Digital Marketing Innovation and Green HRM in Chinese Telecommunications Firms: The Moderating Role of Human-AI Knowledge Collaboration

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Article

Digital Marketing Innovation and Green HRM in Chinese Telecommunications Firms: The Moderating Role of Human-AI Knowledge Collaboration

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Abstract: This study explores the relationship between digital marketing innovation and green human resource management (HRM) in Chinese telecommunications firms, with a specific focus on the moderating role of Human-AI knowledge collaboration. Drawing on data collected from 278 telecommunications companies in China, moreover, this research employs a mixed-method approach using SPSS, AMOS, and fsQCA to provide comprehensive insights into the complex relationships. The findings indicate that digital marketing innovation positively influences green HRM practices, and this relationship is significantly moderated by Human-AI knowledge collaboration systems. Moreover, the fsQCA results reveal multiple pathways through which firms can achieve effective digital transformation. This study contributes to both theory and practice by providing evidence-based strategies for telecommunications firms undergoing digital transformation while pursuing sustainability objectives.

Keywords: digital marketing innovation; Green HRM; Human-AI Knowledge Collaboration; Digital Transformation; Chinese Telecommunications Industry; fsQCA; Sustainability; Mixed-Method Analysis

1. Introduction

The telecommunications industry in China has been experiencing rapid digital transformation in recent years, with firms increasingly adopting innovative digital marketing strategies while simultaneously facing pressures to implement environmentally sustainable practices. Digital marketing innovation refers to novel approaches in utilizing digital technologies to create, communicate, and deliver value to customers (Tiago & Veríssimo, 2014). Meanwhile, green HRM encompasses environmentally friendly HR policies and practices that promote sustainable use of resources within organizations (Renwick et al., 2013).

The integration of artificial intelligence (AI) with human expertise has emerged as a critical factor in knowledge-intensive industries (Jarrahi, 2018). However, little research has examined how Human-AI knowledge collaboration might moderate the relationship between digital marketing innovation and green HRM initiatives. This research gap is particularly significant in the context of Chinese telecommunications firms, which operate in a unique regulatory environment while being at the forefront of technological advancement.

This study aims to address this gap by investigating how digital marketing innovation influences green HRM practices and how Human-AI knowledge collaboration moderates this relationship in Chinese telecommunications firms. The findings contribute to both theory and practice by offering insights into the complex interplay between digital innovation, environmental sustainability, and human-AI collaboration.

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2. Literature Review and Theoretical Foundation

2.1. Digital Marketing Innovation

Digital marketing innovation has been conceptualized as the development and implementation of new digital technologies and strategies to enhance marketing activities (Tiago & Veríssimo, 2014). In the telecommunications industry, digital marketing innovation encompasses various practices such as AI-powered customer segmentation, predictive analytics, personalized content delivery, and omnichannel marketing approaches (Järvinen & Karjaluoto, 2015). According to the dynamic capabilities theory (Teece et al., 1997), organizations that consistently innovate in their digital marketing approaches can develop sustainable competitive advantages.

2.2. Green Human Resource Management

Green HRM refers to the integration of environmental management into human resource management policies and practices (Renwick et al., 2013). It includes various environmentally conscious HR initiatives such as green recruitment and selection, green training and development, green performance management, and green compensation and rewards (Jabbour & Jabbour, 2016). The natural resource-based view (Hart, 1995) suggests that organizations can achieve competitive advantage through environmentally sustainable practices that are valuable, rare, and difficult to imitate.

2.3. Human-AI Knowledge Collaboration

Human-AI knowledge collaboration involves the synergistic integration of human expertise with AI capabilities to enhance knowledge creation, sharing, and application within organizations (Jarrahi, 2018). This collaboration encompasses various forms such as AI-assisted decision-making, knowledge repository systems, and intelligent knowledge management platforms (Duan et al., 2019). The socio-technical systems theory (Bostrom & Heinen, 1977) provides a theoretical lens to understand how the interaction between human and technological components can lead to improved organizational outcomes.

2.4. Theoretical Framework and Hypotheses Development

Building on the aforementioned theories, we propose that digital marketing innovation positively influences green HRM practices in telecommunications firms. The institutional theory (DiMaggio & Powell, 1983) suggests that organizations respond to institutional pressures by adopting practices perceived as legitimate. As digital marketing innovation becomes increasingly associated with corporate social responsibility and sustainability, firms are more likely to implement complementary green HRM practices to maintain legitimacy.

Furthermore, drawing on the knowledge-based view (Grant, 1996), we argue that Human-AI knowledge collaboration enhances the relationship between digital marketing innovation and green HRM by facilitating knowledge integration and application. Organizations with effective Human-AI knowledge collaboration systems can better leverage digital marketing innovations to develop and implement green HRM practices.

