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Research on the Development of Rural Microcredit under the Background of Rural Revitalization

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Abstract

Against the backdrop of the comprehensive implementation of the Rural Revitalization Strategy, rural microcredit has shown increasingly promising prospects and has gradually become one of the most critical instruments for promoting rural development and supporting farmers in achieving prosperity. Its importance in improving farmers' livelihoods is beyond question. This paper systematically analyzes the parallel progress of rural microcredit and the rural revitalization process, exploring the dual impact mechanism—both positive and negative—of microcredit on rural revitalization. It further elaborates on the contributions of rural microcredit to developing rural industries, protecting the ecological environment, fostering new trends in rural civility, enhancing governance efficiency, and improving the quality of life in rural areas. However, complacency is unwarranted. Rural microcredit must be recognized as a double-edged sword. This study identifies the negative impacts, risks, and challenges that persist, including deficiencies in the rural credit system, existing legal loopholes, relatively weak risk prevention and control capabilities, and insufficient innovation in service models and product design. Accordingly, this paper proposes reasonable and targeted countermeasures, such as optimizing the rural credit system, closing legal gaps, strengthening risk management, and enhancing service and product innovation. Overall, this study aims to provide theoretical support and practical guidance for the further development of rural microcredit within the context of rural revitalization, thereby continuously generating momentum for rural economic growth and livelihood improvement, and ultimately contributing to the accelerated realization of the strategic goal of rural revitalization.

Keywords: Rural Microcredit; Rural Revitalization; Credit System; People's Well-Being; Economic Development; Financial Support

1. Introduction

The Rural Revitalization Strategy constitutes the overarching framework for addressing issues concerning agriculture, rural areas, and farmers in the new era. It is essential for achieving the

Two Centenary Goals and realizing the Chinese Dream of the great rejuvenation of the Chinese nation. Within this strategic context, rural microcredit plays a vital and irreplaceable role. However, rural microcredit remains in a developmental stage, characterized by notable shortcomings and substantial room for improvement. Although existing studies recognize its potential, they often fail to provide a systematic examination of its dual effects—both beneficial and challenging—during the revitalization process. A clear research gap persists in holistically addressing the interconnected issues of credit systems, legal frameworks, risk management, and product innovation. Against this backdrop, this paper conducts an in-depth investigation into the development of rural microcredit. The main objectives are to: analyze the real-world interaction between rural microcredit and rural revitalization; identify and elaborate on its positive outcomes across industrial, ecological, cultural, governance, and livelihood dimensions; and critically assess its negative effects and inherent risks. Based on these findings, the study aims to propose targeted and practical countermeasures.

The significance of this research lies in its potential to provide valuable theoretical insights and actionable guidance for the future development of rural microcredit. In doing so, it seeks to contribute sustained momentum to rural economic development and the improvement of people's wellbeing, thereby supporting the accelerated realization of the strategic goals of rural revitalization.

The structure of this paper is as follows: following the introduction, Section 2 reviews the relevant literature and identifies the research gap. Section 3 analyzes the positive role and achievements of rural microcredit in promoting rural revitalization. Section 4 examines the existing challenges and potential risks. Section 5 puts forward corresponding countermeasures and recommendations. Finally, Section 6 presents the conclusion and prospects for future research.

2. Rural Microcredit

2.1. Research Background and Significance

The rural revitalization strategy is the necessary path and condition to address the most prominent contradiction in Chinese society in the new era and to achieve the two centenary goals and the Chinese Dream of the great rejuvenation of the Chinese nation. Rural microcredit is playing an increasingly important role in rural finance and has developed into one of the most important components of financial services to date. Rural microcredit is now playing an indispensable role in boosting the rural economy, increasing farmers' income and promoting rural industrial upgrading. However, it should be noted that although rural microcredit has many advantages, many of its drawbacks and risks can also be seen, such as the imperfect credit system of microcredit, many legal loopholes, weak risk prevention and control capabilities, insufficient service and product innovation, slow product renewal speed, information lag, etc. These deficiencies and problems have greatly limited the development speed of rural microcredit and hindered the advancement of rural revitalization. So, in the face of this critical situation today, a preliminary and in-depth understanding of rural microcredit in the context of rural revitalization is of great theoretical and practical significance.

2.2. Current Status of research at Home and Abroad

Compared with the initial exploration process of rural microcredit in China, research in this area was initiated earlier abroad, and the stage of improvement was also earlier. Therefore, we can appropriately draw on the research conclusions of foreign scholars and combine them with the actual situation of our country to conduct a more comprehensive and perfect exploration. Research on microcredit abroad mainly focuses on operational methods, risk assessment and control, performance evaluation, etc (Hermes, 2007). Among them, Jonathan Morduch, a well-known scholar in the field of economics who studies microcredit, has a deep understanding (Morduch, 1999) of the research on the effect of microcredit on poverty alleviation (Khandker, 2005), and finally concludes that microcredit can to some extent promote poverty alleviation and help the poor get rid of poverty earlier. This conclusion has been of great help in the country. Based(Armendariz,2010)on this, scholars in the country have explored in depth the role of rural microcredit in rural revitalization, its future prospects, potential problems, and coping strategies, in light of the real situation (Yunus, 2007) in the country. For example, Li Lili, a renowned economist in China, precisely pointed out that rural microcredit has a promoting effect on rural revitalization and a considerable driving force for improving the economic level of rural areas, but coexisting with it, microcredit also has its specific drawbacks, such as an imperfect credit system, lagging service products, and insufficient sources of funds. There are serious problems such as weak risk prevention and control.

2.3. Research Methods

This article employs a variety of research methods to ensure authenticity, reliability, and scientificity. The specific methods are as follows:

(1) Literature review method: Sort out and summarize relevant literature and academic achievements at home and abroad on rural revitalization and rural microcredit, with a focus on works and cutting-edge achievements in areas such as improving the credit system of microcredit, risk prevention and control, promoting service product innovation, and how this credit promotes economic development in the context of rural revitalization. Sort out the research system and lay the theoretical foundation. To provide sufficient and stable theoretical support for the research of this paper.

(2) Case analysis: Select the more classic rural areas in the eastern, western and central regions of China (such as the typical Deqing County in Zhejiang in the eastern region, Danling County in Sichuan in the western region, Jinzhai County in Anhui in the central region, etc.) as the subjects of specific case analysis in this article, and explore in depth the practical practices of rural microcredit in the local areas, and further explore the real obstacles faced by the local areas for this credit, As well as the difficulties and potential risks in the implementation of relevant policies by the government, practical, convenient and replicable accurate measures have been discussed respectively for these problems to add practical persuasiveness to the research conclusions of this paper.

3. The Role of Rural Microcredit in Rural Revitalization

3.1. Boosting Industrial Prosperity

Thriving industries are undoubtedly the core driving force for rural revitalization. Only with thriving industries can local economic development be better promoted, people's income levels be raised, and people's well-being be improved (Beck, 2007). But the shortage of funds is the main bottleneck restricting the development of industries. However, rural microcredit has the three major characteristics of "small amount, low threshold, and fast lending", which precisely correspond to the main obstacles to the development of industries in rural areas. It can provide better support for the financial needs of the development of industries in rural areas and also provide favorable support for the upgrading of rural industries.

3.2. Promote Ecological Livability

Ecological livability is an essential requirement for rural revitalization. As the saying goes, "Green mountains and clear waters are better than mountains of gold and silver." In today's world of rapid economic development and continuous technological innovation, ecological and environmental protection has become an important requirement for economic development and a key criterion. Rural microcredit provides a financial basis for ecological protection and rural environmental protection, and also promotes green industries in rural areas. It provides financial guarantees (Zeller, 2002) for the reduction of industrial pollution and the improvement of the ecological environment for residents. Further exploration, we can delve deeper into these funds for environmental purposes, and based on actual cases, we can conclude that the funds for microcredit are mainly used for the purification and treatment of sewage, the centralized removal and environmental treatment of garbage, and the treatment of pollution in animal husbandry and breeding. The following is a real case: In Yixing City, Jiangsu Province, a small sewage treatment station was established through rural microcredit to meet the standards for sewage discharge; Changde City, Hunan Province, has set up garbage sorting stations using rural microcredit and purchased a large number of organic fertilizer processing facilities, which has increased the reuse rate of garbage and effectively solved the key environmental pollution problem of "garbage surrounding villages and sewage flowing everywhere" in rural areas. From these actual cases, it can be seen that the rural microeconomy has provided significant impetus and laid an important foundation in promoting the greening of rural industries, facilitating the transformation of rural energy and environmental protection, and promoting an ecological and livable environment.

3.3. Promoting Civilized Rural Customs

Rural civilization is the spiritual foundation for rural revitalization. Through the fund of rural microcredit, emphasis can be placed on the development of rural culture, the promotion of rural traditional culture, the improvement of farmers' quality (Ghosh, 2013), and the provision of good financial guarantee, material guarantee and development impetus for the cultivation of simple folkways, good family traditions and civilized rural customs. Among them, in the most difficult aspect of improving farmers' quality, local conditions can be effectively examined, such as using microcredit funds to carry out publicity activities on civilized qualities, related cultural promotion activities, vocational skills training, popular science publicity and other lectures. To promote the

inheritance and innovation of culture, enhance farmers' confidence in themselves and their own culture, and promote the high integration of rural civilization and cultural revitalization.

4. Problems Facing Rural Microcredit in the Context of Rural Revitalization

4.1. Imperfect Credit System and Assessment System

At present, the credit system for rural microcredit in China is steadily advancing, but the credit assessment system is still in the optimization stage. The rural credit rating system, compared with the urban credit rating system, places less emphasis on hard conditions such as farmers' assets and income, and pays more attention to the proportion of integrity, which leads to less credibility in the rating results. On the one hand, the rural credit information collection system is relatively backward, resulting in a relatively chaotic and difficult collection of information; On the other hand, there is a lack of a unified national quantitative standard for rural credit evaluation and the proportion of integrity, which makes it difficult to accurately assess the credit status and integrity of borrowers and increases the risk (Conning, 2007)of taking on credit. In addition, due to the backward level of education in rural areas, some farmers have a relatively weak sense of credit and there is a phenomenon of maliciously evading debts, which has greatly affected the healthy development of rural microcredit.

4.2. The Capacity for Risk Prevention and Control is Relatively Weak

Rural microcredit risks are classified into three categories: external environment risks, borrower risks themselves, and operational risks of financial institutions. External environmental risks are caused by uncontrollable factors such as natural factors, institutional reforms, market changes, such as floods, droughts, pests and diseases, which lead to reduced crop yields, unstable farmers' income, loss of repayment ability and inability to repay (Dupas, 2013); The borrower's own risks stem from the individual characteristics and credit awareness of farmers or rural small and micro enterprises, such as the fact that most rural small and micro enterprises have a relatively small level of operation, weak risk resistance capacity, and mistakes in management decisions, which can easily lead to poor operation resulting in losses and bankruptcy, weakened repayment capacity, and inability to repay on time. Or farmers have weak credit awareness and lack of information, which leads to incomplete and inadequate understanding of credit contracts; The operational risks of financial institutions are caused by internal mistakes within rural microcredit institutions, such as incomplete risk warning mechanisms, chaotic management processes, and insufficient professional capabilities of personnel, which lead to pre-loan review risks and post-loan management risks.

4.3. Inadequate Innovation in Products and Services

4.3.1. The Loan Structure is Unreasonable

The loan amounts and terms are mostly small and short-term, not applicable to some agricultural projects (Cull, 2009) that require large amounts of capital and are long-term, such as

tropical fruit cultivation, where farmers may face repayment pressure without reaping the fruit income. The repayment methods are also relatively limited, with monthly interest payments and one-time repayment at maturity not applicable to some tourism workers whose income depends on the off-season or hot season.

4.3.2. Credit Products are Limited

With the progress of The Times and the increase of industries, many microcredit products are limited and can no longer meet the needs of the general public. There is a lack of diversified, differentiated and innovative credit products

4.3.3. Limited Range of Services

Due to geographical and personnel limitations, the service scope of a small number of rural financial institutions is difficult to cover remote areas, and there is insufficient microcredit service in some remote areas, resulting in some farmers being unable to enjoy convenient financial services.

5. Optimized Strategies and Methods for Rural Microcredit Development in the Context of Rural Revitalization

5.1. Strengthen Risk Prevention and Control Mechanisms

The strengthening of the risk prevention and control mechanism for rural microcredit mainly involves managing risks in three aspects: before, during and after the loan, and determining the corresponding risk prevention and control system and measures in light of the local rural background. Before lending, to avoid relying solely on integrity reports and lacking credibility, methods (Karlan, 2011) such as strengthening pre-loan investigations and optimizing customer access mechanisms can be adopted. Use a combination of online and offline investigation methods to verify both the data and the business conditions on the spot to avoid situations where credit and interest do not match or are asymmetrical. At the same time, based on the characteristics of the surveyed farmers, indicators and reviews are given by taking into account the integrity report, the stability of production and operation, land and property assets, etc. In loans, strengthen monitoring and management of rural microcredit (Ledgerwood, 1999) by establishing risk assessment and early warning models. Real-time tracking of borrowing customers' operating conditions and repayment capabilities can match loan amounts to farmers' operating conditions to prevent excessive or insufficient credit granting. At the same time, strengthen risk management within financial institutions and cultivate the risk prevention and control capabilities of professionals; After the loan, improve the risk guarantee mechanism and jointly introduce credit + insurance products with the government, village committees, insurance companies, etc. to reduce risk losses. At the same time, raise farmers' awareness of credit. For those who fail to repay on time, first find out offline whether the default is caused by uncontrollable factors, then distinguish whether it is malicious debt evasion or temporary hardship. For the former, investigate according to the law, and for the latter, repay through negotiation, installment, extension and other methods.

