africa have been identified as critical drivers of e-commerce growth. However, weak infrastructure and underdeveloped legal systems remain significant barriers. Additionally, DHL's expansion of its e-commerce platform into African markets highlights both the region's untapped potential and the logistical challenges it faces [4].

Studies on African e-commerce startups have frequently focused on Nigeria, which serves as a prime example

due to its diverse and thriving e-commerce ecosystem. De Goeij *et al.* observed that inefficiencies in logistics and limited payment options continue to impede e-commerce growth in the country [5]. Nevertheless, the innovative strategies of startups have positioned Nigeria as a model for e-commerce development across Africa.

2.2. Studies on the "Digital Africa" strategy

In the context of the "Digital Africa" strategy, scholars widely acknowledge digital transformation as a key driver of economic and social development. Zhang emphasized the importance of bridging the digital divide through digital literacy education, arguing that enhancing digital skills is essential for equitable access to digital resources [6]. Similarly, Miao and Liu highlighted strategies for fostering high-quality digital economy development, stressing the role of policy frameworks and cross-sectoral cooperation in achieving sustainable growth [7].

The African Union's "African Digital Transformation Strategy (2020–2030)" envisions the establishment of a unified digital market. Noh and Wang examined strategies for overcoming barriers to digital resource utilization, emphasizing the need to address access and usability challenges [8]. These insights are particularly relevant for tackling the digital divide, which remains a major obstacle to "Digital Africa" initiatives.

Additionally, studies have explored digital transformation across various industries, yielding broader implications for Africa's strategy. For instance, Kim and Ma analyzed the digital transformation of a fashion brand, demonstrating how businesses can leverage digital technologies to enhance operational efficiency and consumer engagement [9]. Their findings provide valuable insights for African enterprises seeking to integrate digital solutions into their operations.

To bridge the digital divide and foster inclusive growth, scholars have proposed measures such as optimizing digital literacy education, enhancing technological capabilities, and improving access to digital resources [10]. These strategies collectively aim to establish a solid foundation for Africa's digital transformation goals.

2.3. Studies on factors influencing e-commerce marketing willingness

Existing research on factors influencing e-commerce marketing willingness has yielded diverse findings regarding the impact of merchants' personal characteristics—such as educational background, age, gender, and household income—as well as external environmental factors. Wang and Zhang found that rural e-commerce merchants' willingness to adopt digital upgrades is significantly influenced by their perceptions of digital transformation benefits and the availability of supportive infrastructure [11]. Similarly, Li *et al.* found that consumers' adoption of vegetable e-commerce in Beijing was primarily determined by factors such as trust in the platform, perceived ease of use, and logistics efficiency [12]. These findings highlight the interdependence between consumer behavior and merchant willingness in the development of e-commerce ecosystems.

Guo *et al.* conducted an empirical study on consumers' willingness to purchase agricultural products online, emphasizing that platform reliability, payment system convenience, and product quality assurance directly influence participation [13]. Their research underscores the importance of trust and reliability in motivating both merchants and consumers. Additionally, Do *et al.* highlighted external challenges affecting merchants' willingness, such as inadequate logistics services, which increase operating costs and reduce enthusiasm for participation [14]. Cybersecurity concerns and the absence of robust regulatory frameworks also pose significant barriers, as noted by Udo [15]. Addressing these issues through targeted policy support, platform training programs, and technological enhancements could help mitigate these barriers and boost merchant participation.

In conclusion, merchants' willingness to engage in e-commerce marketing is shaped by a combination of individual characteristics, platform reliability, and external factors such as policy support and infrastructure availability. These insights provide valuable theoretical and practical references for enhancing participation in

e-commerce activities.

3. Theoretical foundation

This study is based on the Theory of Planned Behavior (TPB), a widely recognized theoretical model in behavioral sciences proposed by Ajzen [16]. TPB posits that an individual's behavioral intention is determined by three key factors (**Figure 1**):

(1) Behavioral attitude: An individual's positive or negative evaluation of a specific behavior.

(2) Subjective norms: The expectations of society and significant others regarding the behavior, as well as their influence on the individual's decision-making.

(3) Perceived behavioral control: An individual's self-perception of their ability to perform the behavior, including access to resources and opportunities.

In this study, the TPB framework is applied to analyze the willingness of merchants in Lagos, Nigeria, to participate in e-commerce marketing. Specifically, it examines how behavioral attitudes (e.g., acceptance and interest in e-commerce marketing), subjective norms (e.g., social support and peer influence), and perceived behavioral control (e.g., mastery of digital skills and the usability of e-commerce platforms) collectively influence merchants' decision-making processes.

By integrating TPB into this context, the study aims to validate and extend its applicability within the digital economy, providing theoretical support and practical insights for enhancing merchants' participation in e-commerce marketing.
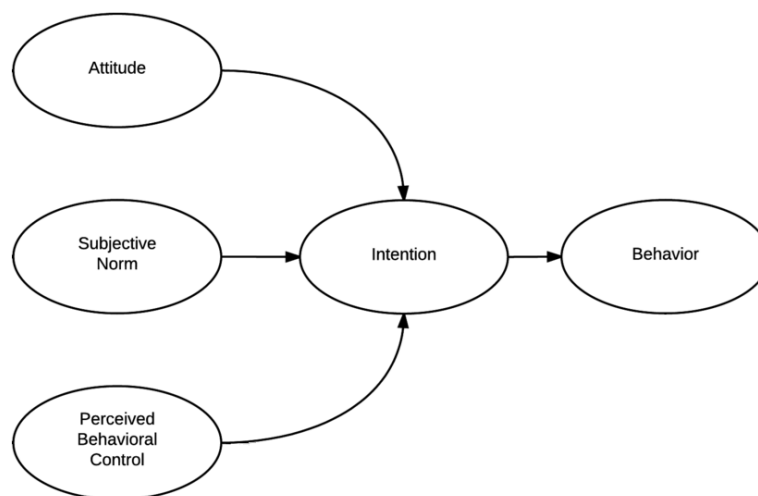

Figure 1. The Theory of Planned Behavior (TPB)

Merchants' willingness to engage in e-commerce is shaped by multiple factors. When this willingness is present, merchants are more likely to adopt e-commerce marketing practices. Therefore, TPB serves as an appropriate framework for analyzing merchants' willingness to participate in e-commerce marketing.

4. Hypothesis development and model construction

4.1. Hypothesis development

Based on the preceding analysis, the factors influencing merchants' willingness to participate in e-commerce

marketing are summarized, and the research hypotheses are formulated as follows:

4.1.1. The impact of behavioral attitude factors on merchants' willingness to participate in e-commerce marketing

Wang and Zhang identified behavioral attitudes as a key determinant of merchants' willingness to adopt digital upgrades in rural e-commerce [11]. Specifically, when merchants perceive that e-commerce marketing can increase sales, enhance revenue, or optimize operational costs, they develop more positive behavioral attitudes, thereby strengthening their willingness to participate.

Sambamoorthi further demonstrated that consumers' positive attitudes toward e-commerce significantly enhance their willingness to adopt such practices. While their study primarily focuses on consumer behavior, its findings offer valuable insights into merchants' willingness to engage in e-commerce marketing [17].

Behavioral attitudes are typically measured through four indicators:

(1) Increased product sales

(2) Higher product pricing

(3) Enhanced industry revenue

(3) Reduced sales costs

These attitudes are jointly influenced by belief strength and outcome evaluation. Merchants with a strong interest in e-commerce marketing and a positive perception of its benefits are more likely to demonstrate a higher willingness to participate. Conversely, those who do not recognize the advantages of the e-commerce model tend to be less inclined to engage, based on subjective judgment. Thus, the following hypothesis is proposed:

H1: Behavioral attitude factors positively influence merchants' willingness to participate in e-commerce marketing.

4.1.2. The impact of subjective norm factors on merchants' willingness to participate in e-commerce marketing

Merchants' willingness to engage in e-commerce marketing is significantly influenced by subjective norm factors, which reflect the role of social environments in shaping behavioral intentions. Kosasih and Sulaiman emphasized that social support, including encouragement from family, friends, and local organizations, plays a crucial role in motivating rural merchants to adopt digital transformation in e-commerce [18]. Similarly, Yaseen *et al.* highlighted that support from close associates and government initiatives enhances merchants' trust and confidence in adopting e-commerce practices [19].

Subjective norm factors can be categorized into four key indicators:

(1) Support from family and friends for e-commerce participation

(2) Encouragement from close associates to engage in e-commerce marketing

(3) Training provided by local alliance organizations in relevant digital technologies

(4) Strong promotion and policy support from government and society

Subjective norms are shaped by normative beliefs and individuals' motivation to align with expectations from significant social groups. Merchants who receive positive reinforcement from trusted individuals and institutions experience reduced psychological barriers and an increased willingness to participate in e-commerce marketing. These findings align with Dai *et al.*, who suggested that social influence and community well-being contribute to individuals' adoption of innovative practices [20]. Thus, the following hypothesis is proposed:

H2: Subjective norm factors positively influence merchants' willingness to participate in e-commerce marketing.

4.1.3. The impact of perceived behavioral control factors on merchants' willingness to participate in e-commerce marketing

Pavlou and Fygenson expanded TPB to e-commerce contexts, demonstrating that perceived behavioral control significantly influences intentions and behaviors in digital environments [21]. Similarly, Nur DP and Gusrafani emphasized that perceived ease of use, operational capabilities, and access to resources are critical determinants of e-commerce adoption [22]. Based on these studies, perceived behavioral control factors encompass a merchant's assessment of their capacity to engage in e-commerce marketing, shaped by their skills, confidence, and access to supporting resources.

Key indicators affecting merchants' willingness to participate in e-commerce marketing include:

(1) Perceived difficulty of entering e-commerce marketing

(2) Availability of personnel and time for managing digital transactions

(3) Competency in operational e-commerce skills

(4) Understanding of transaction and logistics procedures

(5) Access to supportive policies and infrastructure

Perceived behavioral control reflects a merchant's self-efficacy and resource availability. Higher perceived control reduces barriers, fosters confidence, and increases the likelihood of e-commerce participation. According to Widiar *et al.*, when individuals perceive e-commerce systems as manageable, their behavioral intentions strengthen [23]. Similarly, Adams argued that targeted training programs and resource accessibility significantly enhance perceived control, facilitating participation [24]. By equipping merchants with essential skills and resources, barriers to entry can be mitigated, thereby increasing their willingness to adopt e-commerce marketing practices. Thus, the following hypothesis is proposed:

H3: Perceived behavioral control factors positively influence merchants' willingness to participate in e-commerce marketing.

4.1.4. The impact of traditional transaction costs on merchants' willingness to participate in e-commerce marketing

Hennart highlighted the transaction cost theory as a foundational framework for understanding how businesses minimize exchange costs, particularly in international markets [25]. Cuypers *et al.* further demonstrated that reducing transaction costs enhances operational efficiency and decision-making, particularly when adapting to novel business environments [26].

In the context of e-commerce marketing, traditional transaction costs remain a significant barrier for merchants, compelling them to seek alternative solutions. These costs include:

(1) Transportation expenses

(2) Fees for maintaining product quality

(3) Intermediary charges

(4) Information-gathering costs

Merchants operating in traditional markets often encounter challenges such as:

(1) Limited access to timely and accurate market prices and consumer demand information

(2) Unstable and unreliable sales channels

(3) Inconsistent quality standards from intermediaries or vendors

(4) Weak bargaining power due to market asymmetries

E-commerce marketing mitigates these challenges by streamlining market access, improving transparency, and reducing intermediary reliance, thereby lowering transaction costs. Through digital platforms, merchants can bypass inefficiencies associated with traditional markets, enhancing their willingness to participate. Drawing on

transaction cost theory, this study posits that traditional transaction costs serve as a significant factor in merchants' decision-making. Thus, the hypothesis is formulated as follows:

H4: Traditional transaction costs negatively influence merchants' willingness to participate in e-commerce marketing.

4.2. Model construction

This research model examines merchants' willingness to participate in e-commerce marketing, incorporating four core factors: behavioral attitude, subjective norms, perceived behavioral control, and traditional transaction costs (**Figure 2**).

