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Welcome Address from President, Sripatum University

Welcome to the twelfth volume of International Journal of Management, Business, and Economics (IJMBE). IJMBE is dedicated to increasing the depth of the subject across business disciplines with the ultimate aim of expanding knowledge of the subject. The IJMBE is a thrice peer-reviewed journal published by Graduate College of Management, Sripatum University; University of Greenwich; and Lincoln University.

In retrospect, Sripatum University, one of the oldest and most prestigious private universities in Thailand, was established in 1970 by Dr. Sook Pookayaporn by the name " Sripatum College." The name "Sripatum" meaning "Source of Knowledge Blooming like a Lotus" was conferred on the college by Her Royal Highness the Princess Mother. In 1987, the college was promoted to university status by the Ministry of University Affairs, and has since been known as Sripatum University. The university's main goal is to create well-rounded students who can develop themselves to their chosen fields of study and to instill the students with correct attitudes towards education so that they are enthusiastic in their pursuit of knowledge and self-development.

To strive to be among the best, this first issue of the IJMBE is therefore instrumental for the most important academic growths to extend a high quality tradition in the education field to the world. The journal welcomes the submission of manuscripts that meet the general criteria of significance and scientific excellence, and will publish original articles in basic and applied research, case studies, critical reviews, surveys, opinions, commentaries and essays. It is hoped that this first issue will set a new benchmark in terms of academic publications. Through the support of our Editorial and Advisory Boards, I hope this journal could provide academic articles of the highest quality to all readers

Dr. Rutchaneeporn Pookayaporn Phukkamarn
President, Sripatum University

Welcome Address from Dean, Sripatum University

It is appropriate to celebrate the continuity of an exciting and esteemed journal. The IJMBE will serve and provide a forum for exchange of ideas among business executives and academicians concerned with Management, Business, and Economics issues. With the rapid evolution of corporate business from international to global in recent years, general business has been one of the areas of greatest added complexity and concern for corporate managers. The IJMBE will be an academic journal combining academic inquiry and informed business practices. It will publish empirical, analytical, review, and survey articles, as well as case studies related to all areas of Management, Business, and Economics. A sentiment often expressed by practitioners is that academic research in general may not be addressing the most relevant questions in the real world.

It is fair to say that the IJMBE will publish high-quality applied-research papers. Nevertheless, studies that test important theoretical works and shed additional light on the issue with some business implications will also be solicited. Each submitted paper has been reviewed by several members of the IJMBE international editorial board and external referees. On the basis, we would like to thank all of them for their support with review process of submitted papers.

I cordially invite papers with theoretical research/conceptual work or applied research/applications on topics related to research, practice, and teaching in all subject areas of Management, Business, and Economics, or related subjects. I welcome paper submissions on the basis that the material has not been published elsewhere. The ultimate goal is to develop a journal that will appeal to both management and business practitioners. I expect the IJMBE to be an outstanding international forum for the exchange of ideas and results, and provide a baseline of further progress in the aforementioned areas.

Assoc. Prof. Dr. Vichit U-on
Dean, Graduate College of Management
Sripatum University

The Editors

Editor-In-Chief

Dr. Ungul Laptaned is an Assistant Professor in the Graduate College of Management, Sripatum University. He graduated with a Ph.D. in 2003 from the University of Nottingham, United Kingdom in the field of Manufacturing Engineering and Operations Management. Ungul has published over 60 proceedings and journal papers; for instances, Industrial Engineering Network, Asia Pacific Industrial Engineering and Management, International Association of Science and Technology for Development, Operations and Supply Chain Management, Intelligent Manufacturing System, Business and Information, etc. He served as a program chair and a steering committee for several domestic and international conferences. He was a journal editor of International Journal of Logistics and Transport, and Thai Researchers' Consortium of Value Chain Management and Logistics Journal, and has consulted for several public organizations and industrial firms on logistics and supply chain management such as Thailand Research Fund, Phitsanulok Province, Public Warehouse Organization, Amatanakorn Industrial Estate, Wyncoast Industrial Park, Iron and Steel Institute of Thailand, Chacheongsao Province, JWD Infologistics Co., Ltd., Kerry Distribution (Thailand) Co., Ltd., TKL Logistics and Supply Chain Co., Ltd., and Ministry of Transport (Thailand).

Associate Editor

Dr Ioannis Manikas holds a Bachelor in Agriculture and a Master of Science in the field of logistics from Cranfield University. He holds a PhD from the Department of Agricultural Economics in AUTH and his primary interest includes supply chain management, logistics and agribusiness management. Dr Manikas has conducted research for projects regarding supply chain modelling, development of IT solutions for agrifood supply chain management and traceability both in Greece and the UK. He has a wide experience in the elaboration of research proposals under FP6, FP7, and Eurostars-Eureka funding mechanisms; lifelong learning oriented programmes such as Leonardo; and Interregional development programmes such as Interreg III and Interreg IV. His work as a self employed project manager and consultant in the agrifood sector includes the design and development of regional operational programmes; analysis of regional needs and respective development policies focused on rural and food production; definition of funding areas and financing resources; definition of strategic goals for regional development and formulation of respective performance monitoring systems; and assessment (ex-ante, on-going, ex-post) of the implementation of EC and national funding mechanisms in national and regional levels.

Guest Editor

Dr. Gilbert Nartea is an Associate Professor in the Waikato Management School, University of Waikato, New Zealand. Dr. Nartea graduated a Master's Degree from New England and a Ph.D. from Illinois, USA. He is a senior lecturer in Finance. His teaching interests are in the area of investments, futures and options, and finance, futures and options. The area of research interests area asset pricing, investment management, decision-analysis and risk management, and microfinance and poverty alleviation. He has published several papers in such journals as of Property Investment and Finance, International Journal of Managerial Finance, Asian Journal of Business and Accounting, Australian Journal of Agricultural and Resource Economics, Pacific Rim Property Research Journal, Review of Applied Economics, Review of Development Cooperation, American Journal of Agricultural Economics, and Journal of the American Society of Farm Managers and Rural Appraisers.

Foreword

Welcome to the 1st issue of the 12th volume of International Journal of Management, Business, and Economics (IJMBE), the Editors received a number of papers from different countries such as China and Thailand. The received papers encompassed many areas of marketing, banking, economics, insurance and risk management, industrial and operation management, strategic management, and international and global business management. After the review process, a total of ten manuscripts were selected for publication.

The first article is conducted by *Bo Qu*, and is entitled "*A Study on Contract Risk Management for Engineering Projects in Digital Transformation in Business Administration*". This paper analyses the current problems of engineering PCRM and proposes a methodological research framework under the perspective of digital transformation

The second article is authored by *Dezhang Cheng,* and named as "*The Empirical Study on Customer Loyalty in Cross-Border Logistics Enterprises Based on the CRM Value Chain Model*". This research applies the Value Chain theory to construct a model of how the customer relationship management level of cross-border logistics enterprises affects customer loyalty.

Article number third is written by *Hangcheng Yan*, and is entitled "*A Study on Consumers' Willingness to Purchase Nearly Expired Food Based on the Internal Cue Perspective of Cue Utilization Theory*". This article takes consumers on the Credamo platform as the research object. It uses an experimental research method to verify the influence of time frame on consumers' willingness to buy nearly expired food.

The fourth paper is examined by *Jingxian Lu*. Their paper is entitled "*A Study on Post-00S Employee Followability under Digital Transformation Leadership Using Organizational Commitment as a Mediating Variable*". This article analyzes the relationship between digital transformation leadership and followership, explores the impact of digital transformational leadership on the followership of post-00 employees from an empirical perspective.

In the fifth article, entitled "*A Study of Demand Investigation and Analysis of Enterprise Human Resources Knowledge Graph Platform Construction Based on Deep Learning*" is conducted by *Jiajing Chen*. This article is to investigate the demand for knowledge graph platforms for enterprises that intend to improve the efficiency and quality of human resource management through intelligent means.

The sixth article is conducted by *Jiaqi Chen*, and is entitled "*A Study on the Career Advancement Path of Non-Academic Adult Dance Education – Taking the Institute of Continuing Education on Beijing Dance Academy as an Example*". This article analyzes how continuing education courses, especially dance skills courses and interdisciplinary courses, promote students' career transformation.

In the seventh article, entitled "*The Impact of Digital Transformation Strategy on the Innovation Performance of Commercial Banks in China*" conducted by *Jingqiu Zhang and Jun Jiang*. This study explores the relationship between digital transformation strategy, organizational learning capability, and innovation performance in commercial banks.

The eight article is authored by *Kang Gu and Xiaowen Jie*, and is entitled "*A Study of the Impact of Energy Industry Transformation on Economic Quality*". This study explores the need for a clean energy system to support low-carbon economic development during the high-quality development stage of economic growth transitioning from extensive to intensive.

Article number nine is entitled "*A Study of Factors Affecting the Customer Loyalty of Fitness Gyms in Beijing, China*", and is examined by *Liang Xinquan*. This research is to explore and meticulously examine the determinants that significantly impact customer loyalty at Superlife Fitness Club.

Last but not the least, the article entitled "*Social Stratification and Coffee Consumption Groups in Guangxi: Exploring the Mechanisms Influencing Consumption Behavior and the Moderating Role of Price Sensitivity*", is conducted by *Qinshiyi Yan*. This study models the social stratification profile of coffee consumers, and examines how different social strata perceive and accept varying price ranges for coffee.

It is hoped that you will enjoy reading these articles and that they will generate responses and discussions that will help advance our knowledge of the field of Management, Business, and Economics. The Editors and the Editorial Board of the IJMBE would like to welcome your future submissions to make this journal your forum for sharing ideas and research work with all interested parties.

Ungul Laptaned
Editor-In-Chief

Associate Editor
Ioannis Manikas

Guest Editor
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by

Bo Qu
Phetchabun Rajabhat University,
Phetchabun, Thailand
E-mail: 99380527@qq.com

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A Study on Contract Risk Management for Engineering Projects in Digital Transformation in Business Administration

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Bo Qu
Phetchabun Rajabhat University,
Phetchabun, Thailand
E-mail: 99380527@qq.com

Abstract

Digital transformation introduces both new challenges and significant opportunities for contract risk management (PCRM) in engineering projects. This paper begins by providing a comprehensive overview of digital transformation and its implications for engineering project contract risk management. By analyzing the current challenges faced by PCRM in engineering projects, the study identifies key gaps and issues that hinder effective risk management in the traditional context. Building on this analysis, the paper proposes a methodological research framework that approaches contract risk management from the perspective of digital transformation. This framework offers a theoretical foundation and practical guidance for addressing the evolving risks in engineering projects influenced by digital technologies. Furthermore, the optimisation strategy of engineering PCRM under digital transformation is investigated through empirical analysis and case studies, illustrating how digital tools and processes can enhance contract risk management practices. The research findings demonstrate that digital transformation provides innovative ideas and methods that significantly improve the efficiency, accuracy, and responsiveness of engineering project contract risk management. By integrating advanced digital technologies and data-driven approaches, engineering firms can better anticipate, monitor, and mitigate contract risks, ultimately leading to improved project outcomes. Therefore, this study holds important theoretical and practical significance by contributing to the understanding of how digital transformation can be effectively leveraged to promote the modernization and enhancement of engineering project contract risk management. The insights presented herein offer valuable guidance for both academics and practitioners seeking to navigate the complexities of contract risk in the digital age.

Keywords: Digital Transformation, Engineering Project, Contract Risk Management

1. Introduction

Digital transformation has emerged as a critical force reshaping industries across the globe. In the context of engineering project contract risk management (PCRM), it introduces both significant opportunities and complex challenges. This chapter explores the implications of digital transformation for engineering PCRM, focusing on how digital technologies affect risk identification, assessment, and mitigation in contract management. By analyzing the research background and significance, the central research question, and the study's objectives and methods, this chapter aims to provide both theoretical insight and practical guidance for enhancing PCRM in the digital era.

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1.1 Background and Importance of the Problem

With the continued evolution of global economies and technological capabilities, digital transformation has become an inevitable trend across all sectors. In engineering project management, digital transformation is profoundly changing traditional contract management methods. Historically, contract management has relied heavily on manual processes and paper documentation, which are time-consuming, error-prone, and inefficient. By integrating technologies such as big data analytics, cloud computing, and artificial intelligence, digital transformation streamlines operations, enhances accuracy, and improves the efficiency of contract-related processes.

However, the shift to digital systems is not without challenges. The adoption of new technologies introduces potential risks such as data security breaches, rapid technological obsolescence, and resistance to change among personnel. These factors can impede the success of digital transformation initiatives if not properly addressed. As digitalization becomes more embedded in contract workflows, understanding and managing these new forms of risk become increasingly critical.

The ability to digitally manage and automate contract processes can reduce human error, lower labor costs, and improve decision-making through real-time risk assessment tools. Moreover, by enhancing transparency and control in contract execution, digital transformation allows organizations to mitigate risks more proactively. Consequently, a focused study on the application of digital transformation in engineering contract management not only contributes to technological innovation but also provides actionable insights for industry-wide development.

Organizations that effectively manage this transformation will be better positioned to achieve competitive advantage. By improving risk control and operational efficiency in contract management, companies can allocate more resources toward innovation and value creation. Therefore, exploring risk management in engineering contract processes through the lens of digital transformation is of significant theoretical and practical importance.

1.2 Research Question

This study is guided by the following central research question:

1) How does digital transformation affect contract management risks in engineering projects, and what risk response strategies can be developed to address these emerging challenges?

2) This question aims to uncover both the shifting nature of traditional risks and the emergence of new risks brought about by the integration of digital technologies into contract management systems.

1.3 Research Objective

The primary objective of this study is to systematically investigate the impact of digital transformation on contract management risks in engineering projects and to develop effective strategies for risk mitigation. The study seeks to:

1) Identify and classify key risk factors in engineering contract management, including traditional risks (e.g., information asymmetry, change orders, and performance delays) and those emerging from digital processes.

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2) Analyze how digital technologies reshape these risks, either by amplifying, transforming, or mitigating them.

3) Propose targeted risk management strategies that leverage digital tools and capabilities to reduce risk likelihood and severity.

4) Validate the effectiveness of these strategies through empirical research, including case studies, expert interviews, and data analysis from real-world engineering projects.

By fulfilling these objectives, the research aims to provide a robust framework for managing contract-related risks in the context of digital transformation, offering actionable insights for industry practitioners and policymakers alike.

2. Literature Review

2.1 Related Concepts and Theories

Digital transformation refers to the comprehensive reconstruction and upgrading of traditional business models, processes, and value creation through digital and information technologies. In the context of engineering project contract risk management (PCRM), it represents the shift towards intelligent, data-driven approaches that optimize decision-making and monitoring (Li & Lü, 2021). This process often includes technologies such as big data analytics, artificial intelligence, and cloud computing (Boehm et al., 2021), which facilitate a transition from manual and reactive risk management to automated, predictive, and precision-based approaches (Ganguly et al., 2017).

The transformation entails not only technical adaptation but also changes in organizational structures and culture (Wang, 2023). These changes support the development of real-time risk monitoring, early warning systems, and intelligent decision-making mechanisms, thus redefining traditional risk management frameworks.

2.2 Literature Surveys

Digital transformation provides foundational shifts in PCRM by incorporating big data-driven modeling, intelligent contracts, and real-time surveillance tools. Fang et al. (2001) and Pang et al. (2002) explore advanced mathematical techniques that support risk prediction and multivariate modeling, which are applicable in digital platforms for contract risk analysis.

Ganguly et al. (2017) describe the broader transformation of digital risk management in the 2020s, highlighting the operational and strategic shifts it demands. Hayes et al. (2022) and Tummala et al. (2023) emphasize systemic approaches in engineering risk analysis, where integration with digital tools enhances assessment accuracy. Muriana and Vizzini (2017) introduce deterministic quantitative techniques, further solidifying the relevance of data-driven decision support in project risk contexts.

Tah and Carr (2020) advocate for fuzzy logic as a method for construction project risk evaluation, especially under uncertain contract environments. Similarly, Dike et al. (2020) propose decision support frameworks to assist BOT (Build-Operate-Transfer) project sponsors during early risk planning stages.

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In practical applications, Saybani et al. (2018) outline risk prioritization strategies aligned with PM standards in wind farm developments. Iqbal et al. (2021) explore agile methodologies and their implications for managing project uncertainties in software engineering, offering transferable insights for engineering project risk.

Clarke and Low (1993) introduce Monte Carlo simulation in project planning, applicable in the creation of automated early-warning systems and probabilistic models. Zhu (2022) and Wang (2023) present applications of digital transformation in urban and industrial infrastructure, respectively, showcasing integration between digital models and engineering project needs.

2.3 Conceptual Framework

The conceptual framework for this study is grounded in the integration of digital technologies with risk management practices in engineering contracts. It connects three core elements:

1) Technological Enablers (e.g., AI, big data, IoT),

2) Organizational Adaptation (structure, culture, talent), and

3) Risk Management Functions (identification, monitoring, assessment, response).

This tripartite model supports the view that digital transformation not only enhances operational efficiency but also demands structural and strategic alignment for successful implementation in PCRM.

2.4 Research Hypothesis

Based on the literature synthesis and the conceptual framework, the following research hypotheses are proposed:

H1: Digital transformation positively influences the efficiency of contract risk identification in engineering projects.

H2: The use of real-time monitoring and data analytics significantly enhances risk mitigation and responsiveness.

H3: Organizational adaptation moderates the relationship between digital transformation and effective contract risk management.

H4: Higher levels of digital maturity in engineering firms correlate with reduced contractual disputes and improved project outcomes.

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3. Research Methodology

3.1 Research Design

This study adopts a mixed-methods research design that integrates both qualitative and quantitative approaches to comprehensively investigate the impact of digital transformation on contract risk management in engineering projects (PCRM). The research design is structured around four key strategies:

Literature Review: A systematic review of academic publications, industry reports, and policy documents will be conducted to understand the theoretical foundation, emerging challenges, and existing digital applications in engineering PCRM.

Case Study: Selected engineering project cases, both successful and problematic, will be analyzed to reveal the influence of digital transformation on contract management risks. These real-world examples will provide intuitive insights and allow for the extraction of best practices and lessons learned.

Field Research and Interviews: In-depth interviews and site visits will be carried out with project managers, engineers, legal experts, and digital transformation consultants. These interactions will reveal real-world pain points, organizational needs, and coping mechanisms used to manage contract risks.

Survey and Empirical Analysis: Structured questionnaires will be distributed to professionals across the engineering industry. This step aims to collect quantitative data for assessing the magnitude of risk impacts and digital adoption. Qualitative data from interviews will be coded and thematically analyzed to identify patterns and interrelationships.

This comprehensive design ensures that the study captures the dynamic nature of digital transformation and its practical implications for contract risk in engineering contexts.

3.2 Population and Sample

The target population includes professionals involved in contract management within engineering projects, such as:

- Contract and procurement managers
- Project managers and engineers
- Legal consultants
- IT and digital transformation officers
- Executives from construction and infrastructure firms

A purposive sampling technique will be used to select participants who have relevant experience with digital tools or platforms in contract management. The sample will consist of:

- At least 10 engineering project case studies for qualitative analysis
- 30–50 professionals for semi-structured interviews
- 200–300 respondents for the quantitative survey to ensure statistical significance

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Diversity in firm size, project scale, and level of digital maturity will be considered to enhance the generalizability of findings.

3.3 Research Instruments

The following instruments will be employed to collect data:

1) Literature Review Protocol: A structured template will guide the identification, screening, and synthesis of academic and industry literature.

2) Interview Guide: Semi-structured interview questions will focus on digital tool usage, risk identification, mitigation strategies, and perceived impacts on contract management.

3) Case Study Framework: A standardized format will be used to document and analyze each project case, including background, digital applications, encountered risks, and management outcomes.

4) Questionnaire Survey: A closed-ended survey instrument using a 5-point Likert scale will be designed to quantify perceptions, adoption levels, and perceived risks associated with digital transformation in contract management.

5) Data Analysis Software: NVivo or MAXQDA will be used for qualitative coding, while SPSS or SmartPLS will be used for statistical analysis and structural equation modeling (SEM).

3.4 Data Collection

Data will be collected through multiple channels and in sequential phases:

1) Secondary Data Collection (Phase 1): Academic databases (e.g., Scopus, Web of Science), industry whitepapers, and government reports will be reviewed.

2) Case Studies (Phase 2): Project documentation and interviews with case stakeholders will be collected and coded.

3) Interviews (Phase 3): Conducted via Zoom or in person, with consented audio recordings transcribed for thematic analysis.

4) Questionnaire Survey (Phase 4): Distributed online via email and professional networks using platforms like Google Forms or Qualtrics.

Triangulation will be applied to cross-validate data from different sources and ensure reliability.

3.5 Statistics Used for Data Analysis

Data analysis will employ both descriptive and inferential statistics:

1) Descriptive Statistics: Frequency, percentage, mean, and standard deviation will summarize respondent characteristics and perceptions.

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2) Reliability Testing: Cronbach's Alpha will assess internal consistency of the questionnaire items.

3) Exploratory Factor Analysis (EFA): Used to identify underlying risk dimensions and digital transformation factors.

4) Structural Equation Modeling (SEM): Applied to examine causal relationships between digital transformation variables and contract risk outcomes.

5) Comparative Analysis: t-tests and ANOVA will be conducted to compare groups based on digital adoption levels, project size, and firm type.

These statistical techniques will allow for a robust analysis of both linear and complex interactions, helping to validate the conceptual framework and proposed risk mitigation strategies.

4. Data Analysis and Findings

4.1 Introduction

Contract risk management (PCRM) is a fundamental aspect of engineering project management, encompassing a series of interrelated activities such as contract drafting, risk identification, assessment, response formulation, and monitoring. In the contemporary context of engineering project execution, these functions must operate with a high degree of precision and efficiency. However, evidence from field observations and literature reveals that engineering PCRM is fraught with several persistent challenges. Among these are the limited integration of information technology, ambiguities in contractual terms, and the continued reliance on imprecise, experience-based risk assessment methods. These problems not only diminish the effectiveness of risk management but also hinder the overall performance and adaptability of engineering projects. In light of the global movement toward digital transformation, there is a pressing need to rethink and restructure PCRM practices using innovative technologies and data-driven approaches.

The core components of contract risk management in engineering projects involve a systematic approach to identifying, evaluating, and addressing risks that may arise from contractual obligations and project implementation procedures. These include risk management planning at the project initiation phase, during which roles, responsibilities, resources, and timelines are established. Risk identification and assessment are conducted by thoroughly analyzing contract clauses and operational processes to anticipate potential risk events and evaluate their consequences. Based on these assessments, specific response strategies such as risk avoidance, mitigation, transfer, or acceptance are formulated. Subsequently, risk control and monitoring mechanisms are activated to track and respond to risks throughout the project lifecycle.

In recent years, the digital transformation of contract risk management has emerged as a vital trend, offering enhanced tools and capabilities that can significantly improve the precision and responsiveness of PCRM. Technologies such as artificial intelligence, big data analytics, and automated contract analysis have enabled more refined identification and assessment of risks. These digital tools provide real-time monitoring, generate predictive insights, and support faster, more informed decision-making. Consequently, digital transformation not only addresses many of the existing deficiencies in PCRM but also sets the stage for a more proactive and intelligent approach to contract management within engineering projects.

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4.2 Data Analysis of the Qualitative Data

Qualitative data collected from expert interviews, industry reports, and internal project documentation reveal several deficiencies in the existing approaches to contract risk management within engineering projects. One of the most critical issues identified is the limited capacity for effective information collection and analysis. Current practices still depend heavily on manual processes, including data entry, document review, and human interpretation. This reliance on manual input frequently leads to incomplete or inconsistent data, increasing the likelihood of oversight and misjudgment in the risk identification phase. In many cases, the analytical tools employed lack the intelligence and automation required to process large volumes of complex contractual information, thereby delaying the risk assessment process and reducing overall accuracy.

Other significant finding concerns the subjectivity embedded in traditional risk assessment techniques. Presently, risk evaluation is largely influenced by professional judgment and historical experience, rather than by structured, empirical methodologies. This not only introduces bias into the process but also limits the scalability and reproducibility of the risk assessments. Interviewees noted that without systematic frameworks supported by data analytics or predictive modeling, it is difficult to anticipate potential risk events or understand their cascading impacts on project timelines and costs. Furthermore, current methods are reactive rather than proactive; responses to risks are often implemented after incidents have already caused disruptions, rather than through preemptive interventions guided by real-time monitoring and forecasting.

The qualitative data also underscore a significant shortcoming in the area of risk response and control. Traditional risk management approaches depend heavily on post-event interventions and human-driven decision-making. In the absence of digital tools for early warning and automated responses, project teams often face delays in risk mitigation efforts. This reactive posture not only increases operational costs but also compromises project delivery timelines. Without access to real-time data and intelligent alert systems, managers are constrained in their ability to implement timely countermeasures.

Moreover, findings suggest that digital transformation, while promising, presents its own set of challenges to current PCRM systems. For instance, the integration of advanced technologies demands a reconfiguration of existing processes and a redefinition of organizational roles. Risk management teams are required to adapt to new digital tools, which necessitates upskilling in areas such as data analytics, software systems, and information modeling. Interview participants emphasized that the lack of digital literacy among risk management personnel is a barrier to transformation. Additionally, organizations must invest in the development of intelligent contract platforms capable of automating routine functions while supporting strategic decision-making.

Another challenge involves the redesign of business processes to align with digital workflows. Traditional contract risk management procedures are often linear and siloed, whereas digital systems promote integrated, dynamic, and iterative risk handling approaches. The transition from conventional methods to digital platforms thus calls for a rethinking of process logic and cross-functional collaboration. Importantly, successful implementation also depends on leadership support and organizational readiness, as resistance to change can impede the adoption of new systems.

In summary, the qualitative analysis reveals that while the current state of engineering contract risk management is methodologically structured, it remains limited in scope, efficiency, and foresight. The integration of digital technologies holds the potential to transform PCRM into a more intelligent, agile, and resilient function. However, this transformation is not without hurdles,

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particularly in terms of process reengineering, talent development, and system integration. These insights serve as a foundation for developing a robust methodological framework and strategic recommendations in the chapters that follow.

4.3 Data Analysis of the Quantitative Data

4.3.1 Empirical Analysis

1) Risk Identification in Highway Construction Projects

The first task in risk management is risk identification. In highway construction projects, this involves analyzing and predicting, based on existing information, when and where risks may arise during project implementation, what their potential impact might be, and how to describe and archive these risks and their characteristics. Risk identification is the foundation of effective risk management. Without it, risk management becomes blind and ineffective. Through proper identification, theoretical frameworks can be linked to practice, allowing risk management to be tailored to specific projects.

2) Risk Classification and Key Elements in Highway Projects

In highway projects, particularly in the context of risk control and management from the owner's perspective, risks are commonly categorized into four key areas. These are analyzed in detail below.

- Risk of Construction Delay

There are two primary causes of overall construction delays: human factors and natural factors. Both ultimately lead to the contractor's failure to deliver on time, increasing project costs through penalties and compensation. The specific causes of schedule-related risks include:

  - Inadequate preparatory work by the project owner, resulting in unprepared construction conditions that delay commencement.
  - Delays or frequent changes by the design unit in delivering drawings, forcing contractors into passive delays.
  - Corruption or low competency among construction supervisors, which disrupts normal workflows.
  - Poor project management by the contractor, leading to inefficiencies and compromised construction safety.

- Technical Risk in Highway Construction

Technical risk arises from issues related to construction technology and processes. These risks can interrupt progress and are considered critical. Key contributors to technical risk include:

  - Inaccurate design schemes, omissions in detail, and failure to meet design standards, often due to inadequate testing.
  - Ambiguities in bidding documents, particularly when special technologies are required but not clearly stated. Poor communication between stakeholders further exacerbates the risk.
  - Contractors' lack of skilled personnel, high staff turnover, poor departmental coordination, and insufficient handover of technical responsibilities, all leading to errors in construction execution.

- Safety Risks in Highway Construction

With the expansion of highway networks into more complex environments and the increasing technical demands, safety risks have escalated. Intense market competition pushes contractors to cut costs, heightening these risks. Key safety risk factors include:

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The contractor's lack of emergency safety plans and weak enforcement of safety protocols. Inadequate safety education results in workers having low safety awareness, increasing the chance of accidents.

High-risk, complex projects exposed to unfavorable climate and natural conditions, which can trigger unavoidable safety incidents.

- Quality Risks in Highway Construction

Quality issues stem from either construction technique errors or the use of substandard materials. Specific causes include:

  - Contractors hiring unskilled or careless workers and neglecting material inspection, which inevitably leads to quality defects.
  - Subcontractors violating regulations and using poor construction techniques or materials. Their lack of capability further compromises overall construction quality.

3) Risk Assessment Model Based on the Analytic Hierarchy Process (AHP)

The Analytic Hierarchy Process (AHP) was developed by Saaty (1970). AHP is a hybrid method that combines qualitative and quantitative analysis. It is valued for its flexibility, comprehensibility, and relative accuracy in evaluating risks in engineering projects. The core idea is to decompose complex risk problems into their component factors, organize these into a hierarchical structure, compare the elements pair wise to determine their relative importance, and synthesize the results using expert judgment to arrive at a final prioritization. This process relies heavily on professional experience and subjective judgment to assign relative importance values. These are typically scaled from 1 to 9, including reciprocals, as shown in Table 1. AHP reflects fundamental human decision-making processes, decomposition, judgment, and synthesis, and is applicable for assessing both individual risks (e.g., natural disasters, bid risks) and integrated risk levels in various project plans. Steps to apply AHP are shown as follows:

Establish the hierarchical model of the problem:

The problem is structured into a hierarchy with three levels: the top level represents the overall objective, the middle level includes the criteria and sub-criteria used to achieve the objective, and the bottom level contains specific alternatives or solutions.

Construct the judgment matrix:

Experts or experienced project managers evaluate the importance of each element in a pair wise manner. These assessments form a matrix where each entry reflects the relative importance of one element compared to another. This is done at each level of the hierarchy, comparing criteria with respect to the objective, and sub-criteria with respect to each criterion.

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Table 1 Scales Determined for Each Element in the Judgment Matrix

Number	Comparison of Two Objectives
1	i factor is equally important as j factor
3	i factor is slightly more important than j factor
5	i factor is significantly more important than j factor
7	i factor is much more important than j factor
9	i factor is absolutely more important than j factor
2, 4, 6, 8	Importance of i and j factors is between adjacent judgment scales
Reciprocal	Reverse comparison of the importance of the two objectives

The method of determining weights

The application of AHP method for evaluation and decision-making is required to know the relative importance of the judgment of each element Ai about Hs, i.e. the weight of Ai about Hs. The specific steps are as follows:

Set the comparison judgement matrix A:

$$A = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ a_{n1} & a_{n1} & \cdots & a_{nn} \end{bmatrix} \qquad (4.1)$$

Normalizing each column vector of the judgment matrix A yields $B=(b_{ij})_{n\times n}$

$$b_{ij} = a_{ij} \Big/ \sum_{j=1}^{n} a_{kj} \quad (i, j = 1,2,3,..n) \qquad (4.2)$$

Sum the elements of the row vectors of the normalized matrix B:

$$M_i = \sum_{j=1}^{n} b_{ij} (i, j = 1,2,3,..n) \qquad (4.3)$$

Normalizing the vector M yields the feature vector W

$$W_i = M_i \Big/ \sum_{j=1}^{n} M_j \quad (i, j = 1,2,3,..n) \qquad (4.4)$$

Calculate the maximum Eigen value $\lambda_{\max}$

$$\lambda_{i\max} = \frac{1}{n} \sum_{i=1}^{n} \frac{(AW)_i}{W} \qquad (4.5)$$

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Consistency test

Since the judgment matrix is estimated and not very precise, in order to examine whether the judgment matrix is standard consistent for the comparative setting of the importance of each element, it is necessary to carry out the consistency test in each ordering. At this time, the consistency index C.I. is to be calculated, and its calculation formula is as follows.

$$C.I. = \frac{\lambda_{\max} - n}{n-1}$$
$$C.R. = \frac{C.I.}{R.I.} \qquad (4.6)$$

Where R.I. is an indicator of randomness, the specific results are shown in Table 2.

Table 2 Randomness and Indicator R.I. Values

n	1	2	3	4	5	6	7	8	9	10	11
R.I.	0	0	0.58	0.90	1.12.	1.24	1.32	1.41	1.45	1.49	1.51

The larger the C.R. value, the worse the consistency of the judgment matrix. Generally when the consistency index CI < 0.1, the judgment matrix has satisfactory consistency, otherwise the judgment matrix needs to be adjusted until the test is passed.

4) Risk management process of Guizhou highway construction project

The company shall establish a special mechanism for safety risk management, formulate a safety risk management system and emergency response plan, set up a safety risk management and hazard source control desk account, and urge the EPC (which refers to the company entrusted by the owner to carry out the whole process of the construction project or several stages of contracting according to the agreement of the contract, such as the design, procurement, construction, and commissioning of engineering construction projects) project department and supervision unit to establish a project safety risk management system.

Before the commencement of the project, the Company shall organize the EPC project department and supervisory unit to prepare a project safety risk management plan based on the design documents and on-site conditions, and accurately identify and classify the sources of danger.

The Engineering Department of the Company is responsible for organizing relevant experts to assess the project safety risk management scheme, review and determine the project sources of danger and construction safety risk level, and put forward guiding opinions on reducing or controlling safety risks. The Company's Safety and Quality Department shall participate in the review and be responsible for supervising and inspecting the implementation of the programme after the review is passed.

The EPC project department shall prepare a safety special construction programme (hereinafter referred to as the special programme) before the construction of the sub-parts of the project which are classified as high and extremely high safety risks.

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5) Risk Analysis of Guizhou Highway Construction Project

This study applies the risk factor decomposition method to classify the risk of Guizhou motorway construction project into five categories, namely, natural risk, political risk, economic risk, technological risk and social risk, and further refine them into 16 risk factors for various possible risk events among them.

Formation of A-B hierarchical judgment matrix

Based on the aforementioned basic assumptions, the highway professional engineers score the A-B level risks according to their engineering experience, and then form the A-B level two-by-two judgment matrix, as shown in Table 3.

Table 3 A-B hierarchical Judgment Matrix

A	B1	B2	B3	B4	B5
B1	1	1/3	1/6	1/4	4
B2	3	1	1/5	1/2	6
B3	6	5	1	3	9
B4	4	2	1/3	1	7
B5	1/4	1/6	1/9	1/7	1

Calculate the A-B hierarchical judgment matrix A weights, rankings, and consistency test.

Step 1: Find the geometric mean of all elements in each row of A

$$m_1 = \sqrt[5]{1 \times \frac{1}{3} \times \frac{1}{6} \times \frac{1}{4} \times 4} = 0.561$$

$$m_2 = \sqrt[5]{3 \times 1 \times \frac{1}{5} \times \frac{1}{2} \times 6} = 1.125$$

$$m_3 = \sqrt[5]{6 \times 5 \times 1 \times 3 \times 9} = 3.817$$

$$m_4 = \sqrt[5]{4 \times 2 \times \frac{1}{3} \times 1 \times 7} = 1.796$$

$$m_5 = \sqrt[5]{\frac{1}{4} \times \frac{1}{6} \times \frac{1}{9} \times \frac{1}{7} \times 1} = 0.231$$

Step 2: Normalize Mi and calculate the weights Wi:

$$w_1 = \frac{m_1}{\sum_{i=1}^{5} m_i} = 0.561$$

$$w_2 = 14.94\%$$

$$w_3 = 50.69\%$$

$$w_4 = 23.85\%$$

$$w_5 = 3.07\%$$

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Step 3: Calculate the maximum Eigen value λ max of the maximum A

$$\lambda_{\max} = \sum_{i=1}^{n} \frac{(Aw)_i}{nw_i}$$

$$AW = \begin{bmatrix} 1 & \frac{1}{3} & \frac{1}{6} & \frac{1}{4} & 4 \\ 3 & 1 & \frac{1}{5} & \frac{1}{2} & 6 \\ 6 & 5 & 1 & 3 & 9 \\ 4 & 2 & \frac{1}{3} & 1 & 7 \\ \frac{1}{4} & \frac{1}{6} & \frac{1}{9} & \frac{1}{7} & 1 \end{bmatrix} \begin{bmatrix} 7.45\% \\ 14.94\% \\ 50.69\% \\ 23.85\% \\ 3.07\% \end{bmatrix} = \begin{bmatrix} 39.12\% \\ 77.77\% \\ 269.27\% \\ 121.92\% \\ 16.46\% \end{bmatrix}$$

Λmax = 5.248

Step 4: Calculate the CI and perform a consistency test:

$$CI = \frac{\lambda_{\max} - n}{n-1} = \frac{5.248 - 5}{5-1} = 0.062$$

From n = 5, check the table to get the consistency test indicator

$$RI = 1.12$$

Opt $$\frac{CI}{RI} = \frac{0.062}{1.12} = 0.055 \le 0.1$$

This shows that the A-B level judgment matrix satisfies the consistency test and the resulting judgment is reliable.