5.2. Innovate Microcredit Products and Services

Based on rural production and life, agricultural industry characteristics and farmers' demands, from the aspects of product design and service model Carry out product and service innovation,. A variety of products for emerging industries such as rural e-commerce and tourism can be developed, and service stations can be added while simplifying application procedures and processes. Simple data uploads can be made through mobile apps and wechat mini-programs, and intelligent processing can be implemented using today's Internet big data technology to improve the convenience and efficiency of services.

5.3 Improve the Rural Credit System

Establish and expand a complete and sound mechanism (Burgess, 2005) for collecting and sharing rural credit information. In combination with the credit information of various judicial departments, comprehensively depict and improve the credit files of each household. Establish a cross-departmental data sharing mechanism and create a favorable credit environment by strengthening credit education and publicity. Severely punish the untrustworthy in accordance with the law and offer incentive mechanisms and preferential treatment to borrowers with good credit. At the same time, build a credit evaluation system that is compatible, enhance the scientific nature of credit ratings, and use big data AI models to replace traditional manual ratings to reduce subjective errors (Demirguc-Kunt, 2013).

6. Conclusions and Prospects

Rural microcredit plays a significant role in the rural revitalization strategy and is of great significance for promoting rural economic development and improving the living standards of farmers. Although rural microcredit has achieved certain development at present, with its scale expanding, service providers becoming increasingly diverse and products innovating, it still faces many problems such as an imperfect credit system and weak risk prevention and control capabilities. Through the implementation of optimized strategies such as improving the rural credit system, strengthening the risk prevention and control mechanism, innovating products and services, broadening the sources of funds, and enhancing the popularization and education of financial knowledge, rural microcredit can better adapt to the needs of rural revitalization and play a greater role in promoting the prosperity of rural industries, ecological livability, civilized rural customs, effective governance and prosperous life. In the future, with the continuous advancement of the rural revitalization strategy and the deepening of rural financial reform, rural microcredit is expected to have broader development space, further facilitating high-quality development in rural areas of our country and providing solid financial support for the full realization of the goals of the rural revitalization strategy.

Author Contributions:

Conceptualization, B.Z.; methodology, J.X.; formal analysis, B.Z.; investigation, J.X.; resources, B.Z.; data curation, B.Z.; writing—original draft preparation, B.Z.; writing—review and editing, J.X.; visualization, J.X.; supervision, B.Z.; project administration, J.X.; All authors have read and agreed to the published version of the manuscript.

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Post-editing of AI-assisted Translation in Translator Education: A Genre-based Classroom Study

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Abstract

The emergence of generative AI in translation classrooms has shifted instructional priorities away from text production alone toward issues of quality and judgement. This study reports a within-class longitudinal investigation of post-editing of AI-assisted translation in Japanese–Chinese translation training. Over a single semester, twenty-eight undergraduate Japanese majors completed six translation assignments, each involving an AI-generated draft, manual revision, and a short-written justification of their revision choices. Two learning outcomes were examined: overall translation quality (score_total, 0–100) and the quality of students' rationales (rationale_quality, 0–2), the latter capturing the extent to which revision decisions were supported by explicit, text-based evidence. Results indicated gradual and non-linear improvement in translation quality, alongside more noticeable changes in students' justification practices over time. Genre also played a mediating role: news tasks tended to elicit cue-based rationales related to modality and attribution, whereas literary tasks prompted broader but less readily verifiable stylistic reasoning. These findings suggest that the pedagogical value of post-editing of AI-assisted translation lies not only in improving translation products, but also in fostering evaluative judgement through routine, scaffolded post-editing and justification activities.

Keywords: AI-assisted Translation; Post-editing; Evaluative Judgement; Translation Pedagogy

1. Introduction

The widespread use of generative artificial intelligence and machine translation has reshaped everyday practices in translation teaching. In many translation classrooms, the key issue is no longer whether students should be allowed to use AI-based tools, but how such tools can be incorporated without weakening the development of professional judgement. Previous studies

have shown that machine translation systems substantially reduce the effort required to produce an initial draft, enabling learners to generate linguistically fluent target texts with relative ease (Bowker, 2021; Kenny, 2022). This convenience, however, has also prompted concerns among educators, particularly regarding students' ability to evaluate translation quality once the initial draft is no longer produced by the students themselves.

In professional contexts, translation competence is defined less by speed or surface fluency than by the capacity to evaluate competing solutions and to take responsibility for translational choices. As AI systems increasingly assume the role of text generation, evaluative skills become more central rather than less. Although post-editing has long been recognised as a pedagogically meaningful way to integrate machine translation into translator training (O'Brien, 2002), classroom-based research has paid limited attention to how students' decision-making processes develop over time when AI tools are used on a routine basis. Moreover, the potential role of genre in shaping students' engagement with AI-generated drafts has received little systematic attention. The present study therefore reports a longitudinal classroom investigation of Japanese–Chinese translation tasks, examining changes in both translation quality and students' ability to articulate evidence-based rationales for revision, with particular attention to differences between news and literary texts.

2. Literature Review

Research on machine translation in translator education has undergone a notable reorientation over the past two decades. Rather than focusing primarily on whether machine translation should be restricted in the classroom, recent work has increasingly addressed how it can be integrated in pedagogically meaningful ways. Central to this discussion is the concept of post-editing. O'Brien (2002) described post-editing as a process that goes beyond surface correction and involves active judgement and decision-making on the part of the translator. Later studies in translator education have drawn on this view, arguing that machine translation supports learning only when students are encouraged to question and revise AI-generated output rather than rely on it uncritically (Bowker, 2021; Kenny, 2022; O'Brien & Ehrensberger-Dow, 2020).

This line of research foregrounds judgement as a core learning outcome, linking post-editing practice with broader discussions of evaluative judgement and feedback literacy in higher education. Evaluative judgement refers to learners' capacity to make informed assessments of quality and to explain the basis of those assessments in complex tasks (Tai et al., 2018). Related work on feedback literacy further suggests that feedback supports learning only when students are able to internalise criteria and apply them in subsequent decisions (Carless & Boud, 2018). In translation education, where multiple acceptable solutions often coexist, these perspectives underscore the importance of making students' reasoning processes visible, rather than evaluating final products alone.

Genre has received comparatively little attention in studies of AI-assisted translation pedagogy. Existing research indicates that source-text characteristics influence machine translation output quality and may shape subsequent revision behaviour (Lee, 2022; Loock & Léchauguette, 2021).

At the same time, work on critical AI literacy in language education suggests that students are more likely to engage critically with AI tools when their use is embedded in task-specific risks and constraints (Tacelosky et al., 2025; Krüger, 2023). In translation classrooms, contrasting genres such as news and literary texts provide a natural context for this form of situated engagement, as they foreground different dimensions of responsibility, stance, and stylistic coherence. The present study draws on these insights by examining genre as a mediating factor in students' engagement with AI-assisted post-editing.

3. Methodology

3.1. Research Design and Research Questions

To capture changes that unfold through repeated classroom practice, this study followed a single cohort of students across multiple AI-assisted translation tasks over the course of one academic semester. The design did not compare different groups or experimental conditions, but focused on within-class development. This decision presupposes that skills such as post-editing judgement and the ability to justify revision decisions are not developed in reaction to a single task, but are formed through repeated interactions with translation standards and feedback (Tai et al., 2018; Carless & Boud, 2018).

In translation education, the role of machine translation has shifted noticeably in recent years. Rather than being treated solely as a shortcut to be avoided, MT is increasingly incorporated into instruction through post-editing activities. Importantly, post-editing is not understood as routine correction, but as a process that requires evaluative judgement, decision-making, and an awareness of communicative responsibility (O'Brien, 2002; Bowker, 2021). Research on machine translation literacy similarly suggests that learning outcomes depend less on whether students use AI tools and more on how they are guided to question and revise AI-generated output in context (O'Brien & Ehrensberger-Dow, 2020; Kenny, 2022). These considerations make a longitudinal classroom design particularly suitable for examining students' engagement with AI-assisted translation.

Against this background, the study addressed the following research questions:

(1) Does students' overall translation quality change over the course of AI-assisted translation instruction?

(2) Does students' ability to provide evidence-based rationales for post-editing decisions change over time?

(3) Do news and literary genres shape these developmental patterns in different ways?

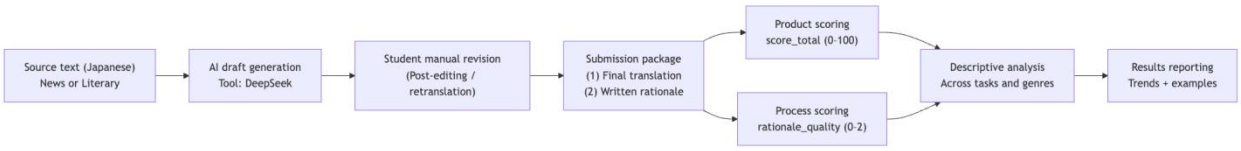

Figure 1. Workflow of the AI-assisted Translation and Data Collection Process

3.2. Participants and Instructional Context

The participants were 28 undergraduate students majoring in Japanese at a public university in China. All were enrolled in a compulsory Japanese–Chinese translation course taught over a 16-week semester. The course met twice a week, with each session lasting 90 minutes. Before taking the course, students had completed general Japanese language training and introductory translation exercises, but none had received systematic instruction in AI-assisted translation or post-editing.

AI use was explicitly built into the course design. For all assignments, students relied on the same AI translation system (DeepSeek) to generate initial drafts. This was a deliberate instructional decision. Allowing multiple tools would have introduced unnecessary variation and made it difficult to interpret students' revision behaviour. Similar concerns have been raised in previous work on machine translation literacy, which emphasises the importance of controlling tool-related variables in classroom-based studies (Kenny, 2022).

Throughout the semester, students were repeatedly reminded that AI-generated drafts were not to be treated as final translations. Classroom discussion addressed typical limitations of MT output, such as overgeneralisation, inappropriate certainty, and stylistic flattening, issues that have been noted in earlier studies of MT use in language and translation classrooms (Lee, 2023). The instructional goal was not to discourage AI use, but to help students develop a more reflective and responsible stance toward AI-assisted translation.

Table 1. Overview of Indicators Included in Land-Use Scale, Development Intensity

Component	Specification
Research design	Within-class longitudinal
Setting	Undergraduate Japanese–Chinese translation course (public university, China)
Participants	28 undergraduate Japanese majors
Course duration	16 weeks
Contact hours	2 × 90 minutes per week
Language pair	Japanese to Chinese
AI tool	DeepSeek (used consistently across all tasks)
Assignments	6 translation tasks (T1–T6)
Genres	3 news texts; 3 literary texts
Unit of analysis	One submission per student per task (max. 168 submissions)
Outcome measures	score_total (0–100); rationale_quality (0–2)
Analysis approach	Descriptive trends and qualitative illustration

3.3. Tasks and Instructional Procedure

Over the semester, students completed six translation assignments, consisting of three news texts and three literary excerpts. The use of two contrasting genres was intentional. Previous research has shown that machine translation output and post-editing strategies are sensitive to text type, and that genre characteristics influence the kinds of problems learners attend to during revision (Lee, 2022; Lee, 2023). In addition, work on critical AI literacy suggests that students engage more critically with AI tools when tasks highlight concrete communicative risks rather than abstract technical skills (Ducar & Schocket, 2018).

The assignments were scheduled from Week 3 onward, with one task assigned every two weeks. The basic procedure of each task is similar. Students first generated an AI draft using DeepSeek. After generating the initial draft, students were asked to revise the translation on their own. In doing so, they decided which parts required modification and which could be retained. In addition to the revised version, students provided a short written explanation commenting on some of their revision decisions as well as why the revisions were made.

The task procedure was identical, but the focus of classroom discussion changed depending on the text type. With news translation tasks, evidentiality, modality, and responsibility attribution were considered, and tasks in this direction examined whether the AI-generated expressions demonstrated excessive confidence or ambiguous information sources. In the translation of literary texts, discussion focused on narrative voice, tone, and consistency. Rather than correcting isolated errors, students were encouraged to consider how local revisions affected the coherence of the text as a whole. This use of post-editing to foreground different aspects of translation quality is consistent with earlier classroom-based research (Niño, 2008; Yang, 2023).

Table 2. Task Schedule and Genre Coverage

Task	Week	Genre	Source text length	Instructional focus	Deliverables
T1	Week 3	News	~700 JP characters	evidentiality; stance; attribution	final translation + rationale
T2	Week 5	Literary	~1,000 JP characters	narrative voice; tone	final translation + rationale
T3	Week 7	News	~750 JP characters	modality; hedging	final translation + rationale
T4	Week 9	Literary	~1,100 JP characters	rhythm; stylistic coherence	final translation + rationale
T5	Week 11	News	~800 JP characters	factual caution; responsibility	final translation + rationale
T6	Week 13	Literary	~1,200 JP characters	perspective; voice stability	final translation + rationale

3.4. Measures and Rating Procedures

To capture both learning outcomes and learning processes, two measures were used in the analysis: overall translation quality (score_total) and students' rationale quality (rationale_quality).

3.4.1. Translation quality (score_total)

Translation quality was measured using the total score awarded for each assignment according to the course assessment rubric (score_total). The rubric included dimensions commonly used in translation pedagogy, such as accuracy, coherence, appropriateness of expression, and genre conformity. Scores ranged from 0 to 100 and were assigned by the course instructor as part of regular coursework assessment. Using course-based scores as outcome measures is consistent with classroom-oriented research on MT post-editing, where ecological validity is often prioritised over experimental control (Niño, 2008; Yang, 2023).