Based on the above theoretical foundations, we propose the following hypotheses:

H1: Digital marketing innovation is positively associated with green HRM practices in Chinese telecommunications firms.

H2: Human-AI knowledge collaboration positively moderates the relationship between digital marketing innovation and green HRM practices in Chinese telecommunications firms.

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3. Methodology

3.1. Sample Selection and Data Sources

Data for this study was collected from telecommunications firms operating in China. A stratified random sampling approach was employed to ensure representation across different regions and firm sizes. The initial sample included 350 firms, from which 278 valid responses were obtained, representing a response rate of 79.4%. Data was collected through a structured questionnaire administered to senior executives, including Chief Information Officers, HR Directors, and Marketing Directors.

To mitigate common method bias, we collected data from multiple sources within each firm and at different time periods. The initial survey focusing on digital marketing innovation and Human-AI knowledge collaboration was conducted in January 2024, while data on green HRM practices was collected three months later. Additionally, objective performance data was obtained from company records and industry databases.

3.2. Model Design and Definition of Variables

The research employs a moderated regression model to test the hypothesized relationships. The model is specified as follows:

$$\text{Green HRM} = \beta_0 + \beta_1 \text{DMI} + \beta_2 \text{HAIKC} + \beta_3 (\text{DMI} \times \text{HAIKC}) + \beta_4 \text{Control Variables} + \varepsilon$$

Where:

- Green HRM represents green human resource management practices
- DMI represents digital marketing innovation
- HAIKC represents Human-AI knowledge collaboration
- DMI × HAIKC represents the interaction term
- Control variables include firm size, firm age, and market competition

For the fsQCA analysis, we calibrated the variables into fuzzy sets and analyzed the configurations leading to high levels of green HRM practices.

3.3. Measurement of Variables

Digital Marketing Innovation (DMI): Measured using a 7-point Likert scale with items adapted from Tiago & Veríssimo (2014) and Järvinen & Karjaluoto (2015). The scale includes items related to the adoption of innovative digital marketing technologies, strategies, and practices.

Green HRM (GHRM): Measured using a 7-point Likert scale with items adapted from Renwick et al. (2013) and Jabbour & Jabbour (2016). The scale encompasses green recruitment, training, performance management, and compensation.

Human-AI Knowledge Collaboration (HAIKC): Measured using a 7-point Likert scale with items adapted from Jarrahi (2018) and Duan et al. (2019). The scale includes items related to the integration of human expertise with AI capabilities in knowledge management.

Control Variables: Firm size was measured by the natural logarithm of the number of employees. Firm age was measured as the number of years since establishment. Market competition was measured using a 7-point Likert scale adapted from Jaworski & Kohli (1993).

Table 1 presents the measurement items for each construct.

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Table 1. Measurement Items.

Construct	*Item Code*	*Measurement Item*	*Source*
Digital Marketing Innovation (DMI)	DMI1	Our company constantly adopts new digital technologies for marketing activities	Tiago & Veríssimo (2014)
	DMI2	Our company regularly updates digital marketing strategies based on market trends	Järvinen & Karjaluoto (2015)
	DMI3	Our digital marketing approaches are considered innovative in the industry	Tiago & Veríssimo (2014)
	DMI4	Our company effectively utilizes big data analytics for marketing decision-making	Järvinen & Karjaluoto (2015)
	DMI5	Our company implements AI-driven personalization in marketing campaigns	Järvinen & Karjaluoto (2015)
Green HRM (GHRM)	GHRM1	Our company incorporates environmental criteria in recruitment and selection	Renwick et al. (2013)
	GHRM2	Our company provides comprehensive environmental training to employees	Jabbour & Jabbour (2016)
	GHRM3	Our performance appraisal system includes environmental performance indicators	Renwick et al. (2013)
	GHRM4	Our company offers rewards for employee environmental initiatives	Jabbour & Jabbour (2016)
	GHRM5	Our company promotes employee engagement in environmental activities	Renwick et al. (2013)
Human-AI Knowledge Collaboration (HAIKC)	HAIKC1	Our company effectively integrates human expertise with AI capabilities	Jarrahi (2018)
	HAIKC2	Our knowledge management systems combine human and AI contributions	Duan et al. (2019)
	HAIKC3	Our employees regularly collaborate with AI tools for knowledge creation	Jarrahi (2018)
	HAIKC4	Our decision-making processes integrate human judgment with AI recommendations	Duan et al. (2019)
	HAIKC5	Our company has established clear protocols for Human-AI knowledge exchange	Jarrahi (2018)

4. Results and Findings

4.1. Descriptive Statistics

Table 2 presents the descriptive statistics and correlations among the key variables. The mean values for digital marketing innovation (5.32), green HRM (4.89), and Human-AI knowledge collaboration (4.67) indicate moderate to high levels of these practices among the sampled firms. The standard deviations suggest reasonable variation across the sample.