(1) Behavioral attitude: Represents merchants' interest, perceived convenience, and expected benefits from e-commerce marketing. The hypothesis posits that a more positive attitude increases willingness to participate.

(2) Subjective norms: Captures the influence of social groups and peers on merchants' decision-making. The hypothesis suggests that stronger social or peer influence enhances willingness to participate.

(3) Perceived behavioral control: Encompasses technical capabilities, financial resources, and internet access. The hypothesis asserts that greater perceived control strengthens willingness to participate.

(4) Traditional transaction costs: Includes logistics expenses, payment efficiency, and information asymmetry. The hypothesis proposes that lower transaction costs facilitate greater willingness to engage in e-commerce marketing.

These variables collectively shape merchants' decision-making processes, interacting to determine their willingness to participate in e-commerce marketing.
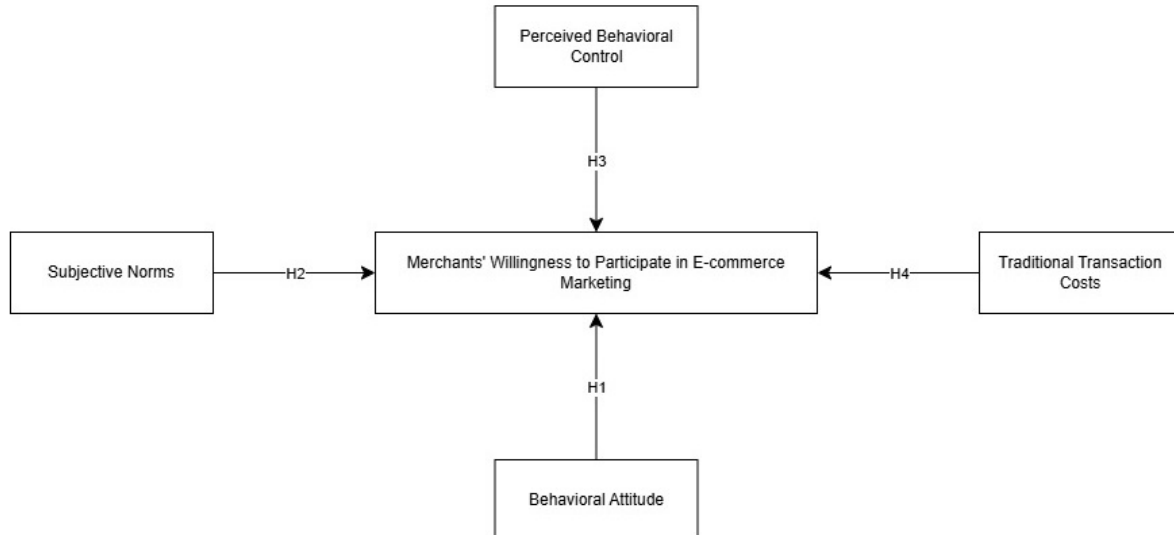

Figure 2. Research model path coefficients

5. Research design

5.1. Sample and data collection

This study targets merchants in Lagos, Nigeria, specifically those operating on Lagos Island. A total of 1,707 questionnaires were distributed for data collection. After excluding invalid responses, 1,583 valid questionnaires were obtained, yielding an effective response rate of 92%. The characteristics of the survey sample are presented in **Table 1**.

Table 1. Descriptive statistics of merchant characteristics

Sample characteristics	Category	Frequency	Percentage (%)
Gender	Female	705	44.5
	Male	876	55.5
Age	Under 20	143	9.0
	20–30 years	483	30.5
	31–40 years	617	39.0
	41–50 years	245	15.5
	Over 51	95	6.0
Education level	Junior high school	87	5.5
	High School/College	1,354	85.5
	University or above	142	9.0
Industry distribution	Transportation/Logistics	222	14.0
	Information Technology/Communication	213	13.5
	Culture/Entertainment/Sports	71	4.5
	Public Administration/Defense	71	4.5
	Other industries	1,006	63.5
Annual household income	Under 1 million RMB	641	40.5
	1–5 million RMB	515	32.5
	5–10 million RMB	427	27.0

Regarding gender distribution, male respondents account for 55.5%, while female respondents constitute 44.5%, aligning closely with the actual gender ratio of merchants in the region. This consistency enhances the analytical reliability of the study.

In terms of educational background, 85.5% of respondents hold a high school or college diploma, 9.0% have a university degree or higher, and 5.5% have completed junior high school, indicating that the majority of surveyed merchants possess a relatively high level of education.

The age distribution is concentrated within the 20–40 age group (69.5%), suggesting a younger demographic predominance in the sample.

With respect to annual household income, the largest proportion falls within the 1–5 million RMB range (32.5%), followed by the 5–10 million RMB category (27.0%).

Overall, the sample characteristics are consistent with the current demographic distribution of merchants engaged in e-commerce marketing, ensuring representativeness and providing a strong data foundation for the subsequent empirical analysis.

5.2. Variable measurement

To ensure reliability and validity, this study adopts well-established measurement scales from domestic and international literature, making necessary adjustments to fit the specific research context. Survey responses are measured using a five-point Likert scale, where: 1 = Strongly disagree; 2 = Somewhat disagree; 3 = Neutral; 4 = Somewhat agree; and 5 = Strongly agree. Higher scores indicate a stronger level of agreement with the

corresponding statement. The questionnaire collects basic merchant information, evaluates their current e-commerce engagement, assesses their operational capabilities and satisfaction levels, and explores potential solutions to existing challenges. All latent variables are measured using a five-point Likert scale, as shown in **Table 2**.

5.2.1. Independent variable measurement dimensions scale

The independent variables include four key dimensions:

(1) Merchants' behavioral attitudes

(2) Subjective norms

(3) Perceived behavioral control

(4) Traditional transaction costs

These dimensions comprise 17 measurement items, presented in **Table 2**.

Table 2. Independent variable measurement dimensions scale

Variable	Code	Measurement Item	Reference
Merchants' behavioral attitudes	BA1	Promote product sales	Wu J-H, Wang S-C, 2005 [27]
	BA2	Increase product sales price	
	BA3	Increase industry income	
	BA4	Reduce sales costs	
Merchants' subjective norms	SN1	Family and friends' support and encouragement	Venkatesh V, Davis FD, 2000 [28]
	SN2	Influence from friends and the surrounding crowd	
	SN3	Village committee organizing training on relevant technology	
	SN4	Strong government and social support and promotion	
Merchants' perceived behavioral control	PBC1	Low entry threshold for participating in e-commerce	Ajzen I, 2002 [29]
	PBC2	Familiarity with online transaction procedures and finds them simple	
	PBC3	Sufficient personnel or time to handle online transactions	
	PBC4	Possesses certain e-commerce operation abilities	
	PBC5	Believes relevant policies facilitate participation in e-commerce	
Merchants' traditional transaction costs	TC1	Difficulty in obtaining market prices and consumer demand information promptly	Wang N, 2007 [30]
	TC2	Unstable channels for selling products in traditional markets	
	TC3	Inconsistent product quality assessment by vendors or intermediaries	
	TC4	Weak bargaining power in the product market	

5.2.2. Dependent variable measurement dimensions scale

The dependent variable is merchants' willingness to participate in e-commerce marketing, measured using two items, as detailed in **Table 3**.

Table 3. Dependent variable measurement dimensions scale

Variable	Code	Measurement Item	Reference
Merchant's willingness to participate in e-commerce marketing	C1	Strong willingness to participate in e-commerce marketing	Parent M, Plangger K, Bal A, 2011 [31]
	C2	Desire to learn about and participate in e-commerce training	

6. Empirical analysis

6.1. Reliability analysis

To assess the reliability and validity of the scale, Cronbach's alpha coefficient is employed to evaluate data reliability. In general, a Cronbach's alpha value exceeding 0.7 indicates a high level of reliability, suggesting that the questionnaire is suitable for further correlation analysis.

As shown in **Table 4**, Cronbach's alpha coefficients for all dimensions in this study exceed 0.7, confirming that the questionnaire demonstrates satisfactory reliability.

Table 4. Reliability test results

Variable name	Number of items	Cronbach's α
Merchant's behavioral attitude	4	0.807
Merchant's subjective norms	4	0.707
Merchant's perceived behavioral control	5	0.835
Merchant's traditional transaction costs	4	0.788
Merchant's willingness to participate in e-commerce marketing	2	0.814

6.2. Validity test

Validity refers to the accuracy and appropriateness of a measurement instrument in assessing the intended constructs. While reliability serves as the foundation of validity, validity represents the ultimate goal of measurement accuracy.

Before conducting factor analysis, it is necessary to assess sampling adequacy using the Kaiser-Meyer-Olkin (KMO) test and Bartlett's Sphericity Test.

In general, a KMO value greater than 0.7 suggests that the dataset is suitable for factor analysis. As presented in **Table 5**, the KMO test result is 0.894, exceeding the 0.7 threshold, while the significance level of Bartlett's Sphericity Test is 0.000 (< 0.001). These findings indicate that factor analysis is appropriate, confirming the sound structural design of the questionnaire.

Table 5. Validity test results

KMO value	Approximate χ^2	Degrees of freedom	Significance
0.894	792.758	171	0.000

6.3. Correlation analysis

SPSS 22.0 software was used to conduct correlation analysis to examine the hypothesized relationships within the model. Factor analysis was first applied to classify the variables into four distinct factors, followed by an examination of their correlations using SPSS 22.0.

As shown in **Table 6**, the "******" symbol in the upper right corner signifies that the correlation is significant at the 0.01 level. This result confirms that each independent variable is significantly correlated with merchants' willingness to participate in e-commerce marketing.

Specifically, the correlation coefficients between merchants' attitudes, subjective norms, perceived behavioral control, and their willingness to participate in e-commerce marketing are 0.823, 0.729, and 0.751, respectively. All P-values are 0.000 (< 0.01), indicating a statistically significant positive correlation with merchants' willingness to engage in e-commerce marketing.

Conversely, the correlation coefficient between traditional transaction costs and merchants' willingness

to participate in e-commerce marketing is -0.767, with a *P*-value of 0.000 (< 0.01). This suggests a significant negative correlation, indicating that higher traditional transaction costs reduce merchants' likelihood of engaging in e-commerce marketing.

Table 6. Correlation test results

		Merchant's attitude	Merchant's subjective norm	Merchant's perceived behavioral control	Merchant's traditional transaction costs
Merchant's willingness to participate in e-commerce marketing	Pearson correlation	0.823**	0.729**	0.751**	-0.767**
	Significance (two-tailed)	0.000	0.000	0.000	0.000
	Case count	504	504	504	504

Note: "0.000" indicates statistical significance at the 0.01 level (two-tailed); "0.823, 0.729, 0.751, and -0.767" represent the strength and direction of the correlations between the variables.

6.4. Path analysis of the structural model

This study examines merchants' intention to participate in e-commerce marketing by assessing the direct impact of merchants' attitudes, subjective norms, perceived behavioral control, and traditional transaction costs on their participation decisions. The objective is to evaluate whether hypotheses H1, H2, H3, and H4 are supported based on the proposed conceptual model and research assumptions.

Following the correlation and validity tests, AMOS 23.0 statistical analysis software was used to construct the initial model path diagram, which integrates both the measurement model and the structural model. The four key factors in this study were treated as latent variables, while data from 17 observed variables were incorporated into the structural model diagram. This process facilitated the formation of second-level (X) and third-level indicators for merchants' intention to participate in e-commerce marketing.

6.4.1. Model fit test of the structural equation model

The model fit test is primarily assessed using fit indices. After refining the initial structural equation model, an exploratory factor analysis was conducted to obtain the final model fit indices, as presented in **Table 7**. The fit indices of the hypothesis model fall within the acceptable range, indicating that the theoretical model aligns well with the empirical data structure and demonstrates a strong model fit.

Table 7. Model fit indices

Fit index	CMIN	DF	CMIN/DF	GFI	AGFI	RMSEA	IFI	TLI (NNFI)	CFI
Standard value	-	-	< 3.00	> 0.80	> 0.80	< 0.08	> 0.90	> 0.90	> 0.90
Measured value	385.236	142	2.713	0.919	0.892	0.058	0.962	0.954	0.962

As shown in **Table 7**, the CMIN/DF value is 2.713, which is below the standard threshold of 3, indicating a good model fit. The GFI (0.919) and AGFI (0.892) exceed the 0.8 threshold, confirming that the model meets the required criteria. Additionally, TLI (0.954), IFI (0.962), and CFI (0.962) all surpass 0.9, indicating an excellent model fit. The RMSEA value (0.058), which falls below 0.08, further confirms the model's suitability.