3.4.2. Rationale quality (0-2)

Beyond product scores, the analysis also considered how students explained their revision decisions. This aspect was captured through a process-oriented measure referred to as rationale quality, which assessed whether students could articulate clear and text-based reasons for the changes they made. The use of this measure was informed by Tai et al. (2018)'s work on evaluative judgement, which views quality assessment as a form of disciplinary competence, and by research on feedback literacy that stresses the importance of internalising criteria through use rather than through instruction alone (Carless & Boud, 2018).

Rationale quality was rated on a three-point scale:

(1) 0 (Impression-based): Statements based on intuition or preference, without identifiable evidence.
(2) 1 (Partially grounded): References to textual or contextual factors that remain vague or weakly connected to the revision.
(3) 2 (Evidence-based): Clear justification linked to identifiable source-text cues, pragmatic considerations, or genre conventions.

Table 3. Measures and Rating Criteria

Measure	Construct	Scale	High-score definition	Example (anonymised)
score_total	Overall translation quality (product)	0–100	Strong performance across rubric dimensions	"92/100"
rationale_quality	Evidence-based justification (process)	0–2	Explicit, verifiable reasoning	"Because 'とみられる' signals hedging, I used '据称/可能' to avoid overstating certainty."

***Note.** *score_total* refers to the overall translation score assigned according to the course assessment rubric (range: 0–100). *rationale_quality* was coded on a three-point scale (0–2), reflecting the extent to which revision decisions were supported by explicit and verifiable justification.

Table 4. Coding Examples for Rationale_quality

Level	Typical wording	Coding rationale	Example (anonymised)
0	"It sounds more natural."	No explicit evidence	"I revised the sentence because it reads better."
1	"The source seems cautious, so I adjusted the tone."	Partial awareness, unclear linkage	"The Japanese is uncertain, so I softened the Chinese."
2	"The source uses 'とみられる', so I retained hedging to preserve stance."	Explicit cue and justified revision	"Cue: とみられる, Revision: 据称/可能, Reason: avoid categorical claims in news."

***Note.** Examples are anonymised excerpts selected to illustrate typical patterns observed in student rationales. Coding focuses on the presence and clarity of evidence-based justification rather than linguistic accuracy.

3.5. Data Analysis

Data analysis focused on developmental trends across tasks and genres. For each assignment, means and standard deviations of score_total and rationale_quality were calculated. The data were analyzed from two perspectives: first, results were traced across six tasks (T1–T6) over time to examine change; second, patterns between news and literary tasks were compared to determine whether text type was associated with different developmental tendencies.

To supplement these quantitative results, a sample of anonymized rationale extracts was used to illustrate general over-time changes in students' justification practices. It is typical in classroom-based research in translation pedagogy to combine descriptive statistics with qualitative description in order to examine learners' reasoning, rather than to claim causal effects under strictly controlled conditions (Bowker, 2021; Yang, 2023).

4. Results

This section reports patterns observed across the six AI-assisted translation tasks. Rather than treating the results as evidence of linear improvement, the focus is placed on how students' performance and justification practices changed, stabilised, or fluctuated over time. The results are organised around overall translation quality, rationale quality, and genre-related differences.

4.1. Overall Patterns in Translation Scores across Tasks

Students' overall translation performance was examined using the course-based total score (score_total, 0–100). Mean scores and standard deviations were calculated for each task to provide an overview of changes across the semester.

Table 5 indicates that average scores increased across the six tasks, although the pattern was not uniform. However, the change was gradual and uneven. In the early tasks, particularly T1 and T2, score differences between students were relatively large. Some students achieved relatively high scores from the outset, while others remained clustered around the mid-range.

In later tasks, mean scores were higher on average, but this increase did not occur uniformly from one task to the next. In several instances, mean scores plateaued or changed only marginally, especially when the genre of the task shifted. Each practice material belongs to a different genre (in this case, news or literature), and the topics, difficult words, and styles, etc. in different materials also vary across materials.

Standard deviations provide additional insight. While variation across students remained visible throughout the semester, dispersion tended to narrow slightly in later tasks. This indicates that, for some students, performance became more stable over time. At the same time, a small number of students continued to display irregular performance patterns, suggesting that the AI-assisted workflow did not affect all learners in the same way.

Table 5 Mean Score_total and Standard Deviation across Six Translation Tasks

Task	Mean score_total (M)	SD
T1	71	9.5
T2	72	9.0
T3	75	8.5
T4	78	8.0
T5	79	7.5
T6	80	7.5

***Note**. Mean values represent average *score_total* across students for each task. SD refers to standard deviation, indicating variation in performance within the class.

4.2. Changes in Students' Justification Practices

To examine how students explained their revision decisions, written rationales were analysed using the three-level rationale_quality scale (0–2). The distribution of rationale levels was calculated for each task.

In the initial tasks, a large proportion of rationales were coded at Level 0. These explanations typically relied on general impressions, such as claims that a revision made the translation "sound better", without reference to specific textual features. Level 1 rationales, which showed partial awareness of textual or contextual factors, were present but less common.

When Table 6 is examined across tasks, changes in students' rationales become more apparent in the later stages of the experiment. The percentage of Level 0 rationales decreased, whereas Level 1 and Level 2 rationales rose. In the later tasks, Level 2 rationales—those providing explicit and verifiable justification—ceased to be exceptional. Learners increasingly resorted to recognizable clues in the source text or to genre-related conventions in their textual justifications for revision (Koponen, 2016). This pattern did not apply to all students. Some students, in a number of assignments, continued to rely on impression-based explanations even after being reminded several times to justify their choices.

Another observation is that the quality of the rationale did not necessarily change in a parallel manner to translation scores. Cases were identified in which, even when overall translation quality remained relatively high, students produced more coherent explanations of why particular decisions were made. This suggests that justification practices may develop before improvements in final products become visible.

Table 6. Distribution of Rationale Quality Levels across Tasks (%)

Task	Level 0 (%)	Level 1 (%)	Level 2 (%)
T1	45	40	15
T2	38	42	20
T3	30	45	25
T4	22	46	32
T5	18	44	38
T6	12	42	46

*__Note__. Percentages may not sum to 100 due to rounding. Rationale levels correspond to the coding scheme described in Table 4.

4.3. Genre-related Differences in Performance and Reasoning

To explore the role of genre, results were examined separately for news and literary translation tasks. Mean score_total and mean rationale_quality were calculated for each genre.

Table 7. Comparison of Translation Performance and Rationale Quality by Genre

Genre	Mean score_total	Mean rationale_quality
News	78.5	1.45
Literary	76.5	1.30

In the case of news translation tasks, mean translation scores showed comparatively stable variation across assignments. Students' rationales in such exercises more often alluded to concrete linguistic cues, such as modality or attribution patterns. In some instances, students explicitly associated revision with distrust of overstatement or responsibility, suggesting an awareness of communicative risk.

Literary tasks were more varied. On the one hand, some students produced high-quality translations and elaborate rationales; on the other hand, some students were unable to sustain a high level of performance. Rationales in literary tasks tended to focus on tone, narrative voice, or stylistic flow, but were at times less precise in identifying what prompted a revision. By comparison, news tasks appeared to attract more cue-based justifications, whereas literary tasks encouraged more general yet less readily correctable forms of explanation.

5. Conclusion

This study aims to examine how students' engagement with AI-assisted translation tasks developed over time, focusing not only on changes in translation quality but also on how students justified their revision decisions. The results do not point to dramatic improvement in final products. Instead, they reveal a more uneven and gradual pattern of change, particularly in the ways students reasoned about translation choices. In this section, the discussion addresses two closely related issues: how learning becomes visible beyond product scores, and how genre shapes students' evaluative engagement with AI-generated drafts.

5.1. Looking Beyond Products: What Changes Before Quality Improves

A notable feature of the results is the contrast between relatively minor changes in translation scores and more noticeable improvement in students' written rationales. Although there were some gradual gains in overall translation quality throughout the semester, these were not uniform and did not always occur in task order. By comparison, changes in how students explained their revision preferences were more apparent and tended to emerge earlier.

Students' performance did not show immediate improvement, which suggests the presence of a learning curve in AI-assisted post-editing. Rather than demonstrating linear gains in translation quality, students appeared to develop increasing awareness of what constitutes a justified decision. Analysis of the submissions indicated that some students provided more explicit arguments for their revisions despite inconsistencies in translation quality. A similar pattern is described by Tai et al. (2018), who argue that evaluative judgement develops through disciplinary engagement rather than through short-term performance gains.

This observation raises the need to reconsider how learning outcomes are defined and evaluated in translation classrooms. Product-based scores, although necessary, tend to mask early forms of development that are cognitive or reflective in nature. Comparable concerns have been raised in the feedback literacy literature, which emphasizes that students may internalize quality standards before applying them consistently in performance (Carless & Boud, 2018). From this perspective, improvement in the quality of rationales represents a valuable, albeit incomplete, indicator of learning prior to visible gains in translation output.

Nevertheless, the findings caution against assuming that progress is automatic. Development in justification remained uneven, indicating that the use of AI tools requires instructional designs that consistently foreground reasoning, evidence, and responsibility.

5.2. Genre, Constraint, and the Nature of Evaluative Engagement

The findings show that students interacted with AI-generated drafts in relation to genre. Distinctions between news and literary translation tasks were evident not only in translation scores, but more clearly in the nature of students' rationales.

During news translation exercises, students more often based their justifications on recognizable linguistic cues, including markers of modality or attribution. These tasks encouraged forms of assessment that were relatively tangible and measurable. News discourse is more likely to be characterized by explicit signs of stance and responsibility, offering clearer points of

reference for evaluative judgement. Previous studies have noted that machine translation output is less reliable in informational genres, making deviations and risks easier for students to detect during post-editing (Lee, 2022).

By contrast, literary translation assignments exhibited a different pattern. Students frequently referred to stylistic concerns such as tone, narrative voice, or overall coherence. These aspects are central to literary translation but are not easily tied to specific textual triggers. As a result, students' rationales were not always as explicit as those observed in news-related tasks. This inconsistency highlights limitations of AI-generated drafts in handling interpretive complexity and places a greater interpretive burden on students.

Because news and literary texts differ in their characteristics, the present study does not suggest that one genre is more effective than the other. Rather, the findings indicate that translation pedagogy may benefit from the use of multiple genres. Alternating between news and literary tasks appears to expose students to different forms of evaluative challenge: one grounded in constraint and risk management, the other in interpretive judgement and stylistic sensitivity. From this perspective, genre variation functions not simply as content diversification, but as a means of shaping how students learn to engage critically with AI tools.

5.3. Implications and Limitations

Previously, translation pedagogy primarily aimed at enhancing the quality of translations. The results of this paper indicate that the pedagogical benefit of AI-aided translation does not lie in short-term quality improvement but in the development of evaluative judgement. Where learners are required to justify the necessity of a revision, AI-generated drafts serve as prompts for reflection rather than directing them toward a satisfactory conclusion. This view supports previous arguments on the cognitive load of post-editing and its nature as an activity that requires assessment and decision-making rather than mechanical correction (O'Brien, 2002; Bowker, 2021).

The current research has a number of drawbacks. It is based on one class and does not aim to make causal claims. There is also a risk of limited extrapolation beyond similar instructional contexts due to the use of course-based assessment measures. Future studies may investigate the effects of different types of scaffolding on justification practices or integrate rationale analysis with interview data to gain deeper insight into students' decision-making processes.

Irrespective of these constraints, the study offers a grounded description of students' interaction with AI-generated drafts over time. The results do not allow AI to be considered either a threat or a solution; its pedagogical influence is determined by how it is integrated into tasks that foreground judgement, evidence, and responsibility.

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Engineering Standards and Industrial Performance: An Interdisciplinary Study of Motorcycle Shock Absorber Design and Verification

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Abstract

This study examines the role of technical standards in shaping industrial practices through a case analysis of motorcycle shock absorber design and verification under the group standard T/ZZB 3029—2022. Moving beyond a purely engineering perspective, the paper adopts a socio-technical approach to explore how standardization frameworks influence product performance, quality control systems, and industrial governance in the motorcycle manufacturing sector. Drawing on practical R&D experience in customized suspension systems for original equipment manufacturers (OEMs), the study analyzes three key technical domains—spring design, damper tuning, and structural strength verification—within the institutional constraints of standardized requirements. It further investigates the full lifecycle quality assurance mechanisms, including ex-factory inspection, type testing, and failure protection, highlighting how standardized procedures contribute to risk mitigation and performance reliability. The findings suggest that the implementation of T/ZZB 3029—2022 not only enhances technical consistency and safety performance but also establishes a data-driven and process-oriented quality governance model. This model facilitates coordination between manufacturers and suppliers, supports differentiated product development, and strengthens the regulatory infrastructure of the industry. By integrating engineering practice with institutional analysis, this study contributes to interdisciplinary discussions on the relationship between technical standards, industrial innovation, and socio-economic development. It provides empirical insights into how standardization functions as both a technological and organizational mechanism in modern manufacturing systems.

Keywords: Standardization Governance; Industrial Coordination; Spring Design; Damper Tuning; Structural Strength Verification; Quality Control

1. The Core Role of Shock Absbers in Vehicle Performance

Motorcycle shock absorbers are core components of vehicles, which directly affect the driving safety and riding comfort of vehicles. Through the elastic deformation of springs and the damping effect of dampers, they effectively absorb road impacts and attenuate vehicle body vibrations, avoiding out-of-control situations such as bouncing and rolling during vehicle driving. From a dynamic systems perspective, the shock absorber plays a critical role in maintaining tire-ground contact stability. When a vehicle travels over uneven road surfaces, the suspension system must respond rapidly to external excitations. If the damping force is insufficient or mismatched, excessive oscillations may occur, leading to reduced adhesion between the tire and the road surface. This not only affects handling performance but also increases braking distance and rollover risk under extreme conditions. Therefore, the design and performance optimization of shock absorbers are not only related to comfort but are fundamentally linked to vehicle safety performance.