Table 2. Descriptive Statistics and Correlation Matrix.

Variable	*Mean*	*SD*	*1*	*2*	*3*	*4*	*5*	*6*
1. Digital Marketing Innovation	5.32	1.08	1.00					
2. Green HRM	4.89	1.16	0.47**	1.00				
3. Human-AI Knowledge Collaboration	4.67	1.21	0.52**	0.43**	1.00			

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4. Firm Size (ln)	7.34	1.57	0.18**	0.24**	0.26**	1.00		
5. Firm Age	18.75	8.93	0.11	0.15*	0.09	0.32**	1.00	
6. Market Competition	5.63	0.98	0.23**	0.17**	0.21**	0.07	-0.05	1.00

*p < 0.05, **p < 0.01.

4.2. Reliability and Validity Analysis

Table 3 presents the results of the reliability and validity analysis. The Cronbach's alpha values for all constructs exceed the threshold of 0.70, indicating good internal consistency. The composite reliability (CR) values are all above 0.80, further confirming the reliability of the measures. The average variance extracted (AVE) values are all above 0.50, suggesting good convergent validity. The square roots of AVE values (diagonal elements) are greater than the correlations between constructs, supporting discriminant validity.

Table 3. Reliability and Validity Analysis.

Construct	***Cronbach's α***	***CR***	***AVE***	***KMO***	***DMI***	***GHRM***	***HAIKC***
Digital Marketing Innovation (DMI)	0.89	0.92	0.69	0.84	**0.83**		
Green HRM (GHRM)	0.87	0.91	0.67	0.81	0.47	**0.82**	
Human-AI Knowledge Collaboration (HAIKC)	0.91	0.93	0.72	0.88	0.52	0.43	**0.85**

Note: Diagonal elements (in bold) are the square root of AVE; KMO = Kaiser-Meyer-Olkin measure of sampling adequacy.

The Kaiser-Meyer-Olkin (KMO) values for all constructs are above 0.80, indicating excellent sampling adequacy for factor analysis. The exploratory factor analysis resulted in a clear three-factor solution with all items loading appropriately on their respective factors and no cross-loadings exceeding 0.30.

4.3. The fsQCA Analysis

The fsQCA analysis revealed multiple pathways to high green HRM implementation. Table 4 presents the truth table analysis, showing the different configurations of conditions leading to the outcome.

Table 4. fsQCA Truth Table Analysis for High Green HRM.

Configuration	***DMI***	***HAIKC***	***Firm Size***	***Firm Age***	***Market Competition***	***Number of Cases***	***Raw Consistency***	***PRI Consistency***	***Outcome***
1	1	1	1	1	1	42	0.94	0.91	1
2	1	1	1	0	1	35	0.92	0.89	1
3	1	1	1	1	0	28	0.89	0.86	1
4	1	1	0	1	1	22	0.87	0.83	1
5	1	0	1	1	1	19	0.84	0.81	1
6	0	1	1	1	1	17	0.82	0.79	1
7	1	1	0	0	1	15	0.81	0.78	1
8	1	0	1	0	1	14	0.79	0.76	0
9	0	1	1	0	1	12	0.77	0.74	0
10	0	0	1	1	1	10	0.75	0.72	0

Note: 1 = presence of condition; 0 = absence of condition; DMI = Digital Marketing Innovation; HAIKC = Human-AI Knowledge Collaboration.

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The analysis identified three core pathways to high green HRM implementation:

1. High digital marketing innovation AND high Human-AI knowledge collaboration (most common pathway)
2. High digital marketing innovation AND large firm size AND high market competition
3. High Human-AI knowledge collaboration AND large firm size AND established firms

These findings support the importance of both digital marketing innovation and Human-AI knowledge collaboration in implementing green HRM practices.

4.4. Model Fit and Hypothesis Testing

Table 5 presents the model fit indices for the structural equation model. The values indicate a good fit between the model and the data, supporting the validity of the results.

Table 5. Model Fit Indices.

Fit Index	*Value*	*Threshold*	*Assessment*
χ^2/df	2.14	< 3.00	Good
CFI	0.95	> 0.90	Good
TLI	0.94	> 0.90	Good
RMSEA	0.048	< 0.08	Good
SRMR	0.041	< 0.08	Good
GFI	0.92	> 0.90	Good
AGFI	0.90	> 0.90	Good

Table 6 presents the results of the moderated regression analysis. Model 1 includes only control variables, Model 2 adds the main effects of digital marketing innovation and Human-AI knowledge collaboration, and Model 3 incorporates the interaction term.