6.4.2. Analysis of standardized load coefficients in the model

Table 8. Factor loading matrix

Variable	Code	Standardized Load
Merchants' behavioral attitude	BA1	0.791
	BA2	0.840
	BA3	0.851
	BA4	0.815
Merchants' subjective norms	SN1	0.801
	SN2	0.780
	SN3	0.731
	SN4	0.739
Merchants' perceived behavioral control	PBC1	0.714
	PBC2	0.784
	PBC3	0.793
	PBC4	0.818
	PBC5	0.683
Merchants' traditional transaction costs	TC1	0.792
	TC2	0.816
	TC3	0.832
	TC4	0.786
Merchants' willingness to participate in e-commerce marketing	C11	0.792
	C12	0.822

As presented in **Table 8**, all factor loading values exceed 0.6, indicating strong construct validity and a well-adapted model structure.

6.4.3. Path coefficient analysis of the structural equation model

The path coefficients between indicators were estimated using the variance and covariance of the variables. This model employs a recursive structure, where the observed variables in the regression equations are generally linear. Consequently, the maximum likelihood estimation (MLE) method was used to estimate the path coefficients.

MLE provides an estimation approach that maximizes the likelihood of observing the given data, ensuring that the path coefficients accurately represent the relationships between variables. These coefficients are then used to assess the strength and direction of the relationships between factors, validating the hypotheses and determining their impact on merchants' intention to participate in e-commerce marketing.

Table 9. Path coefficients

Path relationship		Standardized coefficient	Unstandardized error	Standard error	*t*-value	*P*-value	Hypothesis support
Dependent variable	**Independent variable**						
Merchants' willingness to participate in e-commerce marketing	Merchants' behavioral attitude	0.232	0.206	0.049	4.204	***	Supported
	Merchants' subjective norms	0.190	0.178	0.062	2.87	0.004	Supported
	Merchants' perceived behavioral control	0.215	0.244	0.067	3.641	***	Supported
	Merchants' traditional transaction costs	-0.216	-0.217	0.057	-3.807	***	Supported

From **Table 9**, the following conclusions can be drawn:

(1) Merchants' behavioral attitude significantly positively influences their intention to participate in e-commerce marketing (standardized coefficient: 0.232, $P < 0.05$).

(2) Merchants' subjective norms have a significant positive correlation with their intention to participate (standardized coefficient: 0.190, $P < 0.05$).

(3) Merchants' perceived behavioral control also exhibits a significant positive correlation with their intention to participate (standardized coefficient: 0.215, $P < 0.05$).

(4) Traditional transaction costs are negatively correlated with merchants' intention to participate in e-commerce marketing (standardized coefficient: -0.216, $P < 0.05$).

These findings are visually represented in **Figure 2**, where the numbers on the arrows indicate path coefficients, reflecting the direct effect magnitude between variables.
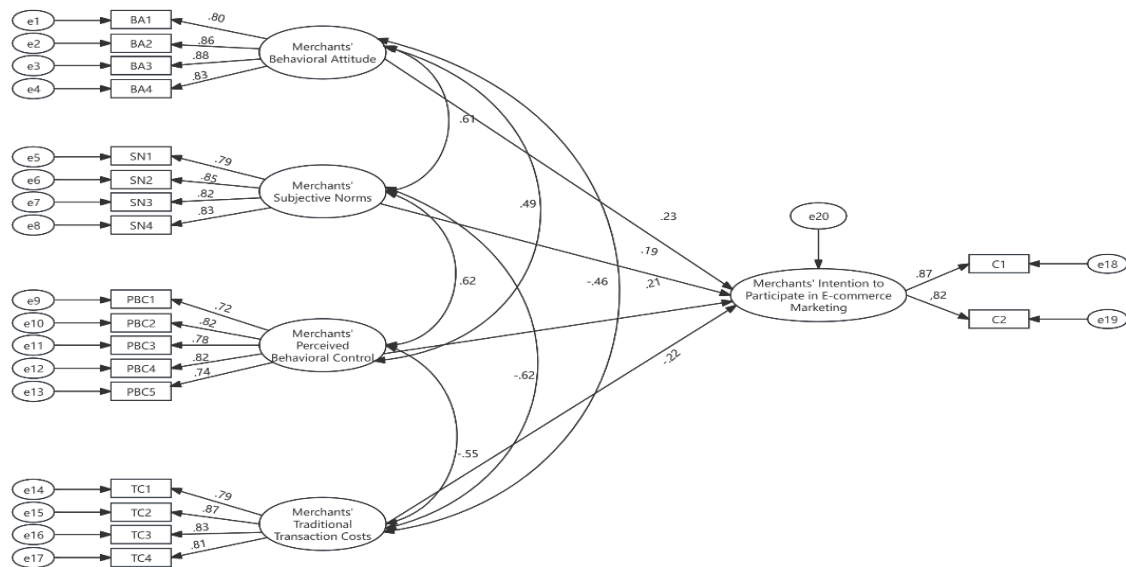

Figure 2 Path Coefficient Analysis of the Structural Equation Model

Figure 2. Path coefficient analysis of the structural equation model

6.4.4. Hypothesis testing summary

Based on the analysis performed using AMOS 23.0, the hypothesized model was thoroughly evaluated, and the path coefficients of influencing factors were analyzed. The results confirm that the structural model is reasonable,

and all hypotheses are supported (**Table 10**).

H1: The merchant's behavioral attitude positively influences the intention to participate in e-commerce marketing.

H2: The merchant's subjective norms positively influence the intention to participate due to peer influence and social encouragement.

H3: The merchant's perceived behavioral control positively impacts the intention to participate, as greater confidence in handling e-commerce operations increases participation likelihood.

H4: Traditional transaction costs negatively influence intention to participate, as higher costs deter merchants from engaging in e-commerce marketing.

Table 10. Hypothesis testing results

Hypothesis	Relationship between variables	P	Test result
H1	Merchant behavior attitude → Merchant e-commerce marketing intention	***	Supported
H2	Merchant subjective norm → Merchant e-commerce marketing intention	0.004	Supported
H3	Merchant perceived behavioral control → Merchant e-commerce marketing intention	***	Supported
H4	Merchant traditional transaction costs → Merchant e-commerce marketing intention	***	Supported

6.4.5. Analysis of merchant participation in e-commerce marketing based on structural equation modeling

After a detailed analysis of the data and path testing of the influencing factors model, the final results indicate that the model and hypotheses are reasonable. The analysis results are summarized as follows:

6.4.5.1. Positive influences

6.4.5.1.1. Behavioral attitude's positive influence on merchant willingness to participate in e-commerce marketing

The standardized coefficient for the influence of merchants' behavioral attitudes on their willingness to participate in e-commerce marketing is 0.232 ($P < 0.05$), indicating a significant positive correlation. This suggests that a more positive attitude toward e-commerce marketing strengthens merchants' intention to participate.

In this study, behavioral attitude refers to a merchant's positive or negative perception of e-commerce marketing, shaped by both emotional and economic considerations. When merchants experience greater emotional satisfaction and perceive higher economic benefits from e-commerce participation, their willingness to engage increases. The estimated standardized regression coefficient for behavioral attitude (0.232) is the largest among the four influencing factors. Survey results based on product sales volume, sales prices, industry revenue, and product sales costs demonstrate that the more favorable the perceived impact, the greater the benefits merchants associated with e-commerce, significantly enhancing their participation intention.

6.4.5.1.2. Subjective norms' positive influence on merchant willingness to participate in e-commerce marketing

The standardized coefficient for the effect of subjective norms on merchant participation in e-commerce marketing is 0.190 ($P < 0.05$), indicating a significant positive influence. This suggests that when merchants perceive strong encouragement or pressure from peers or other influential individuals, their willingness to engage in e-commerce marketing increases.

In this study, subjective norms refer to the influence of significant individuals, such as family, friends, or

peers, on a merchant's decision. Survey results indicate that support from family and friends, encouragement from peers engaged in e-commerce, and social support—such as government or industry association initiatives promoting digital skills—motivate merchants to participate more actively in e-commerce marketing.

6.4.5.1.3. Perceived behavioral control's positive influence on merchant willingness to participate in e-commerce marketing

The standardized coefficient for the influence of perceived behavioral control on merchant willingness to participate in e-commerce marketing is 0.215 ($P < 0.05$), indicating a significant positive correlation. Merchants who perceive themselves as capable of managing e-commerce operations are more inclined to participate.

This study examines five key factors affecting perceived behavioral control: the entry barriers to e-commerce, the availability of sufficient staff and time to manage online transactions, e-commerce operational capabilities, knowledge of online transaction procedures, and the presence of supportive policies. The findings indicate that merchants who receive greater external support and have stronger self-perceived e-commerce capabilities are more likely to engage in e-commerce marketing.

6.4.5.2. Negative influence

6.4.5.2.1. Traditional transaction costs' negative influence on merchant willingness to participate in e-commerce marketing

The standardized coefficient for the influence of traditional transaction costs on merchant willingness to participate in e-commerce marketing is -0.216 ($P < 0.05$), indicating a significant negative correlation. Higher traditional transaction costs reduce merchants' likelihood of engaging in e-commerce marketing.

This study focuses on four key factors related to traditional transaction costs: the availability of timely market price and demand information, the stability of product sales channels in traditional markets, the role of intermediaries in product quality grading, and bargaining power in the market. The results indicate that a lower prevalence of these challenges in traditional market transactions reduces transaction costs, thereby increasing merchants' willingness to participate in e-commerce marketing. These findings support the hypothesis that traditional transaction costs negatively influence merchant participation in e-commerce marketing.

7. Research conclusion and suggestions

7.1. Research conclusion

Through factor analysis, this study categorizes the factors influencing merchants' willingness to participate in e-commerce marketing into four dimensions: behavioral attitude, subjective norms, perceived behavioral control, and traditional transaction costs. The findings are as follows:

    (1) Behavioral attitude: Factors such as product sales volume, pricing, industry revenue, and costs have a significant positive influence on merchants' willingness to participate in e-commerce marketing. The more favorable merchants' perceptions of these factors, the stronger their intention to engage.

    (2) Subjective norms: Support from family and friends, encouragement from peers, and backing from industry associations and the government significantly enhance merchants' willingness to participate in e-commerce marketing. When merchants perceive positive external influences, their likelihood of engagement increases.

    (3) Perceived behavioral control: Elements such as the entry threshold for participation, resource availability, e-commerce operational capabilities, and policy support strongly impact merchants' willingness to participate. When merchants believe they possess the necessary resources and competencies, their

inclination to engage in e-commerce marketing increases.

(4) Traditional transaction costs: Challenges in obtaining market information, channel stability, product quality identification, and bargaining power in traditional markets have a significant negative effect on merchants' willingness to participate. Higher traditional transaction costs discourage participation in e-commerce marketing.

7.2. Suggestions

Policy and practical implications: To enhance merchant participation in e-commerce marketing, efforts should focus on improving merchants' attitudes, strengthening external support, and increasing their perceived control over e-commerce operations. Additionally, reducing traditional transaction costs—particularly by improving access to market information, enhancing channel stability, and simplifying product quality identification—will further encourage engagement.

These findings provide a strong foundation for developing policies and practices aimed at increasing merchant involvement in e-commerce marketing.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Federal Ministry of Communications and Digital Economy, 2020, Nigerian National Broadband Plan 2020–2025. http://ngfrepository.org.ng:8080/jspui/handle/123456789/3349

[2] Peprah AA, Atarah BA, Kumodzie-Dussey MK, 2024, Nonmarket Strategy and Legitimacy in Institutionally Voided Environments: The Case of Jumia, an African E-commerce Giant. International Business Review, 33(2): 102169. https://doi.org/10.1016/j.ibusrev.2023.102169

[3] Chun W, Ogwal E, 2023, E-commerce Localisation to African Markets: Canadian Multinational Enterprise Perspectives. Journal of Cultural Marketing Strategy, 7(2): 134–145. https://doi.org/10.69554/vskl8682

[4] M2 Presswire, 2019, DHL Rolls Out E-commerce Platform to More African Markets Following Initial Success. https://dhl.africa-newsroom.com/

[5] de Goeij C, van Weelden R, Breijer M, et al., 2022, Inefficiencies in Order to Cash Processes in the Logistics Industry: Empirical Evidence from the Netherlands. Vervoerslogistiekewekdagen, 2022: 217–230.