Sorting of risk event levels, i.e., sorting of level C

According to the previous calculation of the weights of the judgment matrix and the results of sorting, for the overall risk level of the highway project 16 risk event level sorting, and do the consistency test of sorting:

$$CI = \sum_{j=1}^{n} B_j CI_j = 0.025$$

$$RI = \sum_{j=1}^{n} B_j RI_j = 0.742$$

$$\frac{CI}{RI} = \frac{0.025}{0.742} = 0.034 \le 0.1$$

Obviously, it meets the requirement of consistency test.

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The probability of occurrence of risk events C1 to C16 is ranked from largest to smallest:

C9 > C12 > C10 > C6 > C8 > C3 > C11 > C5 > C7 > C15 > C1 > C13 > C4 > C2 > C16 > C14

6) Optimization Strategies

Under the wave of digital transformation, engineering PCRM faces new opportunities and challenges. In order to cope with these challenges and make full use of the opportunities, this chapter will discuss the optimization strategies for contract risk management of engineering projects under the perspective of digital transformation from three aspects, namely, protecting information security, enhancing risk identification and assessment capabilities, and strengthening contract management and control.

Optimization Strategies for Protection of Information Security

Under the background of digital transformation, engineering PCRM faces new challenges from information security. The protection of information security is crucial to the risk management of engineering project contracts because engineering project contracts involve a large amount of sensitive information and data, which, once leaked or tampered with, will have a serious impact on the progress of the project and the fulfilment of the contract. Therefore, this section will discuss the optimisation strategies for protecting information security to meet the information security challenges brought about by digital transformation.

- Strengthening Network Security Protection

Strengthening network security protection is one of the important ways to protect information security. Contract management of engineering projects usually requires data transmission and communication through network platforms, so it is crucial to establish a sound network security system. Encryption technology can be taken to protect the security of data transmission, restrict access rights to control the flow of information, establish firewalls and intrusion detection systems and other measures to prevent network attacks and data leakage. In addition, regular scanning and repairing of security vulnerabilities in the network system and timely updating of security patches are also important measures to safeguard information security.

- Strengthening Information Access Rights Management

Strengthening the management of information access rights is a key part of protecting information security. By establishing a strict information access rights management mechanism, unauthorised personnel can be effectively prevented from obtaining sensitive information and the risk of information leakage can be reduced. Identity authentication technology can be used to establish a multi-level authority control system, with different authority controls for different levels of information to ensure secure access to and use of information. At the same time, a perfect operation log recording and auditing mechanism is established to comprehensively monitor and audit the use and operation of information, so that abnormal behaviours can be detected in a timely manner and corresponding countermeasures can be taken.

- Promote Security Awareness Education

In addition, the implementation of security awareness education is also an important means to protect information security. In project contract management, the security awareness of employees and partners is directly related to the actual effect of information security. Therefore, it is necessary to raise the information security awareness and confidentiality consciousness of relevant personnel through training and education activities, so as to enable them to understand the importance of information security, master basic information security knowledge and skills, and improve their ability to cope with information security risks. At the same time, a responsibility system for

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information security management is established to clarify the information security responsibilities and obligations of relevant personnel and form a synergy of information security protection with full participation.

- Strengthen data backup and recovery mechanism

Strengthening the data backup and recovery mechanism is also an important means of protecting information security. In the context of digital transformation, a large amount of data needs to be effectively protected, and the data backup and recovery mechanism is the last line of defence. Establish a regular data backup mechanism to back up important data in the project contract management system on a regular basis and store the backup data in a safe and reliable place to prevent data loss or damage. In case of accidental data loss or damage, data recovery can be carried out in a timely and effective manner to safeguard information security and contract management continuity.

Optimized strategies for protecting information security include strengthening network security protection, reinforcing information access rights management, promoting security awareness education and strengthening data backup and recovery mechanisms. These strategies will help improve the information security level of contract risk management in engineering projects, effectively avoid the information security challenges brought about by digital transformation, and guarantee the smooth progress of contract management and effective control of project risks.

Optimization Strategies for Enhancing Risk Identification and Assessment Capabilities

Under the perspective of digital transformation, it is crucial to enhance the risk identification and assessment capability of contract risk management in engineering projects. This section will explore optimization strategies from various aspects to enhance the efficiency and accuracy of risk identification and assessment.

- Introducing Advanced IT Tools

The introduction of advanced IT tools is a key step in enhancing risk identification and assessment capabilities. For example, analyzing a large amount of historical data through artificial intelligence technology can identify potential risk factors and patterns and help project teams assess risks more comprehensively. At the same time, the use of big data analysis technology can more accurately predict the likelihood and degree of impact of various risks, providing a scientific basis for risk management decisions.

- Establish a multi-dimensional risk identification model

In view of the complexity and diversity of engineering project contract risks, it is very necessary to establish a multi-dimensional risk identification model. In addition to the traditional technical risk and market risk, contract risk, political risk, environmental risk and other factors should also be considered to fully grasp the risk situation. By constructing a comprehensive risk identification model, risk signals can be captured more comprehensively to ensure adequate identification of various risks.

- Strengthen team training and communication mechanism

The professional ability and communication skills of team members directly affect the effectiveness of risk identification and assessment. Therefore, it is essential to strengthen the team's training programme to enhance team members' sensitivity to risks and professionalism. At the same time, the establishment of an efficient communication mechanism to promote information sharing and exchange among all project parties in the process of risk identification and assessment is conducive to the identification of potential risk points and timely response measures.

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- Experience Summarization by Combining Practical Cases

Summarizing experience in combination with practical project cases can provide valuable reference for risk identification and assessment. Through case analysis of historical projects, some common risk points and coping strategies can be found to provide reference and inspiration for risk management of current projects. Meanwhile, the methods and processes of risk identification and assessment can also be adjusted and optimized according to the success or failure experience of actual cases, so as to improve management efficiency and accuracy.

- Establish a standardized process for risk identification and assessment

Establishing a standardized process for risk identification and assessment is a key step in improving the efficiency and accuracy of risk management. Through clear processes and standardized operations, the comprehensiveness and consistency of risk identification and assessment can be ensured, the influence of supervisors' views and subjective judgments on risk identification and assessment can be avoided, and the scientific and reliability of decision-making can be improved.

By introducing advanced information technology means, establishing a multi-dimensional risk identification model, strengthening team training and communication mechanism, summing up experience by combining practical cases, establishing standardized processes and other optimization strategies, the risk identification and assessment capability of contract risk management for engineering projects under the perspective of digital transformation can be effectively enhanced, providing strong support for smooth project implementation and risk control.

Optimization Strategies for Strengthening Contract Management and Control

Under the perspective of digital transformation, strengthening contract management and control is an important optimization strategy for contract risk management in engineering projects. Contract management and control is an important means to protect the interests of all parties in engineering projects, and it is also a key link to avoid contract risks. In order to effectively cope with the challenges brought by digital transformation, a series of optimization strategies need to be adopted to strengthen contract management and control.

- Digital optimization of contract management process

The traditional contract management process suffers from cumbersome document transmission and complex approval processes, leading to inefficient contract management and non-transparent information. Under digital transformation, a contract management system can be introduced to realize the digital management of the contract process, including contract application, approval, signing and change, so as to improve the efficiency and transparency of contract management. At the same time, through data analysis and mining, contract execution can be better monitored, potential risk points can be identified in a timely manner, and data support can be provided for contract management decisions.

- Strengthen contract risk identification and assessment mechanism

Digital transformation provides more data sources and analysis means for contract risk identification and assessment. Big data technology can be used to mine historical contract data and establish a risk model and assessment index system, thus improving the accuracy and comprehensiveness of contract risk identification and assessment. At the same time, combined with professional risk management tools, contract risks can be quantitatively assessed to provide a scientific basis for risk control.

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- Implement contract monitoring technical means

Digital transformation provides more monitoring technical means to monitor contract execution and delivery progress in real time, and detect deviations and abnormalities in a timely manner. For example, project management software can be used to track and monitor contract execution, establish an early warning mechanism, detect problems in time and take corresponding measures, so as to reduce the probability of contract risks.

- Strengthen information sharing and communication mechanism

Under the digital transformation, information technology can be used to establish a contract-related information sharing platform and communication channels to achieve timely sharing and communication of information among all parties. By establishing a collaborative working platform for contract management, the interests of all parties can be effectively coordinated, information asymmetry and misunderstanding in contract execution can be reduced, and the efficiency and accuracy of contract management can be improved.

- Establish a digital supervision system for contract management

Digital transformation provides more supervision means and tools for contract management, and a digital supervision system for contract management can be established, including the tracking, evaluation and supervision of contract execution. By establishing a digital supervision platform for contract management, real-time monitoring and data analysis of contract execution can be achieved, problems can be found and corrected in a timely manner, and the standardization and effectiveness of contract management can be improved.

Under the perspective of digital transformation, strengthening the optimization strategy of contract management and control is an important initiative for contract risk management in engineering projects. By digitally optimizing the contract management process, strengthening the contract risk identification and assessment mechanism, implementing contract monitoring technical means, strengthening the information sharing and communication mechanism, and establishing a digital supervision system, the efficiency and precision of contract risk management in engineering projects can be effectively improved, providing important support and guarantee for digital transformation.

Therefore, through the study of the optimization strategies in the three aspects of protecting information security, enhancing risk identification and assessment capabilities and strengthening contract management and control, this chapter provides important theoretical support and practical guidance for the digital transformation of contract risk management in engineering projects. The implementation of these optimization strategies will help improve the efficiency and precision of contract risk management in engineering projects and promote the development of contract risk management in engineering projects in the direction of digitalization and intelligence.

4.4 Summary of the Results

The findings of this study provide a multifaceted understanding of the current state, challenges, and future potential of contract risk management in engineering projects within the context of digital transformation. Through a combination of qualitative insights and quantitative evaluations, the research underscores critical gaps in traditional practices while also offering evidence-based recommendations for modernizing risk management strategies.

From a qualitative perspective, the research reveals that the existing contract risk management (PCRM) framework in engineering projects is largely constrained by inefficiencies in

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information collection, subjective assessment methods, and reactive risk response mechanisms. Traditional practices are predominantly manual and fragmented, relying on individual expertise and historical intuition rather than real-time data or systematic analysis. These limitations hinder the timely identification of risks, delay response strategies, and reduce the overall accuracy and consistency of risk assessment processes. Moreover, the lack of digital integration impedes the ability of project teams to proactively detect and manage emerging risks throughout the contract lifecycle.

The qualitative analysis further highlights the challenges organizations face during digital transformation. Although technologies such as big data analytics, artificial intelligence, and automated contract management platforms present valuable opportunities, their integration necessitates fundamental changes in organizational structure, workflows, and human capital. Risk management personnel often lack the digital literacy required to utilize these tools effectively, and resistance to process change can slow down adoption. The analysis stresses the need for process redesign, team upskilling, and leadership support to fully realize the potential of digital risk management.

The quantitative analysis, particularly the application of the Analytic Hierarchy Process (AHP), supports and complements these qualitative findings by offering a structured evaluation of contract risks in highway construction projects. Through systematic risk identification and classification, the research identifies four primary risk categories: schedule delays, technological deficiencies, safety hazards, and quality issues. These risks stem from various factors including poor site preparation, delayed design modifications, limited technical capabilities, weak safety protocols, and substandard construction practices.

Using AHP, these risks were quantitatively assessed and prioritized based on expert input and empirical scoring. The model proved effective in converting subjective judgments into measurable weights, providing a clear hierarchy of risks. In the Guizhou highway construction case study, the methodology facilitated the evaluation of five major risk sources, natural, political, economic, technical, and social, each of which was further broken down into 16 individual risk events. The consistency of expert judgments was validated through Eigen value and consistency ratio testing, ensuring the robustness of the results. The ranking of risk probabilities revealed that technical and environmental factors had the highest likelihood of occurrence, reinforcing the need for proactive risk mitigation in these domains.

Additionally, the empirical analysis included a real-world case application in Guizhou Province, which illustrated how a formalized risk management framework can be applied to project planning and execution. A dedicated safety risk management mechanism was implemented, featuring structured risk assessments, expert reviews, hazard identification, and emergency response planning. This process demonstrated the importance of embedding risk governance into every stage of project execution, from design to completion.

The study also outlined several optimization strategies aimed at strengthening PCRM under the digital transformation paradigm. These strategies fall into three main categories: protecting information security, enhancing risk identification and assessment capabilities, and reinforcing contract management and control. In terms of information security, measures such as strengthening network defense systems, improving access control, enhancing security awareness, and establishing robust data backup mechanisms were recommended. To improve risk identification, the introduction of advanced IT tools, multidimensional risk models, standardized processes, and knowledge-sharing practices was emphasized. Finally, digital optimization of contract workflows, real-time monitoring

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technologies, and information-sharing platforms were proposed as ways to improve oversight and control of contract execution.

In summary, the integration of qualitative and quantitative results confirms that the current limitations of traditional contract risk management can be effectively addressed through a targeted digital transformation strategy. The adoption of advanced digital tools, supported by a well-defined organizational framework and competent workforce, holds the potential to transform PCRM into a more intelligent, data-driven, and proactive function. The findings from this study serve as both a diagnostic assessment of existing problems and a strategic roadmap for engineering firms aiming to enhance risk resilience and operational efficiency in an increasingly complex and digitalized project environment.

5. Conclusion, Discussion, and Recommendation

5.1 Conclusion

This thesis has explored the intersection of digital transformation and contract risk management (PCRM) in engineering projects. It begins by identifying the emerging challenges and opportunities that digital technologies bring to managing contract risks. By reviewing the current landscape of digital transformation and contract risk management in engineering projects, this study highlights the critical gaps and issues faced by practitioners today. Based on this understanding, a methodological research framework is developed from the perspective of digital transformation, providing theoretical foundations and practical guidelines for addressing contract risk challenges.

Furthermore, through empirical analysis and detailed case studies, the thesis investigates optimisation strategies for engineering project contract risk management under the influence of digital transformation. The findings offer actionable insights and robust references to support the enhancement of contract risk management practices in real-world engineering projects. Overall, the study contributes to bridging the theoretical and practical divide in this domain, providing valuable directions for future research and industry application.

5.2 Discussion

The research findings underscore that digital transformation fundamentally reshapes contract risk management by introducing new tools, processes, and data-driven decision-making capabilities. This shift necessitates a reevaluation of traditional risk management frameworks to integrate digital elements such as real-time monitoring, automation, and enhanced communication platforms. The study reveals that while digital tools can greatly improve risk visibility and response times, they also introduce complexities, including cybersecurity risks and the need for digital literacy among project stakeholders.

Moreover, the empirical analysis highlights that successful implementation of digital-based PCRM requires not only technological adoption but also organizational change and process redesign. Case studies illustrate how companies that strategically align digital transformation efforts with contract management objectives achieve better risk mitigation outcomes. The discussion points to a balance between technology and human factors as key to optimizing contract risk management in engineering projects.

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5.3 Recommendation

Based on the conclusions and discussions, the following recommendations are proposed to advance contract risk management under digital transformation:

1) Strategic Integration of Digital Tools: Engineering firms should develop comprehensive strategies to incorporate digital technologies, such as AI, big data analytics, and block chain, into their contract risk management processes to enhance transparency and predictive capabilities.

2) Capacity Building and Training: Investment in training programs to improve digital literacy among contract managers and project teams is critical to ensure effective use of new technologies.

3) Process Reengineering: Organizations should redesign existing contract management workflows to fully leverage digital transformation benefits, including automating routine tasks and enabling real-time risk tracking.

4) Risk Governance Framework: Establish robust governance frameworks that address emerging risks from digital transformation, particularly related to data security, privacy, and regulatory compliance.

5) Future Research Directions: Further studies should explore longitudinal impacts of digital transformation on contract risk management across diverse engineering sectors and investigate integration with other project management functions.

By adopting these recommendations, practitioners and researchers can better harness digital transformation to mitigate contract risks, improve project outcomes, and contribute to more resilient engineering project management practices.

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The Empirical Study on Customer Loyalty in Cross-Border Logistics Enterprises, Based on the CRM Value Chain Model

by

Dezhang Cheng
Chinese Graduate School,
Panyapiwat Institute of Management,
Nonthaburi, Thailand
E-mail: 0193700975@shisu.edu.cn

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Dezhang Cheng
Chinese Graduate School,
Panyapiwat Institute of Management,
Nonthaburi, Thailand
E-mail: 0193700975@shisu.edu.cn

Abstract

This research applies the Value Chain theory to construct a model of how the customer relationship management level of cross-border logistics enterprises affects customer loyalty. Taking the main activities and auxiliary activities of customer relationship management of cross-border logistics enterprises as independent variables and customer loyalty as the dependent variable, the influence relationship between the two is studied. This research selects 391 import-export enterprises as the samples, and uses hierarchical regression method for data analysis. The results show that the customer relationship management level of cross-border logistics enterprises has a significant positive impact on customer loyalty. The findings of this research not only enrich the relevant theories on customer relationship management and customer loyalty, but also can guide cross-border logistics enterprises to take relevant managerial measures to improve the level of enterprise customer relationship management, to promote the optimization of organizational design within the enterprise, and strengthen brand building, thus improve the operating performance of the enterprise.

Keywords: Cross-Border Logistics Enterprise, Customer Relationship Management, Value Chain Model, Customer Loyalty

1. Introduction

1.1 Background and Importance of the Problem

Marketing scholars in the United States have long emphasized the positive relationship between a company's market share and its profitability. Empirical evidence suggests that a company's profits tend to rise with increases in market share and decline when its market share decreases. However, subsequent research revealed that customer loyalty is even more closely associated with profitability than market share. In this context, customer relationship management (CRM) emerges as a key driver of both customer retention and financial performance.

In the cross-border logistics industry, the completion of business transactions involves a complex process that integrates operational collaboration and managerial expertise across various stages. The entire life cycle of cross-border logistics is inherently tied to customer relationship management and customer loyalty. Thus, improving the CRM capabilities of enterprise teams and enhancing customer loyalty are of critical importance for increasing the operational efficiency of cross-border logistics enterprises.

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However, customer loyalty does not improve spontaneously. It is influenced by a range of internal and external factors. Among these, the capability of customer relationship management stands out as a core organizational competence. It supports operational efficiency, business growth, and process optimization, all of which are crucial for enhancing customer loyalty in cross-border logistics operations.

1.2 Research Question

This study draws upon two foundational theories: Philip Kotler's Customer Delivered Value Theory and Michael Porter's Service Value Chain Theory.

From Kotler's perspective, the core mission of any enterprise is to create customers by offering the highest delivered value, which balances total customer value (e.g., product, service, and brand value) against total customer cost (e.g., financial, time, and effort-related costs). In this context, CRM becomes not just a tool for acquisition but a mechanism for retention and loyalty development, particularly relevant for service-centric industries like logistics.

Accordingly, the first research question is: *Do the basic activities of the CRM value chain model promote customer loyalty in cross-border logistics companies?* This study further examines the effects of specific dimensions within basic CRM activities on customer loyalty.

Porter's Service Value Chain Theory, introduced in 1985, explains how customer satisfaction and employee satisfaction contribute to business profitability. According to this model, auxiliary CRM activities, such as corporate culture, leadership, organizational design, IT support, human resource management, and brand development, help improve internal management and employee satisfaction. In turn, this enhances service delivery and customer loyalty.

Therefore, the second research question is: Do the auxiliary activities of the CRM value chain model positively affect customer loyalty in cross-border logistics companies? This research also investigates the influence of different dimensions of auxiliary activities on customer loyalty.

1.3 Research Objective

Based on the above research questions and theoretical foundations, the objectives of this study are as follows:

1) To analyze the relationship between the basic activities of the CRM value chain and customer loyalty in the context of cross-border logistics.

2) To explore the relationship between auxiliary CRM activities (e.g., internal systems, leadership, and brand management) and customer loyalty.

3) To provide empirical evidence on how CRM practices influence customer loyalty and, by extension, the operational performance of cross-border logistics enterprises.

4) To offer practical recommendations for logistics enterprises to optimize CRM implementation and foster long-term customer relationships.

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2. Literature Review

2.1 Related Concepts and Theories

2.1.1 CRM and Customer Loyalty

Customer Relationship Management (CRM) is a comprehensive strategy focused on acquiring, retaining, and enhancing customer relationships to maximize profitability and long-term success. In today's highly competitive logistics sector, particularly within cross-border trade, effective CRM practices are crucial in achieving customer loyalty. According to Buttle (2004), CRM involves a value chain model that consists of both basic and auxiliary activities. Basic activities include: customer identification and segmentation, resource allocation, channel management, information collection and analysis, and feedback and re-evaluation. Auxiliary activities include: corporate culture and leadership, organizational design, information technology (IT) support, human resource management (HRM), and brand building.

Together, these activities are designed to create value for both the enterprise and its customers by fostering strong relationships, meeting evolving customer needs, and supporting strategic decision-making.

2.1.2 Cross-Border Logistics and CRM Value

In the context of cross-border logistics enterprises in China, CRM implementation must also address the cultural and operational complexities inherent in international trade. Ma and Zhong (2018) argue that CRM systems that incorporate timely customer feedback lead to service improvements and increased loyalty. Factors such as delivery service quality, return logistics, and cross-border online shopping experiences are key variables that affect customer satisfaction and repurchase intentions (ScienceDirect, 2024).

Moreover, the segmentation and evaluation of customer value, defined as the ratio of perceived benefits to perceived costs (Kotler, 2001), enable firms to allocate resources more effectively. Enterprises can prioritize high-value customers and tailor service levels, leading to more efficient customer acquisition and retention strategies.

2.1.3 Information Technology and System Integration

Effective CRM also requires advanced IT support. Modern logistics platforms must integrate customer relationship tools to facilitate real-time interaction, big data analytics, and automation of customer service processes. These digital capabilities allow logistics firms to respond to customers faster and more accurately, thereby improving satisfaction and loyalty.

Studies have emphasized the necessity of continuous system interaction between departments, which allows for real-time data transmission and enhances both internal operations and external responsiveness. A well-integrated IT system strengthens the feedback loop, enabling companies to adapt more efficiently to market demands.

2.1.4 Human Resource and Organizational Design

Organizational and human resource structures play a pivotal role in CRM performance. A customer-centric corporate culture encourages every employee, from senior executives to front-line staff, to focus on creating value for customers. This necessitates continuous training, performance evaluations aligned with customer outcomes, and incentives that reward CRM-related achievements.

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Organizational design must also promote cross-departmental collaboration. By aligning marketing, customer service, operations, and IT functions, companies can ensure a seamless customer experience.

2.1.5 Brand Building and Loyalty

Brand image, often underappreciated in B2B logistics, is gaining prominence. A strong brand provides assurance of quality, reliability, and professionalism, all of which are essential for retaining business clients in competitive logistics markets. When CRM strategies are aligned with brand positioning, customer trust and long-term loyalty are significantly strengthened.

2.2 Literature Surveys

Ma and Zhong (2018) emphasize that customer interaction and service feedback mechanisms are crucial CRM elements that influence customer satisfaction. These practices lead to more personalized services and improve problem-solving capabilities, ultimately enhancing customer loyalty in cross-border logistics firms.

Additional studies underscore the strategic significance of customer segmentation. Identifying high-value customers enables logistics enterprises to deliver tailored services, allocate resources more efficiently, and concentrate their marketing and service efforts where they have the greatest return (Academia.edu, 2024).

In terms of resource allocation, applying the 80/20 rule (Pareto Principle) allows companies to identify which customer segments generate the majority of profits and which require re-evaluation. This reallocation ensures sustainable business development and enhances customer retention.

Channel management has evolved to emphasize relationship-based channels. These long-term interactions not only ensure service continuity and reliability but also foster emotional connections that increase customer loyalty over time (ScienceDirect, 2024).

Feedback and re-evaluation of customer expectations are vital, particularly in dynamic cross-border environments. Companies must establish proactive listening systems to collect and respond to customer needs, ensuring that service offerings remain relevant and competitive.

On the auxiliary side, corporate culture and leadership are identified as foundational elements. Leadership teams that promote customer-first values and empower employees create a CRM-focused organizational climate.

Organizational design influences information flow and decision-making efficiency. Firms that encourage cross-functional communication and decentralize CRM-related decision-making are more responsive to customer needs.

Information technology not only automates customer interactions but also enables integration with supply chain partners and internal departments. This integration improves responsiveness and transparency, both of which are key determinants of customer satisfaction (Academia.edu, 2024).

Human resources support CRM by selecting, training, and incentivizing personnel to engage in relationship-building activities. Performance appraisals should include customer satisfaction metrics and CRM-related KPIs.

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Brand building, particularly in international markets, helps firms distinguish themselves and develop customer trust. A consistent brand message supported by high service quality reinforces loyalty.

2.3 Conceptual Framework

According to above analysis, the conceptual framework is shown in Figure 1.

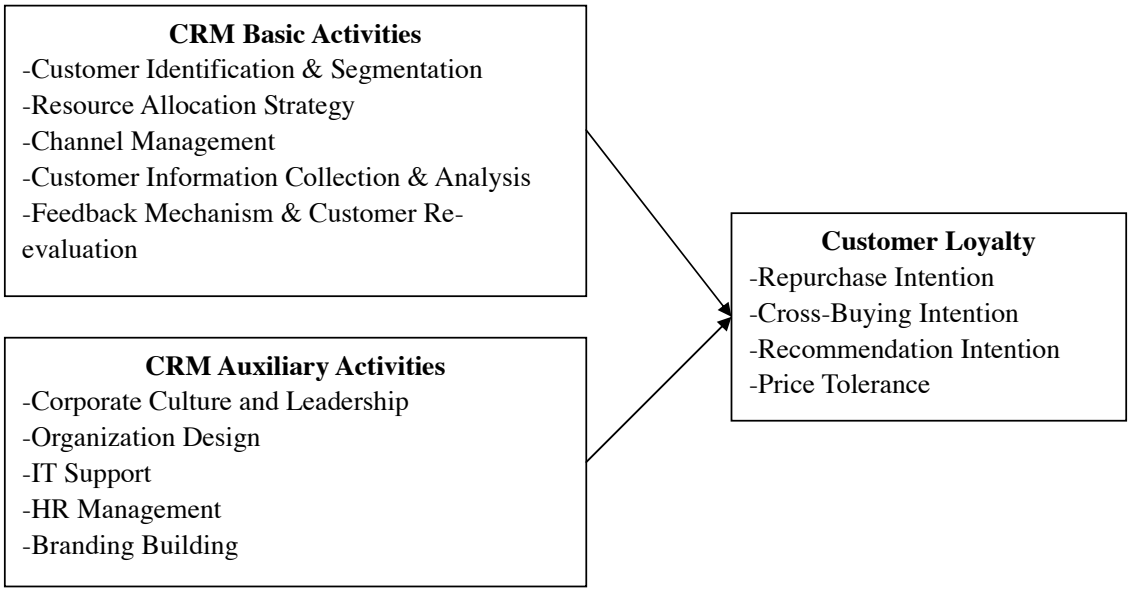

Figure 1 Conceptual Framework

2.4 Research Hypothesis

From the conceptual framework and literature synthesis, the following hypotheses are formulated:

H1: Basic activities of the CRM Value Chain Model have a significant positive influence on customer loyalty in cross-border logistics enterprises.

H1a: Customer identification and segmentation positively influence customer loyalty.

H1b: Resource allocation strategy positively influences customer loyalty.

H1c: Channel management positively influences customer loyalty.

H1d: Customer information collection and analysis positively influence customer loyalty.

H1e: Feedback mechanisms and customer re-evaluation positively influence customer loyalty.

H2: Auxiliary activities of the CRM Value Chain Model have a significant positive influence on customer loyalty in cross-border logistics enterprises.

H2a: Corporate culture and leadership positively influence customer loyalty.

H2b: Organizational design positively influences customer loyalty.

H2c: IT support positively influences customer loyalty.

H2d: Human resource management positively influences customer loyalty.

H2e: Brand building positively influences customer loyalty.

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3. Research Methodology

3.1 Research Design

This study employed a quantitative research design using survey questionnaires to explore the relationship between the CRM value chain model and customer loyalty in the cross-border logistics industry. The research was conducted in the context of the post-COVID-19 era, a period in which global supply chains and cross-border logistics were significantly disrupted. The study focused on companies involved in import and export logistics, reflecting the industry's structural and operational complexity.

A cross-sectional survey was used to collect data from individuals working in both direct customer organizations and peer logistics service providers, enabling cross-level analysis of CRM activities and customer loyalty outcomes.

3.2 Population and Sample

The target population for this study comprised personnel from cross-border logistics enterprises, especially those working in the import and export sector. These companies typically engage in short- to medium-term logistics projects that involve high uncertainty due to fluctuating customer needs, customs regulations, and transportation costs.

The sample included:

- Staff from cross-border logistics enterprises (e.g., sales, operations, customer service)
- Direct customers from import and export companies (logistics and procurement departments)
- Peers from other logistics providers involved in similar operations

A purposive sampling technique was employed to select participants with at least five years of relevant experience, ensuring data quality and appropriateness for cross-level analysis. Out of 400 invited participants, 391 valid responses were retained after data cleaning and company-role matching:

- 193 personnel from direct customer companies
- 198 personnel from logistics peer companies

Demographic data of respondents are detailed in Table 1.

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Table 1 Descriptive Statistics of Samples

Characteristics	Item	Frequency	Percentage
Customer Type	Direct Customer	193	49.36
	Peers	198	50.64
Cooperation Duration	≤1 Year	24	6.14
	2-3 Years	94	24.04
	4-5 Years	124	31.71
	6-7 Years	106	27.11
	> 7 Years	43	11
Annual Revenue	≤ CNY10 Million	54	13.81
	CNY10 Million ≤ Contract Amount < CNY30 Million	131	33.5
	CNY30 Million ≤ Contract Amount < CNY50 Million	145	37.08
	> CNY50 Million	61	15.6
Transaction Scale	≤ CNY1 Million	46	11.76
	CNY1 Million ≤ Contract Amount < CNY3 Million	53	13.55
	CNY3 Million ≤ Contract Amount < CNY5 Million	116	29.67
	CNY5 Million ≤ Contract Amount < CNY10 Million	90	23.02
	CNY10 Million ≤ Contract Amount < CNY50 Million	58	14.83
	> CNY50 Million	28	7.16
Aggregation		391	100.0

3.3 Research Instruments

Measurement indicators for the survey were adapted from established scales in previous literature to suit the cross-border logistics context (see Table 2). Modifications were made to ensure content validity and relevance to logistics operations, especially in areas such as channel management, service coordination, and IT support.

Each construct was measured using Likert-type scales ranging from 1 (strongly disagree) to 5 (strongly agree). Constructs measured include: CRM value chain dimensions (basic and auxiliary activities), customer loyalty, and control variables: customer type, cooperation duration, annual revenue, and transaction scale.

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3.4 Data Collection

The data collection process spanned three months. Surveys were distributed to both direct customers and peer organizations. Responses were coded and matched according to the team or project they were involved in, ensuring a robust dataset for cross-validation. Data cleaning steps included: removing duplicate entries, excluding respondents with fewer than five years of experience, and validating role-company match. After cleaning, a total of 391 valid responses were retained for analysis.

3.5 Statistics Used for Data Analysis

Data were analyzed using descriptive statistics, reliability tests, and structural equation modeling (SEM) to assess the relationships among variables.

Statistical procedures included:

1) Reliability testing (Cronbach's alpha) for internal consistency of constructs
2) Exploratory and confirmatory factor analysis (EFA/CFA) to validate construct structures
3) Regression analysis and SEM to test hypotheses related to CRM activities and customer loyalty
4) Control variable testing to account for external influences (e.g., customer type, revenue size)

These analytical methods enabled the study to empirically validate the CRM value chain model's impact on customer loyalty within the cross-border logistics sector.

4. Data Analysis and Findings

4.1 Introduction

This chapter presents the empirical results derived from the data collected for this study, focusing on the relationship between CRM Value Chain Model activities and customer loyalty in cross-border logistics enterprises. The primary aim is to examine how both basic and auxiliary CRM activities influence customer loyalty. The analysis includes the assessment of reliability and validity of measurement scales, descriptive statistics, correlation analysis, and hypothesis testing using hierarchical regression models. The variables under investigation include CRM basic activities (such as customer identification and segmentation, resource allocation strategy, channel management, customer information collection and analysis, and feedback mechanisms), CRM auxiliary activities (including corporate culture and leadership, organizational design, IT support, human resource management, and brand building), and customer loyalty. To ensure the appropriateness of aggregating responses and evaluating the constructs, this chapter begins with an aggregation appropriateness test and confirmatory factor analysis to assess reliability and validity. Subsequently, correlation analysis is conducted to verify discriminant validity. Finally, the results of hierarchical regression analysis are reported to test the hypotheses.

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4.2 Data Analysis of the Quantitative Data

4.2.1 Aggregation Appropriateness Test

1) CRM basic activities

The measurement of this variable is mainly borrowed from the CRM Value Chain model developed by Yu and Wang(2008), and the meter of each dimension design of each dimension is integrated. This volume table has a total of 20 questions, including CRM and resource allocation strategies, channel management, customer information collection and analysis and feedback mechanisms, and customer re-evaluation the five dimensions to measure the basic activities of the CRM value chain model.

2) CRM auxiliary activities

The measurement of this variable is mainly borrowed from the CRM Value Chain model developed by Yu and Wang, and the meter of each dimension design of each dimension is integrated. This volume table has a total of 20 questions, including corporate culture and leadership, organizational design, IT support, human resource management process, and brand construction five dimensions, to measure the auxiliary activities of the CRM value chain model.

3) Customer loyalty

The measurement of this variable mainly draws on the customer loyalty table developed by Brah (2006). There are 4 questions in this scale, including the number of purchases, low requirements for services, and positive publicity of our company.

Participants were required to answer each question on a scale ranging from 1 to 5 (1, strongly disagree, 5, strongly agree).

4.2.2 Empirical Analysis

Reliability and Validity Test

In terms of content validity, the measurement indicators of various variables in this study have theoretical basis. According to the mature tables used by scholars in the past, a certain revision of the project situation is combined with the project situation. The wording of the sentence is modified, so it can be considered to have good content validity.

Confirmatory factor analysis was conducted to test the measurement validity and reliability in this study. According to the results shown in Table 2, most indicators have factor loadings greater than 0.6. All CR values exceeded the threshold of 0.8, all AVE values exceeded the standard 0.5, and all Cronbach's α values were higher than 0.6. These results indicate the satisfactory reliability and structural validity of all constructs (Yu & Wang, 2008; Brah, 2006).

Furthermore, the square roots of the AVEs for the individual level variables fall within the range of 0.582 to 0.843. Notably, all these values exceed the correlation coefficient observed between the constructs (Table 3), which means a guarantee of discriminant validity.

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Table 2 Reliability and Validity Tests

Variable	Indicator	FL	AVE	CR	Cronbach's α	Variable	Indicator	FL	AVE	CR	Cronbach's α
Customer	RS1	0.929	0.582	0.838	0.865	Corporate	EC1	0.863	0.783	0.932	0.605
Identification &	RS2	0.864				Culture &	EC2	0.702			
Segmentation	RS3	0.868				Leadership	EC3	0.664			
	RS4	0.901					EC4	0.785			
Resource	RA1	0.924	0.843	0.955	0.887	Organization	OD1	0.936	0.786	0.931	0.871
Allocation	RA2	0.883				Design	OD2	0.867			
Strategy	RA3	0.912					OD3	0.868			
	RA4	0.878					OD4	0.926			
Channel	CM1	0.932	0.818	0.947	0.874	HR	HR1	0.816	0.716	0.917	0.617
Management	CM2	0.872				Management	HR2	0.687			
	CM3	0.883					HR3	0.751			
	CM4	0.903					HR4	0.657			
Customer	GA1	0.922	0.813	0.945	0.863	IT Support	IT1	0.942	0.618	0.886	0.868
Information	GA2	0.886					IT2	0.868			
Collection &	GA3	0.852					IT3	0.806			
Analysis	GA4	0.843					IT4	0.851			
Feedback	FR1	0.926	0.762	0.924	0.877	Brand	BB1	0.933	0.823	0.954	0.839
Mechanism &	FR2	0.878				Building	BB2	0.842			
Customer Re-	FR3	0.873					BB3	0.836			
evaluation	FR4	0.866					BB4	0.873			
						Customer	CL1	0.762	0.684	0.907	0.896
						Loyalty	CL2	0.749			
							CL3	0.781			
							CL4	0.747			

Notes: FL, factor loading; AVE, average variance extracted; CR, composite reliability; α, Cronbach's α. All factor loadings are significant at $\alpha < 0.001$.