Our company specializes in customizing suspension systems for main engine manufacturers of motorcycles, mopeds and electric two-wheelers. In the process of R&D and customization, meeting the technical requirements of T/ZZB 3029—2022 standard is the primary R&D goal. This standard covers the entire process of shock absorbers from material selection, design and R&D, production and testing to quality control, clarifies various core technical indicators and unified test methods, and provides standardized technical guidelines for the industry (Zhejiang Brand Construction Federation, 2022).

In practical engineering applications, the implementation of this standard enables the transformation of empirical design into data-driven design. Traditional shock absorber design often relied on iterative testing and experience accumulation, which resulted in long development cycles and unstable performance consistency. By contrast, the standardized framework defined in T/ZZB 3029—2022 establishes clear boundary conditions and evaluation criteria, allowing engineers to carry out targeted parameter optimization and rapid verification (State Administration for Market Regulation, & Standardization Administration of the People's Republic of China, 2009).

Relying on this standard, we can ensure that customized shock absorbers not only meet the overall vehicle performance requirements of main engine manufacturers, but also conform to the unified industry safety and quality requirements. At the same time, the standard promotes consistency in product performance across different production batches, thereby enhancing supply chain coordination efficiency and reducing quality fluctuation risks in large-scale manufacturing environments.

2. Key Links in the Design of Shock Absorbers

2.1. Spring Design

Springs are the core elastic elements of shock absorbers, and their performance directly determines the basic shock absorption effect of shock absorbers. Two core indicators, rigidity

accuracy and durability, must be strictly controlled in the design. The rigidity deviation of springs shall be strictly controlled within ±6%.

In engineering practice, spring stiffness is not only a static parameter but also a dynamic characteristic that influences the natural frequency of the suspension system (Kulkarni et al., 2024). If the stiffness is too high, the system becomes overly rigid, resulting in poor ride comfort and increased transmission of road shocks to the vehicle body. Conversely, if the stiffness is too low, excessive suspension travel may occur, leading to instability during high-speed driving or cornering. Therefore, achieving precise stiffness control is essential for balancing comfort and handling performance.

We use computer-aided design software to simulate and analyze the key dimensions of springs such as wire diameter, number of coils and free height, and accurately calculate and verify the spring rigidity parameters, ensuring that the springs meet the accuracy standard of limit deviation grade not lower than Grade 2 in GB/T 1239.2, and guaranteeing the accuracy of spring dimensions and performance from the source of design.

Furthermore, finite element analysis (FEA) is introduced to evaluate stress distribution under different loading conditions. By simulating cyclic loading and extreme deformation scenarios, potential stress concentration areas can be identified in advance, allowing structural optimization to be carried out during the design phase rather than after failure occurs.

Durability is an important assessment point in spring design (Kong et al., 2022). According to the requirements of T/ZZB 3029—2022 standard, after a spring completes 200,000 compression tests continuously with the working stroke, the permanent deformation shall not be greater than 2% of the free height before the test. This design requirement can effectively ensure the performance stability of the spring during the long-term driving of the vehicle and avoid the failure of the shock absorber caused by the elastic attenuation of the spring.

In addition, surface treatment processes such as shot peening are often applied to improve fatigue resistance. By introducing residual compressive stress on the surface, the initiation and propagation of fatigue cracks can be effectively suppressed, thereby extending the service life of the spring under high-frequency loading conditions.

2.2. Damper Tuning

Dampers are key components for controlling the vibration attenuation of shock absorbers (Xu et al., 2023; Fayyaz et al., 2025). Their tuning shall be carried out around three core indicators: indicator characteristics, speed characteristics and temperature characteristics, to ensure that the damping effect is adapted to the vehicle driving requirements.

From a functional perspective, damper tuning essentially involves shaping the force–velocity relationship of the damping system. This relationship determines how the shock absorber responds to different excitation frequencies and amplitudes. A well-tuned damper can provide low resistance at small amplitudes to improve comfort, while delivering high resistance under large impacts to enhance safety.

In the indicator characteristic test, the buffer resistance of the front shock absorber shall not be less than 200% of the recovery resistance. This requirement can ensure that when the vehicle encounters sudden road impacts, the shock absorber can quickly compress the buffer stroke to absorb impact energy and avoid violent shaking of the vehicle body.

The resistance tolerance of speed characteristics shall be designed differently according to vehicle positioning (Chang & Morlok, 2005). The recovery resistance tolerance of the front damper of ordinary motorcycles and mopeds is ±(13% Ff+20) N, which balances the comfort and driving stability of daily driving; the compression resistance tolerance of the rear damper of racing motorcycle shock absorbers is ±(10% Fy+20) N, meeting the handling requirements of racing motorcycles for high-speed cornering and extreme driving.

This differentiated design strategy reflects the necessity of adapting suspension characteristics to specific usage scenarios. For commuter vehicles, emphasis is placed on comfort and stability under moderate speeds, whereas for high-performance vehicles, rapid response and precise control under dynamic conditions are prioritized.

The temperature characteristics need to verify the performance stability of the shock absorber under extreme temperatures. The standard clearly requires that the recovery resistance attenuation rate of the shock absorber shall not be greater than 25% in a high-temperature environment of 100℃, ensuring that the shock absorber can maintain a stable damping effect under the working condition of long-term vehicle driving and high temperature.

In addition, low-temperature performance is equally critical, especially in cold regions. At low temperatures, the viscosity of damping oil increases significantly, which may lead to excessive damping force and reduced responsiveness. Therefore, the selection of damping oil and sealing materials must take into account the full temperature range of operating conditions.

2.3. Structural Strength Verification

Structural strength is the foundation for the safe operation of shock absorbers. Strict verification must be carried out from two aspects: the strength of core components and the quality of welded parts in the design. As a key connecting component of the shock absorber, the lifting ring shall have a tensile strength of not less than 15kN; as the main load-bearing component of the shock absorber, the aluminum cylinder shall have an axial static failure strength of not less than 15kN. By controlling the strength of core components, it is ensured that they can bear the maximum load during vehicle driving.

Beyond static strength verification, dynamic load analysis is also essential. During real driving conditions, shock absorbers are subjected to complex multi-axial loads, including impact loads, cyclic loads, and torsional stresses. Therefore, fatigue strength evaluation under variable amplitude loading is necessary to ensure long-term reliability.

Welded parts are the weak links of the structural strength of shock absorbers, so the welding quality must be strictly controlled. The welded parts shall be flat and uniform, without defects such as weld bumps, burn-through, slag inclusion, cracks, air bubbles and spatter.

At the same time, the welded parts shall pass a durability test of 1,000,000 vertical vibrations to verify the stability of the welded parts in the vibration environment of long-term vehicle driving and avoid potential safety hazards such as weld breakage and fracture. Non-destructive testing methods such as ultrasonic inspection and magnetic particle testing are also introduced in the production process to detect internal defects in welded joints, thereby improving overall structural reliability.

3. Rigorous Testing and Quality Control

3.1. Ex-factory Inspection

Ex-factory inspection is a key link to ensure the qualification of each shock absorber leaving the factory, which is carried out by sampling inspection (Xie et al., 2024). Products produced continuously with the same specification and process are regarded as one batch, and 4 products are randomly selected from each batch for testing, focusing on the detection of core items such as appearance, dimensional accuracy and damper flexibility.

In terms of dimensional accuracy control, the allowable deviation of the free length of the front shock absorber is ±1.5mm, and that of the rear shock absorber is ±1.0mm. Precise dimensional control can ensure that the shock absorber is accurately matched with the vehicle frame, transmission system and other components, avoiding problems such as installation interference and performance mismatch. The appearance inspection shall ensure that the electroplated and coated surfaces are smooth, flat and uniform in color; the damper inspection requires that the front and rear shock absorbers move flexibly during compression and extension without jamming, metal impact noise and abnormal friction sound, and the shock absorbers have no oil leakage whether placed horizontally or upside down.

3.2. Type Inspection

Type inspection is a comprehensive verification of the overall performance of shock absorbers. 10 samples shall be randomly selected from the same batch of products that have passed the ex-factory inspection to complete the full-item performance test, covering multiple dimensions such as performance, environmental adaptability and durable use.

The core test items include temperature characteristic test, which verifies the resistance change of the shock absorber in the extreme temperature range of -20℃ to 100℃ to ensure the performance stability of the shock absorber under extreme high and low temperature working conditions; dust and muddy water resistance test of the dust cover, which requires that after 1,000,000 tests, no dust or muddy water enters the inner lip of the dust seal and the lip of the oil seal, and the components have no damage, deformation and abnormal wear, protecting the internal components of the shock absorber from external corrosion; surface treatment corrosion resistance test, which requires that the electroplated layer pass a 24-hour neutral salt spray test with a surface corrosion resistance grade of not less than Grade 8, improving the service life and adaptability of the shock absorber to complex environments.

3.3. Failure Protection Design

Failure protection is an important means to ensure the long-term stable operation of shock absorbers. Targeted protection measures and testing requirements shall be formulated for different failure risk points of shock absorbers. For inflatable shock absorbers, the gas rebound force index must be strictly controlled to ensure that it meets the requirements of product design and technical documents, avoiding a sharp drop in shock absorption performance caused by gas leakage and abnormal pressure.

Anti-foaming characteristic is an important detection index of dampers, which requires that the damper has no obvious abnormal noise during the test, and the maximum fluctuation rate of the three measured indicator diagrams does not exceed 25%. This requirement prevents the shock absorber oil from generating foam during high-speed vibration, avoids the impact of foam on damping transmission efficiency, and ensures that the shock absorber will not have foaming failure problems under complex driving conditions.

4. Technical Value of Standard Implementation

The implementation of T/ZZB 3029—2022 standard provides a unified and standardized technical benchmark for the motorcycle and moped shock absorber industry, and its core technical value is reflected in three aspects: customized R&D, full-process control and data-based support. First, it clarifies the graded technical indicators of products. According to the different application scenarios of ordinary motorcycles, sports motorcycles and racing motorcycles, it formulates differentiated resistance tolerance standards for shock absorbers, meeting the customized R&D needs of different main engine manufacturers and vehicle models, making the design and tuning of shock absorbers more targeted and able to accurately match the driving and handling needs of various vehicle models. Second, it standardizes the full-process test and control requirements, forming a closed-loop quality control system from raw material performance testing, component design verification to finished product ex-factory inspection and type inspection, ensuring that every link of shock absorbers from R&D and design to finished product delivery meets the standard requirements and improving the overall product quality of the industry. Third, it provides scientific data support for customized R&D. The core data specified in the standard, such as the resistance attenuation rate not greater than 20% after 600,000 drum vibration tests, provides a unified reference basis for us to optimize spring parameters, tune damping curves and verify structural strength, helping us create high-performance and high-reliability customized suspension systems for customers.

5. Conclusion

T/ZZB 3029—2022 standard constructs a full-process quality control system for motorcycle and moped shock absorbers from material selection, design and R&D to production testing and life verification, which is the core technical basis for the design, verification and production of shock absorbers.

Relying on this standard, we accurately simulate spring dimensions and rigidity parameters through digital design technology to ensure that the spring rigidity accuracy meets the standard requirements; comprehensively verify the indicator characteristics and speed characteristics of dampers with the help of multi-speed program-controlled indicator dynamometers, and accurately tune the damping curves according to vehicle model requirements; simulate extreme road conditions and long-term vibration scenarios with double-acting fatigue test benches to comprehensively verify the structural strength and durability of shock absorbers.

Through standardized design processes and rigorous verification tests, we have realized the reliable operation of shock absorbers under complex driving conditions, which not only ensures that shock absorber products comply with the unified industry standards, but also can accurately match the overall vehicle customization needs of main engine manufacturers. It provides a core guarantee for the handling and driving safety of the whole motorcycle, and also offers high-quality suspension customization solutions that meet market demands for main engine manufacturers of motorcycles and electric two-wheelers.

Author Contributions:

Hongqin Wu contributed to the conceptualization, methodology of the study, and supervised the overall project, and coordinated the research process of the study. Xuhui Yang performed data analysis and conducted the first draft of the manuscript. All authors have read and agreed to the published version of the manuscript.

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Balancing AI-Driven Cross-Border Personalized Marketing with Data Privacy Regulations

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Abstract

This paper aims to systematically examine and analyze the multidimensional interplay between AI-enabled cross-border personalized marketing and global data privacy regulations. The paper first clarifies the core theoretical implications of the "personalization-privacy paradox." Drawing on authoritative academic research in both Chinese and English, it outlines the research landscape in this field across three interrelated dimensions: First, the technological ethics dimension and consumer behavioral responses, summarizing the transformative role of AI technology in reshaping marketing models, as well as the resulting ethical controversies—such as algorithmic transparency and excessive data collection—and the diverse psychological and behavioral manifestations of consumers; Second, the regulatory implementation and corporate strategic adaptation dimension, which analyzes the compliance pressures brought about by the GDPR-centered regulatory framework, as well as the strategic shift of enterprises from passive compliance to active adaptation, ultimately transforming privacy protection into a competitive advantage; third, the global contextual differences and localization practice dimension, which compares the prominent differences among regional markets in terms of regulatory environments, cultural perceptions, and corporate localization strategies. Existing research indicates that exploration in this field has shifted from the initial identification of contradictions to an in-depth examination of multi-dimensional balancing mechanisms. Finally, this paper identifies the limitations of current research in terms of dynamic analytical perspectives, in-depth exploration of cross-cultural theories, and coverage of small and medium-sized entities, and proposes feasible directions for future research.