[6] Zhang X, 2024, A Study on Strategies for Bridging the Digital Gender Divide through Digital Literacy Education. International Journal of Mathematics and Systems Science, 7(3): 5018. https://doi.org/10.18686/ijmss.v7i3.5018

[7] Miao Y, Liu Y, 2023, Study on the Strategies for Promoting the High-Quality Development of China's Digital Economy. Academic Journal of Business & Management, 5(23): 113–118. https://doi.org/10.25236/AJBM.2023.052317

[8] Noh Y, Wang D, 2021, A Study on the Strategy of Resolving Impediments to Use of Digital Resources: The Case of Korean Public Libraries. International Journal of Knowledge Content Development & Technology, 11(3): 81–112. https://doi.org/10.5865/IJKCT.2021.11.3.081

[9] Kim S, Ma JJ, 2019, A Study on the Digital Transformation Strategy of A Fashion Brand. The Research Journal of the Costume Culture, 27(5): 449–460. https://doi.org/10.29049/rjcc.2019.27.5.449

[10] Hamburg I, Lütgen G, 2019, Digital Divide, Digital Inclusion and Inclusive Education. Advances in Social Sciences Research Journal, 6(4): 193–206. https://doi.org/10.14738/assrj.64.6457

[11] Wang Y, Zhang Z, 2023, A Study on the Willingness and Factors Influencing the Digital Upgrade of Rural E-Commerce. Behavioral Sciences, 13(2): 95. https://doi.org/10.3390/bs13020095

[12] Li B, Yin Z, Ding J, et al., 2020, Key Influencing Factors of Consumers' Vegetable E-commerce Adoption Willingness, Behavior, and Willingness-Behavior Consistency in Beijing, China. British Food Journal, 122(12): 3741–3756. https://doi.org/10.1108/BFJ-11-2019-0834

[13] Guo J, Hao H, Wang M, et al., 2022, An Empirical Study on Consumers' Willingness to Buy Agricultural Products Online and Its Influencing Factors. Journal of Cleaner Production, 336: 130403. https://doi.org/10.1016/j.jclepro.2022.130403

[14] Do AD, Ta VL, Bui PT, et al., 2023, The Impact of the Quality of Logistics Services in E-Commerce on the Satisfaction and Loyalty of Generation Z Customers. Sustainability, 15(21): 15294. https://doi.org/10.3390/su152115294

[15] Udo GJ, 2001, Privacy and Security Concerns as Major Barriers for E-Commerce: A Survey Study. Information Management & Computer Security, 9(4): 165–174. https://doi.org/10.1108/EUM0000000005808

[16] Ajzen I, 1991, The Theory of Planned Behavior. Organizational Behavior and Human Decision Processes, 50(2): 176–211. https://doi.org/10.1016/0749-5978(91)90020-T

[17] Sambamoorthi S, 2023, Consumer Perception and Awareness on E-Commerce. International Journal of Scientific Development and Research, 8(5): 1867–1870.

[18] Kosasih A, Sulaiman E, 2024, Digital Transformation in Rural Settings: Unlocking Opportunities for Sustainable Economic Growth and Community Empowerment. Journal of Sustainable Tourism and Entrepreneurship, 5(2): 129–143. https://doi.org/10.35912/joste.v5i2.2278

[19] Yaseen H, Dingley K, Adams C, 2015, The Government's Role in Raising Awareness Towards E-commerce Adoption: The Case of Jordan. Proceedings of the 15th European Conference on eGovernment, 4(1), 29–43.

[20] Dai GS, Ulgiati S, Zhang YS, et al., 2014, The False Promises of Coal Exploitation: How Mining Affects Herdsmen Well-Being in the Grassland Ecosystems of Inner Mongolia. Energy Policy, 67: 146–153. https://doi.org/10.1016/j.enpol.2013.12.033

[21] Pavlou PA, Fygenson M, 2006, Understanding and Predicting Electronic Commerce Adoption: An Extension of the Theory of Planned Behavior. MIS Quarterly, 30(1): 115–143. https://doi.org/10.2307/25148720

[22] Nur DP E, Gusrafani LS, 2021, Analysis of E-Commerce Customer Behavior: A Theory of Planned Behavior Approach. Journal of Theoretical and Applied Information Technology, 99(1): 100–113.

[23] Widiar G, Yuniarinto A, Yulianti I, 2023, Perceived Ease of Use's Effects on Behavioral Intention Mediated by Perceived Usefulness and Trust. Interdisciplinary Social Studies, 2(4): 1829–1844. https://doi.org/10.55324/iss.v2i4.397

[24] Adams K, 2022, E-Commerce Adoption Strategies for Small Retail Businesses, dissertation, Walden University.

[25] Hennart J-F, 2010, Transaction Cost Theory and International Business. Journal of Retailing, 86(3): 257–269. https://doi.org/10.1016/j.jretai.2010.07.009

[26] Cuypers IRP, Hennart J-F, Silverman BS, et al., 2021, Transaction Cost Theory: Past Progress, Current Challenges, and Suggestions for the Future. Academy of Management Annals, 15(1): 111–150. https://doi.org/10.5465/annals.2019.0051

[27] Wu J-H, Wang S-C, 2005, What Drives Mobile Commerce? An Empirical Evaluation of the Revised Technology Acceptance Model. Information & Management, 42(5): 719–729. https://doi.org/10.1016/j.im.2004.07.001

[28] Venkatesh V, Davis FD, 2000, A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies. Management Science, 46(2): 186–204. https://doi.org/10.1287/mnsc.46.2.186.11926

[29] Ajzen I, 2002, Perceived Behavioral Control, Self-Efficacy, Locus of Control, and the Theory of Planned Behavior.

Journal of Applied Social Psychology, 32(4): 665–683. https://doi.org/10.1111/j.1559-1816.2002.tb00236.x

[30] Wang N, 2007, Measuring Transaction Costs: Diverging Approaches, Contending Practices. Division of Labor & Transaction Costs, 2(2): 111–146. https://doi.org/10.1142/S0219871107000324

[31] Parent M, Plangger K, Bal A, 2011, The New WTP: Willingness to Participate. Business Horizons, 54(3): 219–229. https://doi.org/10.1016/j.bushor.2011.01.003

Optimizing Human Capital for ESG Success: A Social Cognitive Theory Perspective on Multinational Corporations in China

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Abstract: Multinational corporations (MNCs) play a pivotal role in driving sustainable development by effectively implementing Environmental, Social, and Governance (ESG) strategies. This study adopts the lens of Social Cognitive Theory to analyze how MNCs operating in China can optimize human capital to enhance ESG outcomes. By exploring the interplay between individual cognition, organizational culture, and incentive mechanisms, the research establishes a human capital-driven framework for ESG implementation. Key findings emphasize the importance of cultivating ESG awareness among employees, fostering an ESG-centric organizational culture, and designing robust incentive structures to align individual behaviors with corporate sustainability goals. This comprehensive approach offers practical insights for MNCs striving to balance profitability with social responsibility and environmental stewardship in a rapidly evolving global landscape.

Keywords: ESG; Environmental protection; Social responsibility; MNCs governance; Social Cognitive Theory

1. Introduction

In the era of deepening global economic integration, multinational corporations (MNCs), who are pivotal players in global economic activities, shape not only their own sustainable development but also exert profound impacts on the global environment, social well-being, and corporate governance structures through their operational conduct. Recently, ESG factors have garnered unprecedented global attention as crucial indicators for assessing non-financial corporate performance. In China particularly, the government's heightened focus on green development and corporate social responsibility (CSR), coupled with investors' and consumers' strong demand for ESG information, has placed MNCs under unprecedented pressure and presented them with unique opportunities, necessitating substantial advancements in ESG implementation. However, achieving this is no easy feat as it demands profound transformations across various levels, including strategy formulation, operational management, and supply chain integration. In this endeavor, the significance of human capital as the core driving force for corporate growth cannot be overstated. The knowledge, skills, attitudes, and leadership capabilities of employees

are crucial for a company's ability to recognize and address ESG (Environmental, Social, and Governance) challenges effectively. These factors also play a significant role in integrating ESG principles into daily operations, helping to create a culture of continuous improvement.

Social cognitive theory offers robust theoretical support for understanding the role of human capital in ESG implementation. According to this theory, individuals' cognitions, emotions, and behaviors are influenced not only by the external environment but also by their cognitive structures and experiences. In the context of ESG implementation by MNCs, this implies that employees' perceptions and attitudes towards ESG, as well as their behavioral habits formed through practice, will directly influence the effectiveness of corporate ESG strategies. Thus, exploring ways to effectively promote ESG implementation among MNCs in China's unique cultural and social context, by optimizing human capital allocation and enhancing employees' ESG awareness and capabilities, holds significant theoretical and practical importance.

2. Literature review

In recent years, with the escalating global focus on sustainable development and corporate social responsibility, ESG criteria have emerged as pivotal benchmarks for assessing the comprehensive performance of enterprises. Many multinational corporations worldwide have integrated ESG into their strategic frameworks, actively showcasing their commitment to environmental protection, social responsibility, and corporate governance by creating ESG policies, publishing ESG reports, and setting ESG targets. In China, the government's focus on the green economy and ecological civilization construction, along with a strong demand for ESG information from investors and consumers, places unprecedented pressure on MNCs to achieve substantial progress in ESG implementation [1]. However, despite the widespread dissemination of the ESG concept globally, MNCs still face numerous challenges in implementing ESG in China. Multinational corporations (MNCs) must take into account the unique characteristics of the Chinese market, including its policy environment, cultural customs, and consumer preferences when developing ESG strategies that emphasize localization. However, MNCs often face challenges such as information asymmetry, resource constraints, and conflicts of interest in implementing these ESG strategies. Therefore, it is essential to identify effective pathways to overcome these obstacles [2].

Human capital, as the core driving force for enterprise development, plays a crucial role in ESG implementation. The components of human capital, including employees' knowledge, skills, attitudes, and leadership, play a crucial role in determining how well companies can identify and tackle ESG challenges. Additionally, these elements influence a company's ability to incorporate ESG principles into its daily operations, promoting a culture of continuous improvement. Research shows that human capital plays a crucial role in the implementation of ESG practices in several ways. Firstly, it is essential to employee training and education, which enhances awareness and understanding of ESG issues, enabling employees to engage actively in related practices. Secondly, designing incentive mechanisms encourages employees to embody ESG principles in their work—such as energy conservation, emission reduction, and protecting consumer rights. Lastly, effective leadership is vital, as senior managers must incorporate ESG considerations into strategic decision-making to drive significant progress in ESG initiatives within the organization.