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Table 3 Correlation Analysis of the Variables

Variable	1	2	3	4	5	6	7	8	9	10	11
1. Customer Identification & Segmentation	**0.763**										
2. Resource Allocation Strategy	-0.024	**0.918**									
3. Channel Management	-0.059	0.722	**0.904**								
4. Customer Information Collection & Analysis	0.006	0.735	0.58**	**0.902**							
5. Feedback Mechanism & Customer Re-evaluation	0.01	-0.055	0.105**	0.729	**0.873**						
6. Corporate Culture & Leadership	0.028**	-0.038**	0.033	0.77**	0.668	**0.885**					
7. Organization Design	-0.018**	-0.048**	0.042**	-0.031**	0.062	-0.022*	**0.887**				
8. HR Management	0.008**	0.016**	-0.036**	0.057	0.055	0.045**	0.732	**0.846**			
9. IT Support	-0.006**	0.701	-0.093	-0.065**	-0.067**	-0.036*	0.755**	0.612	**0.786**		
10. Brand Building	0.072	0.491	0.044**	0.632	0.028*	0.023	0.029	0.027	0.017	**0.907**	
11. Customer Loyalty	0.045**	0.066*	0.051**	0.451**	-0.005*	0.006**	0.051*	-0.058*	0.005**	0.759*	**0.827**

Notes: ***p<0. 001, **p<0. 01, * p<0. 05; bold numbers are AVEs' square roots.

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Hypothesis Test Results

1) Mani Effect test

This study uses the hierarchical regression method to test the assumptions proposed. As a result, it is shown in Table 4. It is shown in model 2 that customer identification&segmentation exhibits a positive influence on customer loyalty (β=0.183, p<0.01). Resource allocation strategy exhibits a positive influence on customer loyalty (β=0.177, p<0.001). Channel management exhibits a positive influence on customer loyalty (β=0.206, p<0.01). Customer information collection&analysis exhibits a positive influence on customer loyalty (β=0.157, p<0.05). Feedback mechanism&customer re-evaluation exhibits a positive influence on customer loyalty (β=0.213, p<0.01), H1a, H1b, H1c, H1d, H1e are supported.

As indicated in model 3, corporate culture&leadership exhibits a positive influence on customer loyalty (β=0.103, p<0.01). Organization design exhibits a positive influence on customer loyalty (β=0.176, p<0.05). HR management exhibits a positive influence on customer loyalty (β=0.139, p<0.05). IT support exhibits a positive influence on customer loyalty (β=0.144, p<0.01). Brand building exhibits a positive influence on customer loyalty (β=0.151, p<0.05). H2a, H2b, H2c, H2d, H2e are supported.

Table 4 Regression Analysis Results

Variable	Customer Loyalty		
	Model 1	**Model 2**	**Model 3**
Customer Type	0.181	0.137	0.156
Cooperation Duration	0.205	0.192	0.197
Annual Revenue	0.223	0.197	0.201
Customer Identification & Segmentation		0.183**	0.166*
Resource Allocation Strategy		0.177***	0.159**
Channel Management		0.206**	0.183*
Customer Information Collection & Analysis		0.157*	0.144*
Feedback Mechanism & Customer Re-evaluation		0.213**	0.202**
Corporate Culture & Leadership			0.103**
Organization Design			0.176*
HR Management			0.139*
IT Support			0.144**
Brand Building			0.151*
R^2	0.255	0.439	0.498
Adjusted R^2	0.251	0.406	0.437
$\triangle R^2$	0.251	0.396*	0.042**
F	44.318	56.153**	56.732**

Notes: ***p<0. 001, **p<0. 01, *p<0. 05.

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4.3 Summary of the Results

This study conducts empirical research on the influence of customer loyalty through the CRM value chain model of cross-border logistics enterprises and obtains the following results:

First, the basic activities of the CRM value chain model have a significant positive influence on customer loyalty. Among the five dimensions of the basic activities, customer identification and segmentation, resource allocation strategies, channel management, customer information collection and analysis, and feedback mechanism and customer re-evaluation, all have a significant positive impact on customer loyalty. The impact of resource allocation strategy on customer loyalty is particularly notable. This is mainly because, compared to other basic CRM activities, resource allocation strategy reflects an enterprise's capability to allocate management efforts toward customers of different value levels. It is a crucial factor in corporate customer relationship management, influencing and being influenced by other dimensions, thereby affecting customer loyalty.

Second, auxiliary activities also have a significant positive impact on customer loyalty in cross-border logistics companies. Among these, corporate culture and leadership, along with IT support, have a significantly greater impact on customer loyalty than organizational design, human resource management processes, and brand building. Studies have shown that the corporate culture and leadership in cross-border logistics enterprises can establish a "customer-friendly" organizational approach that promotes CRM awareness among employees, enabling them to fully understand its importance and thereby enhance customer loyalty.

Last but not least, the basic and auxiliary activities jointly exert a significant positive impact on customer loyalty. When combined with the basic activities of the CRM value chain, the auxiliary activities have a stronger positive influence on customer loyalty. Research indicates that in customer relationship management, basic activities primarily improve customer loyalty through feedback and interaction with external customers, while auxiliary activities focus on reshaping internal organizational processes to enhance service levels offered to customers, thus fostering customer loyalty. Therefore, cross-border logistics enterprises should actively strengthen their customer relationship management capabilities through both the basic and auxiliary activities of the CRM value chain to effectively improve customer loyalty.

5. Conclusion, Discussion, and Recommendation

5.1 Conclusion

This study contributes to the theoretical understanding of how the CRM value chain model influences customer loyalty in the context of cross-border logistics enterprises. The results show that all dimensions, including both basic and auxiliary activities, positively and significantly affect customer loyalty.

Notably, auxiliary activities, such as corporate culture and leadership, brand building, and IT support, are confirmed as critical drivers of CRM effectiveness. These findings reinforce the value chain theory and broaden the application of CRM theory in the field of logistics, particularly within the cross-border context.

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Additionally, the research validates that the combined effect of basic and auxiliary activities provides a more robust mechanism for fostering loyalty. This extends Peter Drucker's theory by demonstrating that internal enterprise operations are not only support functions but are core to building long-term customer relationships and loyalty.

5.2 Discussion

The findings emphasize several implications for cross-border logistics enterprises, especially those that are small or medium-sized and in the early stages of development.

Many such firms operate with a focus on immediate tasks and often lack a structured CRM strategy or customer value awareness. Employees typically follow operational principles like "seeking truth from facts, " which may lead to transactional, short-term relationships rather than long-term loyalty. To address this, companies must cultivate a customer relationship management mindset, encouraging scientific assessments of customer value and focusing on long-term cooperation.

Furthermore, the research highlights the importance of organizational infrastructure. Leadership plays a vital role in promoting CRM values and aligning employee behaviors with customer-centric goals. Internal team development, including training and involvement in customer engagement activities, can significantly enhance the organization's CRM capacity.

IT systems are also essential in facilitating fast and accurate communication, while organizational design must shift from rigid, departmental structures to flexible project-based teams that encourage collaboration across roles.

Lastly, the study challenges the traditional CRM model that relies heavily on personal connections or "private feelings." While such relationships may help initiate cooperation, they do not sustain loyalty in the long run. The findings suggest that enterprise-wide efforts, such as consistent brand messaging, service excellence, and strong internal systems, are more effective in building lasting customer trust and loyalty.

5.3 Recommendation

Based on the study's findings, the following recommendations are proposed for cross-border logistics enterprises:

1) Strengthen Basic CRM Activities

- Instill a management mindset focused on customer relationship value across the organization.
- Implement a customer value evaluation system and feedback mechanism to guide decision-making.
- Align resource allocation with customers' long-term potential and profitability.
- Promote customer retention strategies that emphasize cumulative satisfaction over repeated transactions.

2) Enhance Internal Support Systems for CRM

- Encourage leadership to take an active role in CRM awareness and behavior modeling.
- Redesign internal structures from traditional departments to collaborative project teams.
- Build robust IT systems for real-time data exchange with customers.

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- Integrate CRM principles into HRM processes, including recruitment, training, and performance evaluation.

3) Combine Basic and Auxiliary Activities for Long-Term Loyalty

- Move beyond a reliance on interpersonal relationships and emphasize organization-wide customer engagement.
- Use brand-building strategies (e.g., exhibitions, digital marketing) to increase visibility and reinforce trust.
- Create a cohesive service experience driven by both operational efficiency and a strong organizational culture.
- Ensure that all employees contribute to the company's CRM goals, not just frontline staff.

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A Study on Consumers' Willingness to Purchase Nearly Expired Food, Based on the Internal Cue Perspective of Cue Utilization Theory

by

Hangcheng Yan
Chinese Graduate School,
Panyapiwat Institute of Management,
Nonthaburi, Thailand
E-mail: 172770037@qq.com

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by

Hangcheng Yan
Chinese Graduate School,
Panyapiwat Institute of Management,
Nonthaburi, Thailand
E-mail: 172770037@qq.com

Abstract

Food waste is a global resource problem that has attracted widespread attention from all countries. Based on the cue utilization theory, this article takes consumers on the Credamo platform as the research object. It uses an experimental research method to verify the influence of time frame on consumers' willingness to buy nearly expired food, to prevent and alleviate the related problems of food waste effectively. The study found that consumers in the remaining days framework have a higher willingness to buy nearly expired food; time perception plays a mediating role in this, and excludes the interference variable of cognitive fluency; food type has a moderating effect on the influence of time frame on the willingness to buy nearly expired food, and time perception plays a mediating role in the model. Nearly expired food is food that is close to expiration within the shelf life. As one of the main causes of food waste, its sales and management have become important measures to alleviate food waste. Therefore, exploring how to publicize and promote the consumption of nearly expired food from a marketing perspective has important practical value and practical significance.

Keywords: Time Perception, Time Frame, Purchase Willingness, Expired Food, Internal Cue

1. Introduction

1.1 Background and Importance of the Problem

Among various internal product cues, one prominent feature distinguishing nearly expired food from regular food is its shorter remaining shelf life. The concept of "time framing" can significantly influence consumer behavior related to food consumption and waste (Khalil et al., 2021). Nearly expired foods refer to products that are close to, but not yet at, their expiration date (de Hooge et al., 2017; Zhang & Lai, 2020).

Previous studies on nearly expired foods have primarily focused on three aspects: product-related factors (Samotyja & Sielicka-Róynska, 2021; Fikar et al., 2021), situational factors (Aschemann-Witzel et al., 2018; Lombar et al., 2020; Woo et al., 2022), and consumer personal characteristics (de Hooge et al., 2017; do Carmo Stangherlin et al., 2020). However, these studies often analyze a single influencing factor in isolation and lack a systematic theoretical framework. In

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real-world purchase scenarios, consumers evaluate product quality and attributes through multiple cues, making it essential to investigate more integrated and nuanced models.

A notable research gap exists in understanding how time framing of remaining shelf life (i.e., how many days are left before expiration) influences consumer purchase behavior. Moreover, prior research has seldom examined the psychological mechanisms (e.g., time perception) underlying consumer responses to nearly expired foods, nor the boundary conditions that may influence these effects, such as food type or consumer traits. While some studies (e.g., Munichor & Leboeuf, 2018) have examined the impact of time intervals and event valence on goal pursuit, they have not explored the role of time frames in the context of marketing or as a product-side variable.

1.2 Research Question

To address these gaps, this study focuses on the following research questions:

1) Does the time frame (e.g., number of days remaining before expiration) influence consumers' willingness to purchase nearly expired food?

2) Does consumers' perception of time serve as a significant mediating factor between the time frame and their willingness to purchase nearly expired food?

3) Does the type of food (e.g., fresh vs. packaged) significantly moderate the relationship between time frame, time perception, and purchase intention?

1.3 Research Objective

The main objectives of this study are:

1) To empirically examine the effect of time frame on consumers' willingness to buy nearly expired food.

2) To explore the mediating role of time perception in the relationship between time frame and purchase intention.

3) To investigate whether the type of food moderates the effects of time frame and time perception on purchase behavior.

2. Literature Review

2.1 Related Concepts and Theories

This study builds on key concepts in consumer behavior, particularly the framing of time information, shelf-life perception, and food categorization. Shelf life is considered one of the most typical internal cues of food products and plays a crucial role in consumer decision-making. According to Dinnella et al. (2014), consumers tend to associate a shorter remaining shelf life with increased health risks, which leads them to pay more attention to expiration-related information, especially when purchasing nearly expired food.

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This research adopts Attention Gate Theory, which posits that the human brain allocates cognitive attention across time intervals, influencing time perception. This theoretical framework supports the idea that consumers interpret remaining shelf life differently depending on how it is framed, either as a specific expiration date or a count of remaining days. Sanna et al. (2005) argue that time frames affect time perception, which in turn affects behavioral outcomes. In the context of nearly expired food, a shorter perceived time span can reduce the willingness to purchase.

Additionally, the type of food, whether healthy or unhealthy, plays a significant role in how consumers evaluate expiration information. Healthy foods are generally associated with functional and practical attributes, whereas unhealthy foods are often linked to hedonic attributes (Nagpal et al., 2014; Biswas et al., 2017). Since shelf-life information is a practical cue indicating food safety and quality (Newsome et al., 2014), consumers tend to value it more when purchasing healthy foods. This distinction is essential in understanding how time frames interact with food type to influence perception and purchase intention.

2.2 Literature Surveys

Numerous studies have focused on how expiration-related information affects consumers' willingness to buy nearly expired food. These studies generally fall into the following themes:

1) Shelf-Life Labeling and Knowledge

Wilson et al. (2019) investigated the effect of various shelf-life labels (e.g., "best before," "use by") on consumer behavior.

Manzocco et al. (2016), Melbye et al. (2016), and Collart and Interis (2018) examined how consumers' understanding of shelf-life terminology impacts their willingness to buy and consume nearly expired food.

2) Time Perception and Framing Effects

Sanna et al. (2005) emphasized that the way time is framed alters individual perception.

Samotyja and Sielicka-Różyńska (2020) confirmed that the closer the expiration date, the lower the consumer's willingness to purchase.

DeHart and Odum (2015) further supported the notion that consumers tend to focus more on the duration of time intervals when information is framed in terms of remaining days rather than expiration dates.

3) Food Type and Attribute Processing

Consumers assign different levels of attention to food attributes based on food type. Healthy food attributes are often evaluated more thoroughly, especially regarding safety and shelf life (Nagpal et al., 2014; Biswas et al., 2017).

This context-specific processing suggests that healthy foods may be more sensitive to changes in shelf-life framing, whereas unhealthy foods may elicit relatively consistent behavior regardless of how expiration information is presented.

This study distinguishes itself by integrating these elements, time frame, time perception, and food type, into a unified framework. While earlier research often treats these variables

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independently, this work explores their interactions and mediating/moderating roles, offering a more holistic understanding of consumer decision-making regarding nearly expired foods.

2.3 Conceptual Framework

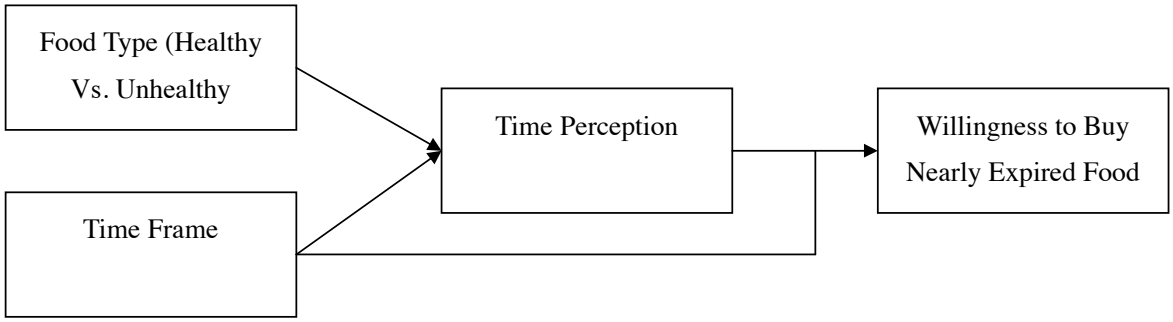

Figure 1 Conceptual Framework

2.4 Research Hypothesis

Drawing on the above theories and empirical evidence, this study proposes the following hypotheses:

H1: Compared with the date frame, consumers have a higher willingness to buy nearly expired foods when the remaining shelf life is presented in the remaining days frame.

H2: Time perception plays a mediating role in the influence of time frame on consumers' willingness to buy nearly expired foods. Specifically, the remaining days frame increases perceived shelf life, which in turn enhances purchase intention.

H3: Food type moderates the impact of time frame on consumers' willingness to buy nearly expired foods.

H3a: When the food type is healthy, the remaining days frame leads to a longer perceived shelf life and a higher willingness to purchase nearly expired food compared to the date frame.

H3b: When the food type is unhealthy, there is no significant difference in the impact of the two-time frames on perceived shelf life or purchase willingness.

In summary, this study expands the theoretical understanding of time framing in product consumption by introducing time perception as a mediator and food type as a moderator. The findings are expected to contribute significantly to theories related to time-based decision-making, food labeling, and consumer psychology, especially in the context of nearly expired products.

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3. Research Methodology

3.1 Research Design

This study employed a quantitative experimental research design to investigate the effect of time framing—specifically, "remaining days" versus "expiry date"—on consumers' willingness to purchase nearly expired food products. A between-subjects experimental approach was adopted across four experiments, each designed to examine a distinct hypothesis:

- Experiment 1: Tested the main effect of time framing on purchase intention.
- Experiments 2a and 2b: Tested the mediating role of time perception while ruling out cognitive fluency and information processing as alternative explanations.
- Experiment 3: Explored the boundary condition of food type (short shelf life vs. long shelf life).

This experimental design enabled the manipulation of independent variables (time framing) and the measurement of dependent variables (purchase intention and cognitive responses) under controlled conditions, thus allowing for valid causal inferences.

3.2 Population and Sample

The population for this study comprised online consumers in China who frequently engage in digital shopping, particularly for food and grocery items.

- Sampling Technique: Non-probability convenience sampling was used, leveraging the Credamo online research platform.
- Sample Size: A total of four experiments were conducted with varying sample sizes:
    - Experiment 1: 100 participants
    - Experiment 2a: 200 participants
    - Experiment 2b: 200 participants
    - Experiment 3: (To be detailed in the next section)

- Demographics: Participants ranged in age from 18 to 55 years, with a balanced gender distribution. All respondents confirmed familiarity with online food shopping and had no food-related occupational biases.

The use of Credamo ensured the samples were demographically diverse and representative of digital consumers in urban and semi-urban areas.

3.3 Research Instruments

The research instruments consisted of structured online questionnaires that included both stimulus materials and validated measurement scales. Each experiment used a customized set of items tailored to test specific hypotheses:

- Stimulus Material: Product images and expiry information presented in two time frame formats:
    - Remaining days (e.g., "Expires in 10 days")
    - Expiry date (e.g., "Expires on April 21, 2024")

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- Scales Used:
  - Purchase Intention: Adapted from Newman et al. (2016) (9-point Likert scale; 1 = very unlikely, 9 = very likely).
  - Time Perception: Adapted from Leboeuf (2006) (single item, 9-point scale).
  - Cognitive Fluency: Adapted from Lee and Aaker (2004) (2-item, 9-point scale; Cronbach's $\alpha > 0.9$).
  - Information Processing: Adapted from Dshemuchadse et al. (2013) (1-item, 9-point scale).

All instruments were developed in Chinese and pre-tested to ensure clarity, consistency, and reliability.

3.4 Data Collection

Data were collected through online experimental surveys administered via the Credamo platform. Each experiment followed a similar protocol:

1) Participant Screening: Respondents were screened for eligibility (age, online shopping experience, food consumption habits).

2) Random Assignment: Participants were randomly assigned to experimental conditions (remaining days vs. expiry date).

3) Stimulus Presentation: Participants viewed the product with its corresponding expiry information.

4) Response Collection: Participants completed the survey, including purchase intention and other cognitive measures.

5) Debriefing: All participants were debriefed regarding the true purpose of the study to uphold ethical standards.

Participation was voluntary, and anonymity was maintained throughout the process.

3.5 Statistics Used for Data Analysis

Data analysis was conducted using SPSS and PROCESS macro developed by Hayes (2018). The following statistical techniques were employed:

1) Descriptive Statistics: Means, standard deviations, and frequency distributions for demographic and key study variables.

2) Analysis of Variance (ANOVA): Used to compare purchase intention and perception scores across different time framing conditions.

3) Mediation Analysis: Conducted using Hayes' PROCESS Model 4 with 5,000 bootstrap samples to test the indirect effect of time perception.

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4) Reliability Analysis: Cronbach's alpha was calculated for multi-item scales (e.g., cognitive fluency).

5) Manipulation Checks: Independent sample t-tests confirmed successful framing manipulation in all experiments.

The use of inferential and causal analysis methods ensured that the hypotheses were rigorously tested and the findings were statistically valid.

4. Data Analysis and Findings

4.1 Introduction

The research experiment is to test the research hypothesis of the influence of time frame on consumers' willingness to buy nearly expired food through four experiments. Experiment 1 aims to verify the main effect, that is, the influence of time frame on consumers' willingness to buy nearly expired food; 2a and 2b in Experiment 2 are to verify the mediating role of time perception in the influence of time frame on consumers' willingness to buy nearly expired food while excluding cognitive fluency and information processing as possible explanatory mechanisms; Experiment 3 is to verify the boundary effect of the influence of food type time frame on consumers' willingness to buy nearly expired food.

The four experiments in this study adopted the same manipulation method in terms of the manipulation of independent variables, that is, to manipulate the time frame of nearly expired food through textual expression. This manipulation method draws on the research of (Munichor & Leboeuf, 2018), which is conducive to ensuring the stability of the experimental process. Secondly, the stimulus selection of the experiment is relatively diverse, including two representative nearly expired foods: bread with a shorter shelf life and biscuits with a longer shelf life. Finally, this experiment eliminated the relevant interference variables one by one, further confirming the robustness of the research theory.

4.2 Data Analysis of the Quantitative Data

Experiment 1: Verifying the Main Effect of Time Frame on Consumers' Willingness to Purchase Nearly Expired Food

This experiment adopts a single-factor (time frame: remaining days vs. date) between-group design. The experiment recruited 100 subjects (41 males, 59 females, with an average age of 29 years old) through the Credamo platform. The experimental stimulus is bread, and this study selects the virtual food brand "Youpin". Manipulation of time frame. The manipulation of the time frame of the remaining shelf life of food refers to the study of (Munichor & Leboeuf, 2018). Among them, the date group is expressed as "expiring on April 21, 2024", and the remaining days group is expressed as "expiring in 10 days". The experimental stimuli are shown in Table 1. Measurement of willingness to buy nearly expired food. The measurement of willingness to buy nearly expired food refers to the scale of Newman et al. (2016). The specific content of the test item is "If you see this product in a supermarket or online store at this time, how likely are you to buy it?" (1=very unlikely, 9=very likely).

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First, the subjects were randomly assigned to two experimental groups and were told that the main purpose of the experiment was to test consumers' preference for expired food. Subsequently, the subjects began to browse the first part of the information related to nearly expired foods, which included the manipulation of the remaining shelf-life time frame. The subjects then entered the second part of the experiment and answered questions related to their willingness to purchase nearly expired foods. Finally, the subjects filled in their demographic information and were informed of the true experimental purpose of this experiment.

Table 1 Experiment 1

	Product Information
	[Product Information] Hand-torn bread [Specification] 480g (10 pieces) [Shelf life] 60 days **Note:** 10 days left to expire
	[Product Information] Hand-torn bread [Specification] 480g (10 pieces) [Shelf life] 60 days **Note:** Eexpires on April 21, 2024

The variance analysis was conducted with consumers' willingness to buy as the dependent variable and time frame as the independent variable. The results showed that compared with the subjects in the date group, the subjects in the remaining days group had a higher willingness to buy nearly expired food (M remaining days = 5.59, SD remaining days = 2.58, M date = 4.54, SD date = 2.55; F (1, 98) = 4.16, p = 0.044). Experiment 1 preliminarily tested the impact of the two-time frames on consumers' willingness to buy nearly expired food. The results showed that compared with the date frame, consumers in the remaining days frame had a higher willingness to buy nearly expired food. The research hypothesis H1 was supported.

Experiment 2a: Verifying the mediating role of time perception

This experiment adopts a single-factor (time frame: remaining days vs. date) between-group design. The experiment recruited 200 subjects through the Credamo platform, of which 200 passed the attention test (75 males, and 125 females, with an average age of 32 years old). The experimental stimulus is a certain brand of biscuits. In addition to the product name, specifications, shelf life, and remaining shelf-life information in the previous experiment, the relevant information of the product also adds the production date information. Measurement of willingness to buy nearly expired food and time perception. The measurement of purchase intention is consistent with the previous experiment. Referring to the scale of Newman et al. (2016), the specific content of the measurement item is "If you see this product in a supermarket or online store at this time, how likely are you to buy it?" (1=very unlikely, 9=very likely). For the measurement of time perception, refer to the research of Leboeuf (2006), the measurement item is "How long do you think this product will expire? (1=very short, 9=very long)".

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Measurement of cognitive fluency of interference variables. For the measurement of cognitive fluency, the research of Lee and Aaker (2004) was modified. The measurement items were "Based on the product information, you can easily know how long the product will expire", and "Based on the product information, you can quickly know how long the product will expire" (1=strongly disagree, 9=strongly agree) (α=0.924).

The main purpose of Experiment 2a is to verify the influence of time frame on consumers' willingness to buy nearly expired food by changing the experimental stimulus; and to explore the mediating role of time perception in the influence of time frame on consumers' willingness to buy nearly expired food, and verify H2; first, tell the subjects that this study mainly tests consumers' preference for nearly expired food, then let the subjects browse the pictures and related information of nearly expired food online, and then the subjects enter the second part of the experiment to answer questions related to the dependent variable willingness to buy nearly expired food, the mediating variable time perception and the interference variable cognitive fluency. Finally, the subjects fill in the demographic information and are informed of the real purpose of the experiment.

The manipulation of the time frame refers to the study of (Munichor & Leboeuf, 2018). The date group is expressed as "expiring on April 19, 2024", and the remaining days group is expressed as "expiring in 42 days".

Analysis of the main effect of time perception. Compared with the date group, the subjects in the remaining day's group have a longer perception of the remaining shelf life (M remaining days = 4.57, SD remaining days = 1.91, M date = 4.06, SD date = 1.97; F (1, 198) = 4.50, p = 0.035).

Analysis of the main effect of willingness to buy nearly expired food. Compared with the date group, the subjects in the remaining day's group have a higher willingness to buy nearly expired food (M remaining days = 5.68, SD remaining days = 2.16, M date = 5.09, SD date = 2.13; F (1, 198) = 4.83, p = 0.029).

Analysis of mediation of time perception. To verify the mediating role of time perception in the mechanism of the influence of different time frames on the willingness to purchase nearly expired food, this study conducted a bootstrap test (Hayes, 2013). The sample size was selected as 5000. Under the 95% confidence interval, the direct effect results of the mediation test included 0, which was not significant (LLCI=-0.1619, ULCI=0.7494), and the indirect effect did not include 0, which was significant (LLCI=0.0288, ULCI=0.5890), indicating that the mediating effect of time perception was significant. The results of the mediation analysis are shown in Figure 2.

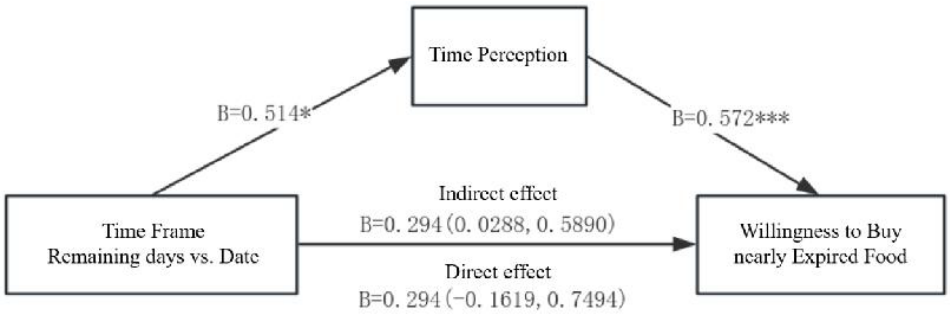

Figure 2 Experiment 2a: Mediating Effect Test

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Cognitive fluency can be used as an alternative explanatory mechanism test. The results show that there is no significant difference in cognitive fluency between the subjects in the date group and the remaining days group (M remaining days = 7.20, SD remaining days = 1.54, M date = 7.35, SD date = 1.43; F (1, 257) = 0.68, p = 0.411), eliminating the influence of cognitive fluency.

The empirical results show that compared with the date frame, consumers in the remaining days frame have a longer perception of the remaining shelf life of nearly expired foods, thus having a higher willingness to buy. On this basis, experiment 2b will change the stimulus and test the main effect and mediation mechanism again, that is, hypothesis H2, and further eliminate the interference factor of the information processing method.

Experiment 2b: Secondary Verification of the Mediating Effect of Time Perception

Verify the mediating effect of time perception again, that is, verify H2; the high cognitive demand caused by the more complex date frame leads to a more thoughtful processing mode (Dshemuchadse et al., 2013). Therefore, this study adds the measurement of information processing to exclude it as a possible explanatory mechanism.

This experiment adopts a single-factor (time frame: remaining days vs. date) between-group design. The experiment recruited 200 subjects through the Marketing Research Room platform, of which 200 passed the attention test (62 males, and 138 females, with an average age of 31 years old). Selection of experimental stimuli. For the rigor of the experiment, the stimulus brand in Experiment 2b was changed to the virtual brand "Le Tu". In addition to the product name, specifications, shelf life, and remaining shelf-life information in the previous experiment, the relevant information of the product also added the production date information.

First, the subjects were told that this study mainly tested consumers' preferences for nearly expired foods. Then, the subjects were asked to browse pictures and related information about nearly expired foods online. Then, the subjects entered the second part of the experiment and answered questions about the dependent variable, willingness to buy nearly expired foods, the mediating variable, time perception, and the interfering variable, cognitive fluency. Finally, the subjects filled in demographic information and were informed of the true purpose of the experiment.

Manipulation of time frame. Referring to the study of (Munichor & Leboeuf, 2018), the date group was expressed as "expiring on May 6, 2024", and the remaining days group was expressed as "expiring in 45 days".

The measurement of willingness to buy nearly expired foods and time perception was based on the study of Leboeuf (2006). The measurement item was "How long do you think the product will expire? (1 = very short, 9 = very long)".

The measurement item of the interfering variable information processing method was "When you were thinking about the willingness to buy the product just now, was it" (1 = based on intuition, 9 = thinking carefully).

Analysis of the main effect of time perception. Compared with the date group, participants in the remaining days group perceived a longer remaining shelf life (M remaining days = 4.663, SD remaining days = 1.810, M date 3.843, SD date = 1.707; F (1, 198) = 9.00, p = 0.003).

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Main effect analysis of willingness to purchase nearly expired food. Compared with the date group, the subjects in the remaining days group had a higher willingness to purchase nearly expired food (M remaining days = 5.627, SD remaining days = 2.117, M date = 4.952, SD date = 2.246; F (1, 198) = 3.966, p = 0.048).

Time perception mediation analysis. To verify the mediating role of time perception in the mechanism of the influence of different time frames on the willingness to purchase nearly expired food, this study used the bootstrap method to test (Hayes, 2013; Model 4). The sample size was selected as 5000. Under the 95% confidence interval, the direct effect results of the mediation test included 0, which was not significant (LLCI = -0.1619, ULCI = 0.7494), and the indirect effect did not include 0, which was significant (LLCI = 0.0288, ULCI = 0.5890), indicating that the mediation effect of time perception was significant. The results of the mediation analysis are shown in Figure 3.

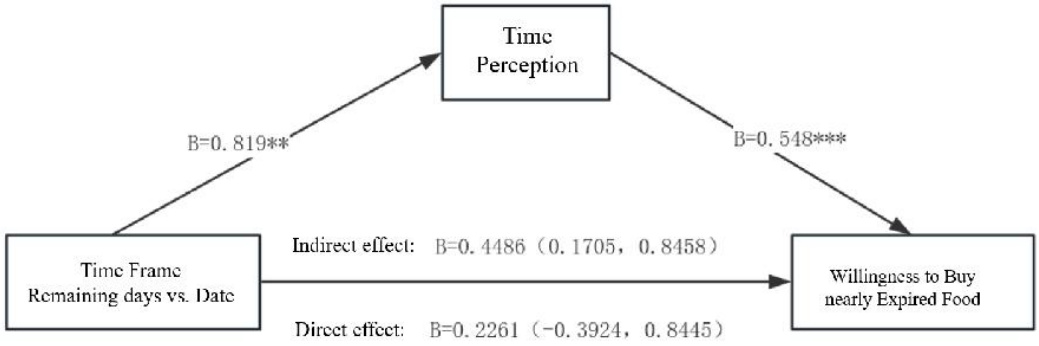

Figure 1 Experiment 2b: Mediating Effect Test

Information processing style can replace the explanatory mechanism test. There was no significant difference in the information processing style of the subjects in the date group and the remaining days group (M remaining days = 7.000, SD remaining days = 1.932, M date = 6.651, SD date = 2.132; F (1, 198) = 1.224, p = 0.27), excluding the influence of information processing style.

The empirical results show that compared with the date frame, consumers in the remaining days frame have a longer perception of the remaining shelf life of nearly expired foods, thus having a higher willingness to buy. On this basis, experiment 3 will further test the boundary conditions of the main effect, that is, hypothesis H3, the moderating role of food type in the influence of time frame on the willingness to buy nearly expired foods.

Experiment 3: Verifying the Moderating Effect of Food Type

The main purpose of Experiment 3 is to verified that food type plays a moderating role in the mediating effect of time perception, that is, to verify H3. In terms of the selection of the moderating variable food type, this study refers to the study of Kleef et al. (2017) and selects whole grain biscuits and cream biscuits as stimuli for healthy and unhealthy foods. A pre-test was conducted on whole grain biscuits and cream biscuits. The pre-test experiment recruited 100 people on the Credamo platform, including 47 male and 53 female subjects with an average age of 32 years old. This experiment selected whole grain biscuits and cream biscuits as stimuli for healthy and unhealthy foods (Kleef et al, 2017), and also used the previous virtual food brand "Le Tu". The relevant information on nearly expired products includes product name, specifications, shelf life, and

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remaining shelf life. In the healthy food group, the subjects saw whole grain biscuits, while in the unhealthy food group, the subjects saw cream biscuits.

First, the subjects were randomly assigned to the healthy food group and the unhealthy food group, and they were presented with different food information. Then the subjects answered the health perception scale for food information. The measurement of health perception refers to the study of Choid et al. (2012). The measurement item is "How healthy is the product in the picture?" (1=very unhealthy, 7=very healthy). Finally, fill in the demographic information. The results of the pre-test showed that consumers' health perception of whole grain biscuits was significantly higher than that of cream biscuits (M whole grain biscuits=5.75, SD whole grain biscuits=0.87, M cream biscuits=5.20, SD cream biscuits=1.18; $F(1,98)=5.63$, $p=0.020$). Therefore, choosing whole grain biscuits and cream biscuits for healthy and unhealthy foods meets the selection criteria.

This experiment adopts a 2 (time frame: remaining days vs. date) × 2 (food type: healthy vs. unhealthy) between-group experiment. The experiment recruited 400 people on the Credamo platform, including 155 male and 245 female subjects, with an average age of 31 years old.

First, the subjects were randomly assigned to one of the four groups and told that this study mainly tests consumers' preference for nearly expired foods. Subsequently, the subjects browsed the pictures and related information about nearly expired foods online and then entered the second part of the experiment to answer the measurement scales of the dependent variable, willingness to buy nearly expired foods, the mediating variable, time perception, and the moderating variable, health perception. Finally, the subjects filled in the demographic information and were informed of the true purpose of the experiment.

Manipulation of the time frame. The "date" group was expressed as "expiring on April 6, 2024", and the "remaining days" group was expressed as "45 days left to expire".

Measurement of willingness to buy nearly expired foods, time perception, and health perception. Referring to the scale of Newman et al. (2016), the specific content of the measurement items is "If you see this product in a supermarket or online store at this time, how likely are you to buy it?" (1=very unlikely, 9=very likely). The measurement of time perception refers to the research of Leboeuf (2006), and the measurement item is "How long do you think this product will expire? (1=very short, 9=very long)". The measurement of health perception refers to the study of Choid et al. (2012). The measurement item is "How healthy is the product in the picture?" (1 = very unhealthy, 9 = very healthy).