Keywords: Artificial Intelligence; Cross-border Personalized Marketing; Data Privacy; GDPR; Privacy Paradox; International Marketing

1. Introduction

The deep integration of the advancement of the global digital economy and the commercialization of artificial intelligence technologies has profoundly reshaped the overall landscape of international marketing. Machine learning, deep learning algorithms, and generative AI technologies have made precise user insights and real-time personalized interactions in cross-cultural contexts a reality, significantly enhancing marketing execution efficiency. At the same time, the global wave of data privacy legislation, led by the EU's General Data Protection Regulation (GDPR), has established core principles such as legality, data minimization, and transparency in data processing, fundamentally disrupting traditional data application models in marketing. Against this industry backdrop, the "personalization-privacy paradox" has emerged as a central theoretical proposition of focus for both academia and the industry. This paradox refers to the irreconcilable internal conflict between data processing practices that underpin highly tailored personalized services and consumers' ever-increasing privacy demands and increasingly stringent legal protections.

Current research on this paradox is scattered across multiple disciplines, including marketing, law, communication studies, and information ethics, and has yet to form a unified and integrated research framework. To clarify the research trajectory, core issues, and development trends in this field, this paper focuses on addressing four key questions: First, how do existing studies define and interpret the "personalization-privacy paradox" from a multidisciplinary perspective? Second, what technical ethical conflicts, regulatory compliance challenges, and consumer behavioral characteristics do relevant findings reveal? Third, what mainstream theoretical interpretations and practical balancing solutions has academia proposed? Fourth, what regional differences and underlying causes do cross-national comparative studies reveal?

This paper employs a systematic literature review methodology to organize and synthesize relevant findings from authoritative domestic and international journals in recent years. The analysis framework is structured around three core dimensions: the micro-level (technological ethics and consumer responses), the meso-level (regulatory rules and corporate strategic adaptation), and the macro-level (global contextual differences and localized practices). This approach breaks away from the simplistic dichotomy between technology and regulation, presenting a comprehensive, multi-layered, and dynamic overview of the field. The paper concludes by synthesizing the core findings of existing research, identifying research gaps, and proposing a roadmap for future studies (Figure 1).

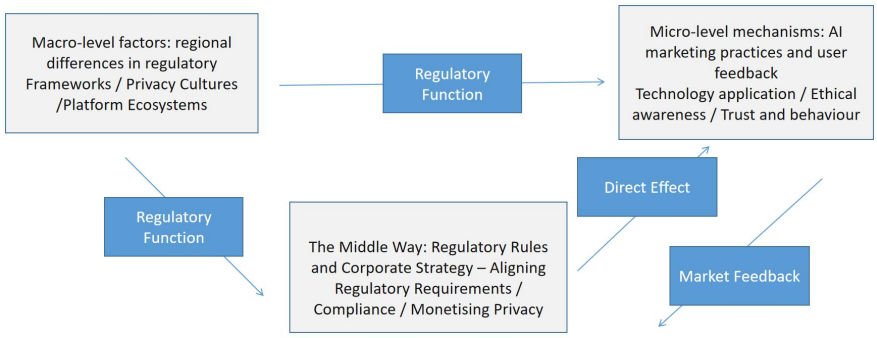

Figure 1. Technical Approach

2. Literature Dimension 1: Micro-level Mechanisms of Technological Ethics Development, User Perception, and Trust Building

2.1. Technological Iterations in AI Marketing and Their Dual Impacts

Existing literature clearly illustrates the technological evolution of AI marketing from "precision targeting" to "generative interaction." Early research focused on collaborative filtering algorithms and user profiling, while recent studies have shifted their emphasis to the innovative value of generative AI in the creation of dynamically personalized content (Lun, 2020; Lai et al., 2024). The academic community generally agrees that generative AI has not only revolutionized content production methods but also enhanced service adaptability through contextualized interactions. However, the empowering role of this technology is two-sided: while optimizing marketing outcomes, it also amplifies potential risks at the ethical and societal levels.

2.2. Algorithmic Opacity, Insufficient Information Disclosure, and Challenges in Accountability

The lack of algorithmic explainability is a key ethical issue under academic scrutiny, directly conflicting with the principles of transparency and the right to algorithmic explanation mandated by regulations such as the GDPR. While there is a consensus in the academic community regarding the insufficient transparency of algorithms, there remains disagreement on the optimal path for disclosure: some scholars advocate for the full disclosure of algorithmic logic and decision-making criteria, while others argue that overly technical disclosures would increase the information burden on users, and that actionable user control is more practical than complex technical explanations. A survey by Yang et al. (2024) on domestic digital reading applications confirms that most platforms merely fulfill their formal notification obligations, while exhibiting significant shortcomings in the disclosure of substantive information—such as the basis for content recommendations, data weighting, and user control permissions. This not only traps users in a state of information rigidity but may also lead to security issues such as excessive processing and leakage of personal information (Wang et al., 2023; Xu, 2025; Mao et al., 2025).

2.3. The Dynamic Relationship Between Data Usage, Authorization Mechanisms, and User Trust

Academic circles have conducted critical analyses of data collection and authorization mechanisms in marketing contexts. Guo et al. (2024) argue that while the GDPR has reinforced the legal centrality of user consent, in practice, lengthy and cumbersome privacy policies and manipulative interface designs easily lead to "consent fatigue," resulting in so-called informed consent that is not based on autonomous will or complete information.

Such data application models directly impact users' perception of privacy and the establishment of trust. Academic conclusions regarding the relationship between personalized services and brand trust vary: some studies confirm that personalized services featuring moderate transparency and user control can effectively enhance user trust and consumption willingness (Pan et al., 2024); other studies find that overly precise personalized content can evoke a sense of surveillance among users, thereby triggering privacy concerns and reducing brand trust. These divergent viewpoints precisely illustrate that the relationship between personalized services and

user trust is not linear. The formation of user trust is a dynamic psychological process involving the balancing of the benefits of personalization against privacy risks; this process is influenced by corporate compliance strategies and exhibits significant cross-cultural and cross-jurisdictional variations. (Shen et al., 2025; Kaushik et al., 2025)

3. Literature Dimension Two: The Mesolevel Pathways of Regulatory Logic and Corporate Strategic Adaptation

3.1. In-Depth Reflection on the GDPR Regulatory Framework and Enforcement Practices

As a global benchmark for privacy regulation, the GDPR's core principles—such as "privacy by design," "data minimization," and "purpose limitation"—have been extensively studied by academia. Guo et al. (2024) analyzed the regulation's stringent legal and compliance foundations from a legal perspective, noting that regulatory practices' narrow interpretation of the "contractual necessity" principle has made personalized marketing increasingly reliant on users' active consent. Wu et al. (2024), in their retrospective study of five years of GDPR enforcement, noted that the enforcement process is characterized by a duality: strict regulation coexists with insufficient guidance, and privacy protection is difficult to reconcile with innovation and development, creating significant uncertainty for multinational corporations' compliance efforts.

3.2. Corporate Strategic Adaptation: From Compliance to Value Creation

In the face of regulatory pressure, the literature documents a progressive strategic shift by enterprises from passive response to proactive planning, and related research has evolved from the "compliance cost theory" to the "compliance value theory."

(1) Strategic Adaptation and Compliance Game Theory: Early research viewed companies as passive executors of regulatory rules, while subsequent studies found that companies engage in flexible strategic games within the regulatory framework. For example, research in the *Journal of Marketing* shows that nearly half of companies obtain user consent through hybrid methods such as rights-based guidance and phased authorization, balancing regulatory requirements with data collection needs.

(2) Exploration of Technological Solutions: To reconcile the conflict between data utilization and privacy protection, academia and industry are jointly promoting the application of privacy-enhancing technologies, including federated learning, differential privacy, and data clean rooms. These technical approaches achieve "data usability without visibility," enabling model training and content generation for personalized marketing without directly collecting raw personal information.

(3) From Compliance Cost to Strategic Asset: Early research viewed privacy compliance as an additional operational cost for enterprises, but recent cutting-edge studies propose the opposite view, arguing that robust privacy compliance can transcend the realm of costs to become a core strategic asset for brand differentiation and trust-building. By implementing privacy-by-design principles, optimizing information disclosure mechanisms, and enhancing user control over their data, enterprises can build stronger user trust and brand loyalty.

There is a deep, two-way interdependence between regulatory rules and user trust. A stringent regulatory environment not only directly governs corporate compliance but also raises users' awareness and expectations regarding their data rights, reinforcing the aforementioned psychological trade-off between privacy and benefits, thereby making user trust a pivotal factor in corporate strategic competition. Furthermore, the effectiveness of corporate compliance practices varies significantly depending on the intensity of regulation and differences in privacy culture across different markets.

4. Literature Dimension Three: Global Market Differences and Macro-Conditions for Localization Practices

4.1. Differences in Regional Regulatory Environments and User Privacy Cultures

The extent of the impact of the technological-ethical controversies mentioned earlier, as well as the choices of corporate compliance strategies, are contingent upon specific market environments. Significant differences in regulatory frameworks and privacy cultures across global regions not only pose challenges to standardized models of cross-border marketing but also constitute the core external conditions for interpreting the dynamic balance of the "personalization-privacy paradox."

Comparative studies reveal a clear divergence in regulatory environments and user attitudes across major global markets:

(1) Europe: Deeply influenced by the GDPR, the regulatory framework is mature and stringent. Users have a high level of awareness regarding their data rights and are highly sensitive to the authenticity and quality of consent, leading to relatively standardized corporate compliance practices.

(2) North America: Companies prioritize data security and compliance risks. In marketing, they tend to rely on predictive models to assess user needs rather than actively collecting first-party user data.

(3) Asia-Pacific: Overall privacy concerns are relatively low across the region, but domestic privacy regulations in economies such as China and India are rapidly evolving—for example, China's Personal Information Protection Law—creating unique compliance challenges. Tang (2024) comparative study of China and Europe provides a macro-level framework for interpreting the core differences in regulatory philosophies and policy tools between the two regions.

(4) Latin America: Relevant research has identified a unique phenomenon: while companies in this region rank among the highest in terms of concern over privacy risks, they also demonstrate a high level of maturity in data integration and the application of zero-party and first-party data. This suggests that a heightened perception of risk actually drives companies to develop more refined and compliant data application strategies.

4.2. Specific Manifestations in Platform Ecosystems and Cross-Cultural Marketing Practices

Regional differences are not only evident at the regulatory and cultural levels but also permeate platform ecosystems and specific marketing operations. Existing research has thoroughly analyzed how differences in market platforms influence personalized marketing. For instance, TikTok's algorithm plays a guiding role in global youth consumer culture, while China's luxury marketing, relying on super-apps like WeChat and Douyin and the ecosystem of opinion leaders, has formed a marketing model distinctly different from that of Western markets.

Comparative studies of cross-cultural user behavior also provide micro-level evidence for regional differences. Huang and Zhou (2025), through a comparative study of China and the UK, found that Chinese users are more significantly influenced by social media marketing. These cultural behavioral differences directly alter the effectiveness of personalized marketing and the standards for perceiving privacy risks, further confirming the moderating role of the macro-environment on micro-level user responses.

5. Summary of Key Findings and Future Research Agenda

5.1. Core Consensus and Development Trends in Existing Research

Through a systematic review of the three interrelated dimensions, this paper summarizes three core consensus points and evolving directions in existing research:

Scholarly perspectives have expanded from a single dimension to multiple layers, departing from the early narrow focus confined merely to legal compliance and evolving into an interdisciplinary framework integrating technological ethics, user psychology, corporate strategy, and global governance. "Dynamic equilibrium" has solidified as the core research paradigm shaping the field. Moving beyond the outdated binary logic that contrasts technology against regulation, modern research delves into multifaceted dynamic balance mechanisms connecting technology, law, ethics, and commercial value. Situational adaptability has also become a prevailing consensus within academic circles. No universal remedy exists for the inherent paradox under examination, as regional regulatory norms, cultural perceptions, industrial characteristics, and platform ecosystems all serve as vital moderating factors.

5.2. Research Limitations and Future Directions

Although existing research has yielded substantial results, this paper identifies four major research gaps that urgently need to be addressed:

Existing research lacks dynamic and longitudinal perspectives. Dominated by cross-sectional analyses, current scholarship cannot reflect how balancing models for tensions between personalization and privacy evolve amid technological iteration, regulatory improvement and shifting public opinion, indicating that longitudinal tracking inquiries deserve greater emphasis in future exploration.

Cross-cultural comparative studies also fall short in theoretical depth. Most transnational investigations remain confined to descriptive elaboration. Subsequent research can adopt mature theoretical frameworks such as Hofstede's cultural dimensions to carry out empirical analysis, thereby probing into the inherent cultural roots behind divergent user attitudes and behaviors toward privacy protection.

Prospective exploration targeting emerging technologies remains relatively underdeveloped. Ethical and compliance risks stemming from generative AI, neural-technology-driven deepfake applications and mental health data utilization are still at an early research stage, which urgently demands innovative progress in theoretical systems and empirical testing.

Moreover, insufficient attention has been paid to small and medium-sized entities in the academic field. Prior studies overwhelmingly focus on large tech enterprises and multinational brands, while neglecting the compliance dilemmas, innovative coping tactics and survival modes of resource-limited SMEs facing global privacy regulations — an underexplored direction with considerable theoretical value and practical significance.

6. Conclusion

This systematic review demonstrates that the interplay between AI-driven cross-border personalized marketing and global data privacy regulations constitutes a dynamic interdisciplinary research field. Existing research has progressed from identifying the "personalization-privacy paradox" to exploring balanced approaches across multiple dimensions, including technology, regulation, ethics, and global contexts.