Social Cognitive Theory (SCT), as one of the important theories in psychology and organizational behavior, provides a foundational framework for exploring the factors influencing individual behavior. Originating from Alber Bandura's Social Learning Theory and later incorporating cognitive components, SCT forms the "Triadic Reciprocal Determinism," emphasizing the interaction between individuals, their environment, and behavior. SCT posits that the best predictor of behavior is an individual's intention to perform a particular behavior, i.e.,

their willingness to participate, which is influenced by self-efficacy, outcome expectations, and satisfaction with the external environment. Individual behavior is the result of the interaction between personal factors and the environment, shaped by intrinsic traits, experiences, and the external social environment [3–5]. The theory suggests that an individual's cognitions, emotions, and behaviors are not only influenced by the external environment but also by their own cognitive structures and experiences. In the context of ESG implementation by MNCs, this means that employees' cognitions, attitudes, and behavioral habits formed through practice will directly impact the effectiveness of the enterprise's ESG strategy implementation [6].
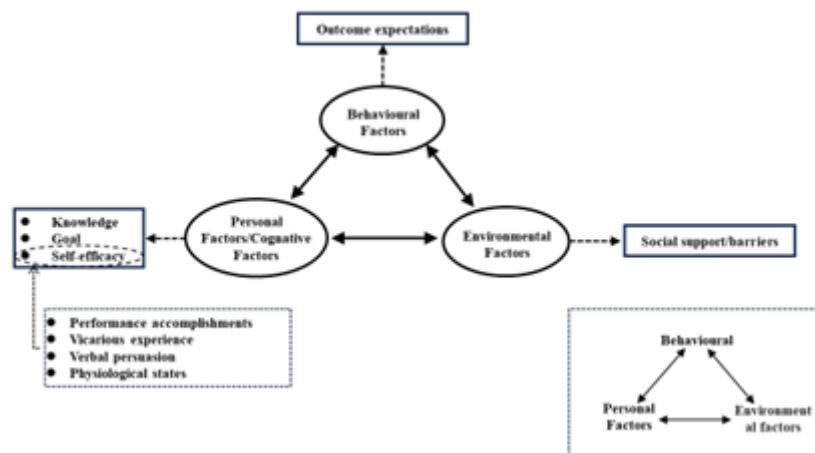
Figure 1. The Social Cognitive Theory model

Human capital plays a vital role in the ESG implementation of MNCs, and Social Cognitive Theory provides robust theoretical support for understanding this process. However, current research on how MNCs in China utilize human capital to enhance ESG implementation is limited, highlighting the need for further research and theoretical exploration to address this gap. Building on this foundation, this study will delve into the pathways through which MNCs in China can harness human capital to drive ESG implementation by constructing a theoretical framework based on Social Cognitive Theory.

3. Research framework

Using Social Cognitive Theory, this study creates a theoretical framework for multinational corporations to utilize human capital in enhancing ESG implementation in China. This framework comprises three core components: individual cognition and attitudes, organizational culture and incentive mechanisms, and ESG practices and performance. These components are interconnected and interdependent, collectively forming a dynamic system that drives ESG implementation within MNCs operating in China.

Individual cognition and attitudes form the solid foundation of the theoretical framework. According to the core tenets of Social Cognitive Theory, an individual's cognitive structure and past experiences play a pivotal role in shaping their behavioral patterns. In the context of MNCs' commitment to ESG strategy implementation, employees' ESG cognition, attitudes, and deep-seated belief systems become critical factors determining their job performance. Employees who have a deep understanding of ESG principles, maintain a positive attitude towards them, and firmly believe in their significance are more likely to take proactive steps that align with these principles in their daily work. This, in turn, contributes to the overall ESG strategy of the company.
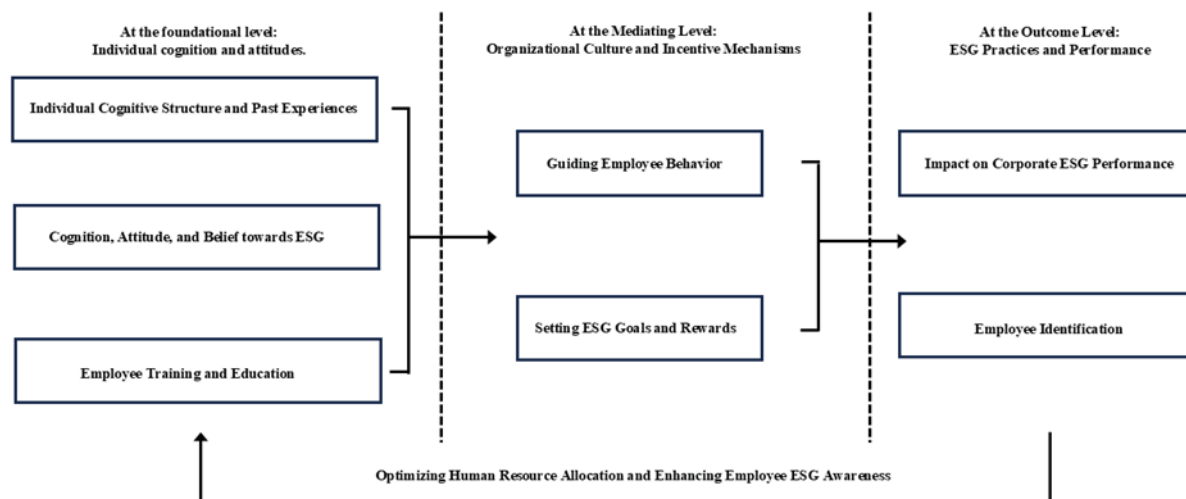
Figure 2. Diagram of theoretical models for multinational enterprises

Organizational culture and incentive mechanisms serve as the intermediary bridge within the theoretical framework. Organizational culture, as a widely shared system of values and behavioral norms within a company, not only provides behavioral guidance for employees but also influences and constrains their behavior through invisible forces. An organizational culture with ESG as its core values can stimulate employees' internal identification and external actions towards ESG practices. Simultaneously, incentive mechanisms, as important external drivers of employee behavior, further reinforce employees' motivation to embrace ESG principles by setting clear and specific ESG goals and corresponding reward measures. This combination of internal and external factors encourages employees to actively engage in ESG practices while pursuing their personal career development.

ESG practices and performance constitute the outcome level of the theoretical framework and are crucial for validating its effectiveness. As direct outcomes of employee behavior, the quality and effectiveness of ESG practices not only reflect employees' level of ESG cognition and their efforts in implementation but also directly impact a company's ESG performance. A successful ESG practice project can enhance a company's environmental and social benefits, while also improving its brand image and market competitiveness, ultimately leading to economic growth. Continuous improvement in ESG performance further reinforces employees' sense of identification and belonging towards ESG practices, fostering a virtuous cycle from individuals to organizations and back to individuals. This cycle not only helps consolidate and deepen a company's ESG culture but also lays a solid foundation for achieving sustainable development.

The current state of human capital in China shows continuous growth in total volume, although the rate of growth is slowing. According to the China Human Capital Report 2023, the total human capital in China, valued at current prices, has reached RMB 337.83 trillion, with a significant proportion coming from urban areas [7]. However, the growth rate has declined compared to the past decade, reflecting the gradual maturity and stabilization of the labor market. Additionally, the average age of the workforce is rising, and educational attainment is generally improving, which brings more highly skilled talent to the market but also poses new challenges for human resource management.

The human resource development dynamics for MNCs in China show that, due to China's rapid economic growth, an increasing amount of MNCs are focusing on localization strategies, with human resource localization being a key element. MNCs not only recruit local employees for the Chinese market but also increase the percentage of Chinese nationals in senior management positions to better integrate into the Chinese market and

enhance their competitiveness. However, the localization process also faces issues such as cultural differences, regulatory compliance, and understanding of employee values.

4. Conclusions and recommendations

We investigated the relationships between individual cognition and attitudes, organizational culture and incentives, and ESG (Environmental, Social, and Governance) practices and performance. This analysis highlighted key factors that influence the implementation of ESG strategies, providing a framework for multinational companies (MNCs) operating in China. Our study focused on employees across various industries and job levels. However, the emphasis on ESG varies by industry. For instance, service sectors such as catering and retail, along with IT and tech firms, often prioritize social responsibility and corporate governance over carbon reduction. In contrast, manufacturing industries tend to concentrate on carbon-related issues. Employees' efforts and intentions are aligned with these strategic focuses as well as with the strategies and governance set by senior executives. Future research should explore specific industries and job levels within MNCs to gain a deeper understanding of employees' behavioral intentions regarding ESG initiatives.

Disclosure statement

The authors declare no conflict of interest.

Author contributions

Conceptualization: Lu Xu
Methodology: Lu Xu
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References

[1] Garcia AS, Mendes-Da-Silva W, Orsato RJ, 2017, Sensitive Industries Produce Better ESG Performance: Evidence from Emerging Markets. Journal of Cleaner Production, 150: 135–147.

[2] Tian B, Yu J, Tian Z, 2024, The Impact of Market-based Environmental Regulation on Corporate ESG Performance: A Quasi-natural Experiment based on China's Carbon Emission Trading Scheme. Heliyon, 10(4): e26687.

[3] Ding S, Huang M, 2024, Is ESG Improvement an Efficient Green Solution for Resource Curse Vulnerability of Enterprise Management? Evidence from Fossil Fuels Extraction Industry. Resources Policy, 98: 105352.

[4] Otaye-Ebede L, Shaffakat S, Foster S, 2020, A Multilevel Model Examining the Relationships Between Workplace Spirituality, Ethical Climate and Outcomes: A Social Cognitive Theory Perspective. Journal of Business Ethics, 166(3): 611–626.

[5] Jiang L, Chang Z, Yao W, et al., 2024, Transcend Local for Global: ESG as a Legitimacy Signal in the Global Expansion of Emerging Multinational Enterprises. Finance Research Letters, 69: 106174.

[6] Luan X, Wang X, 2023, Open Innovation, Enterprise Value and the Mediating Effect of ESG. Business Process Management Journal, 29(2): 489–504.

[7] Korcheva A, 2023, United Nations Development Programme, Encyclopedia of Sustainable Management, Springer, Cham.

Data Empowerment in Precision Marketing: Algorithm Recommendations and Their Associated Risks

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Abstract: This paper examines the impact of algorithmic recommendations and data-driven marketing on consumer engagement and business performance. By leveraging large volumes of user data, businesses can deliver personalized content that enhances user experiences and increases conversion rates. However, the growing reliance on these technologies introduces significant risks, including privacy violations, algorithmic bias, and ethical concerns. This paper explores these challenges and provides recommendations for businesses to mitigate associated risks while optimizing marketing strategies. It highlights the importance of transparency, fairness, and user control in ensuring responsible and effective data-driven marketing.

Keywords: Data-driven marketing; Algorithmic recommendations; Privacy and ethics

1. Introduction

In the digital age, precision marketing has become a cornerstone of modern advertising strategies, with data-driven algorithms playing a central role in shaping consumer experiences. At the core of precision marketing is data empowerment, where businesses utilize vast amounts of user data to deliver highly personalized content and advertisements [1]. These algorithms not only predict consumer preferences but also tailor marketing messages to individual behaviors, driving more effective engagement and increasing conversion rates [2].

However, the growing reliance on algorithmic recommendations raises concerns about transparency, bias, and privacy. These "black-box" systems, while optimizing marketing efforts, pose risks such as data privacy violations and the creation of filter bubbles, which limit exposure to diverse viewpoints. This paper explores how algorithms drive precision marketing by analyzing consumer behavior while also addressing the risks associated with these strategies. The findings aim to balance personalization with ethical considerations, ensuring both effective marketing campaigns and consumer trust.

2. Understanding user behavior in marketing touchpoints

2.1. Behavioral preferences at marketing touchpoints

In the modern digital landscape, marketing touchpoints vary widely, encompassing social media platforms, websites, search engines, and mobile applications [3]. Consumers engage with these touchpoints in different ways, and understanding these interactions is essential for designing effective marketing strategies. User behavior at these touchpoints provides valuable insights into individual preferences, response times, and content engagement.

For instance, social media users often exhibit a preference for instant gratification, engaging quickly with content that aligns with their interests or emotional triggers. In contrast, individuals using search engines tend to demonstrate intent-driven behavior, typically seeking immediate solutions to specific needs or problems [4]. Similarly, interactions on websites and mobile applications—such as time spent on a page, click patterns, and scrolling behavior—offer further insights into user engagement [5].

Marketers leverage these behavioral signals to tailor content, advertisements, and promotions based on user interests and preferences. A key component of this process is clickstream data, which tracks user interactions as they navigate across different touchpoints [6]. By analyzing such data, businesses can identify the types of content, products, or services most likely to resonate with users, thereby enhancing their ability to develop personalized marketing campaigns.

2.2. Data collection through user interaction

The collection of user data across various touchpoints provides businesses with deeper insights into consumer behavior; however, the methods used to gather and analyze this data are equally important [7]. Marketers increasingly rely on event tracking and user segmentation to collect relevant data. Event tracking involves monitoring user actions on websites and mobile applications, such as clicks, page views, purchases, and time spent on specific content. These interactions are recorded as valuable data points that reflect user interests, intent, and real-time behavior [8].