Manipulation test. The results of variance analysis with health perception as the dependent variable showed that the main effect of time frame on health perception was not significant ($F(1, 396) = 1.33$, $p = 0.249$); the main effect of food type on health perception was significant ($F(1, 396) = 3.94$, $p = 0.048$); the interaction effect of time frame and food type on health perception was not significant ($F(1, 396) = 1.60$, $p = 0.206$). This shows that the manipulation of food type on health perception was successful.

Main effect analysis of time perception. The results of the variance analysis with time perception as the dependent variable showed that the main effect of time frame on time perception was significant $F(1,396)=5.87$, $p=0.016$), the main effect of food type on time perception was significant $F(1,396)=3.94$, $p=0.048$); the interaction effect of time frame and food type on time perception was significant ($F(1,396)=7.79$, $p=0.006$). The simple effect analysis of the interaction

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showed that for healthy food, the remaining days frame significantly increased the subjects' time perception compared with the date (M remaining days = 5.66, SD remaining days = 2.05, M date = 4.52, SD date = 2.19; F(1,396) = 13.59, p<0.001). For unhealthy foods, there was no significant difference in the time perception of the subjects under the two-time frames (M remaining days = 4.62, SD remaining days = 2.29, M date = 4.70, SD date = 2.15; F (1, 396) = 0.07, p = 0.795).

The main effect of willingness to purchase nearly expired food. The results of variance analysis with willingness to purchase nearly expired food as the dependent variable showed that the main effect of time frame on willingness to purchase nearly expired food was significant (F (1, 396) = 7.78, p = 0.006); the main effect of food type on willingness to purchase nearly expired food was not significant (F (1, 396) = 0.42, p = 0.517); the interaction effect of time frame and food type on willingness to purchase nearly expired food was significant (F (1, 396) = 3.92, p = 0.048). The simple effect analysis of the interaction showed that for healthy food, compared with the date, the remaining days frame significantly increased the subjects' willingness to buy nearly expired food (M remaining days = 6.21, SD remaining days = 1.89, M date = 5.24, SD date = 2.16; F (1, 396) = 11.37, p = 0.001). For unhealthy food, there was no significant difference in the subjects' willingness to buy under the two-time frames (M remaining days = 5.94, SD remaining days = 1.99, M date = 5.78, SD date = 2.11; F (1, 396) = 0.33, p = 0.568). The results are shown in Figure 4.

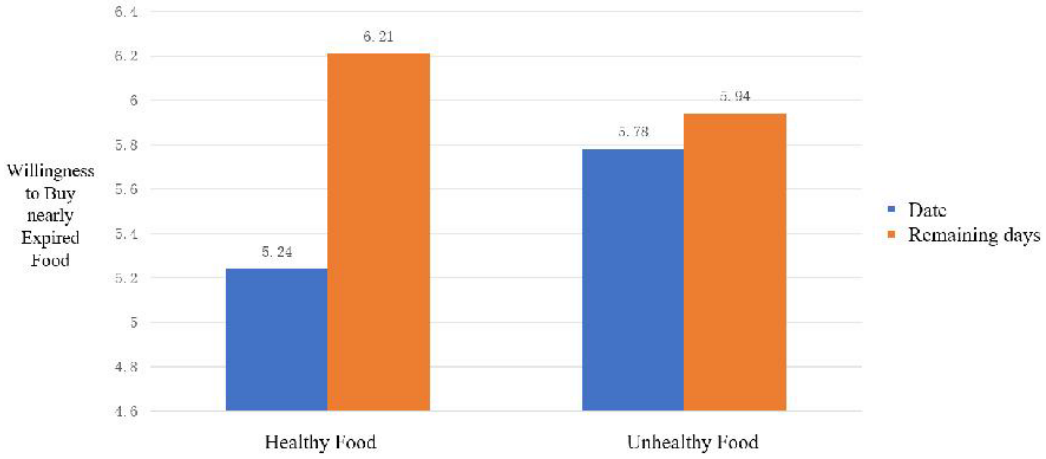

Figure 2 Moderating Effect of Food Type

Analysis of the mediation effect model of food type. Using Bootstrap, Hayes (2013), select a sample size of 5000, and a confidence interval of 95%. When the food is healthy, the interval does not include 0, and the mediation test result is significant (LLCI=0.2559, ULCI=0.8440), indicating that time perception plays a mediating role in the impact of time frame on purchase intention; when the food is unhealthy food, the interval includes 0, and the mediation test result is not significant (LLCI=-0.3199, ULCI=0.2607), indicating that time perception does not play a mediating role in the impact of time frame on purchase willingness.

Experiment 3 confirmed the moderating effect of food type. When the food is unhealthy food, there is no significant difference in the perception of the remaining shelf life in different time frames, so there is no significant difference in the purchase intention of nearly expired food, which reveals the applicable context in which different time frames affect the purchase intention of nearly expired food.

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4.4 Summary of the Results

In summary, the experiment achieved the experimental goal through a more rigorous experimental logic and scientific experimental methods, and carried out a progressive demonstration. The specific hypothesis test results are summarized in Table 2.

Table 2 Experimental Design Overview

Hypothesis		Results
H1	Compared with the date frame, consumers have a higher willingness to buynearly expired food in the remaining days frame	Support
H2	Time perception plays a mediating role in the effect of time frame on consumers' willingness to purchasenearly expired food	Support
H3	The moderating role of food type in the effect of time frame on consumers' willingness to purchasenearly expired food。	Support

5. Conclusion, Discussion, and Recommendation

5.1 Conclusion

This study examined the impact of time framing—specifically the presentation of expiration information as "remaining days" versus "expiry date"—on consumer willingness to purchase nearly expired food products. Through a series of controlled experiments, the study explored how internal product cues, such as shelf life framing and price structure, influence consumer behavior in the context of perishable goods.

Grounded in cue utilization theory, the findings reveal that the use of “remaining days” as a time frame significantly enhances consumer purchase intention compared to the traditional expiry date format. Additionally, the study identifies time perception as a mediating mechanism and highlights the type of food (short shelf-life vs. long shelf-life) as a moderating factor. These insights contribute to a better understanding of how time framing influences purchasing behavior, extending existing research beyond inter-temporal decision-making into product evaluation and consumption domains.

5.2 Discussion

This research makes several significant theoretical contributions:

1) Extension of Time Frame Literature: The study is among the first to extend the application of time frame theory from inter-temporal decision-making into consumer product evaluation, particularly for nearly expired food items.

2) Role of Internal Cues: By applying cue utilization theory, the study demonstrates how internal product cues, such as shelf life format and pricing style, shape consumers’ cognitive evaluations and behavioral responses toward nearly expired foods.

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3) Time Perception as a Mediator: Anchored in attention gate theory, the findings confirm that time perception mediates the relationship between time framing and purchase intention.

4) Consumers exposed to “remaining days” perceive the shelf life as longer and the urgency of expiration as lower, leading to greater willingness to buy.

5) Moderating Role of Food Type: The inclusion of food type as a boundary condition adds an important dimension to the literature on temporal framing. Consumers responded more positively to “remaining days” framing in the case of short shelf-life foods, revealing a nuanced interaction between time format and product characteristics.

6) Cross-Disciplinary Contribution: The study integrates psychological theories with marketing practice, offering a comprehensive perspective on how simple linguistic changes in expiry information can have measurable behavioral effects.

Overall, the findings deepen our understanding of how subtle modifications in product information presentation can influence consumer decision-making, particularly in the food retail sector.

5.3 Recommendation

Based on the research findings, the following managerial recommendations are proposed:

1) Enhance Shelf Life Communication: Retailers and food manufacturers should adopt the “remaining days” format on packaging or shelf labels, especially for nearly expired products. This framing enhances consumers' perception of product freshness and encourages purchase.

2) Segment by Food Type: Marketers should tailor expiry framing strategies based on food type. For short shelf-life items such as fresh dairy or bakery goods, the “remaining days” format is particularly effective.

3) Optimize Pricing Strategies: When applying discounts to nearly expired food with excess inventory, using integer pricing (e.g., ¥10.00 instead of ¥9.73) can enhance consumer perceptions of product stability and quality, making them more likely to buy.

4) Low-Cost Behavioral Interventions: The findings suggest that companies can implement cost-effective yet psychologically impactful strategies to reduce food waste and increase sales of nearly expired items, without requiring major operational changes.

5) Policy and CSR Integration: Companies focused on Corporate Social Responsibility (CSR) and sustainability may use these findings to support initiatives that reduce food waste through consumer education and behaviorally informed marketing.

In conclusion, this research offers both theoretical enrichment and actionable insights that can help food retailers and marketers design more effective communication and pricing strategies for nearly expired food products. It also provides a valuable framework for future academic inquiry into time framing and consumer decision-making.

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A Study on Post-00s Employee Followability under Digital Transformation Leadership Using Organizational Commitment as a Mediating Variable

by

Jingxian Lu
Chinese Graduate School,
Panyapiwat Institute of Management,
Nonthaburi, Thailand
E-mail: 814351040@qq.com

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Abstract

Driven by the wave of digitalization, the leadership style of enterprises is undergoing profound changes. Effectively stimulating the followership of the new generation of employees has become a new research direction in organizational management. This article takes digital transformation leadership as the independent variable, explores its influence mechanism on followership from the perspective of post-00 employees, and analyzes the mediating role of organizational commitment. This article selects a mature scale, and after reliability and validity tests, takes post-00 employees as the research object, and finally collects 311 valid questionnaires, using SPSS analysis. The research results show that digital transformation leadership has a significant positive impact on the followership of post-00 employees; organizational commitment plays a partial mediating role between digital transformation leadership and followership, especially in the dimensions of affective commitment and normative commitment.

Keywords: Digital Transformation Leadership, Organizational Commitment, Followability, Post-00s Employee

1. Introduction

1.1 Background and Importance of the Problem

As time progresses, the job market and competitive landscape have become increasingly intense. Concurrently, the demographic composition of the workforce is gradually shifting, with younger generations, particularly the post-2000 (post-00s) cohort, emerging as the main force among new talents. Unlike previous generations born before the millennium, the post-00s have grown up in a more favorable environment, benefiting from greater material abundance, improved living standards, and broader access to educational resources. This upbringing has fostered distinct personalities characterized by strong self-awareness, individualism, and diversified values.

Recently, the phenomenon of "post-00s rectifying the workplace" has gained attention in the media, reflecting how this generation responds uniquely to the dynamic and often unfamiliar organizational environment. Unlike traditional employees who conform to hierarchical and rigid work cultures, the post-00s tend to adopt more autonomous, values-driven coping strategies.

While previous studies have emphasized the role of leadership in organizational behavior, there remains a relative lack of research on followership, particularly how employees contribute actively to leadership outcomes. In reality, effective leadership is often inseparable from the active

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and voluntary engagement of capable followers. However, many companies today continue to focus solely on productivity-driven metrics such as algorithms and competition ("involution"), neglecting the career goals, values, and aspirations of their employees. Combined with poor management and authoritarian leadership styles, this often results in confusion, disengagement, and underperformance among post-00s employees.

In response, leadership models that integrate digital capabilities with transformational leadership qualities may offer a promising solution. Such leaders can inspire higher levels of organizational commitment and job performance, particularly among the younger generation. Therefore, understanding how digital transformational leadership influences the followership of post-00s employees, and how organizational commitment mediates this relationship, is of critical theoretical and practical significance.

1.2 Research Question

This study seeks to address the following key research question:

How does digital transformational leadership influence the followership of post-00s employees, and what role does organizational commitment play in this relationship?

1.3 Research Objective

The objectives of this study are threefold:

1) To empirically analyze the impact of digital transformational leadership on the followership of post-00s employees in contemporary organizational settings.

2) To explore the motivational mechanisms behind post-00s employees' willingness and capacity to follow organizational goals and leadership directions.

3) To examine the mediating role of organizational commitment in the relationship between digital transformational leadership and employee followership, and to provide multi-level management recommendations that support the sustainable development and engagement of post-00s talent.

2. Literature Review

2.1 Related Concepts and Theories

2.1.1 Digital Transformational Leadership (DTL)

Under the rapid advancement of information technology, enterprise digital transformation has become an irreversible trend. Digital Transformational Leadership (DTL) emerges as a pivotal concept that integrates the principles of both transformational leadership and digital leadership. According to De Waal et al. (2016), and later refined by Alnuaimi et al. (2022), DTL represents a hybrid leadership style that combines the vision-oriented, inspirational traits of transformational leadership with the technology-centric, innovation-driven characteristics of digital leadership. DTL emphasizes not only motivating and inspiring employees but also equipping them with the digital mindset and tools required for navigating change in a digital context. It is particularly relevant in

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leading young, dynamic workforces during periods of technological disruption.

2.1.2 Followability

This study adopts the definition of "followability" proposed by Zhou et al. (2015), which refers to the core behavioral traits exhibited by followers in the process of engaging with leadership. In organizational contexts, "followers" are often synonymous with "subordinates." The concept of followability is crucial, as effective organizational performance relies not only on strong leadership but also on proactive, competent followers. The binary nature of the leader-follower relationship emphasizes that outstanding leadership is often interdependent with the high-quality followership that aligns with organizational goals.

2.1.3 Social Exchange Theory

The theoretical foundation of this study lies in Social Exchange Theory, which posits that interpersonal relationships in organizations are based on reciprocal exchanges. Leaders' behaviors can influence employees' attitudes and work behaviors. Specifically, DTL encourages shared vision, innovation, and personal development, making employees more willing to reciprocate by engaging actively and committing to organizational goals.

2.1.4 Intergenerational Theory

Intergenerational Theory explains how individuals born in the same era and shaped by common historical and social experiences tend to develop a collective consciousness. The post-00s generation is marked by higher education, stronger individualism, and a tendency toward critical thinking and innovation. However, they are also more likely to challenge authority and show lower organizational loyalty. This generation expects leaders to offer purpose, autonomy, and opportunities for growth, aligning well with the vision and practices of digital transformational leaders.

2.2 Literature Surveys

De Waal et al. (2016) introduced Digital Transformational Leadership as a fusion of digital strategy and transformational leadership traits, emphasizing its role in guiding organizations through complex change. Alnuaimi et al. (2022) further confirmed that DTL not only leverages digital capabilities but also cultivates innovation and individual growth among employees.

Zhou et al. (2015), through interviews and empirical studies, defined followability as a set of core behaviors followers demonstrate in response to leadership. They noted that effective followership is indispensable in achieving organizational success, especially when aligned with inspirational and visionary leadership.

Chen (2018) explored the mediating role of Organizational Commitment (OC) between transformational leadership and followership, showing that affective, normative, and continuance commitment serve as crucial links between leader behavior and follower responses. His findings support the idea that employees reciprocate supportive leadership with loyalty and active engagement.

Becker (1960) introduced the concept of Organizational Commitment as an emotional and psychological attachment to an organization, defining it as a form of "unilateral investment." This construct has since evolved into three key dimensions: affective commitment (emotional

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attachment), continuance commitment (perceived cost of leaving), and normative commitment (sense of obligation).

These studies collectively highlight that while transformational leadership can influence follower behavior, the digital context and generational characteristics must also be considered to fully understand the DTL-followability relationship, particularly among post-00s employees.

2.3 Conceptual Framework

In summary, the research framework of this article is shown in Figure 1:

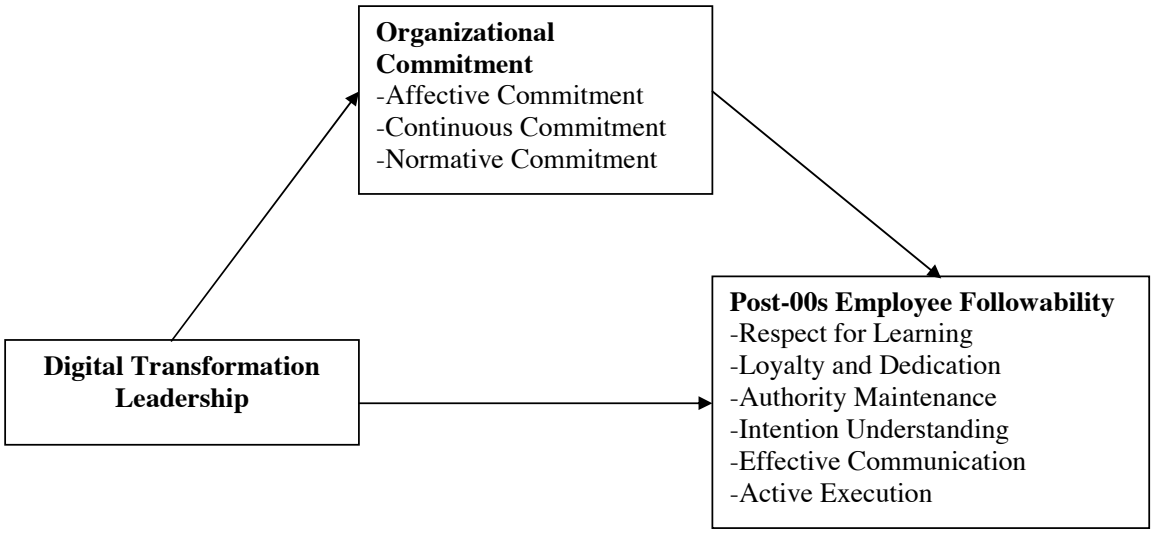

Figure 1 Conceptual Framework

2.4 Research Hypothesis

Based on the above theoretical and empirical foundation, this study proposes the following hypotheses:

H1: Digital Transformational Leadership (DTL) has a significant positive impact on the followability of post-00s employees.

H2: Organizational Commitment (OC) plays a mediating role in the relationship between Digital Transformational Leadership (DTL) and the followability of post-00s employees.

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3. Research Methodology

3.1 Research Design

This study adopts a quantitative research design using a structured questionnaire survey to investigate the impact of Digital Transformational Leadership (DTL) on the Followability of post-00s employees, with Organizational Commitment (OC) as a mediating variable. The research follows a cross-sectional survey approach, allowing for statistical testing of relationships among constructs using empirical data collected at a single point in time. A deductive reasoning process was applied to test predefined hypotheses grounded in existing theories, particularly the theory of meaning construction.

3.2 Population and Sample

The target population for this study consists of employees born after the year 2000 (post-00s) currently employed across various types of organizations in China. A total of 350 questionnaires were randomly distributed, and 311 valid responses were obtained, resulting in a response rate of 93.39%. The sample size is deemed sufficient for statistical analysis, including structural equation modeling.

The demographic breakdown of the sample is as follows:

- Gender: Female respondents accounted for 54.02%, 4 percentage points higher than male participants.
- Educational level: The majority held a bachelor's degree (43.41%), followed by those with a college diploma (23.15%).
- Work experience: Most respondents had 1–3 years of work experience (38.91%).
- Position: A large portion were general staff (80.39%), reflecting the study's focus on rank-and-file employees.
- Type of organization: Employees came from private enterprises (28.62%), joint ventures (20.90%), and state-owned enterprises (12.86%).

3.3 Research Instruments

The study employed standardized measurement scales drawn from authoritative sources and modified to fit the research context:

1) Digital Transformational Leadership (DTL): Measured using a 6-item scale developed by Alnuaimi et al. (2022). The scale was adapted to assess employees' perceptions of their leaders' digital competencies and visionary behavior. The Cronbach's α value of 0.888 confirms high internal reliability.

2) Organizational Commitment (OC): Measured using the three-dimensional scale by Meyer & Allen (1984), which includes:

- Affective Commitment
- Continuance Commitment
- Normative Commitment

3) Followability: Measured using the culturally contextualized scale developed by Zhou W.J. (2015). This instrument captures six sub-dimensions:

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- Respect for learning
- Loyalty and dedication
- Authority maintenance
- Intention understanding
- Effective communication
- Active execution

All instruments were validated in prior research and adjusted linguistically and contextually to align with the cultural and generational attributes of post-00s employees in China.

3.4 Data Collection

Data was collected through self-administered structured questionnaires. The distribution employed random sampling across diverse organizational settings to enhance the generalizability of findings. Respondents were assured of anonymity and confidentiality to promote honest and unbiased responses. All participants met the age and employment criteria relevant to the post-00s generation.

3.5 Statistics Used for Data Analysis

The collected data were analyzed using quantitative statistical methods to ensure empirical rigor and hypothesis testing. The analysis procedures included:

1) Descriptive statistics to summarize demographic variables.

2) Reliability analysis using Cronbach's alpha to assess the internal consistency of measurement instruments.

3) Correlation analysis to examine the relationships among key variables.

4) Structural Equation Modeling (SEM) to test the direct and mediating effects among DTL, OC, and Followability.

All statistical analyses were performed using SPSS and AMOS software packages to ensure accuracy and robustness in model estimation and hypothesis testing.

4. Data Analysis and Findings

4.1 Introduction

4.1.1 Reliability and Validity Test

The questionnaire was tested for Cronbach's Alpha reliability, see Table 1. The Cronbach's α value of the selected DTL is 0.888, and the 6 items have good internal consistency. The Cronbach's α values of the three sub-dimensions of the OC scale are 0.906, 0.877, and 0.908, respectively. The Cronbach's α value of only active execution in the followability scale is 0.754, which is lower than 0.8, but still within an acceptable range. The data obtained through the selected scale can be effectively used in this article's research on digital transformation leadership and employee Followability.

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Table 1 Reliability Test

Variable	Dimension	Cronbach's α Value	Number of Items	Cronbach's α Value	Number of Items
DTL	DTL	0.888	6	0.888	6
OC	Affective Commitment	0.906	6	0.884	18
	Continuous Commitment	0.877	6		
	Normative Commitment	0.908	6		
Followability	Respect for Learning	0.907	5	0.918	21
	Loyalty and Dedication	0.850	3		
	Authority Maintenance	0.875	4		
	Intention Understanding	0.837	3		
	Effective Communication	0.870	4		
	Active Execution	0.754	2		

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After the reliability analysis, this article continued to test the validity of all data and conducted a KMO test on the digital transformation leadership scale. The test results are shown in Table 2. The KMO result is 0.906, which is greater than 0.7 and close to 1. In Bartlett's sphericity test, p<0.001, indicates that there are correlation factors between the variables, and the validity is very good, so further factor analysis can be performed.。

Table 2 DTL KMO and Bartlett's Spherical Test

KMO Value		0.906
Bartlett's test of sphericity	Approximate Chi-Square	894.635
	df	15
	p Value	0.000

As can be seen from Table 3, the absolute value of the factor loading coefficient of each item is greater than 0.4, which means that there is a corresponding relationship between the options and the factors.

Table 3 DTL Rotated Factor Loading Coefficients and Communal Variance

Content	**Element**	**Common Factor Variance Extraction**
	1	
DTL1	0.781	0.610
DTL2	0.819	0.670
DTL3	0.786	0.618
DTL4	0.786	0.618
DTL5	0.82	0.672
DTL 6	0.811	0.658

The KMO test was performed on the OC scale, and the test results are shown in Table 4. The KMO result was 0.907, which was greater than 0.7, and p < 0.001 in Bartlett's sphericity test, indicating that there were correlation factors between the variables, and the validity was very good, so further factor analysis could be performed.

Table 4 OC KMO and Bartlett's Spherical Test

KMO Value		0.907
Bartlett's Test of Sphericity	Approximate Chi-Square	3115.188
	df	153
	p Value	0.000

As can be seen from Table 5, the absolute value of the factor loading coefficient of each item is greater than 0.4, which means that there is a corresponding relationship between the options and the factors.

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Table 5 OC Rotated Factor Loading Coefficients and Communal Variance

Content	Element			Common Factor Variance Extraction
	1	2	3	
Affective Commitment 1		0.764		0.642
Affective Commitment 2		0.829		0.704
Affective Commitment 3		0.815		0.699
Affective Commitment 4		0.794		0.654
Affective Commitment 5		0.806		0.682
Affective Commitment 6		0.834		0.717
Continuous Commitment 1			0.749	0.589
Continuous Commitment 2			0.782	0.617
Continuous Commitment 3			0.754	0.577
Continuous Commitment 4			0.765	0.610
Continuous Commitment 5			0.804	0.657
Continuous Commitment 6			0.814	0.675
Normative Commitment 1	0.808			0.673
Normative Commitment 2	0.806			0.697
Normative Commitment 3	0.803			0.675
Normative Commitment 4	0.831			0.712
Normative Commitment 5	0.783			0.643
Normative Commitment 6	0.836			0.734

The KMO test was performed on the Followability scale, and the test results are shown in Table 6. The KMO result was 0.906, which was greater than 0.7. Bartlett's sphericity test, $p < 0.001$, indicated that there were correlation factors between the variables, and the validity was very good, so further factor analysis could be performed.

Table 6 Followability KMO and Bartlett Spherical Test

KMO Value		0.906
Bartlett's Test of Sphericity	Approximate Chi-Square	3645.115
	df	210
	p Value	0.000

From Table 7, we can see that the absolute value of the factor loading coefficient of each item is greater than 0.4, which means that there is a corresponding relationship between the options and the factors.

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Table 7 Followability Rotated Factor Loading Coefficients and Communal Variance

Content	Element						Jointly Extract Variance
	1	2	3	4	5	6	
Respect for Learning 1	0.807						0.750
Respect for Learning 2	0.857						0.764
Respect for Learning 3	0.806						0.729
Respect for Learning 4	0.772						0.729
Respect for Learning 5	0.814						0.732
Loyalty and Dedication 1				0.821			0.774
Loyalty and Dedication 2				0.798			0.744
Loyalty and Dedication 3				0.839			0.811
Authority Maintenance 1		0.793					0.714
Authority Maintenance 2		0.808					0.739
Authority Maintenance 3		0.801					0.726
Authority Maintenance 4		0.800					0.759
Intention Understanding 1					0.767		0.733
Intention Understanding 2					0.806		0.768
Intention Understanding 3					0.790		0.770
Effective Communication 1			0.785				0.733
Effective Communication 2			0.772				0.701
Effective Communication 3			0.797				0.738
Effective Communication 4			0.790				0.725
Active Execution 1						0.800	0.778
Active Execution 2						0.843	0.815

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4.2 Data Analysis of the Quantitative Data

4.2.1 Descriptive analysis

Descriptive statistical analysis was performed on the relevant dimensions of the questionnaire scale. As shown in Table 8 below, the average score of DTL was 3.39 and the standard deviation was 1.03, showing a certain degree of variability. The three dimensions of OC - affective commitment, continuous commitment and normative commitment - had average scores of 3.05, 3.17 and 3.16 respectively, and standard deviations of 1.14, 1.08 and 1.15 respectively, indicating that there are differences in the level of employees' commitment to the organization. The six dimensions of Followability - respect for learning, loyalty and dedication, authority maintenance, intention understanding, effective communication and active execution - had relatively close average scores, ranging from 3.18 to 3.28, and standard deviations between 1.17 and 1.26, reflecting that employees' performance in Followability was relatively consistent, but there were also individual differences. From all the data obtained, the data obtained from the questionnaire met the requirements of normal distribution.

Table 8 Descriptive Statical Analysis

Variable	Dimension	Sample	Minimum	Maximum	Average Value	Standard Deviation
DTL	DTL	311	1.17	4.83	3.39	1.03
OC	Affective Commitment	311	1.17	4.83	3.05	1.14
	Continuous Commitment	311	1	4.83	3.17	1.08
	Normative Commitment	311	1	4.67	3.16	1.15
Followability	Respect for Learning	311	1	5	3.19	1.20
	Loyalty and Dedication	311	1	5	3.18	1.20
	Authority Maintenance	311	1	5	3.20	1.18
	Intention Understanding	311	1	5	3.24	1.21
	Effective Communication	311	1	5	3.21	1.17
	Active Execution	311	1	5	3.28	1.26

4.2.2 Correlation Analysis

Correlation analysis can verify whether the correlation between each two variables exists and is an effective way to verify whether the model has research value. As shown in Table 9, digital transformation leadership has the strongest correlation with affective commitment, with a correlation coefficient of 0.401, indicating that digital transformation leadership has a significant impact on employees' affective commitment. Continuous commitment and normative commitment also have a strong positive correlation with digital transformation leadership, with correlation coefficients of 0.248 and 0.322, respectively, indicating that the improvement of digital transformation leadership helps to enhance employees' continuous commitment and normative commitment to the organization. In the dimension of Followability, respect for learning, loyalty and dedication, authority maintenance, intention understanding, effective communication, and active execution are all

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significantly positively correlated with digital transformation leadership, especially effective communication, with a correlation coefficient as high as 0.510, showing the importance of digital transformation leadership in promoting effective communication among employees. These data highlight the important role of digital transformational leadership in shaping employees' OC and Followability. They also show the correlations between different Followability dimensions. For example, the correlations between respectful learning loyal dedication, and digital transformational leadership are both over 0.4, while the correlations between authority maintenance and intention understanding are also close to 0.4. These high correlations indicate that digital transformational leadership plays a key role in improving employees' Followability.

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Table 9 Correlation Analysis

	DTL	Affective Commitment	Continuous Commitment	Normative Commitment	Respect for Learning	Loyalty and Dedication	Authority Maintenance	Intention Understanding	Effective Communication	Active Execution
DTL	1									
Affective Commitment	0.401***	1								
Continuous Commitment	0.248***	0.240***	1							
Normative Commitment	0.322***	0.343***	0.205***	1						
Respect for Learning	0.362***	0.403***	0.270***	0.426***	1					
Loyalty and Dedication	0.340***	0.403***	0.342***	0.414***	0.338***	1				
Authority Maintenance	0.347***	0.370***	0.331***	0.428***	0.385***	0.377***	1			
Intention Understanding	0.340***	0.420***	0.327***	0.456***	0.440***	0.413***	0.435***	1		
Effective Communication	0.344***	0.510***	0.362***	0.487***	0.412***	0.442***	0.441***	0.449***	1	
Active Execution	0.317***	0.333***	0.318***	0.409***	0.335***	0.355***	0.382***	0.448***	0.401***	1

Note: * p<0.05 ** p<0.01 *** p<0.001

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4.2.3 Regression Analysis

Regarding the verification of "Hypothesis H1: DTL has a significant positive impact on the followability of post-00s employees.", this article takes DTL as the independent variable and the six dimensions of employee followability, namely, respect for learning, loyalty and dedication, authority maintenance, intention understanding, effective communication, and active execution, as the dependent variables for regression analysis. This article only takes respect for learning as an example for research and explanation, and the measurement methods of other variables are consistent. The regression analysis further confirms the significant positive impact of DTL on each dimension of followability.

From the regression analysis of digital transformational leadership on respect for learning in Table 10 below, it can be seen that digital transformational leadership has a significant positive impact on respect for learning. The model formula is: respect for learning = 1.771 + 0.419 * digital transformational leadership. Specifically, the unstandardized coefficient B of DTL is 0.419, and the standardized coefficient Beta is 0.362, indicating that for every unit increase in digital transformational leadership, respect for learning will increase by 0.419 units, and this effect is statistically significant, with a corresponding t value of 6.833 and a p-value of less than 0.001, indicating that the result is highly statistically significant. In addition, the R-squared value of the model is 0.131, and the adjusted R-squared value is 0.128, which means that DTL can explain 13.1% of the variation concerning learning. The F statistic shows that the model is significant as a whole, F(1,309)=46.696, p=0.000, further confirming the validity of the model. The VIF value of collinearity diagnosis is 1, indicating that there is no collinearity problem in the model. In summary, digital transformational leadership is an important predictor of respect for learning and has a significant positive impact on respect for learning.

Table 10 Regression Analysis of DTL on Respect Learning

	Unstandardized Coefficients		**Standardized Coefficient**	**t**	**p**	**Collinearity Diagnostics**
	B	**Standard Error**	**Beta**			**VIF**
Constant	1.771	0.217	-	8.160	0.000***	-
DTL	0.419	0.061	0.362	6.833	0.000***	1
R^2	0.131					
Adjust R^2	0.128					
F	F (1,309)=46.696,p=0.000					

Dependent Variable: Respect for Learning

Note: * p<0.05 ** p<0.01 *** p<0.001

4.2.4 Mediating Effect Test

To verify the hypothesis "H2: OC plays a mediating role in the relationship between DTL and post-00s employees' followability." This article uses model 4 in the process plug-in developed by Hayes in SPSS26.0 software standardizes each variable, and puts it into the equation to test the mediating effect of the mediating variable OC between the independent variable DTL and the dependent variable Post-00s employees' Followability. The sampling number is set to 5000 times, and the confidence interval is set to 95%. The results of the mediating effect analysis are summarized in Table 11 below.

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The total effect of DTL on post-00s employees' followability is 0.400, of which the direct effect accounts for 34.50% and the total mediating effect accounts for 65.50%, indicating that OC plays a significant mediating role between DTL and post-00s employees' followability. Specifically, the mediating effect of affective commitment is the most significant, with an effect value of 0.103, accounting for 25.75% of the total effect; the mediating effect of normative commitment is second, with an effect value of 0.107, accounting for 26.75%; the mediating effect of continuance commitment is relatively small, with an effect value of 0.052, accounting for 13.00%. These results show that DTL indirectly improves the Followability of Post-00s employees by enhancing employees' affective commitment, continuance commitment, and normative commitment, among which the mediating effects of affective commitment and normative commitment are particularly prominent.

Table 11 OC Mediation Effect Test Analysis

Impact Path	Impact Type	Effect Size	Boot Standard Error	95% Confidence Interval of Effect Size	Effect Size Ratio
DTL→Post-00s Employees Followability	Total Effect	0.400	0.041	[0.319，0.481]	
	Direct Effect	0.138	0.033	[0.073，0.202]	34.50%
	Total Mediation Effect	0.262	0.034	[0.196，0.329]	65.50%
DTL→ Affective Commitment→Post-00s Employees Followability	Mediating Effect	0.103	0.022	[0.066，0.150]	25.75%
DTL→ Continuous Commitment→Post-00s Employees Followability	Mediating Effect	0.052	0.015	[0.026，0.085]	13.00%
DTL→ Normative Commitment→Post-00s Employees Followability	Mediating Effect	0.107	0.023	[0.064，0.157]	26.75%

4.3 Summary of the Results

This section presents the results of reliability, validity, and descriptive statistical analyses to ensure the robustness of the research on the relationship between Digital Transformation Leadership (DTL), Organizational Commitment (OC), and Followability among employees.

1) Reliability and Validity

Cronbach's Alpha results show high internal consistency across all scales. The DTL scale reported an α of 0.888. The OC dimensions, Affective, Continuous, and Normative Commitment, showed α values of 0.906, 0.877, and 0.908, respectively. The Followability subscales also demonstrated strong reliability (α ranging from 0.754 to 0.907), though "Active Execution" was slightly lower but still acceptable. Kaiser-Meyer-Olkin (KMO) and Bartlett's tests were conducted to confirm sampling adequacy and construct validity. The DTL (KMO = 0.906), OC (KMO = 0.907), and Followability (KMO = 0.906) scales all passed the tests with significant results ($p < 0.001$), validating the use of factor analysis. Factor loadings were all above 0.4, confirming the convergent validity of the scales.

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2) Descriptive Statistics

Analysis of 311 samples shows that DTL had an average score of 3.39, suggesting a moderately high level of perceived digital leadership. OC dimensions averaged between 3.05–3.17, indicating variability in employees' organizational commitment. Followability dimensions ranged from 3.18 to 3.28, with standard deviations showing slight individual differences but generally consistent employee behavior in followability traits.

3) Correlation Analysis

DTL showed the highest correlation with affective commitment (r = 0.401***), indicating that transformational leadership in digital contexts strongly impacts emotional attachment to the organization. DTL also positively correlated with other OC components and all six Followability dimensions. The strongest association was with "Effective Communication" (r = 0.510***), highlighting the role of DTL in enhancing interpersonal interaction. Intercorrelations among Followability dimensions suggest they are mutually reinforcing and collectively influenced by digital leadership.

Overall, the findings confirm that Digital Transformation Leadership significantly contributes to shaping employees' organizational commitment and followability, supporting the hypotheses of the study.

5. Conclusion, Discussion, and Recommendation

5.1 Conclusion

Based on the theory of meaning construction, this study investigates the influence and underlying mechanisms of Digital Transformational Leadership (DTL) on the Followability of post-00s employees. Through empirical research, two key findings are revealed:

1) DTL has a significant positive effect on the followability of post-00s employees.

2) Organizational Commitment (OC) plays a mediating role in the relationship between DTL and followability.

These findings confirm that leadership styles aligned with digital transformation can significantly improve the engagement, loyalty, and proactive behavior of younger employees, particularly those born after 2000. In light of the rapid digital and economic development in which this generation was raised, their preference for innovation, autonomy, and purpose-driven leadership aligns closely with the characteristics of digital transformational leaders. Therefore, this study contributes both theoretically and practically to understanding how modern leadership can foster a high-performance and loyal workforce during digital transformation.