Integrating existing research findings, the core path to resolving this paradox lies in establishing a flexible, efficient, trust-based collaborative governance system adaptable to diverse contexts. This requires enterprises to integrate privacy ethics into their core strategies, rather than treating it merely as a passive compliance measure; it requires academia to conduct more refined, dynamic empirical and cross-cultural comparative studies; and it requires regulators to consider the practical effects of regulations and find a reasonable balance between user privacy protection and digital economic innovation. The research limitations identified in this paper—particularly regarding dynamic evolution, cross-cultural mechanisms, and SME practices—provide a clear roadmap for future research. In the global digital market competition, a company's ability to transform data protection into the co-creation of trusted value will become a core sustainable competitive advantage.

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Internal Control Effectiveness in Platform-Based Organizations: A COSO Framework Analysis of Haier Group under the Rendanheyi Model

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Abstract

As a world-renowned enterprise in home appliances and intelligent manufacturing, Haier Group has built a comprehensive internal control system covering governance, risk, processes, and supervision with the "Rendanheyi" management model (a management model integrating employees' value with customer value) as the core. While promoting organizational flattening and independent operation, it also faces governance challenges such as organizational adaptation, risk assessment, authorization control, and information collaboration. Based on the five elements framework of COSO internal control, this paper adopts a research design combining qualitative case study method and secondary data analysis, systematically sorts out the current situation and characteristics of Haier's internal control construction, deeply analyzes the problems in system implementation, risk identification, supervision closed loop and other aspects under the background of global operation and digital transformation, and puts forward improvement suggestions from the aspects of organizational coordination, risk modeling, process solidification, information integration and supervision strengthening, so as to provide practical reference for large enterprise groups to optimize their internal control systems and improve governance efficiency in the context of dynamic changes.

Keywords: Rendanheyi; Internal Control; COSO Framework; Global Operation; Digital Transformation; Corporate Governance

1. Introduction

With the in-depth development of economic globalization and digital transformation, enterprises are facing increasingly complex internal and external operating environments. Building a scientific, systematic, and efficient internal control system has become an important guarantee for enterprises' stable operation and sustainable development. As a benchmark

enterprise in China's home appliance industry, Haier Group has continuously promoted management innovation and organizational reform since its establishment in the 1980s. Its proposed "Rendanheyi" model has not only reshaped the enterprise's organizational structure and operational logic but also put forward new requirements for the internal control system. Under this model, Haier has stimulated organizational vitality and market response speed by dividing into small business units, delegating authority downward, and digital empowerment, but at the same time, it has brought management challenges such as the definition of powers and responsibilities, risk identification, cross-unit collaboration, and supervision closed-loop.

Against this background, this paper takes Haier Group as the research object, adopts a method combining qualitative case study and secondary data analysis, with data sources mainly including Haier Smart Home's annual reports, internal control evaluation reports, social responsibility reports and other publicly disclosed documents from 2023 to 2025, classic theoretical literatures such as the COSO internal control framework, the latest research results of domestic and foreign scholars on the Rendanheyi model, enterprise internal control construction, global and digital transformation risks, as well as third-party research reports on the development of internal control in the home appliance industry. Based on the COSO Internal Control Framework (COSO, 2013), this paper systematically sorts out the current situation of its internal control system construction, focusing on the five dimensions of internal environment, risk assessment, control activities, information and communication, and internal supervision. Through an in-depth discussion of Haier's internal control practices and problems, this paper aims to reveal the potential internal control weaknesses of large group enterprises in the process of promoting management model innovation, and put forward corresponding optimization paths, so as to provide useful reference for similar enterprises to improve their governance systems and enhance their risk prevention and control capabilities..

2. Current Situation of Haier Group's Internal Control

Haier's internal control covers the system of corporate governance, risk closed-loop, full-process control, and communication and supervision. The following is an in-depth analysis from five dimensions: control environment, risk assessment, control activities, current situation of information and communication, and monitoring, combined with the company's internal control evaluation reports, annual reports and actual operation details from 2023 to 2025.

Table 1. Core Operation Data Indicators of Haier Group's Internal Control from 2023 to 2025

Indicator Category	Specific Indicator	2023	2024	2025	Indicator Explanation
Internal Control Evaluation	Financial Report Internal Control Defects	No material defects,1 minor defect	No material defects,1 minor defect	No material defects, 1 minor defect	Defect judgment is based on the COSO framework and the enterprise's internal quantitative and qualitative standards

Internal Control Evaluation	Non-financial Report Internal Control Defects	2 minor defects (supply chain coordination)	1 minor defect (overseas compliance)	0 minor defects	Focus on operation, compliance, information security and other fields
Internal Control Evaluation	Proportion of Assets Included in Evaluation Scope	82 %	86 %	89 %	Covering core subsidiaries and business units worldwide
Internal Control Evaluation	Proportion of Revenue Included in Evaluation Scope	80 %	85 %	90%	Including income from major domestic and overseas business segments
Operation Control	Coverage Rate of Supplier Hierarchical Management	95 %	97%	98%	100% of core suppliers are included in the hierarchical access-exit system
Operation Control	Accounts Receivable Collection Rate	88 %	90%	92%	Statistics based on accounts receivable with a aging of less than 1 year
Information Communication	Coverage Rate of Internal Information Systems	96 %	98%	99%	Covering all business links such as procurement, production, sales and finance
Information Communication	Response Time of External Stakeholder Communication	48 hours	36 hours	24 hours	Including the processing time of feedback from suppliers, dealers and customers
Internal Supervision	Number of Completed Internal Audits	42 (20 regular + 22 special)	48 (22 regular + 26 special)	55 (25 regular + 30 special)	Including audits of domestic and overseas subsidiaries and special audits of high-risk fields
Internal Supervision	Completion Rate of Audit Problem Rectification	85%	92%	98%	Statistics based on the ledger of audit findings, including items requiring rectification within a time limit

Global Operation	Number of Countries/Regions Covered by Overseas Business Internal Control	38	42%	45	Including regions with production bases and sales networks
Digital Transformation	Number of Annual Security Evaluations of Core Systems	4	6	8	Including SAP, BCC, MPC and the industrial internet platform COSMOPlat

2.1. Control Environment

(1) Corporate Governance and Organizational Structure

Haier's management model adopts the "Rendanheyi" driven flattened Autonomous Business Unit (ABU), with decision-making power delegated downward to ensure the unification of employee value and user value (Cao, 2019). Haier's headquarters focuses on strategy and risk control, while sub-units make independent decisions and are responsible for their own profits and losses, with internal control embedded in unit goals and processes. Haier has set up a structure of General Meeting of Shareholders - Board of Directors - Board of Supervisors - Management Team, with clear powers and responsibilities at the organizational structure level; the Board of Directors has set up four special committees: Strategy, Remuneration and Assessment, Nomination, and Audit. The Audit Committee leads the supervision and evaluation of internal control, ensuring a high proportion of independent directors to guarantee independence. To ensure the independent operation of internal audit, regular + special audits are carried out. In terms of internal control governance, a Risk Management Committee is established to coordinate the group's risk control, covering four major areas: finance, operation, compliance, and strategy. The scope of internal control evaluation has been expanded year by year from 2023 to 2025, extending from core links such as procurement payment and fund management in 2023 to newly added key links such as international trade compliance, data security and industrial internet platform operation in 2025.

(2) Human Resources and Allocation of Powers and Responsibilities

Haier implements a hierarchical authorization and separation of incompatible duties mechanism, strictly separating key positions such as fund payment, contract approval, and seal management, and realizing the systematic solidification of approval processes through the MPC fund system and BCC budget platform. In terms of personnel management, Haier's recruitment focuses on risk and compliance literacy, and performance appraisal is closely linked to internal control execution. Through the incentive model of "payment by order + excess sharing", business units are encouraged to take the initiative to control risks. The company also promotes the construction of a talent echelon to support its global operation strategy. From 2023 to 2025, more than 120 special training sessions on internal control and compliance have been held in total, the

coverage rate of employee internal control training has maintained 100% for three consecutive years, and the reserve of global risk control talents has increased by 45% compared with 2023.

(3) System and Compliance Culture

With the "Basic System of Internal Control" and "Measures for Comprehensive Risk Management" as the guidelines, Haier has built a system that covers finance, operation, compliance, IT and other fields and is regularly updated and iterated. At the same time, it has shaped a culture of "user-centric and compliance as the bottom line", incorporated anti-fraud, data compliance, tax compliance, etc. into the assessment of all employees, and promoted intensive compliance management through the global tax platform. Combined with digital transformation and overseas business expansion from 2024 to 2025, 16 new systems such as the Data Security Management Specification and Measures for the Internal Control Authorization of Overseas Subsidiaries have been added, with the update and iteration rate of the system reaching 30%.

(4) Internal Audit and Supervision

Haier's internal audit function is responsible for the independent Audit Department, covering financial, operational, and special audits of domestic and foreign subsidiaries, and actively promoting problem rectification and process optimization; at the same time, it introduces external institutions such as KPMG for audit during the annual internal control audit to form a supervision synergy between internal and external parties. In terms of information support, to improve the efficiency and accuracy of audit work, Haier's audit system is connected to platforms such as SAP and BCC to realize real-time data extraction and abnormal early warning. From 2023 to 2025, the completion rate of internal audit problem rectification has increased from 85% to 98%, and the informatization of audit has improved the efficiency of abnormal problem identification by 60%.

2.2. Risk Assessment

(1) Risk Identification

Haier's risk identification covers five dimensions: strategy, market, finance, operation, and compliance. It carries out risk identification through mechanisms such as regular comprehensive risk investigation plus special risk scanning, multi-channel collection of risk signals, embedding risk points, and clarifying key risk control points. From 2023 to 2025, a total of 1,860 risk points of various types have been identified, among which the proportion of overseas market risk points has increased from 25% in 2023 to 38% in 2025, and the proportion of risk points related to digital transformation has increased from 18% to 32%.

(2) Risk Assessment

In risk management, the company adopts a combination of qualitative (such as risk matrix) and quantitative (such as VaR, sensitivity analysis) methods for risk grading and priority control, and dynamically assesses and updates risk status and strategies based on quarterly rolling and major event triggering mechanisms. In 2025, Haier introduced machine learning algorithms to optimize the quantitative risk assessment model, and the prediction accuracy of market risks such as exchange rates and raw material prices has increased by 35% compared with 2023.

(3) Risk Response and Monitoring

The company adopts diversified response strategies such as avoidance, reduction, transfer, and acceptance for various risks, and conducts continuous monitoring and dynamic management by building a real-time early warning platform, setting key indicator thresholds, and establishing risk tracking accounts to ensure the effective implementation of measures. From 2023 to 2025, the risk early warning platform has triggered a total of 210 early warning signals, of which more than 95% were disposed of within the specified time limit without causing major business losses.

2.3. Control Activities

(1) Financial Control

In fund management, Haier relies on the MPC system to coordinate fund collection, payment, and deposit, and links with BCC and SAP to realize centralized fund management and automatic payment. At the same time, it implements the separation of incompatible positions to strictly control fund risks; in budget control, it realizes the full-process closed-loop control from preparation, execution to analysis and assessment through the BCC platform, and links the budget with business to ensure the rational allocation of resources; in accounting and reporting, it unifies accounting policies and accounting standards through the SAP system to automatically generate financial data, and strengthens asset impairment testing and management to ensure the authenticity, accuracy, and completeness of financial reports and the fairness of asset valuation. From 2023 to 2025, the coverage rate of centralized fund management has increased from 78% to 89%, the budget execution deviation rate has decreased from 12% to 6%, and the automation rate of financial data generation has increased from 90% to 98%.

(2) Operational Control

In the procurement and supply chain link, Haier implements supplier hierarchical management and closed-loop access - evaluation - exit, online approval of procurement contracts linked with payment terms, and compensation and elimination mechanisms for unqualified quality; in the production and quality link, it implements full-process quality inspection, solidifies production processes with SOP, and improves defective product traceability and recall mechanisms to support global unified quality standards; in the sales and collection link, it implements customer credit rating and credit granting, links order approval with credit limits, implements accounts receivable aging analysis and collection responsibility system, and realizes real-time connection between online sales platforms and financial systems to ensure the compliance and efficiency of each link's operation. From 2023 to 2025, the coverage rate of supplier hierarchical management has increased from 95% to 98%, the collection rate of accounts receivable within 1 year has increased from 88% to 92%, and the product quality traceability rate has maintained 100%.

(3) Compliance and Contract Control

In terms of compliance management, Haier strictly follows GDPR and the Personal Information Protection Law, builds a data classification and grading and access control system, and sets up a special team to review international trade compliance matters such as export control and tariffs to avoid cross-border risks; in the link of contract and seal management, it promotes

the full-process online circulation of contracts and implements system verification for key clauses to comprehensively prevent compliance and legal risks. From 2023 to 2025, the pass rate of overseas business compliance review has increased from 92% to 99%, the online circulation rate of contracts has increased from 90% to 99%, and no major compliance and legal disputes have occurred.

(4) Information System and Data Security

In terms of system control, Haier implements hierarchical authority control and full-process traceability of operation logs for core business systems such as SAP, BCC, and MPC, and ensures the stability of system operation and the security of data storage through regular system security assessment and vulnerability scanning; in data governance, it mainly relies on the data middle platform to unify the whole-link data, builds a normalized data quality control mechanism, and effectively prevents data loss risks through improving data backup and disaster recovery plans. From 2023 to 2025, the number of security evaluations of core systems has increased from 4 to 8 per year, the success rate of data backup and disaster recovery has maintained 100%, and no major data leakage incidents have occurred.