Once data is collected, user segmentation is essential for creating meaningful consumer profiles. This process enables marketers to group users based on demographics, behavior, and other relevant factors, facilitating more targeted marketing efforts. For example, young adults may be targeted with technology-related products, while lifestyle goods are promoted to older consumer segments. Analyzing user behavior also helps marketers understand how different segments respond to marketing efforts, such as email campaigns or promotional discounts. While some users respond immediately to price reductions, others take longer to make purchasing decisions. Recognizing these behavioral nuances allows marketers to refine their strategies, ensuring that content remains both timely and relevant.

Furthermore, the integration of artificial intelligence (AI) and machine learning enhances businesses' ability to predict user behavior with greater accuracy [9]. AI-driven models can identify patterns in user interactions with marketing touchpoints, enabling marketers to optimize their strategies and further personalize their offerings [10]. Continuous analysis of user data allows businesses to anticipate emerging trends and adapt their marketing efforts accordingly. A comprehensive understanding of user behavior across various touchpoints is crucial for developing personalized marketing strategies that drive engagement and increase sales.

3. Algorithmic recommendations and the evolution of traditional marketing

3.1. Redefining traditional marketing through algorithmic recommendations

Traditional marketing has long relied on broad, generalized strategies aimed at reaching as many consumers as

possible through mass media channels such as television, radio, and print advertisements [11]. However, with the advent of digital technology and data analytics, marketing has evolved into a more personalized and targeted approach. Algorithmic recommendations have played a central role in this transformation, enabling businesses to shift away from one-size-fits-all strategies and focus on individual preferences, behaviors, and needs.

By leveraging user data, algorithms now deliver personalized content and product recommendations in real time [12]. This shift has allowed marketers to engage with consumers on a more personal level, tailoring offers based on specific behaviors such as previous purchases, browsing history, and social media interactions. For instance, platforms such as Amazon and Netflix utilize sophisticated recommendation algorithms to suggest products or content based on individual usage patterns, significantly enhancing user engagement and conversion rates.

As a result, traditional marketing's broad targeting methods are being replaced by precision-driven tactics that rely heavily on predictive analytics and machine learning. These techniques enable marketers to predict the likelihood of a consumer responding positively to a particular message, content, or product, thereby increasing marketing efficiency and reducing waste [13]. This evolution has fundamentally shifted power dynamics, giving consumers greater control over their experiences while allowing marketers to refine their strategies for maximum impact.

3.2. The role of algorithms in content production and delivery

Algorithmic recommendations influence not only content delivery but also content production [14]. In traditional marketing, content creation was based on general trends and broad consumer profiles. However, with the assistance of algorithms, marketers can now generate content specifically tailored to distinct consumer segments.

Algorithms analyze extensive datasets, including demographic details, browsing patterns, and psychographic characteristics, to help businesses understand which types of content resonate most with their target audiences. This data-driven approach allows brands to produce content that is both highly relevant and personalized. For example, a clothing retailer may generate customized advertisements featuring items that align with a consumer's previous purchases or browsing history [15].

Moreover, content delivery has become increasingly dynamic. Unlike traditional marketing, where advertisements are static and unresponsive, digital algorithms optimize the timing, placement, and format of content based on real-time user behavior. Through programmatic advertising, for instance, marketers can deliver targeted advertisements at optimal moments, adjusting content and format based on live data analysis. This level of precision was previously unattainable in traditional marketing, where advertisements were broadcast without certainty regarding audience engagement or response.

3.3. Changing roles of advertisers and the redistribution of power

One of the most significant changes introduced by algorithmic recommendations is the transformation of the advertiser's role. In traditional marketing, advertisers exercise full control over messaging, from content creation to distribution across various channels. However, in algorithm-driven marketing, advertisers are no longer the sole arbiters of content dissemination [16]. Instead, the focus has shifted toward optimizing algorithms to ensure that content reaches the most relevant audiences at the most effective times.

This shift has redefined the relationship between marketers, consumers, and technology platforms. Advertisers now refine and adjust algorithms, while platforms such as Google, Facebook, and Amazon largely control content distribution. This redistribution of power has raised ethical and regulatory concerns regarding

transparency, accountability, and the potential manipulation of consumer behavior.

Advertisers must now balance the ability to fine-tune their messaging with the need to respect consumer privacy and autonomy. Algorithmic systems introduce a delicate boundary between personalization and overreach. Ethical considerations surrounding data usage must be carefully addressed to prevent breaches of consumer trust. Furthermore, the ability of algorithms to shape consumer behavior has led to debates regarding whether advertisers are increasingly assuming the role of "puppet masters" in influencing purchasing decisions [17].

Ultimately, algorithmic recommendations have not only revolutionized content delivery but also reshaped the distribution and exercise of marketing power. As algorithms continue to evolve, the relationships between advertisers, technology platforms, and consumers will likely undergo further transformation, presenting both opportunities and challenges for the future of marketing.

4. Data mining and machine learning: Building accurate user profiles

4.1. Understanding data mining in marketing

Data mining refers to the process of extracting valuable patterns from large datasets and plays a crucial role in precision marketing. Marketers utilize data mining techniques to analyze customer behaviors, preferences, and trends [18]. By examining past interactions, purchase histories, and browsing patterns, data mining algorithms identify meaningful correlations that enable effective user segmentation and behavioral predictions.

A common data mining technique is association rule learning, which uncovers relationships between different user actions. For example, a user who purchases a smartphone may also be interested in accessories such as cases or earphones. Identifying such correlations allows marketers to develop personalized product recommendations, thereby increasing the likelihood of conversion.

Another essential technique in data mining is clustering, which categorizes users into segments based on shared characteristics, such as age, gender, location, or purchasing behavior. These insights help marketers tailor messages to specific audience groups, improving both the efficiency and relevance of marketing efforts.

4.2. Machine learning for predicting user behavior

Machine learning (ML) extends data mining by enabling algorithms to learn and improve over time without explicit programming. In marketing, ML models analyze user data to predict behaviors such as future purchases, click-through rates, and the likelihood of customer churn. These predictive capabilities allow businesses to personalize marketing efforts and optimize content delivery [19].

Supervised learning techniques, for example, can predict user responses to specific advertisements based on labeled training data, allowing marketers to refine targeting strategies and improve campaign effectiveness. In contrast, unsupervised learning can uncover hidden patterns within user data, offering insights into previously unobserved consumer segments or emerging trends that can be leveraged to enhance marketing strategies.

4.3. Creating detailed user profiles with machine learning models

Once behavioral patterns are identified through data mining and machine learning, user profiles are constructed to represent individual preferences, needs, and behaviors. These profiles incorporate multiple data points, including past interactions, demographic information, and psychographic characteristics.

Two widely used machine learning techniques for building user profiles are decision trees and neural networks. Decision trees model user decisions by creating branches based on specific attributes, such as a user's response to an email promotion. Neural networks, on the other hand, utilize layers of interconnected nodes to

model complex, non-linear relationships between data points.

These detailed user profiles enable marketers to craft highly personalized marketing messages, enhancing user experience and increasing engagement. By gaining a deeper understanding of customer preferences and potential future behavior, businesses can target users with relevant content and offers, ultimately leading to higher conversion rates and improved customer satisfaction.

Table 1. Key techniques in data mining and machine learning for marketing

Technology	Function	Examples
Data mining	Extracts patterns from data.	Analyzes purchase history to suggest related products.
Association rule learning	Identifies correlations between user actions.	Smartphone buyers often purchase accessories.
Clustering	Groups users based on shared traits.	Segments users by demographics or purchasing behavior.
Machine learning	Predicts user behavior and optimizes strategies.	Supervised learning predicts ad responses; unsupervised learning detects hidden trends.
Decision trees & neural networks	Models user behavior using structured data.	Decision trees track responses to promotions; neural networks identify complex patterns.
User profiles & personalization	Enables tailored marketing messages.	Targets users with offers based on preferences and predicted behavior, boosting conversions.

5. Risks in data-driven marketing and algorithmic recommendations

5.1. Privacy and security concerns

In data-driven marketing, the extensive collection and utilization of user data introduce significant privacy and security risks. As businesses gather detailed information on consumer behavior, concerns regarding the storage and management of sensitive data become critical [20]. Data breaches or unauthorized access can compromise user information, resulting in reputational damage for companies and potential legal repercussions. Moreover, many consumers remain unaware of the extent to which their data is being utilized, raising ethical concerns about transparency and informed consent.

Regulations such as the General Data Protection Regulation (GDPR) and the California Consumer Privacy Act (CCPA) aim to address these issues by enforcing stricter data privacy standards. However, ensuring compliance remains a challenge for many organizations. Implementing robust encryption, anonymization techniques, and secure data storage systems is essential to mitigating these risks. Additionally, businesses must communicate their data usage policies clearly to foster consumer trust while adhering to legal frameworks.

5.2. Algorithmic bias and ethical implications

While algorithmic recommendations enhance marketing effectiveness, they are not immune to biases that can distort outcomes and reinforce inequalities. These biases may arise from the data used to train algorithms or from structural flaws in model design. For instance, if an algorithm prioritizes a particular demographic based on historical purchasing trends, it risks excluding other groups, leading to unintended discrimination and reduced customer satisfaction.

Furthermore, excessive personalization in recommendations can contribute to filter bubbles, where consumers are primarily exposed to content that aligns with their existing preferences. This limits diversity and restricts exposure to alternative products, viewpoints, or ideas. To address these ethical challenges, companies must conduct regular audits of their algorithms to ensure fairness and accuracy, preventing unintended biases

in marketing strategies. Maintaining transparency in how recommendations are generated is also crucial for fostering consumer trust and ensuring equitable marketing practices.

6. Case studies on algorithmic recommendations: Effectiveness and challenges

6.1. Effectiveness of algorithmic recommendations in e-commerce

E-commerce platforms such as Amazon and Alibaba exemplify the successful implementation of algorithmic recommendations. These platforms employ advanced algorithms to deliver personalized product suggestions based on user's browsing history, past purchases, and demographic information, creating a customized shopping experience that enhances conversion rates and increases order value. For instance, Amazon's "Customers who bought this also bought" feature, powered by collaborative filtering, improves customer satisfaction and drives sales. Studies indicate that personalized recommendations can contribute to as much as 35% of total sales.

Despite these benefits, challenges persist. Over-promoting popular products can limit diversity in recommendations, potentially frustrating users seeking niche items. Furthermore, excessive reliance on recommendations may lead to oversaturation, where an abundance of suggestions reduces their perceived value and effectiveness.

6.2. Challenges faced in social media advertising

Social media platforms such as Facebook and Instagram utilize algorithmic recommendations to target advertisements based on user interests, behaviors, and social interactions. While these platforms generate significant engagement and revenue, they also face challenges related to data privacy and ethical concerns.

The Facebook-Cambridge Analytica scandal highlighted the risks associated with improper data handling and the potential for algorithmic manipulation to influence political and consumer decisions. This incident underscored concerns about transparency and trust in targeted advertising.

Additionally, social media algorithms have been criticized for fostering filter bubbles, where users are primarily exposed to content that aligns with their existing views. This phenomenon limits exposure to diverse perspectives and can contribute to ideological polarization. These challenges emphasize the need for continued scrutiny and reform in social media advertising to balance effectiveness with ethical responsibility.

7. Conclusion and recommendations

Algorithmic recommendations and data-driven marketing have transformed how businesses engage with consumers, enabling highly personalized experiences that enhance sales and foster brand loyalty. However, these technologies also present significant risks, particularly in relation to data privacy, algorithmic bias, and ethical concerns.

To ensure long-term success, businesses must prioritize transparency in data usage, adhere to stringent privacy standards, and conduct regular audits to identify and mitigate biases in algorithms. Additionally, diversifying recommendation models and providing users with greater control over their data can help reduce the risks associated with filter bubbles and over-personalization. By addressing these challenges proactively, companies can leverage data-driven marketing responsibly, creating sustainable value for both consumers and businesses.

Disclosure statement

The author declares no conflict of interest.