5.2 Discussion

The results support the premise that the post-00s generation, characterized by high self-awareness, innovation, and critical thinking, responds positively to DTL. Unlike traditional leadership styles, DTL emphasizes personalized development, goal alignment, digital vision-setting, and a participative work environment, traits that resonate with the values and expectations of younger employees.

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These employees are more likely to engage with leaders who demonstrate digital competence and strategic vision, which enhances their willingness to follow, commit, and perform. The study confirms the theoretical proposition that social exchange mechanisms underlie this relationship: employees reciprocate visionary, supportive, and digitally competent leadership with increased organizational commitment and followability.

The mediation effect of Organizational Commitment, comprising affective, normative, and continuance dimensions, demonstrates that leadership indirectly shapes employee behavior by fostering deeper emotional and psychological bonds with the organization. This reinforces existing literature and expands it by applying these dynamics to the context of digital transformation and generational workforce characteristics.

5.3 Recommendation

Based on the findings, several practical implications for organizational leaders and management teams are proposed:

1) Enhance Digital Literacy and Strategic Vision: Senior managers must continuously update their understanding of digital technologies, industry trends, and customer needs to align leadership capabilities with digital transformation goals.

2) Communicate a Compelling Digital Vision: Leaders should construct and convey a clear, inspirational digital vision that connects with employees' personal growth goals. This is particularly important for post-00s employees who value purpose and autonomy.

3) Foster an Inclusive Digital Culture: Cultivate an open and innovative organizational environment where employees feel valued, trusted, and encouraged to contribute digital solutions.

4) Develop Talent Strategically: Implement targeted development programs to identify and promote individuals with strong digital capabilities. Build flexible team structures and agile workflows that adapt to market changes and technological advancement.

5) Tailor Engagement for Post-00s Employees: When engaging with post-00s employees, leaders should demonstrate digital competence, trust in their abilities, and recognition of their contributions. These efforts will enhance motivation, loyalty, and alignment with organizational goals.

6) Invest in Digital Training: Regular digital skills training should be organized to improve employees' understanding and practical application of digital tools, ultimately enhancing their self-efficacy and organizational commitment.

These strategies will not only improve the effectiveness of leadership in digital contexts but also support the development of a more agile, loyal, and high-performing workforce capable of sustaining long-term digital transformation.

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A Study of Demand Investigation and Analysis of Enterprise Human Resources Knowledge Graph Platform Construction Based on Deep Learning

by

Jiajing Chen
Chinese Graduate School,
Panyapiwat Institute of Management,
Nonthaburi, Thailand
E-mail: 1390119584@qq.com

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Jiajing Chen
Chinese Graduate School,
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Abstract

With the rapid development of big data and artificial intelligence (AI) technology, enterprises have an increasing demand for human resource knowledge management and information integration. As an effective knowledge representation and reasoning tool, a knowledge graph can store and display various types of knowledge information of enterprises in a structured manner, providing strong support for the intelligent decision-making. Therefore, building an enterprise human resource knowledge graph platform based on deep learning is particularly important. This article conducts an in-depth investigation of the actual needs of many companies through interviews and questionnaires. It analyzes the specific needs of enterprises for the functions, performance, and ease of use of human resource knowledge graph platforms. The survey results show that enterprises generally hope that the knowledge graph platform can have efficient knowledge extraction, fusion, and reasoning capabilities, as well as a friendly user interface and convenient operation process. At the same time, the platform should also support the import and export of multiple data formats to meet the needs of different business scenarios of enterprises.

Keywords: Human Resources, Knowledge Graph, Deep Learning, Demand Survey

1. Introduction

1.1 Background and Importance of the Problem

Modern enterprise human resource management (HRM) faces mounting challenges. As organizations scale up in size and complexity, the volume and heterogeneity of human resource data have significantly increased. Traditional HRM methods, reliant on manual processing and static databases, struggle to manage, analyze, and derive insights from such complex data ecosystems. This limitation has led to a pressing need for advanced technologies that can enhance the efficiency, accuracy, and intelligence of HRM systems.

Knowledge graphs, structured representations of interconnected data, offer a promising solution. By organizing HR information into semantic networks, knowledge graphs allow enterprises to integrate, access, and reason over data more effectively. Simultaneously, the emergence of deep learning has further revolutionized this domain. As a class of neural network-based machine learning, deep learning enables automatic feature extraction, classification, and prediction from vast datasets. Its application in knowledge graph construction, particularly in extracting entities and relationships from unstructured data, greatly enhances the coverage and precision of HR knowledge systems.

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1.2 Research Question

How can knowledge graph platforms, powered by deep learning technologies, meet the needs of enterprises aiming to improve the efficiency and quality of human resource management?

1.3 Research Objective

This study aims to investigate the demand for knowledge graph platforms among enterprises seeking to enhance their human resource management through intelligent technologies. Specifically, it explores how deep learning-based knowledge graphs can address key HRM challenges and what functionalities are most required by organizations to achieve improved efficiency, accuracy, and decision-making capabilities.

2. Literature Review

2.1 Related Concepts and Theories

Enterprise human resource management has evolved significantly, guided by several interrelated concepts and theoretical frameworks. Traditional human resource management (HRM) has transitioned toward strategic HRM, which emphasizes alignment with organizational goals. The integration of Green HRM promotes sustainable development by embedding environmental concerns into HR policies. Additionally, theories related to digital transformation and technology acceptance—such as the Technology Acceptance Model (TAM)—provide a foundation for understanding how HR departments adopt digital tools. The Resource-Based View (RBV) further supports the strategic importance of HR as a source of competitive advantage, particularly when enhanced by data-driven technologies like big data analytics and artificial intelligence (AI).

2.2 Literature Surveys

Research on enterprise HRM has shown a trend toward diversified development. Scholars have examined various themes, including the sustainability of green HRM, strategies for digital HR transformation, and the impact of the Internet on HR development models. For instance, Xin (2024) discussed strategies for reforming HRM in the era of big data, highlighting digitalization and intelligent decision-making as core trends. In the field of knowledge graph construction, Liu et al. (2021) proposed methods to continuously update HR-related concepts and ontologies, offering new frameworks for structured knowledge management. Li and Zhai (2022) focused on leveraging open data to build and apply knowledge graphs in enterprise contexts, contributing to the integration and intelligent use of HR information. Additionally, Mateen et al. (2024) explored how big data–driven practices and electronic HRM can enhance HRM effectiveness, underscoring the growing role of data technologies in employee management.

2.3 Conceptual Framework

Based on the reviewed literature, a conceptual framework is established that links knowledge graph technology, deep learning, and big data analytics to the enhancement of HRM practices. The framework proposes that knowledge graphs serve as the foundation for structured HR data, while deep learning facilitates the automatic extraction of entities and relationships. Big data supports real-time decision-making and predictive analytics. This integration is expected to improve HR functions such as talent acquisition, performance appraisal, and employee development. The framework also

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acknowledges mediating factors such as technical support, employee acceptance, and organizational readiness.

2.4 Research Hypothesis

Drawing from theoretical insights and empirical findings, the following hypotheses are proposed:

H1: The demand for knowledge graph platforms is positively associated with improvements in HRM efficiency.

H2: Technical support significantly enhances the effectiveness of knowledge graph implementation in HRM.

H3: Employee acceptance and cognitive understanding positively influence the success of knowledge graph platform adoption, although the impact may not be statistically significant.

H4: Deep learning applications in entity recognition and data integration significantly increase the accuracy and usefulness of HR knowledge graphs.

3. Research Methodology

3.1 Research Design

This study adopts a mixed-method research design, combining both qualitative interviews and quantitative questionnaires to obtain a comprehensive understanding of employee needs and expectations regarding the Human Resource (HR) Knowledge Graph platform. The interview outline serves as a guiding framework for semi-structured interviews, allowing for in-depth exploration of individual experiences and insights. Concurrently, the structured questionnaire provides measurable data on employee perceptions of the current HR system and their willingness to adopt the proposed platform. This triangulation enhances the credibility and richness of the findings.

3.2 Population and Sample

The research targets employees from various departments across multiple enterprises that are either currently implementing or considering digital HR transformation. The sampling strategy involves a purposive sampling approach for qualitative interviews, selecting key personnel with relevant HR experiences. For the quantitative phase, a stratified random sampling technique is used to ensure representation across job functions, departments, and hierarchical levels. The total sample size was determined based on statistical adequacy for regression analysis and thematic saturation for interviews.

Table 1 Basic Demography and Questionnaire Content

Modules	Dimension	Question
Basic Demography	Information	Gender
		Education
		Age
		Occupation

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Current Status of Human Resource Management	Current Situation Survey	Whether you are directly involved in human resource management related work
		What is the biggest challenge facing human resource management today?
		How satisfied are you with the current human resource management system?
Knowledge Graph Platform Demand Survey	Acceptance and Awareness	Do you understand the concept of "knowledge graph"?
		What are the potential applications of knowledge graphs in human resource management?
		Are you willing to invest additional resources in platform usage and training?
		Do you want to introduce a human resources knowledge graph platform?
	Requirements and Suggestions	What core functions should a human resources knowledge graph platform have?
		What existing HR management tools or systems can the platform integrate with?
		What are the requirements for the platform's usability?
		How important is the platform's data security and privacy protection?
		How do you want the platform to be deployed?
		What are the biggest obstacles in platform implementation?
	Technical Support	What are the key indicators for evaluating platform effectiveness?
		What kind of feedback or reports do you want the platform to provide?
		Are you willing to participate in the testing and feedback process of the platform?
		What new features or improvements can the platform add in the future?

3.3 Research Instruments

Two primary instruments were used:

1) Interview Outline: Developed to guide semi-structured interviews, it begins with general questions and transitions to specific inquiries about HR challenges, data integration issues, and perceptions of knowledge graphs. The design ensures logical flow, adaptability to interviewee responses, and depth of insight.

2) Questionnaire: Divided into three key sections:

- Demographic Information: Includes variables such as age, gender, job position, and department.
- Current HRM Perception: Measures employee satisfaction with existing HR systems, covering areas like data management, training and development, performance appraisal, and analytics. A 5-point Likert scale is used (1 = very dissatisfied, 5 = very satisfied).

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- Awareness of Knowledge Graph Platform: Captures the level of understanding, perceived importance, willingness to engage with the platform, and expectations for changes in work roles and processes.

3.4 Data Collection

The data collection process involves two sequential phases:

1) Qualitative Phase: Interviews were conducted face-to-face or online, depending on availability and preference. Each interview began with a briefing on the study's purpose, assurance of confidentiality, and verbal consent. The sessions were recorded (with permission) and supplemented by note-taking.

2) Quantitative Phase: Questionnaires were distributed electronically via email and internal company communication systems. Participation was voluntary, and responses were anonymized to ensure data privacy and candid feedback. Adequate time was provided for completion, and reminders were sent to maximize response rates.

3.5 Statistics Used for Data Analysis

The quantitative data collected from questionnaires were analyzed using descriptive statistics (mean, standard deviation, frequency) to summarize demographic variables and satisfaction levels. To examine relationships between variables, multiple linear regression analysis was conducted, focusing on the influence of platform demand, technical support, and employee acceptance on HRM effectiveness. The reliability of the questionnaire was assessed using Cronbach's alpha, and exploratory factor analysis was used to validate construct dimensions. For qualitative data, thematic analysis was employed to extract recurring patterns and insights from interview transcripts.

4. Data Analysis and Findings

4.1 Introduction

Based on the design of interview survey and demand questionnaire, this article selects China A Technology Enterprise as the case implementation object.

This study interviewed 10 senior executives of Enterprise A. Based on the interview survey results; we established descriptive statistics on the word frequency of the interview results. The word frequency chart is shown below:

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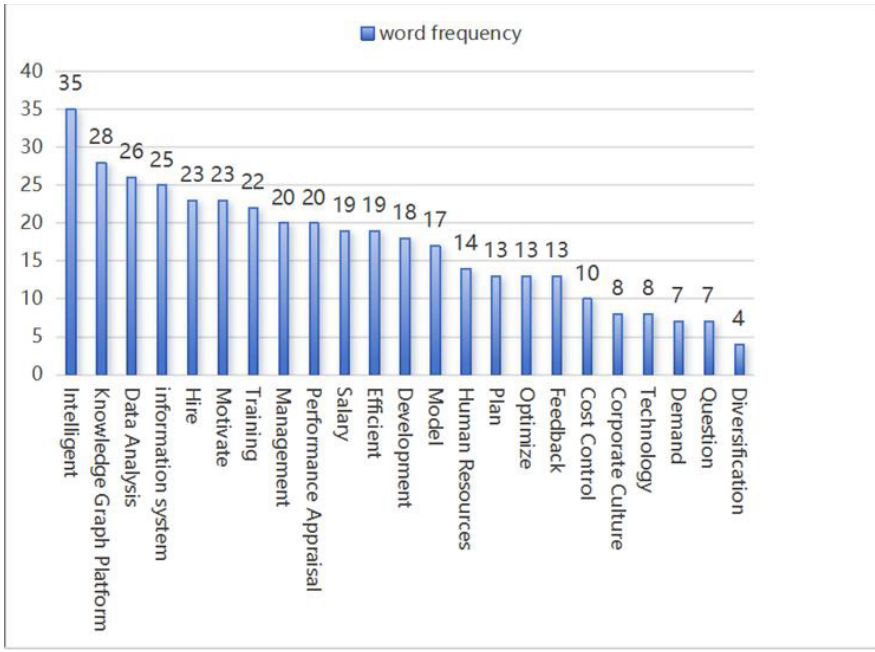

Figure 1 SEQ Figure /*ARABIC 1 Word Frequency Graph

"Intelligence" and "knowledge graph platform" are the two most frequently appearing words, which shows the core concerns of human resource managers in Enterprise A. Intelligence is an indispensable theme in human resource management, and the knowledge graph platform is a key element in the process of human resource management in enterprises. The high frequency of "data analysis" and "information system" shows that in the digital management needs of the knowledge graph platform for human resource management, data analysis in human resource management is quite important, and the information system is a means of intelligent human resource management. Data-driven decision-making will also become an important working method for Enterprise A in the transformation of AI led by science and technology. Although the frequency of "model" and "training" is relatively low, it is still significant. This shows that in the process of human resource management, Enterprise A attaches importance to the optimization of human resource models and the training and development of employees. The appearance of "technology" and "diversification" shows that Enterprise A pays attention to technology investment and system upgrades in the knowledge graph platform, hoping to improve the efficiency and accuracy of human resource management by introducing new technologies. The appearance of words such as "recruitment", "management", "motivation", "optimization", and "cost control" reflects the different aspects that Enterprise A focuses on in the process of building the knowledge graph platform, including internal corporate processes, employee needs, problem-solving, and management efficiency. The appearance of "problems" and "needs" indicates that Enterprise A faces some problems and challenges in the process of building the knowledge graph platform, but the knowledge graph platform based on deep learning can solve these problems to meet the needs of employees and enterprises. The mention of "efficiency" and "feedback" indicates the expectations and goals of Enterprise A in the process of building the knowledge graph platform.

The interview word frequency chart of Enterprise A on the construction of the knowledge graph platform for human resource management reflects the key issues that Enterprise A focuses on

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in the development of artificial intelligence, the importance of data, the innovation and security of technology, employee training and development, performance management, salary and benefits, and corporate culture construction. This provides very important information for this article on how to build a knowledge graph platform for the human resource management of Enterprise A based on deep learning.

To ensure that the platform can accurately meet the needs of both employees and enterprises, the questionnaire designed in this paper uses the online platform Questionnaire Star. With the help of the internal office WeChat group of Enterprise A, the questionnaire link was pushed to all 112 employees. Finally, 107 valid questionnaires were collected, and the effective feedback rate was as high as 95%, which fully met the statistical requirements for sample validity.

4.1.1 Descriptive Statistics

Enterprise A recently conducted a questionnaire survey on the needs of a human resource management knowledge graph platform, aiming to understand the needs of employees in the process of building the knowledge graph platform. A total of 107 valid samples were received in this survey, covering employees from various departments and different levels of the enterprise. In terms of gender distribution, male employees accounted for 49.5% and female employees accounted for 50.5%. The gender distribution was relatively balanced, and the balance of gender distribution helped to ensure the comprehensiveness and representativeness of the survey results. In terms of education, the survey results showed that the education level of employees in Enterprise A was generally high, and employees with bachelor's degrees or above accounted for more than 70%. Among them, employees with master's degrees or above accounted for 13.1%, showing that Enterprise A attaches great importance to and attracts high-quality talents. In terms of age, employees aged 30 (inclusive) to 40 (inclusive) account for the largest proportion, followed by employees under 30, followed by employees aged 40-50 (inclusive), and employees over 50 are relatively few. In terms of job distribution, other professionals and IT/technical personnel account for a large proportion, while management and HR account for a relatively small proportion.

Analyzing the current status of human resource management, the survey results show that about 71% of employees are involved in human resource management-related work, and these employees have a more intuitive experience and demand for the use of the human resource management system. From the survey data, employees are not very satisfied with the data information of the current human resource management system, accounting for 73.8%, and only 10.2% of employees are generally satisfied or satisfied. Regarding the biggest challenge currently faced in human resource management, the survey results show that data fragmentation and difficulty in integration account for the highest proportion, followed by low information retrieval efficiency. The specific survey results are shown in the following table.

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Table 2 Descriptive Statistics of the Questionnaire Survey on the Demand for the Knowledge Graph Platform for Human Resource Management in Enterprise A

Content	Items	Frequency	Percentage
Gender?	Male	53	49.5
	Female	54	50.5
Education	College degree and below	32	29.9
	Undergraduate	61	57.0
	Master degree and above	14	13.1
Age	Under 30 years old	31	29.0
	30 (inclusive) - 40 years old (inclusive)	40	37.4
	40-50 years old (inclusive)	26	24.3
	Over 50 years old	10	9.3
Occupation	Other professionals	50	46.7
	IT/Technicians	43	40.2
	Management and HR	14	13.1
Are you directly involved in or managing human resources related work?	Yes	76	71.0
	No	31	29.0
You are not satisfied with the current human resource management system	Strong Agree	41	38.3
	Agree	38	35.5
	Normal	17	15.9
	disagree	7	6.5
	Strongly Disagree	4	3.7
What do you think is the biggest challenge facing human resource management today? (Multiple choice)	Data is fragmented and difficult to integrate	76	71.0
	Inefficient information retrieval	70	65.4
	Mismatch between employee skills and job requirements	65	60.7
	High recruitment and training costs	58	54.2
	Low employee satisfaction and loyalty	56	52.3

4.1.2 Reliability and Validity Analysis

Table 3 Reliability Analysis of Questionnaire Survey on Demand for Knowledge Graph Platform for Human Resource Management in Enterprise A

Cronbach's Alpha Coefficient	Standardized Cronbach's Alpha Coefficient	Sample Size
0.899	0.899	107

To ensure the quality and reliability of the obtained data, this paper conducted a reliability analysis. As shown in Table 3. The main purpose of reliability analysis is to test the consistency or stability of the questionnaire to evaluate the reliability of the measurement results. Cronbach's α coefficient is a key indicator for measuring the internal consistency of a questionnaire or scale. Its value is between 0 and 1. The higher the value, the better the reliability of the questionnaire or scale. Generally speaking, if the Cronbach's α coefficient is greater than 0.7, it can be considered that the questionnaire has good reliability. The Cronbach's α coefficient of this questionnaire is 0.899, which

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is close to 1, indicating that the internal consistency of the questionnaire is very high and the measurement results are very reliable.

The reliability analysis results of the questionnaire survey on the demand for the knowledge graph platform of human resource management of Enterprise A show that both the Cronbach's α coefficient and the standardized Cronbach's α coefficient are very high, indicating that the internal consistency of the questionnaire is very good and the measurement results are very reliable. Therefore, it can be considered that this questionnaire has good reliability, which provides a reliable basis for subsequent data analysis and research.

Table 4 Validity Analysis of Questionnaire Survey on Demand for Knowledge Graph Platform of Human Resource Management in Enterprise A

KMO Value		0.909
Bartlett's test of sphericity	Approximate Chi-Square	375.124
	Degrees of Freedom	21
	Significance	0.000

To ensure that the questionnaire can truly reflect the content of the study, validity analysis is mainly to evaluate whether the measurement results of the questionnaire truly and accurately reflect the concepts or constructs to be measured. This report mainly uses the KMO test and Bartlett's sphericity test to analyze the structural validity of the questionnaire. The KMO test is a statistic used to evaluate sample adequacy and the applicability of factor analysis. As shown in Table 4, the KMO value is between 0 and 1. The larger the value, the more common factors there are between the variables, and the more suitable it is for factor analysis. Generally speaking, if the KMO value is greater than 0.7, the data can be considered suitable for factor analysis. According to the data provided, the KMO value of this questionnaire is 0.909, which is very close to 1, and its significance is less than 0.001, indicating that the correlation between the variables is very strong and very suitable for factor analysis.

4.2 Data Analysis of the Quantitative Data

4.2.1 Regression Analysis

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Table 5 A Regression Analysis of the Questionnaire Survey on the Demand for Enterprise Human Resource Management Knowledge Graph Platform

	Unstandardized Coefficients		**Standardized Coefficient**	**t**	**P**	**VIF**	**R^2**	**Adjust R^2**	**F**
	B	Standard Error	Beta						
Constant	0.234	0.189	-	1.241	0.217	-	0.521	0.508	F=37.418 p=0.000***
Requirements and Suggestions	0.568	0.125	0.484	4.524	0.000***	2.468			
Acceptance and Awareness	0.005	0.114	0.005	0.048	0.962	2.271			
Technical Support	0.359	0.130	0.288	2.770	0.007***	2.329			

To deeply explore the relationship between the influencing factors of the demand for the knowledge graph platform for human resource management of enterprises and the current status of human resource management, this article uses the linear regression analysis method to analyze the collected data from 107 valid questionnaires. Through linear regression analysis of 107 valid questionnaires on the demand for the knowledge graph platform for human resource management of Enterprise A, it was found that demand, suggestions, and technical support have a significant positive impact on the current status of human resource management. Although employee acceptance and cognition have a positive impact on the current status of human resource management, it is not significant. This analysis provides decision-making support for Enterprise A, indicating that when promoting the knowledge graph platform for human resource management, we should focus on employee needs, suggestions, and technical support, while not neglecting to improve employee acceptance and cognition. Overall, linear regression analysis provides an in-depth understanding of the relationship between the influencing factors of the demand for the knowledge graph platform for human resource management and the current status of human resource management.

4.3 Summary of the Results

This chapter presents the results of both qualitative interviews and quantitative surveys conducted to explore the demand for a knowledge graph platform in human resource management within China A Technology Enterprise. The qualitative data were collected from interviews with 10 senior executives, while the quantitative data came from 107 valid employee questionnaires.

From the interview analysis, a word frequency chart revealed that terms like “intelligence,” “knowledge graph platform,” and “data analysis” appeared most frequently, reflecting the core concerns of Enterprise A. The emphasis on intelligence and data highlights the organization’s shift towards smart, data-driven HR management. Other frequently mentioned terms, such as “information system,” “technology,” and “training,” reflect Enterprise A’s focus on integrating advanced technologies and improving employee development through the platform. Terms like “efficiency,” “feedback,” “recruitment,” and “cost control” indicate a desire to streamline HR processes and enhance management quality.

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In the quantitative section, descriptive statistics showed a balanced gender distribution and a highly educated workforce, with over 70% of employees holding at least a bachelor's degree. Most respondents were aged between 30–40 years, and nearly half were professionals in IT or technical roles. Notably, 71% of employees were directly involved in HR-related work. However, 73.8% expressed dissatisfaction with the current HR system, with major concerns including data fragmentation, low retrieval efficiency, and skill-job mismatches.

Reliability and validity tests confirmed the robustness of the survey tool. The Cronbach's α was 0.899, indicating high internal consistency. The KMO value was 0.909, and Bartlett's test was significant ($p < 0.001$), confirming the dataset's suitability for factor analysis.

Finally, regression analysis demonstrated that employee requirements and suggestions ($\beta = 0.484$, $p < 0.001$) and technical support ($\beta = 0.288$, $p < 0.01$) significantly influence perceptions of the current HR management status. While employee acceptance and awareness showed a positive but insignificant effect, the model overall explained 52.1% of the variance (Adjusted $R^2 = 0.508$). These findings suggest that Enterprise A should prioritize practical support and respond to user feedback to successfully implement a knowledge graph platform, while also improving employee engagement and awareness of the system.

5. Conclusion, Discussion, and Recommendation

5.1 Conclusion

Based on a comprehensive investigation into the need for knowledge graph platforms in human resource management (HRM), several conclusions can be drawn. First, modern enterprises face increasingly complex HRM challenges due to business expansion and data heterogeneity. Knowledge graphs, as structured and semantically rich representations, offer a viable solution for the integration and management of HR data. When combined with deep learning techniques, they enable the automatic extraction of entities and relationships from large-scale data, enhancing the accuracy and scalability of knowledge systems.

Second, the results from questionnaires and in-depth interviews indicate that enterprises across various industries and sizes are generally dissatisfied with existing HRM systems, especially regarding data integration and information retrieval capabilities. There is a clear demand for intelligent platforms that can streamline these functions.

Third, employee feedback shows a high degree of acceptance and cognitive readiness for knowledge graph-based HRM platforms. Linear regression analysis reveals that demand articulation and technical support have a significant positive effect on the perceived effectiveness of HRM. Although employee acceptance also shows a positive trend, its impact is statistically insignificant, suggesting that technical infrastructure and functionality may be more critical in the adoption process.

5.2 Discussion

These findings underscore the transformative potential of integrating knowledge graphs with deep learning in the HR domain. Not only do they allow enterprises to manage complex HR data more effectively, but they also provide a foundation for intelligent decision-making and service personalization. However, the gap between technical capabilities and user expectations must be bridged through thoughtful system design and user-centric development.

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The insignificant effect of employee acceptance on HRM outcomes might be due to the early stage of platform adoption or limited user exposure. This highlights the importance of organizational change management, training, and iterative feedback loops when implementing intelligent platforms. Furthermore, enterprises should not view knowledge graph deployment as a purely technical upgrade but as a strategic transformation requiring cultural and procedural alignment.

5.3 Recommendation

To maximize the benefits of a knowledge graph-based HRM platform, the following recommendations are proposed:

1) Prioritize User Needs and Functionality: Developers should prioritize features that address immediate pain points in data integration, retrieval, and real-time analytics, as indicated by user feedback.

2) Invest in Technical Support and Scalability: Effective implementation depends on robust backend systems and responsive technical support. Enterprises should allocate sufficient resources for platform maintenance and continuous improvement.

3) Enhance Employee Engagement: Although employee acceptance showed a limited statistical impact, fostering awareness, providing hands-on training, and incorporating user feedback into platform design are essential to long-term adoption.

4) Promote Cross-Functional Integration: HR knowledge graphs should not operate in isolation but be integrated with other enterprise systems such as performance management, recruitment, and employee development for comprehensive value creation.

Future Research Directions: Further studies should explore detailed application scenarios, performance benchmarks, and longitudinal impact assessments of knowledge graph platforms in HRM to refine both technological and managerial frameworks.

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A Study on the Career Advancement Path of Non-Academic Adult Dance Education - Taking the Institute of Continuing Education on Beijing Dance Academy as an Example

by

Jiaqi Chen
Chinese Graduate School,
Panyapiwat Institute of Management,
Nonthaburi, Thailand
E-mail: 932288750@qq.com

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Jiaqi Chen
Chinese Graduate School,
Panyapiwat Institute of Management,
Nonthaburi, Thailand
E-mail: 932288750@qq.com

Abstract

With the rapid development of the social economy and cultural industry, the career paths of the dance industry are becoming more and more diversified, and non-academic continuing education provides key support for adult students' career transformation and advancement. However, the current research on how non-academic adult dance education affects students' career development is still insufficient, especially in the design of continuing education courses, student's background characteristics, social support, and market demand balance. This study takes the Institute of Continuing Education of Beijing Dance Academy as a case study, adopts a qualitative method, and uses a three-level coding method to analyze the data obtained through in-depth interviews to explore the impact of non-academic adult dance education on career transformation and advancement paths. The study found that the type, duration, and student participation in continuing education courses significantly affects their career development; students' educational background, dance experience, and learning motivation play an important role in the transformation of professional roles; the social support system is an important guarantee for career advancement. In addition, students find a balance between artistic creation and market demand, which significantly improves their career adaptability.

Keywords: Non-Academic Adult Dance Education, Career Transformation, Career Advancement, Continuing Education Courses, Social Support, Artistic Creation

1. Introduction

1.1 Background and Importance of the Problem

As the dance profession undergoes structural transformation, adult learners often find themselves at a career crossroads. Many seek to transition from pure performance to broader roles in education, cultural management, or interdisciplinary creative industries. Non-academic continuing education programs, especially those combining dance skills with interdisciplinary content, offer new avenues for growth. However, this shift is not without difficulty. Students frequently encounter obstacles such as rapidly changing market conditions, limited social support, and the tension between artistic ideals and commercial demands. Understanding how continuing education contributes to overcoming these barriers is crucial for informing educational program design and policy development.

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1.2 Research Question

1) How do non-academic continuing education courses, particularly in dance and interdisciplinary subjects, contribute to adult students' career transformation in the dance industry?

2) In what ways do students' personal backgrounds (e.g., age, education level, and dance experience) influence their career choices and adaptability during the transformation process?

1.3 Research Objective

1) To analyze how continuing education courses, especially dance skills training and interdisciplinary learning, facilitate career transformation among adult dance students.

2) To explore how individual background characteristics such as education level, age, and prior dance experience affect students' career choices and adaptation to new professional roles.

2. Literature Review

2.1 Related Concepts and Theories

2.1.1 Career Development Theories

Career development theories provide a foundation for understanding the evolving paths of individuals in dynamic occupational environments. Super's Career Development Theory (1978) proposes a five-stage model, growth, exploration, establishment, maintenance, and decline, emphasizing the gradual concretization of self-concept over time. However, its linear structure limits its application in explaining the diverse, nonlinear transitions seen in the dance profession.

Career Construction Theory suggests that individuals dynamically build their careers through reflective self-narratives, making it highly relevant to understanding how adult dance students reinterpret their identities amid career shifts. Chaos Theory of Careers further emphasizes unpredictability and external factors, such as physical limitations or market disruptions, highlighting the instability of career progression, especially in physically demanding fields like dance.

Career Anchor Theory introduces the idea that individuals' core career motivations (technical/functional competence, managerial competence, security/stability, etc.) evolve with career stages, influencing role changes from performer to educator or manager.

Social Capital Theory adds an external dimension, emphasizing how mentor support, alumni networks, and industry resources play a critical role in facilitating career transition, especially in non-academic education settings.

Social Identity Theory (Tajfel, 1982) explains how individuals derive self-worth and motivation by belonging to a professional group. In the context of adult dance education, students initially lacking identification with the dance profession gradually construct a professional identity through interaction, participation, and shared values, which enhances their commitment and motivates continued development (Li C.X., 2023; Lai C.F., 2024).

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2.2 Literature Surveys

2.2.1 International Research Status

Research in Europe and North America emphasizes the role of adult education in career transitions. Savickas (2013) underscores the value of career construction in adapting to changing roles. Lee (2018) finds that adult dance education combines skill training with interdisciplinary curricula (e.g., project management, cultural planning), enabling broader professional pathways. Sweden's model integrates education with the cultural industry, offering real-world practice to enhance career adaptability.

2.2.2 Domestic Research Status (China)

Chinese research primarily focuses on technical training (e.g., dance instruction and choreography), with relatively weak emphasis on career orientation. While some studies acknowledge that non-academic continuing education improves professional skills, few explore career support mechanisms such as mentoring and alumni networks. Additionally, research is lacking on how students balance artistic freedom with market-oriented employment, limiting understanding of sustainable career development in the arts sector.

2.2.3 Key Gaps in Existing Research

- Dynamic Mechanism of Career Transition: Limited analysis exists on how students construct and redefine their self-identity during professional transformation, particularly under volatile market conditions.
- Role of Social Support Systems: While mentoring and peer networks are recognized as valuable, their specific roles in non-academic adult dance education remain underexplored.
- Art-Market Balance: There is insufficient theoretical and empirical research on how students navigate the tension between artistic creation and commercial viability.

2.3 Conceptual Framework

This study integrates career development theories with social identity and capital theories to construct a multi-level analytical framework for adult dance students' career transformation.

1) Individual Dimension: Based on Career Construction Theory, students actively reconstruct their professional identity through self-reflection and learning.

2) Social Dimension: Drawing from Social Identity Theory and Social Capital Theory, the framework considers how belonging to a professional community, mentoring relationships, and access to industry networks influence career motivation and adaptability.

3) Institutional Dimension: Educational institutions act as mediators by offering interdisciplinary courses, mentoring systems, and alumni engagement, which help bridge skill gaps and create social support for career transformation.

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This framework allows for a comprehensive analysis of how dance students navigate role change, form professional identities, and sustain long-term motivation in a dynamic career environment.

2.4 Research Hypothesis

Based on the literature and conceptual framework, the following hypotheses are proposed:

H1: Participation in interdisciplinary and dance skills courses has a positive effect on adult students' career transformation.

H2: Students with higher levels of social capital (e.g., mentor support, alumni networks) show stronger professional identity and motivation for career advancement.

H3: Background factors such as age, educational level, and prior dance experience significantly influence adaptability in career transition.

H4: The construction of professional identity mediates the relationship between continuing education and career transformation outcomes.

H5: A higher sense of belonging to the professional group positively influences career motivation and long-term engagement in the dance industry.

3. Research Methodology

3.1 Research Design

This study adopts a qualitative research approach to explore how non-academic adult dance education influences students' career advancement paths. Using semi-structured interviews and participatory observation, it aims to reveal the psychological mechanisms behind career role transformation, the practical functioning of social support systems, and the dynamic balance between artistic creation and market demands.

Through thematic analysis, the research identifies key patterns and themes from the lived experiences of adult learners, contributing to a deeper theoretical understanding of professional identity development in arts-based continuing education.

3.2 Population and Sample

The target population for this study comprises students and graduates from the School of Continuing Education at the Beijing Dance Academy. The sample includes 12 participants:

- 6 current students and
- 6 graduates, with diverse backgrounds in dance performance, teaching, and cross-disciplinary career transitions.

This purposive sampling strategy ensures data richness and variability in career experiences. Participants were selected based on their enrollment in non-academic dance programs and active engagement in the professional dance field or related transitions.

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3.3 Research Instruments

The primary instrument used in this study is a semi-structured interview outline, developed based on the research objectives and theoretical framework. It covers five core themes:

1) Career Background: Previous work experience, professional roles, and initial dance exposure.

2) Learning Motivation: Drivers for choosing continuing education, such as skill enhancement or career transformation.

3) Career Transformation and Challenges: Experiences in adapting to new roles, physical and market-related difficulties.

4) Social Support System: Influence of mentors, peer networks, and industry contacts.

5) Future Career Planning: Long-term career goals and suggestions for improving the continuing education system.

The semi-structured format allows for flexibility in probing emerging topics while maintaining consistency across interviews.

3.4 Data Collection

Data were collected through individual semi-structured interviews, each lasting between 45 and 60 minutes. Interviews were conducted in a conversational manner, allowing for real-time adjustments based on the participants' responses.

All interviews were audio recorded, transcribed verbatim, and anonymized to ensure data accuracy and ethical compliance. Prior to participation, informed consent was obtained from all respondents, with assurances regarding data confidentiality and voluntary participation.

The interviews were conducted in settings that were convenient and comfortable for the participants, ensuring an open and reflective atmosphere.

3.5 Statistics Used for Data Analysis

The collected data were analyzed using qualitative thematic analysis, following three stages of coding:

1) Open Coding: Identifying initial concepts from raw transcripts.

2) Axial Coding: Linking concepts to develop categories and subcategories.

3) Selective Coding: Integrating categories around core themes to form theoretical patterns.

The coding process was conducted manually and iteratively, allowing for constant comparison and refinement. NVivo or similar qualitative software may be optionally employed to support text categorization and improve traceability of analytical decisions.

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The goal of analysis is to generate conceptual insights into the career development experiences of non-academic adult dance students, supporting the theoretical model proposed in earlier sections.

4. Data Analysis and Findings

4.1 Introduction

4.2 Data Analysis of the Qualitative Data

4.2.1 Open Coding

Through open coding, key concepts in the interview texts were extracted and classified into major themes such as professional background, learning motivation, social support, and the balance between art and the market.