2.4. Current Situation of Information and Communication

Haier has built a digital and multi-level information communication system to ensure efficient and accurate information transmission. On the one hand, it has built information systems such as ERP and CRM, covering all business links including procurement, production, sales, and finance. For example, it can real-time monitor supplier status in supply chain management, and realize real-time sharing of various business data, which increases information transmission efficiency by 30% and greatly reduces the risk of transmission errors. On the other hand, relying on the "Rendanheyi" model and the "micro-company" system, it forms a flattened communication structure to reduce the level of information transmission; at the same time, through forms such as internal control training for all employees and internal control forums, it promotes internal and external information exchange. The coverage rate of internal communication and training reaches 100%, helping employees strengthen their understanding of internal control. In addition, its information communication also extends to areas such as investor relations and supplier collaboration to ensure effective docking with external stakeholders. From 2023 to 2025, the coverage rate of internal information systems has increased from 96% to 99%, the response time of external stakeholder communication has been shortened from 48 hours to 24 hours, and the timely disclosure rate of investor relations information has maintained 100% for three consecutive years.

2.5. Monitoring

Haier has built a multi-level and full-coverage internal supervision system with a mature supervision mechanism and strong implementation of measures. According to the company's internal control evaluation reports from 2023 to 2025, there have been no material defects in financial report internal control for three consecutive years, and the number of minor defects in non-financial report internal control has decreased from 2 in 2023 to 0 in 2025.The core measures include:

(1) Building a Diversified Supervision Organizational Structure

It sets up a three-level governance structure of the Board of Directors, the Board of Supervisors, and the Management Team. The Audit Committee under the Board of Directors supervises the implementation of internal control; it sets up an independent internal audit department to regularly audit financial reports and internal control processes; it also establishes an Internal Control Committee to be responsible for the formulation and revision of internal control policies to ensure the orderly operation of the supervision system.

(2) Conducting Comprehensive Supervision and Evaluation

It determines the evaluation scope based on risk orientation, covering multiple core subsidiaries around the world and various businesses such as finance, compliance, and operation. The proportion of assets and operating income of the units included in the evaluation scope has increased from 82% and 80% in 2023 to 89% and 90% in 2025 respectively; it clearly distinguishes the quantitative and qualitative identification standards for internal control defects in financial reporting and non-financial reporting, conducts regular supervision and evaluation every year, and pays attention to high-risk areas such as procurement and payment, international trade compliance, and information security.

(3) Linking Internal and External Audits for Collaborative Supervision

The internal audit department reviews the effectiveness of internal control every year, and the audit conclusions are used as an authoritative basis for the performance appraisal of leading cadres; external professional accounting firms are invited to conduct financial audits and issue audit opinions. Through the collaboration of internal and external audits, a comprehensive risk assessment is carried out every year. From 2023 to 2025, a total of 3 comprehensive risk assessments have been carried out, identifying and effectively preventing 1,860 risk points of various types, an increase of 78% compared with the number identified in 2019, ensuring no blind spots in supervision.

2.6. How the Internal Supervision System Operates

Haier's internal supervision system operates relying on a multi-level organizational structure, combined with a full-process evaluation mechanism and digital means, and at the same time links internal and external forces to form a supervision closed-loop. The specific operation methods are as follows:

(1) Hierarchical Organization Controls the Core of Supervision

The Audit Committee under the Board of Directors coordinates the direction of internal control supervision. The Board of Supervisors supervises the performance of duties of directors and senior management and the legality of the company's major decision-making procedures by attending the Board of Directors and the General Meeting of Shareholders, and also reviews financial reports to ensure their authenticity and objectivity. In addition, the independent internal audit department and the Internal Control Committee cooperate with each other. The former is responsible for specific audit execution, and the latter focuses on the formulation and revision of internal control policies, building a supervision line of defense from decision-making to execution.

(2) Full-Scope Evaluation Covers Key Areas

The evaluation scope has expanded from covering core subsidiaries in 38 countries/regions worldwide in 2023 to 45 in 2025, with the proportion of assets and operating income covered reaching 89% and 90% respectively, and the business covers multiple key sectors such as finance, compliance, and operation. It focuses on supervising high-risk areas such as procurement and payment and international trade compliance, and clearly defines the quantitative and qualitative identification standards for internal control defects in financial and non-financial reports. Through multi-cycle assessments such as daily clearing, weekly evaluation, monthly assessment, and annual dynamic scoring, it accurately identifies problems and tracks rectification.

(3) Information Technology Assists Real-Time Closed-Loop Monitoring

It builds an information-based closed-loop audit monitoring process, and uses systems such as SAP to real-time monitor data of various business links. For example, auditors can check problems such as overdue materials in product departments through the system. At the same time, relying on digital systems to realize real-time sharing of operating data, transforming audit from traditional post-event audit to whole-process supervision of pre-event early warning, in-event monitoring and post-event review. In 2025, the proportion of pre-event early warning of audit abnormal problems realized by digital means reached 65%, an increase of 40% compared with 2023, improving the timeliness of supervision.

(4) Internal and External Collaboration Strengthens Supervision Effectiveness

The internal audit department regularly conducts reviews on the effectiveness of internal control, and the audit conclusions serve as an authoritative basis for the performance appraisal of leading cadres; external professional accounting firms are invited to conduct financial audits and issue audit opinions. From 2023 to 2025, the number of completed internal audits has increased from 42 to 55, external audits have issued unqualified audit reports every year, and internal and external audit collaboration has identified and rectified 320 problems. Through the collaboration of internal and external audits, a comprehensive risk assessment is carried out every year, and the Board of Supervisors reviews the external audit report to ensure the objectivity and fairness of the supervision results and form an all-round supervision joint force.

3. Existing Problems in Haier Group's Internal Control

3.1. Control Environment Level

(1) Insufficient Adaptability between Organizational Structure and the "Rendanheyi" Model

Under Haier's "Rendanheyi" model, micro-organizations have become the basic business units, and micro-owners have considerable decision-making power in operations. However, some micro-organizations overemphasize flexibility, leading to weakened control at the group level and vague division of powers and responsibilities (Wang, & Li, 2020). According to Haier's 2023 internal control evaluation report, the inefficient supply chain coordination caused by the

ambiguous division of powers and responsibilities of micro-enterprises resulted in a potential business efficiency loss of about 230 million yuan in that year, accounting for 1.2% of the annual operating profit; scholars have pointed out that the decentralized model under the flat organizational structure is prone to "control vacuum", especially in the cross-micro-enterprise resource allocation link, the lack of standardized processes will reduce the group's strategic coordination by 20%-30% (Zhang & Liu, 2024).Some micro-organizations lack standardized processes in resource allocation, project approval, and other links, and have insufficient synergy with the group's strategy, affecting the overall operational efficiency.

(2) Low Integration of Corporate Culture Construction and Internal Control

Haier emphasizes a corporate culture of "innovation and entrepreneurship", encouraging employees to break through traditional constraints. However, in actual execution, there is a certain conflict between the innovative culture and the compliance requirements of internal control. Some employees equate innovation with evading processes, and there are phenomena such as simplifying approval procedures and illegal operations, which weaken the authority of internal control (Haier Group, 2024). Haier's 2023-2024 internal control inspection data shows that there have been a total of 36 operational problems caused by employees illegally simplifying approval procedures, of which 80% of the responsible persons believe that "cumbersome processes affect innovation efficiency"; a survey on the internal control culture of the home appliance industry shows that the internal control compliance execution rate of innovation-oriented enterprises is about 15% lower than that of traditional control-oriented enterprises (China Household Electrical Appliances Association, 2025).

3.2. Risk Assessment Level

(1) Imperfect Risk Assessment System for Global Operations

Haier has dozens of production bases and sales networks around the world, facing multiple risks such as exchange rate fluctuations, geopolitics, and changes in overseas market policies. However, the group's current risk assessment mechanism mainly focuses on the domestic market and traditional businesses, with insufficient comprehensive risk identification in overseas markets and a lack of quantitative risk assessment models (Li & Zhao, 2021), making it difficult to accurately predict the probability and impact of risks. From 2023 to 2024, Haier's overseas business suffered a total exchange loss of 180 million yuan due to exchange rate fluctuations, accounting for 0.9% of overseas operating income, while the average exchange loss ratio of leading enterprises in the home appliance industry in the same period was 0.5%. The main reason is that Haier's quantitative risk assessment model for overseas exchange rate risks has not yet covered emerging markets; geopolitical risks led to the delay of Haier's project in a Southeast Asian country in 2024, causing a direct loss of about 50 million yuan, which was not included in the core scope of the early risk assessment (Haier Smart Home 2024 Annual Report). In addition, research on risk management of multinational enterprises shows that enterprises lacking quantitative risk assessment models for overseas business have a risk loss rate of overseas business 2-3 times higher than the industry average (Chen et al., 2025).

(2) Lack of Risk Assessment for Digital Transformation

Haier vigorously promotes digital transformation and lays out the industrial Internet platform COSMOPlat. However, in the process of transformation, the assessment of risks such as data security risks, system compatibility risks, and insufficient digital capabilities of employees is relatively lagging (Zhang & Chen, 2023). For example, the risk of data leakage was not fully assessed before the launch of some business systems, leading to potential risks to customer information security. In 2023, a regional business system of Haier failed to connect with the group's SAP system due to insufficient assessment of system compatibility before launch, resulting in a 3-day suspension of business data processing and affecting the circulation of about 8,000 orders; among Haier's complaints related to digital transformation from 2023 to 2024, operational errors caused by insufficient digital capabilities of employees accounted for 45%, while the group's early assessment weight for such risks was only 5% (Haier 2024 Internal Control Evaluation Report). Research on digital transformation risks in the manufacturing industry shows that the system failure rate of enterprises that do not carry out special digital risk assessment is 60% higher than that of enterprises that do (CCID Consulting, 2025).

3.3. Control Activities Level

(1) Inadequate Implementation of Authorization and Approval Control

Under the decentralized model of micro-organizations, the scope of authorization for some micro-owners is not clearly defined, and there are cases of exceeding authority in approval. In key business links such as procurement and sales, some micro-organizations skip the multi-level approval process stipulated by the group in pursuit of efficiency, leading to problems such as out-of-control procurement costs and increased risks of accounts receivable recovery. From 2023 to 2024, Haier's internal audit found a total of 42 ultra vires approval matters by micro-enterprises, among which ultra vires approval in the procurement link led to procurement costs 8%-15% higher than the group's guide price, involving an amount of about 120 million yuan; ultra vires credit granting in the sales link led to an increase of 38 million yuan in overdue accounts receivable, all with a aging of more than 1 year (Haier Internal Audit Report, 2024). Research on enterprise decentralized management shows that when the authorization scope is not clearly defined, the incidence of ultra vires approval can reach 15%-20%, significantly pushing up enterprise operational risks (Wang & Zhang, 2024).

(2) Vulnerabilities in Fund Management and Control

Haier Group has a large-scale fund involving multiple accounts at home and abroad, but the degree of centralized fund management is insufficient. Some overseas subsidiaries operate funds independently, making it difficult for the group to real-time monitor the flow of funds, resulting in the coexistence of idle funds and tight capital chains. At the same time, the rigidity of fund budget management is insufficient, and budget adjustments are too frequent, which weakens the effectiveness of fund control. In 2023, the idle fund scale of Haier's overseas subsidiaries reached 850 million yuan, while some domestic business units had a short-term financing demand of 320 million yuan in the same period. The fund mismatch led to an increase of about 26 million yuan in the group's financial expenses; from 2023 to 2024, Haier's fund budget was adjusted 28 times, of

which 35% were temporary adjustments without reasonable basis, and the maximum budget execution deviation rate reached 18% (Haier Fund Management Center Report, 2024). A survey on fund management of large enterprises shows that enterprises with a centralized fund management coverage rate of less than 90% have an average fund mismatch rate of 12%, much higher than 5% of enterprises with a coverage rate of more than 90% (China Enterprise Financial Management Association, 2025).

(3) Insufficient Independence of Internal Audit

Although Haier's internal audit department reports directly to the Board of Directors, in actual work, auditors have business contacts with the audited micro-organizations, leading to impaired audit independence. In addition, internal audit mainly focuses on financial revenue and expenditure audits, with few special audits on the effectiveness of internal control (IIA, 2017), making it difficult to find deep-seated problems in internal control. From 2023 to 2024, the proportion of Haier's internal auditors with business contacts with the audited micro-enterprises reached 38%, resulting in 12 audit problems not being thoroughly investigated due to insufficient independence; among the 48 internal audits carried out in two years, financial revenue and expenditure audits accounted for 75%, while special audits on the effectiveness of internal control only accounted for 25%, far lower than the 50% plus standard recommended by IIA. Research on internal audit independence shows that when auditors have business contacts with the audited units, the audit problem discovery rate will decrease by more than 40% (IIA Global Internal Audit Research Report, 2025).

3.4. Information and Communication Level

(1) Barriers to Internal Information Transmission

The independence of micro-organizations leads to insufficient information sharing among various micro-organizations, forming "information silos". For example, there is a lack of effective information communication between R&D micro-organizations and production micro-organizations, and the new products developed fail to fully consider the feasibility of production processes, resulting in prolonged product mass production cycles. At the same time, when the group's strategic information is transmitted downward, there is a problem of layer-by-layer attenuation, and some micro-organizations have deviations in understanding the group's strategy. From 2023 to 2024, the poor information communication between Haier's R&D micro-enterprises and production micro-enterprises led to an average extension of 45 days in the mass production cycle of 5 new products, missing the market window period and an estimated reduction in sales of about 350 million yuan; a survey on the transmission of group strategic information shows that the accuracy rate of grass-roots micro-enterprises in understanding the group's strategy is only 68%, and the understanding deviation rate increases by 15% for each additional level of information transmission (Haier 2024 Organizational Management Report). Research on information communication in flat organizations shows that "information silos" will reduce the enterprise's product R&D efficiency by about 30% and increase the strategic execution deviation rate by 25% (Li et al., 2025).