References

[1] Liu Y, 2021, Analysis of Consumer Demand in the Advertising Industry under the Development of the Internet Big Data and the Enterprise Precision Marketing. 2021 5th International Conference on Economics, Management Engineering and Education Technology (ICEMEET 2021), 2021: 157–161. https://doi.org/19,25236/icemeet.2021.039

[2] Panesar A, Saini I, 2024, Ethical Dimensions of AI Integration in Influencer Campaigns: Balancing Authenticity, Targeting Precision, and User Privacy, in Dutta S, Rocha Á, Dutta PK, et al., (eds), Advances in Data Analytics for Influencer Marketing: An Interdisciplinary Approach. Springer, Cham. https://doi.org/10.1007/978-3-031-65727-6_24

[3] Yang Z, 2022, Research on Personalized Product Recommendation Algorithm for User Implicit Behavior Feedback. Proceedings of the 12th International Conference on Computer Engineering and Networks. Springer, Singapore. https://doi.org/10.1007/978-981-19-6901-0_149

[4] Hoque S, Hossain MA, 2023, Social Media Stickiness in the Z Generation: A Study Based on the Uses and Gratifications Theory, 11(4): 92–108. https://doi.org/10.1633/JISTaP.2023.11.4.6

[5] Siregar Y, Kent A, Peirson-Smith A, et al., 2023, Disrupting the Fashion Retail Journey: Social Media and GenZ's Fashion Consumption. International Journal of Retail & Distribution Management, 51(7): 862–875.

[6] Jahagirdar AD, Morankar H, 2023, The Impact of Advertising on Consumer Behaviour: A Study on Various Advertising Types and Effectiveness. International Journal of Research and Analytical Review, 10(3): 716–744.

[7] Murshed NA, Ugurlu E, 2023, Navigating the Digital Marketplace: A Holistic Model Integrating Social Media Engagement and Consumer Behavior Factors to Enhance Online Shopping Adoption. Journal of Theory and Applied Management, 16: 542–559. https://doi.org/10.20473/jmtt.v16i3.52059

[8] Vasilopoulou C, Theodorakopoulos L, Igoumenakis G, 2023, The Promise and Peril of Big Data in Driving Consumer Engagement. Technium Social Sciences Journal, 45(1): 489–499. https://doi.org/10.47577/tssj.v45i1.9133

[9] Noman AA, Akter UH, Pranto TH, et al., 2022, Machine Learning and Artificial Intelligence in Circular Economy: A Bibliometric Analysis and Systematic Literature Review. Annals of Emerging Technologies in Computing, 6(2): 13–40. https://doi.org/10.33166/AETiC.2022.02.002

[10] Dietrich T, Hurley E, Kassirer J, et al., 2022, 50 Years of Social Marketing: Seeding Solutions for the Future. European Journal of Marketing, 56(5): 1434–1463. https://doi.org/10.1108/EJM-06-2021-0447

[11] Davis Noll BA, Revesz RL, 2019, Regulation in Transition. Minnesota Law Review, 104. http://dx.doi.org/10.2139/ssrn.3348569

[12] Xing S, Liu F, Wang Q, et al., 2019, A Hierarchical Attention Model for Rating Prediction by Leveraging User and Product Reviews. Neurocomputing, 332(C): 417–427. https://doi.org/10.1016/j.neucom.2018.12.027

[13] Al-Dmour R, Al-Dmour H, Al-Dmour A, 2024, The Crucial Role of EWOM: Mediating the Impact of Marketing Mix Strategies on International Students' Study Destination Decision. SAGE Open, 14(2): 972–995. https://doi.org/10.1177/21582440241247661

[14] Sykes M, Rosenberg-Yunger ZRS, Quigley M, et al., 2024, Exploring the Content and Delivery of Feedback Facilitation Co-interventions: A Systematic Review. Implementation Sci, 19: 37. https://doi.org/10.1186/s13012-024-01365-9

[15] Cai J, 2023, Research on the Influencing Factors of Consumer Buying Behavior. Highlights in Science, Engineering and Technology, 61(1): 119–127. https://doi.org/10.54097/hset.v61i.10281

[16] Zhang Y, Gosline R, 2023, Human Favoritism, Not AI Aversion: People's Perceptions (and Bias) Toward Generative AI, Human Experts, and Human–GAI Collaboration in Persuasive Content Generation. Judgment and Decision

Making, 18: e41. https://doi.org/10.1017/jdm.2023.37

[17] Chu J, 2023, The Effects of Personalized Advertisements on Consumer Decision-Making Behavior. International Journal of High School Research, 5(3): 54–59. https://doi.org/10.36838/v5i3.11

[18] Masana SNDS, Rudrapati GS, Gudiseva K, et al., 2024, Temporal Data Mining on the HighSeas: AIS Insights from BigDataOcean. Machine Intelligence, Tools, Applications, 2024: 394–402. https://doi.org/10.1007/978-3-031-65392-6_34

[19] Obucic E, Poturak M, Keco D, 2023, Predicting User Engagement of Facebook Post Images in Leading Universities: A Machine Learning Approach. Revue d'Intelligence Artificielle, 37(4): 1039–1045. https://doi.org/10.18280/ria.370426

[20] Özkan Özen YD, Sezer D, Özbiltekin M, et al., 2022, Risks of Data-driven Technologies in Sustainable Supply Chain Management. Management of Environmental Quality: An International Journal, 34(4): 926–942. https://doi.org/10.1108/MEQ-03-2022-0051

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

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Abstract: In recent years, managing rural living environments has become a vital component of the rural revitalization strategy. Jiangsu Province, rich in economic and cultural resources, has accumulated valuable experience in exploring rural environmental governance by integrating culture and tourism. This research analyzes the practical logic of rural environmental governance in Jiangsu from both theoretical and practical perspectives. It emphasizes the importance of integrating culture and tourism to enhance environmental governance while addressing the associated challenges. The results show that the integration of culture and tourism not only enhances rural ecological environments and living facilities but also boosts regional economic development and the preservation of cultural resources. Nevertheless, there are still challenges in aspects such as the collaboration of stakeholders, the establishment of long-term mechanisms, and the application of digital technologies. Based on real cases in Jiangsu, this study suggests optimization strategies and policy recommendations to improve rural environmental governance within the framework of cultural and tourism integration.

Keywords: Cultural and tourism integration; Rural living environment; Jiangsu; Governance logic; Optimization strategies

1. Introduction

The enhancement of living conditions in rural districts is instrumental for the efficacy of rural rejuvenation efforts and is essential for improving the quality of life of rural residents while promoting sustainable growth [1]. A well-kept rural living environment enhances the mental and physical well-being of community members and attracts outside investment and talent, which revitalizes the rural economy. Jiangsu Province, known for its strong economic foundations and rich cultural heritage, has taken active measures in improving rural settings by incorporating cultural and touristic elements. This initiative has shown significant progress and provides insights that could be replicated across China [2]. However, the governance of these rural environments involves

tackling complex issues like ecological sustainability, economic development, and cultural conservation, as well as facilitating collaboration among diverse stakeholders. In integrating cultural and touristic dimensions, the main challenge is in aligning the interests of these varied stakeholders and encouraging collaborative growth in both the environment and cultural tourism sectors. Exploring the strategies and principles in managing rural environments through the cultural-tourism perspective is therefore both a theoretical and a practical endeavor of great importance.

2. Literature review and discussion

2.1. Collaborative mechanism of multiple stakeholders in rural living environment governance

The effective administration of rural habitats requires the collaborative effort of multiple stakeholders, including governmental agencies, private sector entities, and community members. As highlighted by Rau, it is crucial for local government authorities to lead efforts in minimizing disparities between urban and rural growth [1]. Through the deployment of well-crafted policy measures and efficient resource management, these governments have the potential to drive substantial enhancements in the condition of rural landscapes. They have the capacity to establish thorough plans and standards that form the foundation of policies aimed at the betterment of these areas. However, it is also important to acknowledge that a management style that relies solely on a single authority might not adequately address the complex issues prevalent in rural environmental scenarios.

Westerink *et al.* put forward a theoretical framework centered on collaborative governance. Their thesis argues that building strong collaborative relationships among diverse stakeholders improves the management of environmental challenges, especially regarding resource allocation and infrastructure development [3]. They contend that the distinct strengths and weaknesses of each stakeholder highlight the necessity for a cooperative strategy, making it essential for the effective deployment of resources in environmental management.

In Jiangsu, local governmental bodies are diligently working to improve environmental management by implementing specific policies and allocating financial resources. These policies mainly focus on improving conditions in rural areas, establishing clear governance objectives and outlining specific responsibilities. Funds have been designated specifically for the enhancement of rural infrastructure and the carrying out of environmental clean-up projects. According to Shen, despite the progress made in these areas, the level of participation from local villagers has not met expectations [4]. In certain rural regions, a significant challenge remains the limited awareness among the inhabitants regarding these environmental policies, which significantly affects the successful application of such initiatives. Moreover, there's a distinguished lack of environmental awareness among a portion of the rural population. This often leads to neglect in crucial areas such as waste segregation and sewage management, with some even showing resistance to these efforts.

This phenomenon highlights how crucial it is to increase the participation of villagers and the autonomy of the community in order to reach sustainable environmental governance. Initiatives such as strengthening public education and establishing incentive systems should be implemented to improve environmental awareness and encourage active participation from villagers. This approach will empower them to become key players in environmental governance.

2.2. Synergistic development of cultural tourism and environmental governance

Integrating cultural elements with tourism has proven to be a significant factor in enhancing the management of rural environments. Research from Wu and Cao revealed a significant relationship between the development of cultural tourism and effective local environmental management. They suggest that the rise of tourism in rural

regions not only upgrades the physical infrastructure but also enhances the quality of life and environmental awareness among the residents [2].

The development of tourism in rural areas has resulted in significant improvements in critical services such as waste management and sewage systems, essential for preserving environmental health. These upgrades are important not only to accommodate a growing number of visitors but also to improve the living conditions of the local community. The influx of tourists leads to increased consumer spending which subsequently drives further investments into vital infrastructure like transportation, water facilities, electricity, and communication services.

Additionally, interactions with diverse groups of tourists boost local residents' awareness and appreciation for a clean and healthy environment. This increased consciousness fosters a proactive approach to environmental conservation within these communities. Consequently, this cultivates a pattern of sustainable development in rural areas, propelled by both economic motives and a collective dedication to caring for the environment.

The approach of merging cultural heritage with tourism in Jiangsu Province has effectively promoted both the economic and ecological development of rural areas [5]. Highlighted by Gu, this tactic enables villages to explore and capitalize on their cultural resources while protecting their environmental landscapes [5]. Suzhou serves as a notable case where many ancient villages have leveraged their historical and cultural backgrounds to create rural tourism initiatives. These initiatives play a crucial role not only in conserving historical architecture and traditional customs but also in improving local ecosystems. As a result, these attractions have drawn a large number of tourists, playing a pivotal role in boosting the region's economy.

Within the sphere of cultural tourism, recurring challenges have emerged as a result of initiatives that lead to the overt commercialization of cultural resources. This trend tends to diminish the original cultural value and contributes to ecological degeneration [6]. Motivated by the potential for rapid financial gains, various regions have overly exploited their tourism resources, disrupting ecological balance and altering the inherent cultural atmosphere. Therefore, it is vital to focus on the protection and judicious exploitation of cultural assets when merging culture with tourism. This approach promotes a balanced synergy between economic development, conservation of the environment, and societal benefits.

2.3. The empowering role of digital technologies

With the advancement of technology, managing rural environments has increasingly relied on digital tools. Research by experts like Xi and Xing highlighted the impact of digital platforms in managing routine tasks such as waste and wastewater management. These platforms facilitate real-time monitoring, enhancing both the precision and efficiency of these functions [7]. In the Jiangsu region, the use of Internet of Things (IoT) technology is widespread, with sensors continuously monitoring environmental parameters and providing prompt feedback to local governance structures. This technology supports swift and well-informed decision-making processes. Particularly in rural areas around Nanjing, the introduction of smart waste bins and wastewater tracking devices allows for the consistent tracking of waste generation and sewage flows, generating vital data that supports targeted management practices. However, the adoption of digital technology in rural management is not without its hurdles [8]. Critical obstacles include insufficient infrastructure and financial constraints. Remote rural areas often suffer from weak internet connections and a dearth of necessary digital instruments, which hampers the seamless integration of modern technological solutions into their management systems.