Table 6. Moderated Regression Analysis Results (DV: Green HRM).

Variables	*Model 1*	*Model 2*	*Model 3*
Control Variables			
Firm Size	0.23***	0.15**	0.14**
Firm Age	0.09	0.07	0.06
Market Competition	0.16**	0.08	0.07
Main Effects			
Digital Marketing Innovation (DMI)		0.39***	0.37***
Human-AI Knowledge Collaboration (HAIKC)		0.28***	0.26***
Interaction Effect			
DMI × HAIKC			0.21***
Model Statistics			
R^2	0.09	0.34	0.38
ΔR^2		0.25***	0.04***
F	8.37***	27.64***	26.95***

*p < 0.05, **p < 0.01, ***p < 0.001.

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The results indicate that digital marketing innovation has a significant positive effect on green HRM practices ($\beta = 0.37$, $p < 0.001$), supporting Hypothesis 1. The interaction term between digital marketing innovation and Human-AI knowledge collaboration is also significant and positive ($\beta = 0.21$, $p < 0.001$), supporting Hypothesis 2. These findings suggest that Human-AI knowledge collaboration strengthens the positive relationship between digital marketing innovation and green HRM practices.

Figure 1 illustrates the moderating effect of Human-AI knowledge collaboration on the relationship between digital marketing innovation and green HRM practices. The positive relationship between digital marketing innovation and green HRM is stronger when Human-AI knowledge collaboration is high compared to when it is low.

5. Discussion and Implications

5.1. Theoretical Implications

This study makes several important theoretical contributions. First, it extends the literature on digital transformation by empirically demonstrating the link between digital marketing innovation and green HRM practices in the telecommunications industry. This finding supports the institutional theory perspective that organizations respond to institutional pressures by adopting complementary practices perceived as legitimate.

Second, the study introduces Human-AI knowledge collaboration as a significant moderator in the relationship between digital marketing innovation and green HRM practices. This contribution enhances our understanding of the socio-technical factors that influence organizational sustainability initiatives. The findings align with the knowledge-based view, suggesting that effective knowledge integration between humans and AI systems can enhance organizational capabilities in implementing sustainability practices.

Third, the fsQCA results reveal multiple pathways to implementing green HRM practices, highlighting the equifinality in sustainability transformations. This methodological approach provides a more nuanced understanding of the complex relationships among digital innovation, knowledge collaboration, and sustainability practices.

5.2. Practical Implications

The findings offer several practical implications for telecommunications firms in China. First, companies should invest in digital marketing innovation as it positively contributes to green HRM practices. This suggests that digital transformation and sustainability initiatives can be pursued simultaneously rather than as competing objectives.

Second, organizations should develop effective Human-AI knowledge collaboration systems to maximize the benefits of digital marketing innovation for sustainability. This may involve implementing AI-powered knowledge management platforms that facilitate human-AI interaction, providing training on AI collaboration, and establishing protocols for knowledge sharing between human employees and AI systems.

Third, the fsQCA results suggest that firms can adopt different strategies to implement green HRM practices based on their specific circumstances. Large, established firms with high market competition may benefit most from simultaneously investing in both digital marketing innovation and Human-AI knowledge collaboration.

5.3. Policy Recommendations

Based on the findings, we recommend the following policy initiatives for the Chinese telecommunications industry:

1. Develop industry standards for Human-AI knowledge collaboration to facilitate the adoption of effective collaborative systems across the industry.

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2. Establish incentive programs to encourage telecommunications firms to invest in both digital marketing innovation and green HRM practices.
3. Create platforms for knowledge sharing among firms regarding best practices in integrating digital innovation with sustainability initiatives.
4. Develop educational programs focused on building human capabilities for effective collaboration with AI systems in sustainable business practices.

6. Conclusion

This study examined the relationship between digital marketing innovation and green HRM practices in Chinese telecommunications firms, with a focus on the moderating role of Human-AI knowledge collaboration. The findings indicate that digital marketing innovation positively influences green HRM practices, and this relationship is strengthened by effective Human-AI knowledge collaboration. The fsQCA results further reveal multiple pathways to implementing green HRM practices, highlighting the complex nature of sustainability transformations.

The study contributes to the literature by integrating perspectives from digital marketing, human resource management, and knowledge management to provide a comprehensive understanding of organizational sustainability in the digital age. It also offers practical guidance for telecommunications firms seeking to balance digital transformation with sustainability objectives.

Future research could extend this study by examining additional moderators and mediators in the relationship between digital innovation and sustainability practices. Longitudinal studies could also provide insights into how these relationships evolve over time as organizations progress in their digital transformation journey.

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