Table 1 Open coding (Excerpt)

Interview Excerpts	Coding	Coding Purpose/Intention
"I've been learning dance since I was a kid."	Dance Background	Understand the learner's initial background and identify their dance learning experience and history
"But before entering the Dance Education Institute, I was just an ordinary dancer, mainly participating in stage performances."	Dance performers	Determine the professional roles and work experience of students before entering the continuing education program
"It wasn't until I took an adult continuing education course that I realized I had a passion for choreography"	Choreography Interests	Uncover new career interests and motivations that students discover after entering the program
"The instructors in the course were very supportive and gave me a lot of guidance on choreography"	Tutor support	Emphasize mentors' support for trainees' career development and provide specific guidance
"The transition process is difficult, especially as we age and the market changes."	Transformation Challenges Age Impact Market Changes	Understand the difficulties and challenges faced by students in their career transition, especially the impact of age and market
"I feel like I need to adapt to new challenges constantly"	Adaptability	Describe the students' self-adjustment and coping strategies in career transition

Through the open coding process, we extracted core concepts related to the research questions from the interview data and classified them into several key coding categories. The main purpose of this process is to identify factors related to the career advancement of students and provide a solid foundation for subsequent analysis and classification. The above coding laid the foundation for subsequent axial coding and selective coding, helping us to deeply understand the career advancement path of dance students and how they cope with the challenges of career transition through education, social support, and self-adjustment.

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4.2.2 Axis Coding

The purpose of axial coding is to categorize the relevant concepts extracted from open coding and reveal the relationships between them.

Table 2 Axis Coding

Topic	Coding Category	Description	Related Codes
Professional Background and Motivation	Dance background of students	Participants' dance experience and professional identity before entering further education.	Dancers, dance background
	Learning Motivation	Students are intrinsically motivated to enter continuing education courses, usually driven by career needs or a desire for self-improvement.	Learning motivation, self-improvement, and career transformation needs
Career Transformation and Advancement Path	Role change and transformation	The process of students transforming from their original dance roles to choreographers, dance teachers or cultural project managers.	Career role transition, choreographer, dance teacher, transformation path
	Skill expansion	Participants acquire new skills through continuing education courses, broadening their career paths, from dance skills to cultural project management.	Dance skills improvement, cultural project management, interdisciplinary skills, skills development
Social Support and Resource Accumulation	Tutor support	Mentors provide guidance and support to trainees in their career development, helping them to gain direction and decision-making support during their career transition.	Mentoring, career planning, and personalized support
	Peer Support	Mutual support among classmates or peers provides experience sharing and emotional support for career development.	Classmate support, peer interaction, experience sharing
	Industry Resources	The accumulation of social capital resources such as alumni networks, industry cooperation, and industry connections helps students gain more career opportunities and development paths.	Alumni network, industry connections, social networking, career resources
The Balance between Market and Art	The balance between creative freedom and market demand	In the process of artistic creation, students face the compromise between creative freedom and market demand and have to find a balance.	Creative freedom, market demand, creative compromise
	Compromise between artistic creation and commercialization	Students' artistic creations may need to make commercial compromises and adjust their creative direction or content to adapt to the market.	Compromise, marketization, and adjustment of creative direction in artistic creation

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Topic	Coding Category	Description	Related Codes
Adaptability and Coping with Challenges	The impact of age and career transition	The impact of aging on careers, particularly the physical changes dancers face and how to transition to other professional roles.	Aging, career transition, and physical condition
	Market changes and adaptability	Changes in market demand have prompted students to adjust their career direction and creative content and to respond to external challenges by continuously improving their adaptability.	Changes in market demand, adaptability, and career adjustments
	Continuous learning and self-adjustment	Through continuous learning and adjustment of their self-positioning, students can find the right balance between artistic creation and market demand and continue to develop their careers.	Continuous learning, self-adjustment, career adaptation, and innovation ability

4.2.3 Selective Coding

Selective coding is the last step of grounded theory, which aims to further refine the core categories and themes in the study and form a systematic theoretical framework. In this stage, we will screen out the core themes based on the analysis results of open coding and axial coding, and summarize the main factors of the students' career advancement path and their interrelationships. Through selective coding, the main themes of axial coding are integrated to form the final theoretical framework. The study found that continuing education curriculum design and social support system played a core role in students' career transformation, the balance between art and market became an important challenge for career advancement, and continuous learning was the key strategy for students to cope with changes in the professional environment.

The interview data analysis revealed the key role of non-academic adult dance education in career transformation. Students' career transformation is comprehensively influenced by continuing education courses, mentor support, and industry resources. At the same time, the balance between market and art has become a core challenge for career development, and continuous learning has significantly improved students' career adaptability and stability. These findings provide an important reference for continuing education institutions to optimize curriculum design and strengthen career support systems.

4.3 Summary of the Results

Through data analysis, this study clarified the core role of non-academic adult dance education in career transformation:

First, continuing education courses are key supports for students' career transformation. Dance skills courses consolidate professional foundations, and interdisciplinary courses (such as cultural project management) expand career choice paths, enabling students to meet the diverse needs of the cultural industry. The pertinence and market adaptability of course content significantly improves students' career adaptability.

Second, the social support system is an important driving force for career development. The planning guidance provided by mentors helps students cope with transformation challenges, while

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peer networks and industry resources expand career opportunities and enhance professional competitiveness. Social support and course learning complement each other and significantly improve the success rate of students' career advancement.

At the same time, the balance between artistic creation and market demand has become a core challenge for students in career transformation. With the help of mentor guidance and industry resources, some students have adapted to market demand while maintaining artistic innovation and achieving sustainable career development.

Finally, continuous learning is an important strategy for coping with career changes. Through continuous learning, students have adapted to market fluctuations and changes in career requirements, significantly improving long-term career stability and competitiveness.

In summary, continuing education courses, social support and trainees' self-adjustment ability jointly promote the success of career transition. The figure below is a path map drawn based on key findings.

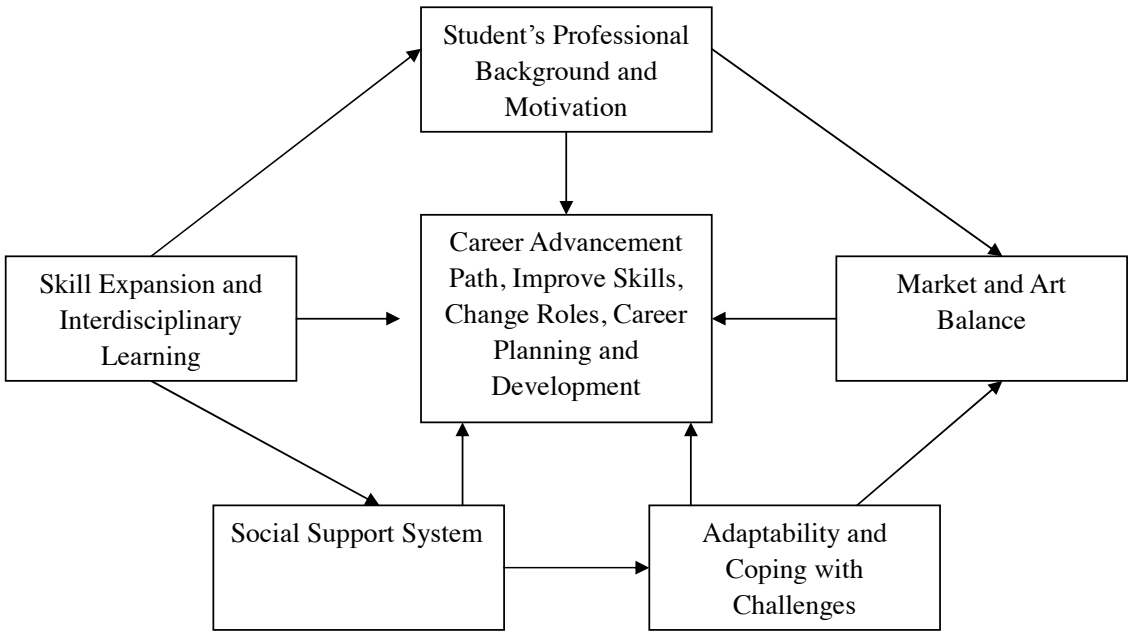

Figure 1 Research Results Path Map

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5. Conclusion, Discussion, and Recommendation

5.1 Conclusion

This study investigated the impact of non-academic adult dance education on students' career advancement paths, focusing on the Continuing Education programs at the Beijing Dance Academy. The findings demonstrate that continuing education courses are critical enablers of career transformation, particularly through the integration of interdisciplinary content, long-term learning engagement, and participatory experience. Key findings include that interdisciplinary curricula, such as cultural project management and art promotion, significantly broaden students' career choices. Long-term participation fosters skill accumulation and enhances career adaptability. Prior dance experience and educational background influence the nature and success of career transitions, while a strong alignment between learning motivation and career needs is essential for effective transformation. Additionally, social support systems—including mentor guidance, peer collaboration, and industry networks—play a decisive role in students' professional development. The ability to balance artistic innovation with market demand directly impacts students' long-term career stability and competitiveness. Overall, the study concludes that continuing education provides a critical foundation for skill enhancement, resource access, and sustainable career development in the field of adult dance education.

5.2 Discussion

The findings of this research contribute to both theoretical and practical understandings of career development in arts-based continuing education. Theoretically, this study validates and extends career development and construction theory, particularly within creative industries, and proposes a multi-role transition framework to reflect the complex identity shifts experienced by adult learners. It highlights the mediating role of learning motivation, social support, and interdisciplinary learning in professional transformation. Practically, the study offers several insights: dance education institutions should focus on interdisciplinary curriculum development to equip students for broader career paths beyond performance. Curriculum planning must remain flexible and personalized, allowing learners to match their personal motivations with emerging industry demands. Robust student support systems, including mentorship programs and industry networking, are vital to help learners navigate career uncertainties. Furthermore, the capacity to balance artistic expression and market viability should be nurtured through real-world project experience and reflective practice. These findings highlight how continuing education is not merely supplementary but central to career adaptability and long-term employability for adult learners in the dance sector.

5.3 Recommendation

Based on the study's findings and limitations, the following recommendations are proposed for future research and educational practice. For educational institutions, it is recommended to expand course offerings in art management, cultural entrepreneurship, and digital media to align dance education with contemporary industry needs. Developing modular and cross-disciplinary curricula that accommodate diverse learning goals and career aspirations is also essential, along with establishing comprehensive student support ecosystems that include career counseling, mentorship programs, and alumni networks. For future research, broadening the sample scope to include other regions and institutions will enhance the generalizability of findings. Integrating objective data sources, such as employment records and performance metrics, can complement self-reported narratives. Investigating career development in non-performance roles like choreography, cultural policy, and education is important, as is conducting longitudinal studies to trace career outcomes

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over time and identify evolving factors influencing success. Finally, exploring the specific contributions of mentors and industry professionals in shaping students' career trajectories will deepen understanding. By addressing these areas, future studies can further clarify the role of adult continuing education in nurturing resilient, creative, and market-responsive professionals in the arts sector.

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The Impact of Digital Transformation Strategy on the Innovation Performance of Commercial Banks in China

by

Jingqiu Zhang
International College, National Institute of Development Administration (NIDA), Thailand
E-mail: jingqiuzhang95@163.com

and

Jun Jiang
International College, Phetchabun Rajabhat University, Phetchabun, Thailand
E-mail: jun.jia@pcru.ac.th

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The Impact of Digital Transformation Strategy on the Innovation Performance of Commercial Banks in China

by

Jingqiu Zhang
International College, National Institute of
Development Administration (NIDA), Thailand
E-mail: jingqiuzhang95@163.com

and

Jun Jiang
International College, Phetchabun Rajabhat University,
Phetchabun, Thailand
E-mail: jun.jia@pcru.ac.th

Abstract

This study explores the relationship between digital transformation strategy, organizational learning capability, and innovation performance in commercial banks. With the increasing adoption of digital technologies such as mobile internet, big data, cloud computing, and artificial intelligence, banks are under pressure to innovate and adapt to rapidly changing market dynamics. The research employs a quantitative approach, using SPSS to analyze data collected from a sample of 258 middle and senior management leaders from various commercial banks. The study finds that digital transformation strategy has a significant positive impact on both organizational learning capability and innovation performance. Moreover, organizational learning capability plays a mediating role in the relationship between digital transformation strategy and innovation performance, amplifying the positive effects of digital transformation on innovation outcomes. The findings suggest that banks should prioritize digital transformation initiatives, enhance their organizational learning processes, and invest in advanced technologies to remain competitive and improve their innovation performance.

Keywords: Digital Transformation Strategy, Innovation Performance, Organizational Learning Capability, Commercial Banks

1. Introduction

1.1 Background and Importance of the Problem

As traditional banking models face increasing competition from fintech companies and the growing demand for more personalized and efficient customer experiences, commercial banks are compelled to adopt digital transformation strategies (Zhu & Jin, 2023). These strategies encompass a wide range of initiatives, including the digitization of customer services, the integration of advanced analytics, the implementation of artificial intelligence, and the development of innovative digital products and services. Digital transformation is no longer just an option for banks, but a necessity for survival and growth in an increasingly competitive and technology-driven financial landscape (Yao

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& Song, 2023).

China, as one of the largest and fastest-growing economies in the world, has seen significant changes in its banking industry due to digital advancements. The Chinese government's push for financial innovation and the widespread adoption of digital payment systems have further accelerated the transformation of the banking sector (Chen, You, & Chang, 2021). Commercial banks in China are increasingly shifting their focus from traditional banking operations to digital innovation in order to stay ahead in a highly competitive market. This shift towards digitalization is not only reshaping how banks interact with customers but also influencing how they manage internal processes, structure their organizational culture, and foster innovation.

However, while the importance of digital transformation in the banking sector is clear, its impact on innovation performance remains an area of considerable interest and inquiry. Innovation performance, in the context of commercial banks, refers to the ability to create and implement new products, services, or processes that provide value to both the bank and its customers (Zhou & Xu, 2023). The successful implementation of a digital transformation strategy is expected to enhance a bank's innovation performance by facilitating the development of new business models, streamlining operations, and improving customer experiences (Li et al., 2023). Despite the growing body of research on digital transformation, the specific pathways through which digital transformation strategies lead to enhanced innovation performance in commercial banks are still not well understood.

Organizational learning capability refers to an organization's ability to acquire, assimilate, and apply knowledge, which is essential for adapting to new technologies and driving innovation (Kalmuk & Acar, 2015). As banks integrate digital technologies into their operations, the ability to learn from both internal and external sources, to experiment with new ideas, and to adapt to changing environments is crucial for fostering a culture of innovation. The connection between digital transformation and innovation performance is likely to be mediated by how well an organization learns and adapts to the changing technological landscape.

1.2 Research Question

This study seeks to explore the relationship between digital transformation strategies and innovation performance in commercial banks, with a particular focus on the mediating role of organizational learning capability. The central research question is: How do digital transformation strategies impact innovation performance in commercial banks? Furthermore, the study examines the role of organizational learning capability as a mediator in this relationship. In particular, the study will address the question of how well a bank's capacity to absorb, integrate, and apply new knowledge can enhance the effectiveness of digital transformation strategies in improving innovation outcomes.

1.3 Research Objective

The primary objective of this study is to investigate the impact of digital transformation strategies on innovation performance in commercial banks in China, focusing specifically on the mediating role of organizational learning capability. The study aims to examine how various elements of digital transformation—such as technological adoption, process innovations, and customer engagement—affect the innovation performance of commercial banks. Additionally, the study will explore how organizational learning capability mediates this relationship, particularly in terms of how a bank's ability to acquire, process, and apply new knowledge influences the success of

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its digital transformation efforts. By achieving these objectives, the study seeks to provide actionable insights for banking executives, helping them understand how they can strategically leverage digital transformation and organizational learning to foster innovation and improve overall performance. Ultimately, this research aims to contribute to the broader understanding of digital transformation in the banking sector, offering valuable guidance for financial institutions aiming to navigate the complexities of a rapidly evolving digital landscape.

2. Literature Review

2.1 Related Concepts and Theories

2.1.1 Digital Transformation Strategy

In the context of commercial banks, a digital transformation strategy involves adopting technologies like mobile internet, big data, cloud computing, and artificial intelligence to improve operational efficiency, innovate customer services, and create new business models. The driving force behind this transformation is the need for banks to adapt to rapidly changing market conditions, rising customer expectations, and increasing competition, particularly from fintech firms. It goes beyond automating existing processes to rethinking traditional business models and customer engagement practices, requiring banks to deliver more personalized, accessible, and efficient services (Cosa, 2024; Kaondera et al., 2023).

Scholars emphasize the strategic importance of integrating digital technologies into banks' core operations and cultures (Cosa, 2024). A successful digital transformation requires aligning technological advancements with business goals, creating a culture of continuous innovation, and fostering organizational agility in response to a fast-evolving digital landscape (Tuerk, 2023). This study defines digital transformation strategy as the comprehensive integration of digital technologies across all aspects of the bank's operations and business models to improve processes, products, and services.

2.1.2 Innovation Performance

Innovation performance in the existing literature is generally divided into two dimensions: product innovation and process innovation. Product innovation focuses on developing new products or services that meet market demands, improve customer satisfaction, or create new opportunities, such as digital banking services or mobile payment solutions in the banking sector (Wang et al., 2021). Process innovation, on the other hand, refers to improvements in internal operations like enhancing efficiency, reducing costs, or improving service quality, which in banking can include innovations in risk management, compliance, or the use of automation and AI in transaction processing and fraud detection (Ardito et al., 2021; Obeng et al., 2024). While product and process innovations are often studied separately, scholars increasingly recognize their interconnection in driving overall innovation performance. For instance, a bank may develop a new financial product that is enhanced by process innovations such as streamlined customer onboarding or AI-driven fraud detection (Rutskiy et al., 2022). This study defines innovation performance as the outcomes of innovation efforts that contribute to a bank's competitive advantage and long-term success, including the introduction of new or improved products, services, processes, or business models, all of which are crucial in the rapidly evolving banking sector.

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2.1.3 Organizational Learning Capability

Organizational learning capability is commonly understood as the ability of an organization to acquire, integrate, and apply new knowledge. This study adopts a two-dimensional framework that distinguishes between absorptive capability and transformative capability. Absorptive capabilities, as defined by Jerez-Gomez et al. (2005), refers to the ability to recognize the value of external knowledge, assimilate it, and apply it to business goals. In the context of commercial banks, this might involve identifying and integrating emerging digital technologies or market trends to maintain a competitive edge.

Transformative capability, as described by DiBella et al. (1996), emphasizes an organization's ability to continuously adapt and integrate new knowledge and technologies over time. In banking, this could involve evolving digital services, adopting innovations, and aligning processes with changing customer needs or regulatory requirements. This study defines organizational learning capability as the ability of a bank to absorb, transform, and apply external knowledge to enhance its competitive position, accelerate product development, and improve operations.

2.2 Literature Surveys

Based on the conceptual framework and literature review, this study aims to explore the relationships between digital transformation strategy, organizational learning capability, and innovation performance within commercial banks. As banks increasingly adopt digital technologies such as artificial intelligence, big data, and cloud computing, they become more capable of absorbing and applying external knowledge, which is a key component of organizational learning. Digital transformation enhances the infrastructure, tools, and systems necessary for learning, thereby strengthening both absorptive and transformative capabilities. Previous research indicates that a strong digital strategy facilitates the acquisition, absorption, and innovation processes of knowledge within the organization, thereby enhancing overall learning capability (Shen et al., 2022; Valdez-Juárez et al., 2024).

The digital transformation of commercial banks is expected to promote innovation by developing new products, services, and business processes that meet the ever-changing demands of customers (Shen et al., 2022). By adopting digital technologies, banks can streamline operations, enhance customer experience, and create new revenue models, thereby improving their innovation performance. Previous studies have shown that digital technologies are key drivers of innovation in the banking sector, improving service delivery, enhancing customer satisfaction, and strengthening market competitiveness (Bai et al., 2024). Therefore, we hypothesize that a strong digital transformation strategy directly contributes to improved innovation outcomes.

Although digital transformation strategy can directly drive innovation, its impact may be further amplified when the organization's learning capability is enhanced. As banks absorb and integrate new knowledge through their organizational learning processes, they are better able to translate digital transformation initiatives into innovative practices and outcomes (Alegre & Chiva, 2013). Organizational learning capability, including both absorptive and transformative capabilities, enables banks to effectively apply new knowledge, refine processes, and generate innovative solutions (Kalmuk & Acar, 2015). Therefore, we propose that organizational learning capability moderates the relationship between digital transformation strategy and innovation performance, thereby amplifying the positive impact of digital transformation on the bank's innovation outcomes.

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2.3 Conceptual Framework

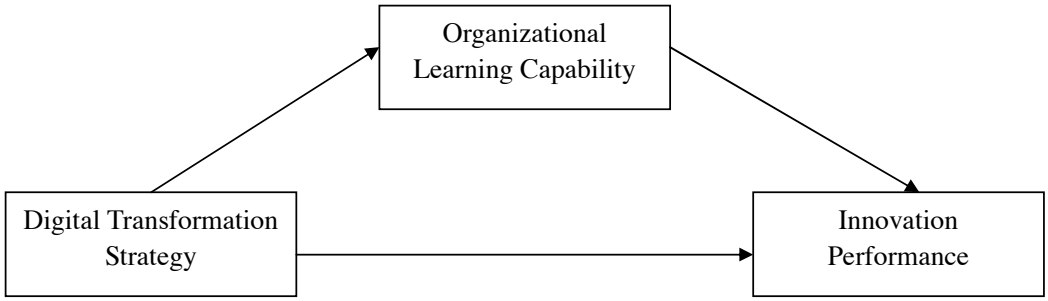

Figure 1 Conceptual Framework

Based on the conceptual framework and the literature review,the following hypotheses are proposed:

H1: Digital transformation strategy has a significant positive impact on the organizational learning capability.

H2: Digital transformation strategy has a significant positive impact on the innovation performance.

H3: Organizational learning capability has a significant positive impact on the innovation performance.

H4: The Organizational learning capability plays a mediating role in the impact of digital transformation strategy on innovation performance.

3. Research Methodology

3.1 Population and Sample

The sample for this study consists of 258 employees from various commercial banks. The gender distribution is relatively balanced, with 52% female and 48% male participants. In terms of age, 36% of respondents are between 31-40 years old, followed by 32% under 30 years, 24% between 41-50 years, and 8% over 51 years. Regarding education level, 46.5% hold a college degree or below, while 53.5% have completed higher education, including 40.7% with a Master's degree and 46.1% with a Doctoral degree. The majority (46.1%) have between 5 to 10 years of experience, followed by 51.2% with 11-20 years. A small proportion (12.8%) has less than 5 years, and only 4 participants (1.6%) have more than 20 years of experience. In terms of bank division, most respondents work in retail business (37.6%), followed by corporate business (22.7%) and interbank business (22.8%). The sample includes employees from a variety of banks, with the largest group (46.5%) working in large state-owned commercial banks, followed by 29.1% in joint-stock commercial banks, and smaller proportions in other types of banks such as city, rural, private, and foreign banks.

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3.2 Research Instruments

1) Digital transformation strategy scale

The digital transformation strategy of traditional commercial banks involves integrating emerging technologies such as mobile internet, big data, cloud computing, and artificial intelligence into their existing operations and services to drive innovation and high-quality development. This integration aims to innovate business processes, products, and business models, ultimately enhancing digital innovation performance. Drawing from Hess, Matt, Benlian, and Wiesböck (2016) and Barragan and Becker (2024), this study measures the digital transformation strategy using an 11-item scale, assessing the strategic application of digital technologies in commercial banks . A 5-point Likert scale is used, ranging from "Strongly Disagree" (1) to "Strongly Agree" (5), providing a comprehensive evaluation of the effectiveness and progress of digital transformation strategies.

2) Innovation performance scale

Innovation performance is commonly defined as the advantage gained through the application of innovative technologies across products, services, business processes, and business models. However, measuring this performance solely with objective indicators may overlook subjective perceptions unique to organizations (Ardito et al., 2021; Pesch, Endres, & Bouncken, 2021). To address this, this study adopts a subjective approach, assessing innovation performance through a two-dimensional framework: process innovation performance and product innovation performance. Process innovation performance focuses on improvements in operational efficiency, service reliability, and support functions, while product innovation performance evaluates the development outcomes of new products or services, including technological advancements and customer satisfaction. Using a 5-point Likert scale, the study includes reverse-coded items to control for response biases and enhance measurement accuracy.

3) Organizational learning capability scale

In this study, organizational learning capability is measured as a holistic construct that includes both absorptive capability and transformative capability. Absorptive capability refers to the firm's ability to recognize, acquire, and assimilate valuable external knowledge, as well as its capacity to predict future developments in core areas. Transformative capability, on the other hand, involves the firm's ability to apply and utilize both existing and new knowledge to address specific problems and capitalize on opportunities. This study employs a set of 7 measurement items to assess organizational learning capability, integrating both dimensions to evaluate the overall effectiveness of a firm's learning processes and its ability to adapt and innovate in the context of digital transformation.

3.3 Statistics Used for Data Analysis

In this study, data analysis was conducted using SPSS (Statistical Package for the Social Sciences). Reliability was assessed using Cronbach's alpha to evaluate the internal consistency of the measurement scales. Convergent validity was tested through average variance extracted (AVE), while discriminant validity was confirmed using the Fornell-Larcker criterion to ensure the constructs were distinct. Path analysis was performed to examine the direct relationships between digital transformation strategy, organizational learning capability, and innovation performance, with path coefficients assessed for significance. Additionally, mediation analysis was conducted to test the indirect effect of organizational learning capability in the relationship between digital transformation strategy and innovation performance, using bootstrapping techniques to confirm the mediation effect. These statistical methods ensured the reliability, validity, and robustness of the study's findings.

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4. Data Analysis and Findings

4.1 Introduction

4.1.1 Reliability and Validity

In this study, the reliability of the variables was assessed using Cronbach's alpha, which measures the internal consistency of the scales. The results indicate that all the variables exhibited satisfactory reliability. Specifically, the Cronbach's alpha for Digital Transformation Strategy was 0.837, for Organizational Learning Capability it was 0.820, and for Innovation Performance it was 0.883. These values are all above the commonly accepted threshold of 0.7, suggesting that the scales used in this study are reliable and consistent in measuring the intended constructs. The high reliability values indicate that the items within each variable are closely related, providing confidence in the accuracy and dependability of the data collected.

Table 1 Reliability of Variables

Variable	Cronbach's Alpha
Digital Transformation Strategy	0.837
Organizational learning capability	0.820
Innovation Performance	0.883

4.2 Data Analysis of the Quantitative Data

The KMO (Kaiser-Meyer-Olkin) measure and Bartlett's Test of Sphericity were conducted to assess the suitability of the data for factor analysis. The KMO value was found to be 0.866, which is above the recommended threshold of 0.6, indicating that the sample size and data are appropriate for factor analysis. A higher KMO value suggests that the correlations between the variables are strong enough to proceed with the analysis. Additionally, Bartlett's Test of Sphericity yielded a significant p-value of 0.000, which indicates that the correlation matrix is not an identity matrix, further supporting the suitability of the data for factor analysis. These results confirm that the data meet the necessary assumptions for factor analysis and that the factor model is likely to produce reliable and meaningful results.

Table 2 KMO and Bartlett Test

KMO and Bartlett Test		
KMO Value		0.866
Bartlett's test of sphericity	Approximate chi-square	3668.666
	df	351
	p value	0.000

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The correlation analysis in this study reveals the relationships between key variables, providing insights into their interconnections. Innovation Performance (IP) shows significant positive correlations with both Digital Transformation Strategy (DTS) (r = 0.465) and Organizational Learning Capability (OLC) (r = 0.426), suggesting that these two factors have a meaningful impact on innovation performance in banks. DTS and OLC are also positively correlated with each other (r = 0.358), indicating that the adoption of a digital transformation strategy may facilitate organizational learning processes. However, demographic variables such as gender (Sex), age (Age), education level (Edu), and bank division (Div) show weak or no significant correlations with the main study variables, implying that these factors have a minimal direct effect on innovation performance or the digital transformation process. Notably, years of experience (Exp) shows a significant positive correlation with education (r = 0.208) and a strong correlation with age (r = 0.686), reflecting that more experienced employees tend to be older, but this does not translate directly into stronger innovation performance. Overall, the analysis suggests that while some demographic factors have limited correlations, digital transformation strategy and organizational learning capability are the primary drivers of innovation performance in the context of banking.

Table 3 Correlation Analysis

	IP	**DTS**	**OLC**	**Sex**	**Age**	**Edu**	**Exp**	**Div**	**Type**
IP	1								
DTS	0.465**	1							
OLC	0.426**	0.358**	1						
Sex	0.080	0.033	0.032	1					
Age	0.068	-0.030	0.045	0.039	1				
Edu	0.040	0.045	0.076	0.021	0.208**	1			
Exp	0.028	-0.091	-0.023	-0.009	0.686**	0.000	1		
Div	0.077	0.076	0.085	-0.029	-0.008	-0.054	-0.108	1	
Type	-0.001	0.080	0.038	0.068	0.066	-0.039	-0.029	-0.005	1

Note: ** p<0.01, IP=Innovation performance, DTS=Digital transformation strategy, OLC=Organizational learning capability, Edu=Education, Exp=Years of experience, Div=Bank division, Type=Type of bank.

Table 4 illustrates that the diagonal values represent the square roots of the AVE for each variable (Innovation Performance (IP), Digital Transformation Strategy (DTS), and Organizational Learning Capability (OLC)). These values are 0.678, 0.608, and 0.646 for IP, DTS, and OLC, respectively. These values are all greater than the off-diagonal correlations between the variables, such as the correlations between IP and DTS (0.465), and between IP and OLC (0.426). Therefore, the square root of each construct's AVE exceeds the correlation values, which suggests that the constructs are sufficiently distinct from each other.

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Table 4 Convergent Validity& Discriminant Validity

	AVE	CR	IP	DTS	OLC
IP	0.369	0.852	0.678		
DTS	0.418	0.825	0.465**	0.608	
OLC	0.459	0.884	0.426**	0.358**	0.646

4.1.2 Hypothesis Test

The path analysis results, conducted using SPSS, provide strong support for all three hypotheses in this study. Hypothesis 1 (H1) posits that digital transformation strategy (DTS) has a significant positive impact on organizational learning capability (OLC). The unstandardized path coefficient of 0.350, with a z-value of 6.149 and a p-value of 0.000, indicates a significant and positive relationship between DTS and OLC, supporting H1. Similarly, Hypothesis 2 (H2) suggests that DTS has a significant positive impact on innovation performance (IP). The path coefficient of 0.384, with a z-value of 6.396 and a p-value of 0.000, shows a significant and positive influence of DTS on IP, confirming H2. Lastly, Hypothesis 3 (H3) proposes that organizational learning capability (OLC) positively influences innovation performance (IP). The unstandardized path coefficient of 0.326, a z-value of 5.314, and a p-value of 0.000 further validate the significant positive impact of OLC on IP, thereby supporting H3. All path coefficients are positive and statistically significant, indicating that the hypothesized relationships hold true in this study.

Table 5 Path Analysis

X	→	Y	Unstandardized Path Coefficients	SE	z (CR)	p	Standardized Path Coefficients
DTS	→	OLC	0.350	0.057	6.149	0.000	0.358
DTS	→	IP	0.384	0.060	6.396	0.000	0.358
OLC	→	IP	0.326	0.061	5.314	0.000	0.298

Note: → indicates path influence relationship

The mediation analysis, conducted using the SPSS PROCESS plugin with 5000 bootstrap samples, provides strong support for Hypothesis 4 (H4), which suggests that organizational learning capability (OLC) plays a mediating role in the impact of digital transformation strategy (DTS) on innovation performance (IP). The indirect effect of DTS → OLC → IP is 0.114, with a 95% confidence interval (CI) ranging from 0.062 to 0.157, which does not include zero, indicating a significant partial mediation. Furthermore, the direct effect of DTS on IP is 0.384, with a 95% CI between 0.266 and 0.503, also showing significance. These results suggest that while DTS directly influences IP, part of this effect is mediated through OLC. Specifically, DTS positively affects OLC, which in turn positively influences IP. The findings confirm that organizational learning capability partially mediates the relationship between digital transformation strategy and innovation performance, supporting H4.

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Table 6 Mediation Analysis

Item	Effect	95% BootCI		SE	z value	p value	Result
		Lower	Upper				
DTS→OLC→IP	0.114	0.062	0.157	0.024	4.718	0.000	Partial Mediation
DTS→OLC	0.350	0.238	0.462	0.057	6.125	0.000	
OLC→IP	0.326	0.205	0.447	0.062	5.283	0.000	
DTS→IP	0.384	0.266	0.503	0.060	6.359	0.000	
DTS→IP	0.498	0.382	0.615	0.059	8.401	0.000	

4.3 Summary of the Results

The data analysis results provide strong support for all four hypotheses proposed in this study. First, Hypothesis 1 (H1) posits that digital transformation strategy (DTS) has a significant positive impact on organizational learning capability (OLC), which is confirmed with a path coefficient of 0.358 and a p-value of 0.000, indicating a significant relationship. Second, Hypothesis 2 (H2) suggests that DTS positively influences innovation performance (IP), and the analysis supports this with a path coefficient of 0.358 and a p-value of 0.000, confirming the significant impact of DTS on IP. Third, Hypothesis 3 (H3) hypothesizes that OLC has a significant positive impact on IP, and the results validate this hypothesis with a path coefficient of 0.298 and a p-value of 0.000, showing that organizational learning capability is a key driver of innovation performance. Finally, the mediation analysis (H4) reveals that OLC partially mediates the relationship between DTS and IP. The indirect effect of DTS on IP through OLC is significant (0.114, p = 0.000), further supporting the idea that organizational learning capability plays a crucial role in enhancing the effect of digital transformation strategy on innovation performance. Overall, the findings confirm the robustness of the proposed hypotheses and highlight the importance of digital transformation and organizational learning in driving innovation in commercial banks.

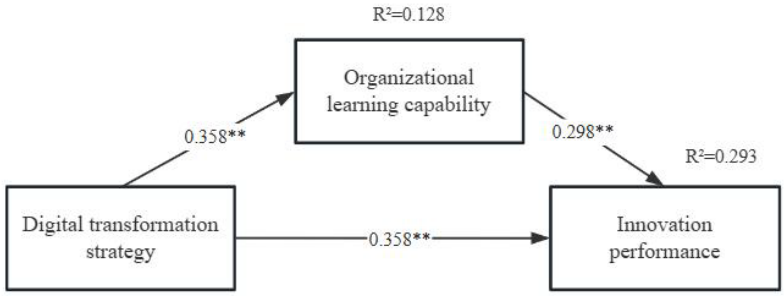

Figure 1 Result Analysis

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5. Conclusion, Discussion, and Recommendation

5.1 Conclusion

This study investigated the relationships between digital transformation strategy, organizational learning capability, and innovation performance in commercial banks. The analysis of the collected data confirmed that all the proposed hypotheses were supported, highlighting the significant roles of digital transformation and organizational learning in driving innovation performance.

The results show that a well-implemented digital transformation strategy has a positive impact on organizational learning capability. By adopting emerging digital technologies like artificial intelligence, big data, and cloud computing, banks can enhance their ability to absorb and transform external knowledge, which is essential for fostering innovation. Additionally, the study finds that a digital transformation strategy directly contributes to innovation performance, improving both process and product innovation in commercial banks.

Importantly, the study also revealed that organizational learning capability plays a mediating role in the relationship between digital transformation strategy and innovation performance. This means that the positive effects of digital transformation on innovation are amplified when banks are capable of absorbing and applying new knowledge effectively.

5.2 Discussion

The findings of this study align with and extend the existing body of research on digital transformation, organizational learning, and innovation in the banking sector. By confirming that digital transformation strategy positively impacts organizational learning capability, this study echoes previous studies that suggest digital technologies play a key role in enhancing the learning and knowledge management processes within organizations (Albukhitan, 2020). The integration of digital technologies enables commercial banks to access and apply external knowledge more effectively, thus facilitating the development of innovative solutions.

In terms of innovation performance, the study's findings provide empirical evidence that digital transformation is a significant driver of both product and process innovations in the banking sector. This is consistent with prior research that emphasizes the role of digital transformation in streamlining processes, improving service delivery, and enhancing customer satisfaction through technological advancements (Ardito et al., 2021; Ritter & Gemünden, 2004). By leveraging technologies such as artificial intelligence and cloud computing, banks can enhance operational efficiency and develop new financial products that meet customer demands.

The study also highlights the critical mediating role of organizational learning capability. This finding extends the understanding of how digital transformation leads to innovation. While digital technologies provide the tools and infrastructure for innovation, organizational learning enables banks to internalize and effectively apply the knowledge gained, making it an essential driver of sustainable innovation. The ability to absorb and apply external knowledge allows banks to adapt to market changes, respond to customer needs, and stay ahead of competitors.

However, the study's findings also raise important implications for practice. While adopting a digital transformation strategy is crucial, banks must also foster a culture of learning to ensure that the knowledge and insights gained through digital transformation are effectively utilized. This

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suggests that banks should invest not only in technological infrastructure but also in developing their organizational learning capabilities to ensure that digital transformation leads to long-term innovation and competitive advantage.