In their 2023 study, Gao and Dong highlighted how the implementation of digital technologies in rural

areas could simultaneously advance cultural tourism and environmental conservation. By leveraging cutting-edge big data analytics, these regions can gain insights into tourist behaviors, aiding in the regulation of visitor numbers to prevent over-tourism. This precision in managing tourism flows not only protects the local environment, but also aids in crafting enhanced visitor experiences [8]. Detailed analyses of visitor origins, duration of stay, and spending habits enable tourist destinations to tailor their offerings more effectively, thereby improving infrastructure and services. This advancement underscores the significant role digital tools play in promoting sustainable development within the tourism sector, ensuring that cultural heritage and environmental health co-evolve beneficially.

In order to completely unlock this potential, it is extremely important to increase the investment in the digital infrastructure in rural areas. Moreover, developing digital talents is of great significance in establishing favorable circumstances for the application of digital technologies in the governance of the rural living environment.

2.4. Research assessment and limitations

Existing studies show that in both theory and practice, there is a certain degree of agreement on the governance of rural living environments. Nevertheless, there are still several limitations:

It's clear from the outset that there's a notable gap in empirical research regarding the collaboration between different stakeholders, particularly in the context of developing engagement strategies for rural communities [3,4]. While the importance of such collaborations is often emphasized in theoretical discourse, there's a pressing need for comprehensive research to identify the most effective methods to enhance the participation and interest of rural populations in real-world applications.

There remains a gap in our understanding of how the integration of culture and tourism impacts environmental management, especially when trying to balance the preservation of cultural assets with promoting tourism development [5,6]. It is critical to carry out more comprehensive investigations to ascertain ways in which tourism can be developed sustainably while also protecting cultural heritage. This approach will help establish a symbiotic relationship where cultural preservation and tourism both support each other's growth and sustainability [9].

It is important to thoroughly investigate the societal attitudes towards digital technologies and assess their role in enhancing governance at a local scale [7,8]. Such technologies hold immense potential for the administration of rural areas. However, one must evaluate the acceptance of these tools by local communities and determine their actual effectiveness in strengthening governance through real-world applications.

3. Theoretical framework

3.1. Collaborative governance theory

The concept of collaborative governance emphasizes the necessity for coordinated action among varying stakeholders when addressing public issues. It utilizes the collective capabilities of governmental bodies, the private sector, and community members to create a stronger governance structure [3]. Specifically, in the pursuit of better living conditions in rural Jiangsu, this concept provides a critical perspective on the synergy required among different actors.

In this framework, government bodies take on a central role by delivering policy support and financial backing. They establish relevant regulations that guide the actions of involved parties and provide the financial infrastructure needed for project execution. Meanwhile, the business sector contributes by applying its technological know-how, management skills, and strategic market insights. Their involvement, particularly in

rural environmental projects, not only augments the available technical and financial resources but also injects a level of professionalism into these endeavors.

Local community engagement is vitally important and is led by the villagers themselves. Having intimate knowledge of their environment, they offer valuable feedback that helps customize policies to meet the unique requirements and circumstances of their area. Their engagement is critical in ensuring that strategies are appropriately adjusted and thus more effective.

The improvement of living conditions in rural areas of Jiangsu relies on the effective cooperation of government entities, private businesses, and local communities. Each sector plays a vital and mutually reinforcing role in this collaboration, aiming to foster thorough and lasting environmental management in rural settings. This partnership highlights the mutual responsibilities and benefits, manifesting in enhanced life quality for rural populations.

3.2. Cultural and tourism integration development theory

The idea of combining culture with tourism involves leveraging cultural resources to enhance the tourism industry, which in turn can spur economic development and foster environmental conservation [5]. This **theory** is particularly relevant in regions like Jiangsu, known for its rich cultural history, unique folklore, and picturesque landscapes. By transforming cultural assets into attractions for visitors, this method does more than just expand the tourism market; it also helps in preserving cultural identities and transmitting heritage to future generations. Additionally, it plays a significant role in the economic betterment of rural communities and improving environmental sustainability. This integration offers a vital model for exploring environmental management within the context of cultural and tourism integration, proving to be advantageous for areas rich in cultural assets.

4. Research findings and conclusions

4.1. Research findings

Through an in-depth study of rural living environment governance in Jiangsu Province, several key findings have emerged.

In Jiangsu Province, there has been a notable push by governmental bodies at various levels to improve the rural landscape using detailed policy frameworks. Key initiatives such as the "Three-Year Action Plan for Rural Living Environment Improvement in Jiangsu Province" outline precise goals and delegate responsibilities concerning governance. Moreover, definite funds are allocated to support the improvement of rural infrastructure and environmental enhancement projects [4]. This organized allocation of financial resources and directives has facilitated the establishment of critical infrastructure like sewage pipeline networks and waste management systems, thus laying a strong foundation for subsequent environmental conservation efforts.

The successful integration of culture with tourism has been evidenced at Mingyue Bay, an old village nestled in Suzhou. Local authorities have tapped into the rich historical and cultural backdrop of the area to launch rural tourism projects. This approach has allowed for the appreciation and preservation of cultural treasures while simultaneously promoting environmental conservation [5]. Data indicates a steady increase in the number of tourists visiting Mingyue Bay each year after the merger of these two sectors. This increase in visitors has favorably affected the local economy, particularly by augmenting the incomes of residents through the growth of ventures such as homestays and eateries. Furthermore, the boost in tourism numbers has led to improved infrastructure developments, including better transportation, water, and power systems. This has greatly enhanced the village's environmental conditions, and as a result, both economic and ecological

advantages have been achieved simultaneously.

In some countryside areas of Jiangsu Province, initial efforts are underway to fuse digital technologies into daily practices. For instance, in the rural communities of Jiangning District in Nanjing, technologies like the Internet of Things (IoT) have been implemented by setting up smart garbage bins and systems to observe sewage levels. Such developments enable the ongoing monitoring of garbage generation and sewage discharge, fostering more dynamic and data-driven management strategies [7]. By incorporating these advanced technologies, local authorities can not only manage their environments more effectively but also refine their administrative approaches based on real-time data, ensuring that management strategies are specific and accurate.

In the process of implementing policies for effective governance, numerous challenges have emerged. Active participation by government bodies notwithstanding, engagement at the community level, especially within rural villages, remains disappointingly low. As highlighted by Shen, in some rural areas, the villagers' limited understanding of environmental governance techniques compromises the success of these initiatives [4]. Furthermore, when attempting to integrate culture with tourism, the over-commercialization of cultural heritage is seen to not only erode its inherent worth but also negatively impact the environment. In addition, the spread of digital technology faces hurdles due to inadequate infrastructure and insufficient financial backing, a situation that is particularly acute in remote rural areas marked by poor network coverage and a lack of digital resources [8].

4.2. Research conclusions

This study demonstrates that rural living environment governance in Jiangsu, from the perspective of cultural and tourism integration, has achieved notable successes but also reveals areas for improvement. Cultural and tourism integration is indeed an effective approach to promoting rural economic development, enhancing ecological environments, and preserving cultural resources. By developing the cultural and tourism industry, local economic growth is stimulated, residents' quality of life is improved, and environmental conditions are enhanced.

Effective governance relies heavily on the collaborative efforts of various stakeholders. The government must retain its leadership role to steer these collaborations effectively. To bolster the participation of enterprises and community residents, the implementation of structured policies and motivating incentives is crucial. Such strategies facilitate the efficient allocation of governance resources [6]. Furthermore, the establishment of enduring governance structures that integrate technological advancements and regular evaluations is essential in preserving the efficacy and ongoing success of governance initiatives [3–8].

In the endeavor of merging cultural aspects with tourism, it's crucial to focus on the sustainable oversight and safeguarding of cultural heritage. This can be facilitated by conducting thorough assessments of cultural assets and crafting detailed strategies prior to launching developmental initiatives. Strengthening the monitoring of such initiatives and limiting excessive commercialization are essential measures to maintain the authenticity of cultural heritage [5,6]. Moreover, considering the diverse natural scenery, cultural treasures, and varying levels of economic development across different regions in Jiangsu, it's imperative to develop and enforce governance frameworks that are tailor-made for each area's distinct characteristics. Such tailored approaches play a significant role in efficiently tackling the unique needs and obstacles present in these areas.

Future research should focus on developing more effective mechanisms for villager participation. It should also clarify the specific connections between cultural and tourism integration and environmental governance. Additionally, in-depth studies are needed to assess the social acceptance of digital technologies and their impact

on local governance capacities.

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References

[1]   Rau S, 2021, Bridge to Future Livable Cities and City Clusters in the People's Republic of China: Policy Opportunities for High-Quality Urban Development. ABD East Asia Working Paper Series, 40: 1–83.

[2]   Wu Y, Cao L, 2023, The Construction of a Coordinated Integration System of Rural Tourism and Habitat Environment in China Based on Coupled Coordination Degree Model. *Applied Mathematics and Nonlinear Sciences*, 8(3): 456–472.

[3]   Westerink J, Jongeneel R, Polman N, 2017, Collaborative Governance Arrangements to Deliver Spatially Coordinated Agri-Environmental Management. *Journal of Environmental Planning and Management*, 60(5): 791–808.

[4]   Shen D, 2023, Spatial Reconstruction: Practical Logic and Optimization Path of Rural Living Environment Governance under the Background of Rural Revitalization. *Exploration*, 39(3): 45–53.

[5]   Gu W, 2021, A Multi-Case Analysis of Cultural and Tourism Integration Development in Jiangsu. Business Exhibition Economy, 19(8): 56–61.

[6]   Han B, Bi M, Huang L, 2020, Research on the Organic Combination of Rural Tourism Development and Rural Living Environment Governance Based on the Concept of Cultural Expression. *Farmers' Counsel*, 14(4): 78–83.

[7]   Xi C, Xing L, 2023, How Does Digital Governance Affect the Level of Domestic Waste Separation for Rural Residents? Empirical Evidence from Rural Areas in Jiangsu Province. *Frontiers in Public Health*, 10: 1048721.

[8]   Gao RW, Dong H, 2023, Social Foundation and Practical Logic of Digital Empowerment in Rural Living Environment Governance. Journal of Northwest A&F University (Social Science Edition), 43(6): 110–118.

[9]   Li Y, Huang Z, 2022, Research on the Long-Term Governance Mechanism of Urban and Rural Living Environment Based on the Ordered Logistic-ISM Model in the Perspective of Sustainable Development. *International Journal of Environmental Research and Public Health*, 19(4): 3421.

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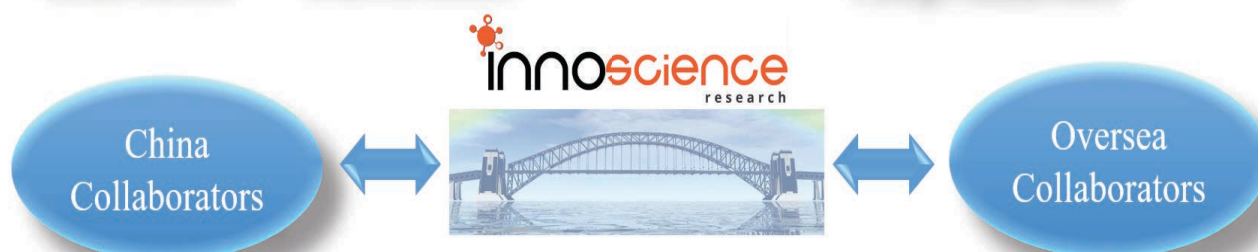
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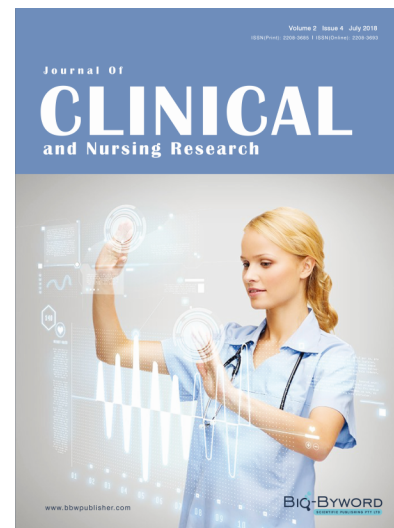
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