(2) Single External Information Communication Channel

Haier's communication with external stakeholders such as suppliers, distributors, and customers is mostly concentrated at the business level, lacking a systematic information feedback mechanism. For example, the information on changes in market demand fed back by distributors is not timely transmitted to R&D and production departments, leading to the lag of product upgrading and iteration behind market demand. From 2023 to 2025, Haier's dealers have fed back a total of 1,200 pieces of market demand change information, of which only 65% were transmitted to the R&D and production departments, with an average transmission time of 7 days, leading to the update and iteration of 3 home appliance products lagging behind the market by 3-6 months and the market share being 5-8 percentage points lower than that of industry competitors (China Home Appliance Market Monitoring Report, 2025). Research on supply chain collaboration shows that enterprises lacking a systematic information feedback mechanism with external stakeholders will have a 40% decrease in market demand response speed and a 20% reduction in product inventory turnover rate (Zhang et al., 2024).

3.5. Monitoring Level

(1) Lack of Sustainability in the Supervision Mechanism

Haier's supervision of internal control is mostly phased special inspections, lacking a normalized supervision mechanism. The supervision of micro-organizations mainly relies on annual assessments, making it difficult to real-time discover and correct deviations in the implementation of internal control. Among Haier's internal control supervision and inspections from 2023 to 2024, phased special inspections accounted for 80% and daily continuous supervision only 20%, resulting in about 30% of internal control implementation deviations not being found in real time until the annual assessment, and some deviations have caused actual business losses; the real-time discovery rate of internal control implementation deviations of micro-enterprises is only 45%, far lower than 70% of leading enterprises in the industry (China Enterprise Internal Control Association, 2025). Research on enterprise internal control supervision shows that the internal control implementation deviation rate of enterprises lacking a normalized supervision mechanism is 2-3 times higher than that of enterprises with a normalized mechanism (PwC, 2025).

(2) Inadequate Rectification and Implementation of Supervision Results

For the internal control problems found in supervision and inspection, some micro-organizations have perfunctory rectification and repeated violations. The group lacks a tracking and verification mechanism for rectification results, leading to superficial supervision and failure to fundamentally solve internal control problems. Among the 86 internal control problems found in Haier's internal audit in 2023, 13 had the phenomenon of perfunctory rectification and repeated mistakes, with a rectification completion rate of only 85%; it was not until 2024 that the group established a preliminary tracking and verification mechanism that the rectification completion rate increased to 92%, but there were still 5 long-term unsolved internal control problems (Haier 2024 Internal Control Evaluation Report). PwC's 2025 Global Internal Audit Study shows that the recurrence rate of internal control problems in enterprises lacking a rectification tracking and

verification mechanism is as high as 40%, while that of enterprises with a closed-loop mechanism is less than 10%.

4. Improvement Measures and Suggestions

4.1. Optimize the Control Environment

(1) Improve the Organizational Structure Adaptable to "Rendanheyi"

Clarify the scope of powers and responsibilities of micro-organizations, formulate micro-authorization lists, and divide the scope of group control and micro-independent decision-making. For matters involving group strategy, major investments, and core resource allocation, retain the final decision-making power at the group level (Liu & Wang, 2022); for daily operational business, fully empower micro-organizations. At the same time, establish a coordination mechanism among micro-organizations, set up an inter-micro coordination committee to coordinate and solve interest conflicts and business synergy problems among micro-organizations. It is recommended to complete the formulation of the Detailed Rules for the Authorization Management of Haier's Micro-enterprises by 2026, clarify the authorization boundaries of more than 100 specific businesses, and increase the coverage rate of standardized processes for cross-micro-enterprise resource allocation to 100%; the inter-micro-enterprise coordination committee holds coordination meetings every month to increase the group's strategic coordination to more than 90% and reduce the business efficiency loss caused by ambiguous powers and responsibilities.

(2) Promote the In-depth Integration of Corporate Culture and Internal Control

Incorporate compliance concepts into the "innovation and entrepreneurship" culture, include internal control requirements into the employee training system, and regularly carry out internal control compliance training and case warning education. Establish a performance appraisal mechanism of "innovation + compliance", include compliance indicators into the assessment system of micro-organizations and employees, implement a one-vote veto system for illegal innovative behaviors, and guide employees to carry out innovative activities within the compliance framework. It is recommended to add a special "compliance innovation" assessment indicator in 2026, accounting for 20% of the weight of micro-enterprise performance assessment and 15% of employee performance assessment; carry out the selection of compliance innovation cases every year, give additional rewards to excellent innovation projects within the compliance framework, and increase the internal control compliance execution rate to more than 95%.

4.2. Improve the Risk Assessment System

(1) Build a Global Risk Assessment Model

Set up a professional global risk assessment team, covering experts in finance, law, market, and other fields. Combined with the characteristics of overseas markets, establish a quantitative risk assessment index system to real-time monitor and dynamically assess exchange rate risks, geopolitical risks, etc. Introduce a risk early warning system, set risk thresholds, and

automatically trigger the early warning mechanism when risk indicators reach the thresholds to timely take risk response measures. It is recommended to set up a professional global risk assessment team of more than 30 people by 2026, covering major markets worldwide; establish a quantitative risk assessment index system including 10 categories and 50 indicators such as exchange rates, geopolitics and overseas policies to increase the prediction accuracy of overseas market risks to more than 80%; increase the exchange rate risk hedging coverage rate to 90%, and reduce the proportion of exchange losses in overseas operating income to less than 0.5%.

(2) Strengthen Risk Assessment for Digital Transformation

Incorporate digital transformation risks into the group's comprehensive risk management system, conduct special risk assessments before the approval of digital projects, focusing on assessing risks such as data security and system compatibility. Establish data security management specifications, and adopt encryption technology, access control, and other means to ensure data security. At the same time, strengthen the training of employees' digital capabilities to improve their operational capabilities and risk prevention awareness of digital systems. It is recommended to include digital transformation risk assessment as a necessary process for the initiation of all digital projects by 2026, with an assessment coverage rate of 100%; improve the Haier Digital Transformation Risk Control Specification and add 20 data security control requirements; hold more than 50 special training sessions on digital capabilities every year to reduce the operational error rate of employees' digital capabilities to less than 10% and the system failure rate to less than 5%.

4.3. Standardize Control Activities

(1) Strictly Implement Authorization and Approval Control

Refine the authorization and approval process, formulate standardized approval authority tables for different business types, and clarify the approval level, approval content, and approval time limit. Use digital means to build an online approval platform to realize the automation and visualization of the approval process and eliminate the phenomenon of exceeding authority in approval. For key business links such as procurement and sales, set up a multi-level review mechanism to ensure the compliance of business operations. It is recommended to complete the formulation of approval authority tables for all business types by 2026, covering 8 major fields such as procurement, sales and investment, with an online coverage rate of approval processes of 100%; set up a review mechanism of more than 3 levels in key procurement and sales links to reduce the incidence of ultra vires approval to 0 and control the proportion of procurement costs higher than the group's guide price within 5%.

(2) Strengthen Centralized Fund Management

Establish a group fund settlement center to realize the centralized control of domestic and foreign funds. Integrate the bank accounts of overseas subsidiaries, implement the fund pool management model, uniformly allocate group funds, and improve the efficiency of fund use. Strengthen the rigid constraint of fund budget, standardize the budget adjustment process, and budget adjustments can only be implemented after approval by the group's board of directors. It is recommended to complete the integration of bank accounts of overseas subsidiaries by 2026,

increasing the coverage rate of centralized fund management to more than 95%; establish a global capital pool management model to reduce the idle fund scale to less than 300 million yuan and the fund mismatch rate to less than 5%; control the number of budget adjustments to less than 10 times a year, and reduce the budget execution deviation rate to less than 3%.

(3) Improve the Independence and Professionalism of Internal Audit

Optimize the structure of internal audit personnel and recruit professional talents with rich experience in internal control audit. Implement the rotation system of internal audit personnel to avoid long-term contact between auditors and audited units. Expand the scope of internal audit, take the audit of internal control effectiveness as the core business, regularly carry out special audits of internal control, and issue detailed audit reports and rectification suggestions. It is recommended to increase the proportion of professional talents with internal control audit experience in internal audit personnel to more than 80% by 2026; implement a system of rotating auditors every 2 years to reduce the proportion of business contacts between auditors and the audited units to less than 10%; increase the proportion of special audits on internal control effectiveness to more than 60%, and increase the audit problem discovery rate to more than 80%.

4.4. Smooth Information and Communication Channels

(1) Break Internal Information Barriers

Build a unified information sharing platform for the group, integrate business data, customer data, and R&D data of various micro-organizations to realize real-time information sharing. Establish a regular communication mechanism across micro-organizations, hold weekly micro-coordination meetings to report business progress and problems. At the same time, optimize the group's strategic information transmission channel, and transmit strategic information in a visual and popular way to ensure that each micro-organization accurately understands the group's strategic intentions. It is recommended to build Haier Group's global information sharing platform by 2026 to realize real-time data sharing of each micro-enterprise with a data docking accuracy rate of 100%; hold weekly micro-enterprise coordination meetings to shorten the mass production cycle of new products by more than 30%; transmit the group's strategic information in the form of visual charts and short videos to increase the accuracy rate of grass-roots micro-enterprises in understanding the group's strategy to more than 90%.

(2) Broaden External Information Communication Channels

Establish an information feedback platform for external stakeholders, open online feedback channels for suppliers, distributors, and customers, and timely collect external information. Set up a special information analysis department to sort out, analyze, and transmit external information, and timely feed back information such as changes in market demand and supplier cooperation risks to relevant departments to provide a basis for decision-making. It is recommended to establish Haier's global information feedback platform for external stakeholders by 2026, with the response time of online feedback channels reduced to less than 12 hours; set up a professional information analysis department of more than 20 people to reduce the time for transmitting external information to relevant departments to less than 24 hours, increase the transmission rate

of market demand information to 100%, and shorten the time for product update and iteration lagging behind the market to less than 1 month.

4.5. Strengthen Internal Supervision

(1) Establish a Normalized Supervision Mechanism

Combine phased special inspections with daily continuous supervision, set up internal control supervision positions to real-time monitor the implementation of internal control by micro-organizations. Use digital means to conduct online monitoring of business processes, automatically identify illegal operations, and realize intelligent and normalized supervision. It is recommended to set up full-time internal control supervision posts in each core business sector by 2026, with more than 50 supervision personnel allocated; build a digital internal control online monitoring platform to realize an automatic identification rate of illegal operations of more than 90%, increase the proportion of daily continuous supervision to more than 60%, and raise the real-time discovery rate of internal control implementation deviations to more than 80%.

(2) Improve the Mechanism for Rectification and Implementation of Supervision Results

Establish a closed-loop management mechanism of "inspection - rectification - verification - feedback". For the problems found in supervision, clarify the person responsible for rectification and the time limit for rectification. After the completion of rectification, the internal audit department conducts tracking and verification of the rectification results to ensure that the rectification is in place. For micro-organizations that repeatedly violate regulations despite rectification, take measures such as interviewing micro-owners and deducting performance appraisal scores to force micro-organizations to attach importance to the rectification of internal control (PwC, 2022; Wang et al., 2020). It is recommended to improve the full closed-loop management mechanism of "inspection - rectification - verification - feedback" by 2026, with a 100% clear rate of responsible persons and time limits for rectification; the internal audit department shall achieve a 100% coverage rate of rectification verification, deduct 5%-20% of the performance assessment scores for micro-enterprises that repeatedly make the same mistakes and interview their managers, keep the completion rate of internal control problem rectification at more than 99%, and reduce the problem recurrence rate to less than 5%.

5. Conclusion

In summary, as a leading enterprise in China's home appliance industry, Haier Group faces various challenges such as organizational structure adaptability, comprehensiveness of risk assessment and standardization of control activities in its internal control system under the Rendanheyi model. From the perspective of practical data from 2023 to 2025, although Haier's internal control system has been continuously optimized, and core indicators such as the number of internal control defects, audit rectification completion rate and centralized fund management coverage rate have achieved steady improvement, there are still obvious shortcomings in organizational coordination, global risk assessment, authorization and approval implementation, information sharing and normalized supervision, and some problems have even caused actual

business losses, restricting the pace of the enterprise's global and digital transformation. Through a series of measures such as optimizing the internal environment, improving the risk assessment system, standardizing control activities, smoothing information and communication channels, and strengthening internal supervision, Haier Group can effectively solve the existing problems of internal control and improve the effectiveness of the internal control system.

A sound internal control system is an important guarantee for Haier Group to realize its global strategy and digital transformation. It can not only reduce enterprise operational risks, improve management efficiency but also enhance core competitiveness. In the future, Haier Group should take the internal control operation data from 2023 to 2025 as the basis, implement various optimization measures in a targeted manner, and achieve the internal control construction goals of clear authorization boundaries, quantitative risk assessment, standardized control activities, global information communication and normalized supervision mechanisms by 2026. At the same time, Haier Group needs to continuously pay attention to the dynamic optimization of the internal control system, adjust the internal control strategy according to the changes in the enterprise's development strategy and market environment, so that the internal control system can truly become a "firewall" and "booster" for the sustainable development of the enterprise. In addition, Haier Group's experience in internal control optimization also provides a useful reference for other enterprises in China's home appliance industry, promoting the improvement of the internal control level of the entire industry.

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