Future research could expand on these findings by exploring how specific digital technologies, such as blockchain or robotic process automation, influence organizational learning and innovation performance in banks. Additionally, research could examine the role of external factors, such as regulatory pressures or market competition, in shaping the digital transformation strategies and learning capabilities of commercial banks.

5.3 Recommendation

First, commercial banks should enhance the overall planning of their digital transformation strategy, ensuring that the application of technologies not only focuses on product innovation but also optimizes internal processes and services. Banks should prioritize the integration of digital technologies with business models and organizational structures at the strategic level, fostering a synergistic development between technological and management innovations.

Second, improving organizational learning capability is key to driving innovation performance. Banks should focus on enhancing their ability to absorb new knowledge and technologies. This can be achieved by strengthening employee training programs, establishing knowledge management platforms, and promoting the integration of external knowledge with internal expertise, thereby boosting their innovation capacity and market competitiveness.

Lastly, banks should increase investments in data analytics and artificial intelligence to further drive product and process innovation. By leveraging big data and AI technologies, banks can optimize customer service, risk management, and operational efficiency, ultimately achieving continuous innovation and improving overall business performance.

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A Study of the Impact of Energy Industry Transformation on Economic Quality

by

Kang Gu[1] and **Xiaowen Jie**[2]
Chinese Graduate School,
Panyapiwat Institute of Management,
Nonthaburi, Thailand
E-mail: 605038138@qq.com[1], 605038138@qq.com[2]

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Kang Gu[1] and Xiaowen Jie[2]
Chinese Graduate School,
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E-mail: 605038138@qq.com[1], 605038138@qq.com[2]

Abstract

This article defines the concepts of energy transition and economic growth quality by combining domestic and foreign research. Based on the grounded theory research method, this paper explores the specific path of China's energy transformation, including energy structure transformation aimed at promoting energy structure adjustment, energy technology transformation aimed at promoting energy technology innovation, and energy policy transformation aimed at providing institutional guarantees. On this basis, based on relevant theories, an overall research framework for improving the quality of economic growth driven by energy transformation has been constructed. Based on the differential impact of energy structure transformation, energy technology transformation, and energy policy transformation on the quality of economic growth, this study simulates and analyzes the dynamic effects of energy transformation on the quality of economic growth at the national level through different combinations of three energy transformation paths. It gradually explores and identifies more effective combinations of energy transformation paths, and provides energy transformation development directions and references for regions with different development conditions. Finally, countermeasures based on energy transformation to promote the quality improvement of economic growth were proposed from three aspects: optimizing energy structure, advancing energy technology, and ensuring energy policies.

Keywords: Energy Transition, Economic Growth Quality, Energy Structure

1. Introduction

1.1 Background and Importance of the Problem

China’s economic growth has long exhibited the characteristics of “high quantity, low quality, and low efficiency”, resulting in significant structural challenges. These include the depletion of demographic dividends, rising production costs, environmental degradation, resource constraints, and a noticeable slowdown in growth momentum. As the nation enters a phase often referred to as the “new normal,” the traditional growth model, heavily reliant on factor input, must be urgently transformed. The central task now is to shift from extensive, high-speed expansion to medium-to-high-speed growth that emphasizes quality and sustainability.

Improving the quality of economic growth is now viewed as the core strategy to ensure long-term health and sustainability of the economy. However, while the importance of energy transformation is increasingly recognized, most existing studies narrowly define it as an adjustment of the energy structure, overlooking the broader dimensions and diverse pathways of transformation.

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In addition, these studies often fail to link energy transformation efforts with the evolving stages of economic development, specifically, they neglect the question of which specific energy transformation paths can minimize economic and environmental costs while supporting the economy's capacity for adaptation and long-term improvement.

Given the pressing need for a greener and more resilient economic model, it becomes critical to explore how different energy transformation pathways, namely structure, technology, and policy, individually and jointly affect the quality of economic growth. This inquiry is essential for China's long-term energy strategy, supply-side structural reform, and the construction of a green and ecologically sustainable economy.

1.2 Research Question

This study seeks to address the following central research question:

How do different energy transformation pathways, namely energy structure transformation, energy technology transformation, and energy policy transformation, affect the quality of economic growth in China under the "new normal" of economic development?

Sub-questions include:

- What are the distinctive roles of structure, technology, and policy transformations in driving economic growth quality?
- How do combinations of these transformation paths perform under different economic development scenarios?
- Which pathway or combination offers the most cost-effective and sustainable strategy for long-term economic quality improvement?

1.3 Research Objective

The main objective of this research is to investigate the impact of energy transformation on the quality of economic growth in China during its transition from an extensive to an intensive development phase. More specifically, the study aims to:

1) Clarify the conceptual framework of energy transformation by categorizing it into three distinct but interconnected paths:

- Energy structure transformation (optimizing the energy mix),
- Energy technology transformation (advancing clean and efficient technologies),
- Energy policy transformation (institutional and regulatory guidance).

2) Analyze the differential effects of each energy transformation pathway on economic growth quality through empirical and simulation methods.

3) Evaluate dynamic trends in the influence of energy transformation on economic quality from a long-term perspective.

4) Provide strategic guidance for how China can leverage energy transformation to drive sustainable, inclusive, and high-quality economic development.

In doing so, the study aims to support national strategic planning and contribute to theoretical and practical discussions on integrating green energy transformation with economic modernization.

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2. Literature Review

2.1 Related Concepts and Theories

2.1.1 Energiewende and Energy Transformation

The concept of Energiewende, or energy transition, is widely recognized in both domestic and international academic literature. Traditionally, energy transition has been understood narrowly as the shift in dominant energy sources within a country or region. The German Institute of Applied Ecology describes it as the transition from fossil fuels such as oil and nuclear power to renewable energy. Robert Hefner III, in The Great Energy Transition, outlines energy transformation as a long-term progression from solid to liquid to gaseous fuels, illustrating the historical evolution of energy types.

In China, Zhao Hongtu (2009) describes energy transformation as breaking away from a fossil fuel-based system, particularly one dominated by coal, oil, and gas. Wei Wei (2018) echoes this view, defining energy transition as the gradual replacement of non-renewable energy by renewable sources. These definitions often equate energy transformation with the expansion of renewable energy, clean energy consumption, and increased proportions of new energy use.

In light of China's current energy use patterns and developmental goals, this study defines energy transformation as a systemic shift from high-carbon to low-carbon energy structures, emphasizing changes in energy structure optimization, technological innovation, and institutional guarantees, a definition more aligned with the needs of sustainable, high-quality economic development.

2.1.2 Economic Growth Theory

Understanding economic growth theory is essential for conceptualizing how energy transition affects economic quality. Traditional models primarily focus on capital and labor as growth inputs. However, new economic growth theory, which emerged from the endogenous growth paradigm, extends the role of human capital, not merely as labor, but as a complex factor comprising knowledge, skills, and coordination abilities. This theory highlights several critical dimensions:

- Returns to scale in knowledge tend to increase through knowledge spillovers, creating a virtuous cycle between capital accumulation and knowledge growth.
- Technological progress is treated as an endogenous variable, meaning it is influenced by investment in R&D and education, and is central to long-term growth.
- The theory also explains disparities in per capita income levels across nations based on differences in specialized human capital.

2.1.3 Sustainable Development Theory

Sustainable development theory provides a framework that integrates economic, environmental, and social dimensions. It posits that development must meet present needs without compromising the ability of future generations to meet their own. At its core, the theory requires economies to abandon development strategies that sacrifice the environment, reduce resource depletion and waste, and pursue ecologically beneficial growth.

This approach emphasizes alignment between economic structures, social equity, and ecological systems, making it directly relevant to improving economic growth quality in the context

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of energy transition.

2.1.4 Energy–Economy–Environment (3E) System Theory

As sustainable development and energy economics evolve, scholars increasingly adopt the 3E system theory, which integrates energy, economy, and environment into a dynamic research system. This perspective acknowledges that interactions among these three subsystems are non-linear and vary across development stages.

China currently faces a shift from old to new growth drivers, resulting in slower economic transformation. The 3E system theory provides a lens to understand how energy transition policies interact with macroeconomic variables and environmental outcomes. Enhancing economic growth quality thus requires an integrated, multi-perspective approach grounded in systems thinking.

2.2 Literature Surveys

Both domestic and international literature offer varied perspectives on energy transformation:

International literature often defines energy transition in terms of structural change in energy sources, especially focusing on the shift from fossil fuels to renewable energy (e.g., the German Energiewende and Robert Hefner's typology of fuel transitions).

Chinese scholars have contributed nuanced understandings. Zhao Hongtu (2009) and Wei Wei (2018) frame energy transformation in terms of decarbonization and clean energy adoption, emphasizing national energy security and sustainable growth.

In terms of economic growth theory, endogenous growth models (e.g., Romer, Lucas) dominate modern literature, asserting that technological innovation and human capital accumulation are the central engines of sustained growth.

Literature on sustainable development consistently highlights the need for resource efficiency, pollution control, and ecological preservation as prerequisites for long-term economic stability.

Scholars working on the 3E system (energy–economy–environment) increasingly adopt dynamic simulation models and systems thinking to examine the interaction effects of policy, technology, and resource flows.

Despite these contributions, few studies comprehensively evaluate the differentiated effects of specific energy transformation paths, structure, technology, and policy, on economic growth quality. This research seeks to address that gap.

2.3 Conceptual Framework

Based on the synthesis of existing theories and literature, this study constructs a conceptual framework that links energy transformation with the quality of economic growth, structured around three primary transformation pathways:

1) Energy Structure Transformation: Refers to adjusting the energy mix by increasing the proportion of renewable energy and reducing reliance on high-carbon sources like coal and oil.

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2) Energy Technology Transformation: Involves promoting innovation in energy generation, storage, distribution, and consumption technologies to improve energy efficiency and sustainability.

3) Energy Policy Transformation: Encompasses institutional changes, regulations, and strategic planning that facilitate the above two transformations through incentives, subsidies, carbon pricing, and green finance.

These pathways are hypothesized to have differential impacts on the quality of economic growth, defined in terms of:

- Environmental sustainability,
- Resource efficiency,
- Technological innovation capacity, and
- Social inclusivity and equity.

This framework is grounded in economic growth theory, sustainable development principles, and 3E system theory.

2.4 Research Hypothesis

Based on the conceptual framework and literature review, the following hypotheses are proposed:

H1: Energy structure transformation has a positive and significant impact on the quality of economic growth by reducing carbon emissions and enhancing environmental sustainability.

H2: Energy technology transformation significantly enhances economic growth quality by improving energy efficiency, encouraging innovation, and promoting the development of high-value industries.

H3: Energy policy transformation provides an institutional foundation that amplifies the effects of structural and technological changes, resulting in a stronger and more stable improvement in the quality of economic growth.

H4: The interactive effects of energy structure, technology, and policy transformation pathways have a synergistic impact on the quality of economic growth, greater than the sum of their individual effects.

These hypotheses will be tested through empirical analysis and dynamic simulation, providing practical guidance for China's energy transition strategy.

3. Research Methodology

3.1 Research Design

This study adopts grounded theory as the primary qualitative research methodology. Grounded theory distinguishes itself from traditional qualitative methods by systematizing the research process, enabling theory generation from empirical data. Its principal advantage lies in its iterative approach, allowing data collection and analysis to proceed simultaneously. The process includes three levels of decoding:

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- Open coding: Continuously comparing and categorizing raw data to identify dimensions and initial categories.
- Axial coding: Exploring relationships among the initial categories to establish main categories.
- Selective coding: Analyzing interconnections between main categories to build a typical relationship structure model and determine the core category that represents the research issue.

In addition to the qualitative approach, a quantitative analytical framework is established to examine the nonlinear and spatial effects of energy transformation on economic growth quality. Specifically, threshold regression and spatial econometric models are employed to evaluate policy impacts and spatial spillovers from energy technology innovation.

3.2 Population and Sample

The population for this research includes experts, scholars, and stakeholders engaged in China's energy transition. A total of 27 valid interview transcripts were collected. A stratified sampling approach was applied to select 22 records for initial grounded theory modeling, ensuring a diverse representation of viewpoints. The remaining 5 interview records were reserved for the theoretical saturation test, which validates whether new categories or concepts emerge from additional data.

3.3 Research Instruments

The main research instruments included semi-structured interviews, guided by open-ended questions such as:

- "How to promote China's energy transformation?"
- "What are the core elements of promoting China's energy transformation?"
- "What are the key and difficult points in China's energy transformation?"

These guiding questions enabled in-depth discussion and flexibility in capturing a wide range of opinions. Additional secondary data sources such as corporate annual reports, peer-reviewed academic articles, and public news reports were also used to triangulate findings and reduce bias.

3.4 Data Collection

Data was collected through semi-structured interviews, recorded, and transcribed for analysis. The interviews were designed to stimulate discussion around the challenges and opportunities in China's energy transition. A total of 27 interviews were conducted, and grounded theory procedures were used to analyze the 22 primary transcripts, with 5 transcripts used to test theoretical saturation. In addition, secondary data was collected to enhance the credibility of the qualitative findings and ensure reliability and validity through cross-verification.

3.5 Statistics Used for Data Analysis

To quantify the impact of energy transformation on economic growth quality, the study integrates several statistical techniques:

1) Threshold Regression Analysis: Used to detect nonlinear effects of energy structure transformation on economic quality, accounting for turning points in influence.

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2) Spatial Econometric Models: Applied to analyze spatial spillover effects arising from energy technology innovation.

3) Policy Effectiveness Evaluation: Energy policies are classified into clean energy development, energy conservation, and new energy industry policies. The study empirically tests the effectiveness and timeliness of these policies on enhancing the quality of economic growth.

These quantitative tools complement the grounded theory approach, creating a mixed-methods framework that bridges qualitative insight and empirical validation.

4. Data Analysis and Findings

4.1 Introduction

Dependent variable: Based on the measurement of the quality of economic growth, the economic growth quality index obtained through the super efficiency SBM method takes labor, capital, and ecological footprint as input indicators, regional total output value as expected output, and carbon dioxide emissions as unexpected output.

Core explanatory variables: Energy technology transition lnet and its quadratic term (lnet) 2. Under the framework of technological innovation research, the transformation of energy technology is mainly based on the utilization and development of energy elements. This chapter provides a comprehensive definition of energy technology transformation from two aspects: innovation in new energy utilization technology and innovation in energy conservation and emission reduction technology. In the definition of indicators, specific reference is made to the approach of Ye Qin and Fan Dan (2020), where the number of patent applications for "non fossil energy (new and renewable energy)" and "energy conservation and emission reduction" represent the level of non fossil energy technology transformation and innovation, respectively. The proxy variable for energy technology transformation is obtained by weighting the patent quota allocation method. Taking into account the balance between the "energy rebound effect" and "carbon emission effect" generated by technological progress, as well as the comparison between labor level and innovation cost, this chapter adds a quadratic term (lnET) 2 of energy technology transformation level to comprehensively interpret its spatial effects.

Control variables: selecting government intervention Gov, information technology level JCT, urbanization level Urb, population density People, environmental regulation level Regulation, and openness to the outside world 0pen, the consistency of control variables ensures the overall robustness and persuasiveness of the model to a certain extent.

4.2 Data Analysis of the Quantitative Data

4.2.1 Verification of Spatial Econometric Models

Determine whether the SDM model can degrade into SLM or SEM through Wald test and LR test. The Wald test is used to determine whether SDM can degrade into SLM, while the LR test is used to determine whether SDM can degrade into SEM. The two types of tests reject the null hypothesis at the 1% significance level for all four statistical values, indicating that the model cannot degrade to SLM or SEM. The selection of spatial econometric models is extremely important, but there are also strict conditions. Only when the Wald test and LR test results are consistent with the

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LM test results of non spatial panel models, can SDM degrade into SLM or SEM. In addition, when both Wald test and LR test pass the significance test, it can be determined that the model setting should be SDM. The results in Table 1 show that under the three weight matrices, both types of null hypothesis results were rejected. This chapter ultimately selects the Spatial Durbin Model (SDM) for estimation. Through Hausman test and LR test, the three types of test statistics are significant at the 1% level under all three weight matrices. Therefore, the paper ultimately chooses the fixed effects spatial Durbin model and focuses on analyzing the econometric results of the time and space dual fixed effects panel model.

Table 1 SDM Degradation Test

Matrix Type	**0-1 Adjacency Distance Weight Matrix**		**Geographic Distance Weight Matrix**		**Geographic Economic Distance Weight Matrix**	
Statistical Test	**Statistical**	**P-Value**	**Statistical**	**P-Value**	**Statistical**	**P-Value**
Wald-SLM	43.1000	0.0000	58.3800	0.0000	35.2100	0.0000
Wald-SEM	46.6000	0.0000	57.8800	0.0000	37.4900	0.0000
LR-SLM	42.0600	0.0000	55.2500	0.0000	34.5800	0.0000
LR-SEM	45.1700	0.0000	54.2300	0.0000	36.1900	0.0000
Hausman	311.6200	0.0000	160.8500	0.0000	163.1900	0.0000
LR-ind	159.8100	0.0000	117.0500	0.0000	158.8600	0.0000
LR-time	84.1300	0.0000	110.8600	0.0000	89.4600	0.0000

Overall, the independent variables within the region under the spatial econometric model have the same direction of impact on the quality of economic growth in this region, with similar significance levels and impact coefficients, indicating that the overall establishment of the model has a certain degree of scientific validity. From a regional perspective, under the three weight matrices, the transformation of energy technology has a "U" - shaped impact on the quality of economic growth, manifested as early inhibition and later promotion. The level of informatization and population density can significantly affect the quality of economic growth within a region. From a spatial perspective, it can be concluded that the transformation of energy technology has a significant spatial impact on the quality of economic growth, as evidenced by the WX * lnet and WX * (lnet) terms. The effect exhibits a "U" - shaped variation, and under the weight matrix of geographical distance, the "U" - shaped impact coefficient of energy technology transformation on the quality of economic growth is greater. This is reflected in the stronger effect of energy technology transformation on the quality of economic growth under the influence of spatial geographical distance. It should be noted that the Moran's index test on spatial correlation in the previous text only applies to the dependent variable quality itself, while the spatial lag terms WX * lnet and WX * (lnet) 2 here are both aimed at the spatial spillover effects of the core explanatory variable energy technology transformation lnet on the quality of economic growth, and there is no contradiction between the two results. In addition, in terms of controlling variables, both environmental regulation level and population density have a negative impact on the quality of external economic growth. Among them, the spatial inhibitory effect of environmental regulation level on the quality of economic growth is stronger, and under the geographical distance weight matrix, the impact coefficients of each indicator are relatively large, as shown in Table 2

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Table 2 Double Fixed Effect SDM in Different Metrics

	0-1 Adjacency Distance Weight Matrix		Geographic Distance Weight Matrix		Geographic Economic Distance Weight Matrix	
	Coef.	**z**	**Coef.**	**z**	**Coef.**	**z**
lnet	-0.0196**	-2.1900	-0.0189**	-2.2300	-0.0168*	-1.9600
(lnet)2	0.0020***	2.5700	0.0012*	1.7200	0.0012*	1.7000
Gov	0.1709*	1.8500	0.0530	0.6300	0.0254	0.2900
ICT	-0.0943***	-2.4000	-0.0909**	-2.3200	-0.0819**	-2.0000
Urb	-0.0033	-0.1200	0.0263	0.8800	-0.0016	-0.0600
People	-0.9268***	-4.6200	-1.6583***	-7.7500	-1.3450***	-6.3300
Regulation	-1.5354	-0.8600	-4.4696**	-2.4500	-2.9900	-1.6500
Open	-0.0072	-0.4100	-0.0241	-1.3900	-0.0011	-0.0600
Wx * lnet	-0.0504**	-2.3900	-0.1768***	-3.0800	-0.0576**	-2.3600
Wx * (lnet)2	0.0039**	2.4800	0.0181***	3.8100	0.0064***	3.3000
Wx * Gov	-0.2283	-1.4100	-0.1399	-0.2400	0.0496	0.2100
Wx * ICT	-0.0565	-0.8200	0.2727	1.3400	0.0507	0.8100
Wx * Urb	0.0417	0.6400	0.5808***	3.0500	0.0529	0.8500
Wx * People	-2.3534***	-4.1200	-8.7666***	-6.2100	-1.6284***	-4.1500
Wx * Regulation	-8.5109**	-2.1000	-34.3868***	-2.7600	-8.9452*	-1.7100
Wx * Open	-0.0144	-0.4600	-0.1993**	-1.9700	-0.0408	-1.3600
ρ	0.1770***	3.2300	-0.4693***	-2.6200	0.0279*	0.3500
σ2	0.0012***	17.2200	0.0012***	17.2000	0.0013***	17.3200
Log-likelihood	1161.5649		1160.9096		1151.0245	

Note: * * * indicates significance at the 0.01 level** Indicating significance at the level of 0.05* Indicating significance at the level of 0.1

Through the results of spatial econometric models, it can be concluded that the impact of energy technology transformation on the quality of economic growth is not simply a promotion or inhibition relationship, but presents a "U" - shaped influence relationship, that is, its impact on the quality of economic growth varies at different stages of energy technology transformation, confirming the hypothesis in this chapter.

4.2.2 Reliability Analysis

In terms of the direct effects of energy technology transformation, there is a significant "U-shaped" relationship between energy technology transformation and the quality of economic growth within the region, and the effect is even stronger under the influence of regional geographical adjacency. This indicates that in the short term, the level of energy technology transformation is relatively weak, whether from the perspective of energy-saving and emission reduction technology innovation or non fossil energy utilization technology innovation. Its high cost and low benefits cannot compensate for the environmental benefits brought by green innovation; In the long run, mature energy technology can play a good role in economies of scale, and through the non-equilibrium power of technology, promote the reconfiguration of factor resources, drive the development of the clean energy industry, achieve dual benefits of economy and environment, and improve the quality of economic growth.

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4.2.3 Validity Analysis

1) Analysis and Statistics

In terms of the indirect effects generated by energy technology transformation, the impact of energy technology transformation within the region on the quality of external economic growth also presents a "U" - shaped effect, and the effect is stronger under the influence of regional geographical distance. The reason for this may be that although energy technology patents are intangible assets, the positive externalities of technology and knowledge achievements promote the circulation and imitation of technological elements. When the level of energy technology is low in the short term, the technology core areas will rely on market mechanisms to absorb factor capital from neighboring regions. The transfer of factors causes a significant decrease in productivity in geographically adjacent provinces and economically disadvantaged areas. Energy technology spillover dominated by polarization effects cannot exert positive economic and environmental benefits on external regions.

2) Effectiveness Analysis Results

Compared to short-term spatial effects, the spatial effects of energy technology transformation are more pronounced in the long term. In the long run, the level of energy technology transformation gradually matures, and at this time, both the diffusion ability of regional energy technology and the absorption ability of energy technology receiving areas are improved. The replication and transfer of energy technology transformation achievements between regions, as well as the development of production methods and green trade activities, will to some extent promote the transformation of green industry structure in neighboring regions, form a regional energy technology leading and driving green industry development model, and thus promote the coordinated improvement of economic growth quality.

3) Verification statistics

From the perspective of policy timeliness, on the one hand, energy conservation policies have short-term policy effects, but their sustainability is not strong, while the immediate effects of new energy industry policies are relatively poor, with more significant effects in the long term. This indicates that promoting the transformation and development of high energy consuming industries is a long process, and China should attach great importance to the dependence of industrial development on fossil energy consumption such as coal, and provide necessary support for the transformation and development of energy enterprises. On the other hand, the lagged effect of the energy policy combination is also more significant. This indicates that in the short term, the fact that China is the world's largest energy consumer and greenhouse gas emitter cannot be changed. We should fully recognize the long-term and arduous nature of the energy transformation process and energy policy transformation work, clarify the long-term strategic goals of energy policy formulation, and integrate them with social and economic activities to promote the optimization of energy resource allocation and the upgrading of consumption structure, promote the green development of industries, and thereby improve the quality of economic growth

4.4 Summary of the Results

This study evaluates the spatial effects of energy technology transformation on the quality of economic growth using a Spatial Durbin Model (SDM) under different spatial weight matrices. The results consistently indicate a nonlinear "U-shaped" relationship between the level of energy technology transformation and economic growth quality, both within regions (direct effects) and across neighboring regions (indirect spatial spillover effects). The empirical findings show that in the early stages of energy technology transformation, high innovation costs and limited output efficiency can suppress growth quality. However, in the later stages, once technology matures and economies of

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scale emerge, energy technology contributes positively to economic and environmental performance. This is evident in both innovation dimensions: new energy utilization and energy-saving/emission-reduction technologies. In terms of spatial spillovers, the "U-shaped" effects are more pronounced when using the geographic distance weight matrix, suggesting that spatial proximity intensifies both negative and positive externalities. In the short term, underdeveloped regions neighboring innovation hubs may suffer from resource outflows and reduced productivity, while in the long term, knowledge diffusion and technology absorption enable these regions to benefit from green innovation and structural upgrading. Control variables further support the robustness of the model. Notably, population density and environmental regulation exert significant negative spatial impacts on growth quality, with the latter showing stronger inhibitory effects across neighboring areas. These findings underscore the complex dynamics between policy, innovation, and regional interdependence. Overall, the results validate the chapter's hypothesis that energy technology transformation has stage-dependent and spatially heterogeneous impacts on economic growth quality. Policymakers should therefore adopt differentiated strategies that balance short-term innovation costs with long-term regional coordination and capacity-building to harness green technological progress effectively.

5. Conclusion, Discussion, and Recommendation

5.1 Conclusion

Based on the simulation analysis results presented in the study, it is evident that the development trend of China's future economic growth quality is closely tied to the country's energy transformation trajectory. The three major energy transformation pathways, energy structure transformation, energy technology transformation, and energy policy transformation, each play a significant role in enhancing the quality of economic growth. Among these, energy structure transformation emerges as the most influential factor in the long run. Meanwhile, energy policy transformation, largely driven by government interventions, plays a dominant role in steering the regional energy transition processes, and energy technology transformation serves as a critical means for implementation at the enterprise level. The results further suggest that combinations of different transformation paths yield varying effects, and the synergy between policy and structure transformation is particularly effective. Hence, strategic energy transformation not only determines China's carbon neutrality progress but also becomes a lever for sustainable economic quality improvement.

5.2 Discussion

The study identifies that while each of the three energy transformation paths contributes to enhancing economic growth quality, their individual and combined impacts vary over time. Initially, before 2030, energy technology transformation and energy structure transformation are found to have comparable impacts. However, by 2050, energy structure transformation distinctly outpaces the others in terms of effectiveness. Despite this, the energy policy transformation demonstrates the strongest and most sustained positive effect across the entire simulation period. This suggests that policy support provides the essential framework for enabling and guiding both technological and structural transformations.

Importantly, the study underscores the complementarily between energy policy and structure transformation. The combination of these two approaches yields the most stable and substantial improvements in economic growth quality over time. Conversely, reliance solely on energy technology and structural transformation without adequate policy support tends to generate weaker

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outcomes. This highlights the critical role of state intervention and coordinated policy frameworks in aligning technological innovation and structural shifts with national development goals.

Moreover, regional disparities in China continue to pose a challenge to uniform energy transformation. Regions with limited economic capacity and infrastructure may struggle to implement all three transformation pathways simultaneously. Therefore, differentiated and context-specific strategies, tailored to the developmental conditions of each region, are essential for achieving equitable progress in energy transformation and economic growth quality nationwide.

5.3 Recommendation

To promote high-quality economic growth through energy transformation, the following recommendations are proposed:

1) Strengthen Energy Structure Transformation: Emphasize optimizing the national energy mix by gradually reducing coal dependency and expanding the share of clean and renewable energy sources. By 2050, this transformation is projected to yield the most substantial improvements in economic growth quality, indicating its long-term strategic value.

2) Enhance the Synergy Between Policy and Structural Changes: Develop integrated policy frameworks that incentivize and regulate energy structure adjustments, ensuring alignment with national carbon reduction and economic development targets. Policies should provide long-term guidance, investment support, and regulatory certainty to facilitate private and public sector participation.

3) Use Technology Transformation as an Implementation Tool: Promote innovation-driven energy technology solutions at the enterprise level, but within a well-structured policy and structural transformation framework. Without such alignment, technology-led efforts may lead to inefficient resource allocation and opportunity costs.

4) Adopt Regionally Differentiated Strategies: Recognize and address the uneven economic and infrastructural conditions across regions in China. Local governments should be encouraged to adopt energy transformation measures that are compatible with their regional development status and resource endowments.

5) Balance Fossil and Clean Energy Resources: Given China's energy resource profile ("rich coal, low oil, and low gas"), efforts should be made to improve fossil energy efficiency while accelerating clean energy development through technological innovation. This dual approach will help stabilize energy supply, reduce emissions, and support sustainable economic quality improvement.

6) Institutional Mechanism Reform: Promote deeper institutional reforms that support market-based energy transformation, such as energy pricing, carbon trading, and performance-based regulation. Institutional innovation is key to ensuring that technological and structural changes translate into tangible economic outcomes.

In summary, a coordinated, policy-led, and regionally adaptive approach to energy transformation, centered on structural optimization and guided technological innovation, will be essential for China to achieve high-quality economic growth while ensuring energy security and environmental sustainability.

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A Study of Factors Affecting the Customer Loyalty of Fitness Gyms in Beijing, China

by

Liang Xinquan
International College, Phetchabun Rajabhat University,
Phetchabun, Thailand
E-mail: Liangxinquan123@gmail.com

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Liang Xinquan
International College, Phetchabun Rajabhat University,
Phetchabun, Thailand
E-mail: Liangxinquan123@gmail.com

Abstract

This study investigates the key factors influencing customer loyalty at Superlife Fitness Club, focusing on perceived service quality and brand image. Using a mixed-methods approach, data were collected from 400 club customers through structured questionnaires. The demographic profile revealed that the majority of customers are young (18–30 years old), male, well-educated, and earn moderate to high incomes. Descriptive statistics showed high levels of customer satisfaction, reflected in strong mean scores for perceived quality and brand image. Pearson correlation analysis confirmed significant positive relationships between these factors and customer loyalty, highlighting their crucial roles in fostering long-term commitment. Additionally, demographic variables such as age and gender were found to significantly affect loyalty, with younger and male customers demonstrating higher loyalty levels. Based on these findings, tailored loyalty programs were recommended, including customized fitness classes, enhanced service quality through staff training, strategic social media marketing, digital loyalty systems, and improvements to the club's physical environment. The study offers practical insights for fitness club managers aiming to strengthen customer engagement and competitive advantage. Limitations include the study's geographic focus and the evolving nature of the fitness industry, suggesting avenues for future research incorporating broader samples and digital innovations.

Keywords: Fitness Industry, Customer Loyalty, Perceived Quality, Brand Image

1. Introduction

1.1 Background and Importance of the Problem

In today's highly competitive market, most organizations strive to gain unique advantages over their rivals in order to secure a favorable position. Customers increasingly seek suppliers that can provide superior goods and services. With many suppliers now offering high-quality products, consumers are presented with multiple options when purchasing goods and services. As a result, they actively search for distinguishing features that can help them identify the optimal provider (Kavousi & Saghaei, 2005).

In the context of China, public awareness of healthy lifestyles has been rising steadily (Wu et al., 2022). Engaging in regular physical activity at fitness centers is recognized as an effective means of maintaining health. This growing awareness has fueled a surge in demand for health-oriented services, leading to a boom in the fitness gym industry. Fitness gyms, which offer indoor sports

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facilities and related amenities, are increasingly viewed as safe, convenient, and diverse environments for exercise (Huang and You, 2004).

According to Jeng (2012), over 30,000 fitness clubs have been established in the United States, and more than 38,000 across Europe. In Taiwan, approximately 1,500 fitness clubs are currently in operation. However, Chen (2012) noted a decline in the total number of fitness service companies, employee turnover, and average staff numbers in Taiwan since 2007. Despite this, the proliferation of fitness gyms continues, intensifying competition in the industry.

The competitive nature of the fitness industry requires clubs to adopt two key strategies: acquiring new customers and retaining existing ones. While acquiring new members is important, retaining current customers is more cost-effective and leads to greater long-term value. Many fitness companies have therefore turned their focus toward cultivating customer loyalty, which is considered essential for business sustainability (D'Ecary-Hétu and Quessy-Doré, 2017). Loyal customers not only make repeat purchases and pay premium prices but also contribute to business growth by generating positive word-of-mouth referrals (Ganesan et al., 2021). Moreover, the cost of acquiring new customers is generally five times higher than the cost of retaining existing ones (Edward and Sahadev, 2011).

Marketing literature emphasizes the need to build lasting relationships with customers as a foundation for achieving loyalty (Nguyen et al., 2013). In the case of fitness centers, particularly those operating in highly competitive urban environments, understanding how to boost customer loyalty is crucial to long-term success. As Dekimpe et al. (2022) argue, firms that effectively retain their current customers and foster brand loyalty are better positioned for sustained profitability.

Against this backdrop, Superlife Fitness Club, operating in Beijing, faces the dual challenge of maintaining its current customer base while also growing its market share. With economic pressures and fierce competition in tier-one cities, gaining insights into the key drivers of customer loyalty is essential for developing effective business strategies. This study, therefore, aims to investigate the specific factors that influence customer loyalty within the context of Superlife Fitness Club.

1.2 Research Question

Based on the discussion above, it is evident that retaining current customers is vital for Superlife Fitness Club to remain competitive and reduce operational costs amid economic uncertainty. Therefore, this study seeks to answer the following research question:

RQ: What factors may affect customer loyalty at Superlife Fitness Club in Beijing, China?

1.3 Research Objective

The primary objective of this study is to explore and analyze the determinants that significantly influence customer loyalty at Superlife Fitness Club. In particular, the research focuses on two critical constructs widely recognized in the service industry: perceived service quality and brand image.

Furthermore, the study aims to examine how various demographic factors—including age, gender, educational attainment, income, and marital status—interact with these constructs and

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influence customer loyalty. By understanding these interactions, Superlife Fitness Club can segment its customer base more effectively and develop tailored marketing strategies.

In addition, the study seeks to provide practical and actionable recommendations for club management. These recommendations will be based on the research findings and are intended to support the development of strategies that improve customer retention and satisfaction. Ultimately, the goal is to help Superlife Fitness Club strengthen its competitive position in the fitness market by fostering a loyal customer base.

2. Literature Review

2.1 Related Concepts and Theories

Customer loyalty is a complex and multifaceted construct that has received extensive attention in marketing and service management literature. It is typically defined as a deep and enduring commitment by a customer to continue purchasing or using a product or service over time. In service industries such as fitness clubs, customer loyalty is shaped by a range of interrelated factors, with perceived service quality and brand image being especially prominent.

Perceived quality refers to a customer's subjective evaluation of the overall excellence of the service provided. It includes several dimensions: the effectiveness of the fitness programs, the competence and professionalism of staff and instructors, the cleanliness and maintenance of facilities, and the responsiveness and friendliness of employees. These perceptions are formed through direct interactions and experiences with the fitness club and serve as a critical determinant of customer loyalty.

Brand image, meanwhile, represents the collective perception and overall impression that a customer holds about the brand. It incorporates elements such as reputation, visual identity, brand personality, and the emotional and psychological associations customers attach to the brand. A strong and favorable brand image enhances customer trust, generates differentiation in the market, and increases the likelihood of continued patronage.

Both constructs are further influenced by demographic characteristics such as age, gender, income, educational background, and marital status. These demographic variables often moderate customers' expectations, preferences, and behavior patterns, thereby shaping their level of loyalty to a fitness club.

2.2 Literature Surveys

Numerous empirical studies have supported the importance of perceived quality and brand image in influencing customer loyalty. Research in the fitness industry has consistently demonstrated that when customers perceive a high level of service quality—particularly in terms of well-maintained facilities, professional instructors, and responsive service—they are more likely to remain committed to the club and recommend it to others.

Similarly, a strong brand image has been found to contribute significantly to customer loyalty by reinforcing customer trust and emotional connection with the service provider. A positive brand image can serve as a psychological anchor that encourages customers to overlook minor service failures and continue their patronage.

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Additionally, several studies have explored how demographic factors interact with service perceptions. For instance, younger customers may prioritize modern equipment and technology integration, while older clients may value personalized service and staff attentiveness. Understanding these nuances allows fitness clubs to tailor their strategies to the expectations of diverse customer segments.

2.3 Conceptual Framework

Based on the theoretical foundations and empirical evidence reviewed above, this study proposes a conceptual framework linking three key constructs: perceived quality, brand image, and customer loyalty, while accounting for demographic differences.

The framework posits that:

1) Perceived quality positively influences customer loyalty.

2) Brand image positively influences customer loyalty.

3) Customer demographic characteristics may moderate these relationships.

This framework serves as the foundation for testing the relationships between the constructs and understanding how they jointly impact customer loyalty in the context of Superlife Fitness Club in Beijing.

2.4 Research Hypothesis

Drawing from the research objectives and conceptual framework, the study proposes the following hypotheses:

H1: There are significant differences in perceived quality, brand image, and customer loyalty among customers of Superlife Fitness Club in Beijing based on demographic background (age, gender, education, income, marital status).

H2: There is a positive relationship between perceived quality, brand image, and customer loyalty among customers of Superlife Fitness Club in Beijing.

3. Research Methodology

3.1 Research Design

This study employed a mixed-method approach, integrating both quantitative and qualitative research methods to comprehensively analyze data obtained from research surveys and to draw valid conclusions.

1) Qualitative research in this study served an exploratory purpose. It was used to understand the potential causes, viewpoints, and motivations of the participants. It provided deep insights into emerging problems and helped formulate potential hypotheses. Data was collected using semi-structured techniques, particularly focus group discussions, to explore customer engagement indicators. This approach is consistent with DeFranco (2011), who emphasized that qualitative

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research often uses small sample sizes and unstructured or semi-structured methods like interviews, observations, and focus groups.

2) Quantitative research was used to gather and analyze numerical data, providing measurable evidence to support statistical conclusions. This method quantified variables such as customer attitudes, opinions, behaviors, and satisfaction. Data collection tools included structured surveys, ensuring consistent data for analysis. Following DeFranco (2011), techniques such as face-to-face interviews, mobile surveys, and online questionnaires were deemed appropriate.

As this study aims to support marketing operations and strategic decision-making, it primarily adopts a descriptive research design, which helps to:

- Describe characteristics of specific customer groups,
- Estimate frequency patterns, and
- Measure the relationships between variables such as service quality, brand image, and customer loyalty.

3.2 Population and Sample

The target population consisted of customers of Superlife Fitness Club. Due to logistical constraints and the need for efficient data gathering, the study used a convenience sampling method.

A total of 400 participants were selected based on precedent in similar studies and the statistical power needed for correlation testing. The sample represented diverse customer segments across age, gender, education, income, and marital status, providing a comprehensive cross-section of the club's clientele.

3.3 Research Instruments

The primary tool for collecting data was a structured questionnaire, developed based on a thorough review of relevant literature to ensure content validity and clarity. The questionnaire was divided into four key sections:

1) Demographic Information – Captured age, gender, education level, marital status, and income.

2) Service Quality Perception – Measured using a five-point Likert scale, assessing customer opinions on various aspects of service quality.

3) Brand Image – Included multiple items to evaluate customer perceptions and emotional associations with the brand.

4) Customer Loyalty – Focused on assessing behavioral intentions such as continued use, word-of-mouth referrals, and commitment to the brand.

Questions were worded clearly to avoid ambiguity and ensure reliable responses.

3.4 Data Collection

Data were gathered directly from customers of Superlife Fitness Club using on-site distribution of the structured questionnaire. Focus group discussions were also conducted to

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complement survey findings and to derive qualitative insights about customer engagement. Both types of data were collected during a specific timeframe, with appropriate measures taken to ensure ethical standards, confidentiality, and voluntary participation.

3.5 Statistics Used for Data Analysis

The collected data were analyzed using both descriptive and inferential statistical methods, employing SPSS software for reliability and accuracy.

1) Cronbach's Alpha was used to assess the reliability of the scales used in the questionnaire.

2) Descriptive statistics (mean, frequency, percentage) summarized demographic variables and responses.

3) Pearson correlation analysis was conducted to examine the relationships between independent variables (e.g., service quality, brand image) and the dependent variable (customer loyalty).

This methodological approach allowed for a robust analysis of customer engagement and loyalty in the context of a fitness service provider.

4. Data Analysis and Findings

4.1 Introduction

This chapter presents the results of the data analysis conducted to examine the relationships between perceived service quality, brand image, and customer loyalty among members of Superlife Fitness Club. The purpose of this analysis is to uncover patterns, trends, and statistical relationships that provide insights into customer behavior and preferences, thereby supporting the research hypotheses. Both descriptive and inferential statistics were employed to interpret the data collected from 400 respondents using structured questionnaires. The descriptive statistics help summarize the demographic characteristics of the sample, including age, gender, education level, income, and marital status, providing a comprehensive profile of the club's typical customer. Furthermore, descriptive measures such as mean and standard deviation were used to evaluate key constructs, including perceived quality, brand image, and customer loyalty. The analysis also applied Pearson correlation tests to assess the strength and significance of relationships among these variables. Additionally, the influence of demographic variables on customer loyalty was explored to determine which groups show higher levels of loyalty and engagement. Based on these findings, practical recommendations were developed to enhance customer retention and competitive positioning. This chapter thus bridges raw data with actionable insights, laying the foundation for the discussion and conclusion of the study.

4.2 Data Analysis of the Quantitative Data

4.2.1 Descriptive Statistics

The respondents' demographic analysis showed that most of the customers were male, making up 69% of the sample. In terms of age, the largest group (40.5%) was between 18 and 30 years old. As for educational attainment, 55.2% of the respondents had a bachelor's degree.

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Concerning marital status, 51.5% were single, and regarding income, 54.5% had a monthly income of 10,000 - 100,000 RMB. These demographic results give valuable insights into the typical customer of Superlife Fitness Club. They help in understanding customers' preferences, needs, and behaviors. Younger customers and those with higher education may have different fitness goals and expectations compared to other groups. This information can be used to make targeted marketing and service plans.

4.2.2 Perceived Quality and Brand Image

The mean scores of perceived quality and brand image were quite high, showing that customers generally have a good impression. For example, the mean score for service quality excellence was 4.93, meaning that customers are mostly satisfied with the club's services. This means the club has been good at providing services that meet or are better than what customers expect in terms of quality. High - perceived quality not only makes customers more satisfied but also is a strong sign of customer loyalty. In the same way, a good brand image can make the club's services seem more valuable and create an emotional bond with customers, making them more loyal.

Table 1 Level of Each Variable

Variable	Mean	Standard Deviation
Perceived Quality	4.934	0.417
Brand Image	4.893	0.459
Customer Loyalty	4.944	0.220

4.2.3 Relationship between Variable

The Pearson correlation analysis results revealed significant positive correlations. The correlation coefficient between perceived quality and customer loyalty was 0.766 ($p < 0.001$), and that between brand image and customer loyalty was 0.847 ($p < 0.001$). These results strongly support the research hypotheses, indicating that better perceived quality and a stronger brand image lead to higher customer loyalty. Customers who highly value the club's quality and have a good brand image in their minds are more likely to remain loyal and actively recommend the club. This relationship highlights the importance of improving service quality and building the brand to enhance customer loyalty.

Table 2 The relationship between Customer Loyalty and Predictors

Variable		r-value	p-value	Decision	Interpretation
Customer Loyalty	Perceived quality	0.766	0.000	Reject null hypothesis	Significant strong positive correlation
	Brand image	0.847	0.000	Reject null hypothesis	Significant strong positive correlation

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4.2.4 Impact of Demographic Variables

The analysis also showed that age and gender significantly influence customer loyalty. Customers who are younger (18–30 years old) and male are more loyal than other groups. However, education level, marital status, and income do not have a significant direct effect on customer loyalty. This means the club should focus on attracting younger and male customers but also consider other factors that could affect loyalty. For example, younger customers might prefer trendy and new fitness programs, while male customers may have different fitness preferences compared to female customers. Understanding these differences can help the club create more personalized and effective loyalty programs.

4.2.5 Customer Loyalty Program Recommendations

According to the research results, some suggestions for customer loyalty programs are made. These suggestions involve customizing fitness classes for different age groups and income levels, improving service quality by training staff and optimizing processes, increasing brand awareness and reputation through strategic social media marketing and partnerships, and fostering customer loyalty through personalized interactions and incentives. For example, the club could create special fitness programs for young adults, provide discounted group classes for low - income customers, invest in top - notch equipment and keep the club environment clean and inviting, and start a loyalty points system to reward customers for their continuous patronage and referrals. These programs can assist the club in improving customer loyalty and achieving a competitive edge in the market.

Table 3 Customer Loyalty Program

Objective	Initiatives	Measure	Person
Care different gender and age customer	Set different contents class for different age group customer	The increase 10% customer of female customer and different age customer.	Coach Team Manager/ Vice President/ Sale Manager
Attract different income customer	Providing some cheap class or group class with lower price for lower income customer, and providing one to one class to those high income customer	The increase 10% customer of low income and high income customer.	Coach Team Manager/ Vice President/ Sale Manager
Attract different education level customer	Set fitness club as social platform, to help their customer to know more friends or business partners	The increase 10% customer of different education level customer	Coach Team Manager/ Vice President/ Sale Manager
Customer Big Data analysis	Set a comprehensive digital system to manage the information of customer with different demographic information and class, set “loyal points” for each customer	The percentage of customer information in digital system and increase “loyal points” of customer (100%)	IT Manager/ /Customer Relationship Manager
Increase the perceived value of their customer	Make sure customer have a "give and take" mentality (sense of gain) with reasonable price, using a good price strategy to attract target customer.	The percentage of customer satisfaction toward price and value (increase 10%)	Vice President/ Marketing Manager/ Sale Manager

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Increase the perceived quality of their customer	Improve service quality, deeper know customer demand and to satisfy their demand, increasing training for all employee	The percentage of customer satisfaction toward service quality (increase 10%)	Vice President/ Marketing Manager/ Sale Manager
Increase the brand image of their customer	Make its brand be more famous in China, spend more money on media especially on new medias, such as Wechat and Tiktok	The percentage of customer or audience give a "like" on new media, the percentage of sale compare with advertising spending (increase 10%)	Vice President/ Marketing Manager/ Sale Manager
Improve the physical environment	Pay more attention on physical facilities, infrastructure, functions, equipment, cleanliness and environmental peace room. Then, they also need to care the smell and other physical environment.	The percentage of customer satisfaction toward physical environment (increase 10%)	Vice President/ Shop Manager
Increase the customer commitment of their customer	Pay more attention on how to build customer commitment, the customer commitment can help customer spend more time in the fitness club and keep long time relationship with fitness club. And those fitness club can build good training to it staff which spend more time with customer, know their demand, and then build customer commitment with customer for their fitness clubs.	The increase average time of each customer spending in all shops or with employee of Superlife fitness club (increase 10%)	Vice President/ Marketing Manager/ Sale Manager

4.3 Summary of the Results

The results of the study offer important insights into the customer profile and loyalty dynamics at Superlife Fitness Club. The demographic analysis showed that most customers are male (69%), aged 18–30 (40.5%), and hold a bachelor's degree (55.2%), with over half earning between 10,000–100,000 RMB monthly. These findings highlight a core customer base of young, educated, and financially capable individuals. Perceptions of the club are highly positive, with strong mean scores for perceived quality (4.934) and brand image (4.893), reflecting high customer satisfaction and a favorable brand impression. Correlation analysis revealed significant and strong positive relationships between customer loyalty and both perceived quality ($r = 0.766$) and brand image ($r = 0.847$), confirming that improving service quality and strengthening brand image are key drivers of loyalty. Additionally, age and gender were found to significantly influence loyalty, with younger and male customers showing greater commitment, while other demographic factors had limited impact. Based on these findings, several loyalty program recommendations were proposed, including offering customized fitness classes by age and income level, enhancing service through staff training, leveraging social media to build brand awareness, implementing a digital loyalty system, and improving the club's physical environment. These targeted strategies aim to deepen customer engagement, enhance satisfaction, and foster long-term loyalty, positioning the club for sustained success in a competitive fitness market.

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5. Conclusion, Discussion, and Recommendation

5.1 Conclusion

This study concludes that perceived quality and brand image are significant determinants of customer loyalty in Superlife Fitness Club. The majority of the club's customers are young, male, single, highly educated, and earn relatively high incomes. By enhancing the perceived quality of its services, reinforcing its brand image, and implementing targeted loyalty initiatives, Superlife Fitness Club can effectively foster customer loyalty and improve its competitive standing in the fitness market. These findings offer valuable guidance for fitness club managers and marketers in understanding the key drivers of customer loyalty.

5.2 Discussion

The results emphasize the strategic importance of investing in service quality and brand image to retain customers in a competitive fitness environment. Customers' perceptions of quality influence not only their satisfaction but also their long-term commitment to the club. A strong brand image can reinforce emotional attachment, trust, and perceived value, all of which are critical to customer loyalty. The demographic profile suggests that a personalized and premium service strategy may resonate more with the current clientele. However, while perceived quality and brand image are impactful, other factors—such as customer satisfaction, switching costs, and competitive alternatives—may also contribute to loyalty but were not the focus of this study. These additional variables warrant further investigation.

Moreover, the study was geographically limited to Beijing and focused only on one fitness club, which limits generalizability. The dynamic nature of the fitness industry, including the increasing role of digital platforms and virtual services, points to a need for broader and more technologically focused future studies.

5.3 Recommendation

Superlife Fitness Club should prioritize continuous service quality improvement by investing in staff training, ensuring consistency in program delivery, and fostering a customer-centric culture. The club should also develop and execute a comprehensive brand-building strategy that leverages both digital and traditional marketing channels to enhance brand visibility and reputation.

Additionally, customer loyalty programs should be carefully designed, regularly monitored, and adapted based on customer feedback and evolving expectations. The club is encouraged to conduct regular customer satisfaction surveys to identify areas for improvement and track service performance.

Future efforts should consider expanding the study scope to multiple clubs and regions and exploring the long-term effects of loyalty strategies. Incorporating technological innovations, such as virtual fitness classes, mobile fitness apps, and data-driven personalization, may also provide new opportunities to enhance customer engagement and loyalty in the digital age.

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Social Stratification and Coffee Consumption Groups in Guangxi: Exploring the Mechanisms Influencing Consumption Behavior and the Moderating Role of Price Sensitivity

by

Qinshiyi Yan
Panyapiwat Institute of Management,
Nonthaburi, Thailand
E-mail: 472277587@qq.com

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Social Stratification and Coffee Consumption Groups in Guangxi: Exploring the Mechanisms Influencing Consumption Behavior and the Moderating Role of Price Sensitivity

by

Qinshiyi Yan
Panyapiwat Institute of Management,
Nonthaburi, Thailand
E-mail: 472277587@qq.com

Abstract

This study investigates the interplay between social stratification, consumer behavior, and price sensitivity within the context of coffee consumption in China. Drawing on classical sociological theories from Marx and Weber, and applying Lewin's behavioral framework, the study conceptualizes social stratification through education, occupation, income, and vehicle ownership, with consumer behavior as the dependent variable and price sensitivity as a moderating factor. Using data collected from 412 respondents, reliability and validity of the constructs were confirmed. Correlation and regression analyses revealed that social stratification alone does not significantly influence consumer behavior; however, price sensitivity significantly moderates this relationship ($\beta = 0.916$, $p < 0.001$), substantially enhancing model explanatory power ($R^2 = 0.842$). Age emerged as a critical demographic factor, influencing price acceptability and brand preference, while income shaped consumers' acceptable price range. The findings suggest that coffee consumption is shaped more by the emotional and symbolic value of the product than by stratification alone. The study recommends that coffee brands adopt differentiated pricing strategies based on price sensitivity, focus on product uniqueness and ethical pricing, and cultivate brand loyalty through cultural and emotional engagement.

Keywords: Coffee, Consumption Behavior, Price Sensitivity

1. Introduction

1.1 Background and Importance of the Problem

Since coffee was introduced to the Chinese market over a century ago, the industry has experienced substantial growth, making coffee consumption a fashionable trend enthusiastically embraced by consumers. According to iResearch data, China's coffee market size reached 381.7 billion RMB in 2021. In the first half of 2022, the number of coffee shops in Guangxi surged by 265%, with 7,993 coffee-related businesses registered across 14 cities in the region. Influenced by Western lifestyles, coffee has long been viewed as a symbol of a refined and high-quality lifestyle. Over time, it has evolved from a special occasion drink to a habitual product, deeply embedded in consumers' daily routines and financial considerations. Despite the popularity and rapid expansion of coffee consumption in Guangxi, most existing research primarily addresses health impacts, agricultural processes, or consumer motivations and emotional responses. There is a notable gap concerning how social stratification affects coffee purchasing behavior, particularly when moderated

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by consumers' price sensitivity. This study aims to fill that gap by providing new insights into consumer behavior in the region.

1.2 Research Question

This study seeks to answer two core questions: First, what is the social stratification profile of coffee consumers in Guangxi? Second, how do consumers from different social strata perceive and respond to varying coffee price levels, particularly considering the moderating role of price sensitivity?

1.3 Research Objective

The primary objective of this research is to investigate the relationship between social stratification and coffee purchasing behavior, with a specific focus on the moderating effect of price sensitivity among coffee consumers in Guangxi. By addressing these objectives, the study aims to contribute valuable knowledge to consumer behavior research and support more effective market segmentation strategies within the region.

2. Literature Review

2.1 Related Concepts and Theories

2.1.1 Social Stratification

Social stratification refers to the hierarchical ordering of social relationships, categorized into various levels based on different criteria across historical periods. The theoretical foundations of social stratification mainly derive from Karl Marx's class theory and Max Weber's multidimensional stratification theory.

In China, Lu Xueyi introduced a social stratification system based on occupational classification, dividing society into ten tiers across five levels. Li Li further simplified this into three broad classes (upper, middle, lower) based on scores from occupation, education, and income, although such occupational classifications can be limited.

Another approach, exemplified by scholars such as Xie Jianshe and Huang Jiangquan, emphasizes household registration and the rural-urban divide, particularly focusing on migrant workers. As China's social structure evolves, the criteria for stratification diversify, increasingly recognizing the influence of social and cultural factors. This study adopts education level, occupation, income, and household vehicle ownership as variables to represent social stratification.

2.1.2 Consumer Behavior

Consumer behavior is shaped by individual cognitive patterns that can vary even within the same person across contexts, complicating the identification of a single analytical model. Based on Watson's stimulus-response (S-R) theory, Kurt Lewin proposed the behavior formula: $B = f(P, E)$, where B is behavior, P is the person (individual or group), and E is the environment (social and physical). Personal factors such as age, education, occupation, and income notably influence consumer behavior.

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Consumption objects can be categorized into internal attributes (e.g., usability, quality, and functionality) and external attributes (e.g., price, packaging, brand, reputation).

2.1.3 Price Sensitivity

Price sensitivity describes the extent to which consumers perceive and respond to price changes. Factors influencing price sensitivity include consumer factors—such as age, product familiarity, budget proportion, price expectations, and perceived value—and product factors—such as availability of substitutes, product significance, uniqueness, usability, and switching costs. Marketers often adjust strategies based on the varying price sensitivity of consumer segments.

2.2 Literature Surveys

Analysis of the moderating role of price sensitivity on social stratification and consumer behavior in Guangxi's coffee market reveals key insights. Table 1 shows a positive correlation between price sensitivity and the proportion of product cost within consumer groups, indicating that higher-income groups generally have lower price sensitivity, whereas lower-income groups are more sensitive to price changes. Table 2 demonstrates a negative correlation between price sensitivity and product importance. Coffee, once valued mainly for its stimulating effects, now holds unique emotional significance and has become an essential part of daily life for many consumers.

2.3 Conceptual Framework

This study proposes a conceptual framework in which social stratification, operationalized through education level, occupation, income, and household vehicle ownership, serves as the independent variables influencing coffee consumer behavior as the dependent variable. Price sensitivity is introduced as a moderating variable, hypothesized to affect the relationship between social stratification and consumer behavior. The framework is grounded in Lewin's behavioral formula ($B = f(P, E)$), which emphasizes the interaction between personal factors and environment in shaping behavior. The framework guides empirical analysis of how variations in social strata and price sensitivity jointly shape coffee consumption patterns among consumers in Guangxi.

Table 1 Relationship between Price Sensitivity and Consumer-Related Factors

Consumer Factor	Age	Product Familiarity	Price Proportion	Price Change Expectation	Value Perception
Price Sensitivity	Negative	Positive	Positive	Negative	Negative

Table 2 Relationship between Price Sensitivity and Product-Related Factors

Product Factor	Substitutes	Importance	Uniqueness	Usability Attributes	Switching Costs
Price Sensitivity	Positive	Negative	Negative	Positive	Negative

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2.4 Research Hypothesis

Based on the above analysis, the study proposes the following hypotheses:

H1: A positive correlation exists between social stratification and consumer behavior.

H2: Social stratification positively influences consumer behavior through price sensitivity.

H3: Price sensitivity negatively moderates the role of coffee's importance within consumer group stratification.

3. Research Methodology

3.1 Research Design

This study employed a quantitative research design using a structured questionnaire developed based on established scales and prior surveys. The questionnaire was tailored to fit the developmental level of the Guangxi region and the current coffee industry context. Measurement variables included nominal, ordinal, and ratio types, with responses recorded on a five-point Likert scale ranging from 1 ("strongly disagree") to 5 ("strongly agree").

3.2 Population and Sample

The target population comprised coffee consumers in Guangxi. A total of 413 questionnaires were distributed online via Wenjuanxing, a popular survey platform in China. After excluding one invalid response due to logical inconsistencies, 412 valid questionnaires were obtained, yielding a 99.76% valid response rate. The demographic profile of respondents showed 39.8% male and 60.2% female participants. Educational levels included 5.1% with high school education or below, 74.5% holding college degrees or equivalents, and 20.4% with graduate degrees or higher. Occupational categories covered a wide range based on Ministry of Human Resources and Social Security standards. Income levels varied across six brackets, with the majority earning between 10,001 and 100,000 RMB annually. Compared to the general population in Guangxi, the sample had relatively high education and income levels, matching the profile of typical coffee consumers.

3.3 Research Instruments

The questionnaire items were derived from validated measurement scales and adjusted according to the research context. To ensure reliability and validity, a pilot survey was conducted with 10 randomly selected coffee consumers. Feedback from the pilot was used to refine the questionnaire. Reliability was assessed through Cronbach's alpha, while validity was evaluated using the Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity.

3.4 Data Collection

Data collection was conducted online through Wenjuanxing. Participants completed the finalized questionnaire, designed to measure variables related to social stratification (education, occupation, income, economic source, employment status, household vehicle ownership) and consumer behavior (purchase frequency, purchase reasons, product characteristics, purchase context, price considerations, and consumption factors).

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3.5 Statistics Used for Data Analysis

The study employed descriptive statistics to analyze demographic variables. Reliability and validity tests included Cronbach's alpha, KMO, and Bartlett's sphericity tests. Further inferential analyses were conducted to examine relationships among social stratification, consumer behavior, and the moderating effect of price sensitivity.

4. Data Analysis and Findings

4.1 Introduction

Reliability Testing: Cronbach's alpha was used to assess the reliability of the scales employed in this study. The Cronbach's alpha values for social stratification, consumer behavior, and price sensitivity ranged from 0.74 to 0.82, all exceeding the threshold of 0.7, indicating satisfactory reliability.

Validity Testing: Convergent validity was assessed using standardized factor loadings, with all loadings exceeding 0.5 and p-values less than 0.001. The t-values were above 2, and the Average Variance Extracted (AVE) values exceeded 0.5, with AVE square root values ranging from 0.817 to 0.986 and Composite Reliability (CR) values from 0.855 to 0.991. These results indicate strong convergent validity for the scales used.

Table 3 Reliability and Validity Testing

Variable	Measurement Item	Standardized Factor Loading	p-value	t-value	AVE	AVE Square Root	CR
Social Stratification Cronbach's α=0.739	Q11	0.86	0.000***	12.189	0.667	0.817	0.855
	Q12	0.923	0.000***	14.237			
	Q13	0.641	0.000***	29.431			
Consumer Behavior Cronbach's α=0.982	Q19	0.692	0.000***	6.91	0.860	0.927	0.991
	Q32	0.798	0.000***	6.425			
	Q3101	0.914	0.000***	7.780			
	Q3102	0.911	0.000***	6.452			
	Q3103	0.92	0.000***	5.239			
	Q3104	0.915	0.000***	4.434			
	Q3105	0.946	0.000***	7.784			
	Q3106	0.946	0.000***	7.784			
	Q3107	0.966	0.000***	9.874			
	Q3108	0.957	0.000***	3.808			
	Q3109	0.917	0.000***	3.784			
	Q31010	0.979	0.000***	9.422			
	Q31011	0.953	0.000***	8.483			
	Q31012	0.985	0.000***	9.344			
	Q31013	0.987	0.000***	8.943			
	Q31014	0.976	0.000***	3.843			

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	Q31015	0.950	0.000***	3.234			
	Q31016	0.933	0.000***	8.700			
Price Sensitivity Cronbach's α=0.963	q3301	0.945	0.001***	3.422	0.971	0.986	0.872
	q3302	0.945	0.000***	9.629			
	q3303	0.959	0.000***	12.236			
	q3304	0.891	0.000***	6.015			
	q3305	0.927	0.000***	10.349			

Note: *p < 0.05, **p < 0.01, ***p < 0.001, same applies below.*

4.2 Data Analysis of the Quantitative Data

4.2.1 Correlation Analysis

The correlations among key variables are presented in Table 4. Spearman's correlation analysis indicates a significant positive correlation between social stratification and price sensitivity ($r = 0.124$, $0.01 < p < 0.05$), showing a one-star level of significance. Additionally, a strong positive correlation is observed between consumer behavior and price sensitivity ($r = 0.915$, $p < 0.01$), with a two-star level of significance. These results provide preliminary support for the hypotheses proposed in this study.

Table 4 Preliminary Support for the Hypothesis

Variable	Social Stratification	Consumer Behavior	Price Sensitivity
Social Stratification	1	.129**	.124*
		0.009	0.012
Social Stratification		1	.915**
			0.000
Price Sensitivity			1

Note: Pearson Correlation, Sig. (two-tailed)

From the perspective of social stratification, this study uses age, educational level, occupation, and individual and household annual income as independent variables. A cross-tabulation analysis was conducted for these variables against six coffee purchasing factors: personal preference, coffee price, coffee quality, tendency to purchase coffee at regular price, tendency to purchase coffee at promotional price, and acceptable coffee price range. Table 5 presents the results of the Pearson Chi-square values and p-values for these associations.

The results in Table 5 indicate significant differences across age groups concerning the six coffee purchasing factors, suggesting notable variance in purchasing considerations and acceptable price ranges among different age groups. Educational level shows a one-star significance with personal preference, indicating a difference between the two. Occupation displays a two-star significance with regard to coffee price consideration, implying a relatively significant difference. Individual annual income shows a one-star significance for personal preference and regular price purchase tendency, suggesting discernible differences for both factors. Furthermore, both individual and household annual income exhibit three-star significance with acceptable coffee price range,

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underscoring substantial differences in coffee price acceptability based on income levels.

Table 5 Correlation Analysis of Social Stratification Variables

Variable	Age Group	Educational Level	Occupation	Individual Income	Household Income
Personal Preference	87.640***	38.108*	53.313	44.544*	30.478
Price	66.329***	29.717	67.564**	28.030	34.634
Quality	51.174*	18.905	37.360	21.452	15.600
Tendency to Buy at Regular Price	55.130**	21.461	51.520	44.364*	26.977
Tendency to Buy at Promotional Price	55.719***	20.624	36.563	23.418	24.962
Acceptable Coffee Price Range	77.373*	42.291	82.612	87.366***	89.594***

4.2.2 Hypothesis Testing Analysis

Main Effect Test: Models 1 and 2 in Table 6 were used to test the hypotheses. Model 1 serves as the baseline model, including only control variables for the dependent variable, while Model 2 builds upon Model 1 by incorporating the independent variable, social stratification. In Model 2, the coefficient $\beta_1 = 0.033$ with $p > 0.1$, indicating that Hypothesis 1 is not supported.

Moderating Effect Test: Model 3 extends Model 2 by adding the moderating variable, price sensitivity. The coefficient $\beta_2 = 0.916$ with $p < 0.001$, indicating a significant effect and supporting Hypothesis 2. This result suggests that higher price sensitivity strengthens the positive relationship between social stratification and consumer behavior.

Table 6 Main Effect Test Results and Moderating Role of Price Sensitivity

Variable	Consumer Behavior		
	Model 1	Model 2	Model 3
Control Variables			
Gender	.042	.033	.033
Age	-.159	-.143	.002
Education	.046	.054	-.066
Years of Employment	-.073	-.069	.041
Individual Annual Income	-.063	-.179	-.017
Household Annual Income	.093	-.079*	.016
Independent Variable			
Social Stratification	.042	.033	.015

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Moderating Variable			
Price Sensitivity			.916***
R^2	.031	.049	.842
ΔR^2	.031	.018	.793
F	2.134	2.965	267.619***
ΔF	2.134	7.741	2016.648***

4.3 Summary of the Results

This study conducted a comprehensive analysis of the relationships among social stratification, consumer behavior, and price sensitivity in the context of coffee consumption. The reliability and validity tests confirmed that the measurement scales used were both reliable and valid. Cronbach's alpha values ranged from 0.74 to 0.98 across key constructs, exceeding the accepted threshold of 0.7, indicating strong internal consistency. Convergent validity was supported by factor loadings above 0.5, significant p-values (<0.001), and satisfactory Average Variance Extracted (AVE) and Composite Reliability (CR) values.

Correlation analysis revealed significant positive associations among the key variables. Notably, social stratification was positively correlated with price sensitivity ($r = 0.124$, $p < 0.05$), while consumer behavior showed a strong positive correlation with price sensitivity ($r = 0.915$, $p < 0.01$). These findings suggest that social stratification influences consumers' sensitivity to price and that price sensitivity plays a crucial role in shaping consumer behavior.

Further analysis using cross-tabulation and Pearson Chi-square tests demonstrated significant differences in coffee purchasing factors across social stratification variables. Age group showed significant effects on all six purchasing factors analyzed, including personal preference, price, quality, and acceptable price ranges, highlighting age as an important determinant of coffee consumption patterns. Educational level and occupation were also significant predictors for certain purchasing factors, such as personal preference and price consideration. Both individual and household income had substantial impacts, particularly on the acceptable coffee price range, indicating that income levels strongly influence price acceptability.

Hypothesis testing through regression models revealed mixed results. The main effect of social stratification on consumer behavior was not statistically significant ($\beta = 0.033$, $p > 0.1$), leading to rejection of Hypothesis 1. However, the moderating role of price sensitivity was strongly supported ($\beta = 0.916$, $p < 0.001$). This suggests that price sensitivity significantly amplifies the positive relationship between social stratification and consumer behavior. The inclusion of price sensitivity in the model dramatically increased explanatory power (R^2 increased from 0.049 to 0.842), indicating that price sensitivity is a key factor influencing coffee consumption behaviors within different social strata.

Overall, the findings highlight that while social stratification alone does not directly predict consumer behavior in coffee purchasing, it interacts significantly with price sensitivity to shape consumption patterns. These results underscore the importance of considering price sensitivity as a crucial moderating variable when examining consumer behavior across social groups, especially in markets where price and income differences are prominent.

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5. Conclusion, Discussion, and Recommendation

5.1 Conclusion

This study examines the impact of social stratification on consumer behavior through the lens of price sensitivity, focusing on coffee consumption from the consumer's perspective. Drawing on Karl Marx's class theory, Max Weber's multi-dimensional stratification theory, and relevant domestic research on social stratification post-reform and opening-up, this study identifies educational attainment, occupation, income, and household vehicle ownership as independent variables representing social stratification. Following Lewin's behavior formula, which states that human behavior is influenced by both individual and environmental factors, consumer behavior is treated as the dependent variable, while price sensitivity acts as a moderating variable. Based on empirical analysis of 412 survey samples, the results indicate that social stratification has no significant direct effect on coffee consumption behavior, but price sensitivity positively moderates this relationship. Key findings include the significant impact of age on coffee consumption choices, the limited influence of education and occupation on consumption behavior but their role in shaping consumer awareness and price sensitivity, and the recognition of coffee's social and emotional significance, leading to generally low price sensitivity among consumers.

5.2 Discussion

Age emerges as a significant factor influencing coffee consumption. As individuals enter the workforce and acquire disposable income, they gain greater autonomy in their coffee choices. The Lorenz curve suggests a positive correlation between income and age, with older consumers more likely to accept higher-priced coffee and prioritize quality and personal preference. Although education level and occupation are not strongly linked to coffee consumption behavior, occupational differences influence consumers' awareness of coffee, which in turn affects their price sensitivity. The positive correlation between price sensitivity and awareness implies that more informed consumers tend to be more sensitive to price changes. Despite demographic differences, coffee consistently serves as both a stimulant and a source of emotional value in modern social and professional settings, which explains the generally low price sensitivity observed across consumer groups.

5.3 Recommendation

Based on these findings, several recommendations are proposed for coffee brands. First, considering the moderating role of price sensitivity, brands should segment consumers by their price sensitivity levels and implement differentiated production and marketing strategies accordingly. Second, coffee brands should enhance their strategic positioning by emphasizing product uniqueness, developing specialty products, improving quality, innovating product formats, enriching brand meaning, fostering corporate culture, and contributing to a positive industry environment. Lastly, brands are encouraged to uphold ethical standards by setting fair prices and avoiding exploitation of information asymmetries that might justify inflated prices. This approach will help cultivate a trustworthy corporate image and strengthen long-term customer loyalty.

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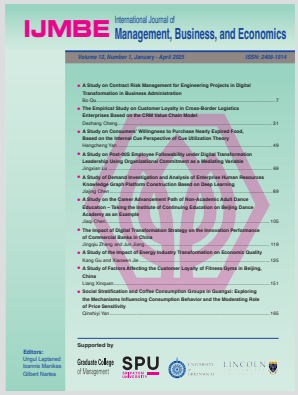

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Graduate College of Management
Sripatum University, Building 11, floor 11, 2410/2 Phaholyothin Road,Jatujak, Bangkok 10900, Thailand
Tel: (+66) 2579 1111 ext. 3000 - 4 Fax: (+66) 2579 1111 ext. 3011 E-Mail: phongvitchulada.su@spu.ac.th

Sripatum International College
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Sripatum International College
Sripatum University, Building 11, floor 8, 2410/2 Phaholyothin Road, Jatujak, Bangkok 10900, Thailand
Tel: (+66) 2579 1111 ext. 1017, 1018, 1308 Fax: (+66) 2558 6868 E-Mail: intl@spu.ac.th

Sripatum University, Thailand

Sripatum University is one of the oldest and most prestigious private universities in Bangkok, Thailand. Dr. Sook Pookayaporn established the university in 1970 under the name of "Thai Suriya College" in order to create opportunities for Thai youths to develop their potential. In 1987, the college was promoted to university status by the Ministry of University Affairs, and has since been known as Sripatum University. "Sripatum" means the "Source of Knowledge Blooming Like a Lotus" and was graciously conferred on the college by Her Royal Highness, the late Princess Mother Srinagarindra (Somdet Phra Srinagarindra Baromarajajanan). She presided over the official opening ceremony of SPU and awarded vocational certificates to the first three graduating classes. Sripatum University is therefore one of the first five private universities of Thailand. The university's main goal is to create well-rounded students who can develop themselves to their chosen fields of study and to instill students with correct attitudes towards education so that they are enthusiastic in their pursuit of knowledge and self-development. This will provide students with a firm foundation for the future after graduation. The university's philosophy is "Education develops human resources who enrich the nation" which focuses on characteristics of Wisdom, Skills, Cheerfulness and Morality.

University of Greenwich, United Kingdom

The University of Greenwich is a British university with campuses in south-east London and north Kent. These include the Greenwich Campus, located in the grounds of the Old Royal Naval College in the Royal Borough of Greenwich, London, England. It is the largest university in London by student numbers and the greenest in the UK as assessed by The People & Planet Green League. The university's wide range of subjects includes architecture, business, computing, education, engineering, humanities, natural sciences, pharmacy and social sciences. It has a strong research focus and well-established links to the scientific community.

Lincoln University, New Zealand

Lincoln is New Zealand's third oldest university. Founded in 1878 as a School of Agriculture, the organisation was linked to Canterbury College, welcoming its first intake of students in 1880. In 1896, with agriculture now well established as the mainstay of New Zealand's exports, the School of Agriculture separated from Canterbury College and became Canterbury Agricultural College, with its own governing body and the ability to award degrees through the University of New Zealand. In 1961, the university was officially renamed Lincoln College, becoming a constituent college of the University of Canterbury. In 1990 Lincoln University formally separated from the University of Canterbury and became the self-governing national university that it is today. Internationally Lincoln University has academic alliances with complementary institutions in Asia, the Middle East, Europe and the Americas. These alliances support academic relationships and enhance educational opportunities for teaching staff, students and those undertaking advanced research.

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Sripatum University
2410/2 Phaholyothin Rd., Jatujak, Bangkok, 10900, Thailand
Tel.: +66 2 579 1111, Fax.: +66 2 558 6868
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