Exploring the Impact of Digital Leadership on Competitive Advantage in the Specialized and Special New Enterprise: A Pathway to Boost Digital Economy

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Abstract

As China's economy enters the digital transformation phase, investigating the impact mechanisms of digital leadership becomes crucial. This study integrates digital leadership with the development of Specialized and Special New Enterprises in China, focusing on 21 managers from such enterprises in three major cities in Guangxi. Using semi-structured interviews, firsthand data on how digital leadership influences the competitive advantages of enterprises was collected. Analysis of interview transcripts provides theoretical and policy foundations for enhancing the competitive advantages of Specialized and Special New Enterprises, as advocated by the government. Results indicate that managers generally perceive the positive impacts of digital leadership on competitive advantages. Factors such as digital capabilities, innovation orientation, knowledge management strategies, and ambidextrous learning positively influence the relationship between digital leadership and competitive advantages, with occasional neutral or negative sentiments observed. These factors can play a vital role in China's digital economy.

Keywords: Digital Leadership; Competitive Advantage; Semantic Network Analysis; Sentiment Analysis

Introduction

The rapid development and iteration of Internet technologies have propelled the digital economy into a new phase of high-quality growth, accelerating digital transformation as a critical task for global enterprises (Tigre et al., 2023). Digital transformation enhances organizational digital governance capabilities, expanding and extending the boundaries of managerial work in time and space. Organizations must comprehend and address the challenges of digital transformation in a digital environment where traditional leadership advantages no longer suffice, thus necessitating the emergence of digital leadership (Memon & Ooi, 2023; Zhang et al., 2023).

The 2023 Chinese Government Work Report emphasizes the vigorous development of new quality productive forces, combining the development of these forces with specialized and special new enterprises. It highlights that advancing these forces should prominently focus on constructing a modern industrial system with advanced manufacturing as the backbone, promoting the formation of a "Wild Goose Queue effect" where leading enterprises in the industrial chain stand out, high-tech enterprises proliferate, and specialized and special new enterprises seize high ground (Zhong, 2024) Specialized and special new enterprises are pioneers in digital transformation, forming the initial ecosystem of digital leadership. Currently, digital leadership empowers enterprises to establish professional teams, implement refined

management, drive management innovation, enhance market competitiveness, and promote the trend of enterprises' high-quality development(Du, 2024).

Digital leadership is an emerging and hot research area, though there is no unified concept based on theoretical or empirical verification (Eberl et al., 2021). Currently, discussions on the essence of digital leadership can be categorized from three perspectives: social influence perspective, leader trait perspective, and organizational change perspective. From the social influence perspective, scholars such as Avolio et al. (2014) define digital leadership as the process of using advanced information technology to change individuals', groups', and organizations' attitudes, emotions, thoughts, and behaviors. The leader trait perspective emphasizes the role of leaders, their digital capabilities, and literacy in organizational digital transformation. These studies suggest that digital leadership is crucial for leaders to successfully address challenges in the digital age, influencing and guiding teams through digital technology to enhance team digital skills and organizational performance (Jackli & Meier, 2020). The organizational change perspective highlights the role of digital leadership in driving organizational change and improving performance, asserting that it is a rapid, cross-level, team-oriented collaborative approach that promotes organizational digitalization processes, ensuring the successful implementation of enterprise digital strategies (Oberer & Erkollar, 2018).

Current research on the impact of digital leadership effects mainly examines organizational and individual levels. In terms of organizational innovation, Ardi et al. (2020) found that transformational digital leadership positively influences organizational innovation, with knowledge-based empowerment interactions mediating between transformational digital leadership and organizational innovation capability. Benitez et al. (2022), through empirical research on 117 European companies, found that digital leadership needs to influence firms' innovation performance through platform digital capabilities. Xie et al. (2023) surveyed 256 mid-to-senior-level managers in China and found that digital leadership promotes organizational innovation by enhancing digital platform capabilities, with environmental competitiveness positively moderating the relationships between digital leadership, digital platform capabilities, and organizational innovation. Regarding organizational performance, Mihardjo and Rukmana (2019) found that digital leadership has a positive impact on innovation management and dynamic capabilities, with market orientation moderating the relationship between digital leadership and dynamic capabilities.

Research Objective(s)

According to 2023 Chinese government statistics, Guangxi has a total of 103 nationally recognized "Little Giant" enterprises, 667 regionally recognized "Specialized and Special New" small and medium enterprises (SMEs), and 1200 municipal-level "Specialized and Special New" SMEs (Liang, 2023). Among the 14 cities in Guangxi, Nanning, Liuzhou, and Guilin host 1396 Specialized and Special New enterprises, accounting for 70.86% of the total, as detailed in Table 1. Due to the concentration of enterprises in these three cities, conducting interviews in Nanning, Liuzhou, and Guilin is representative and efficient for capturing the development characteristics of Specialized and Special New enterprises in Guangxi, thereby reducing sample collection costs and time. This study focuses on managerial personnel of Specialized and Special New enterprises in Guangxi, encompassing three levels of management: senior, middle, and grassroots. Qualitative text sampling is conducted based on a stratified sampling principle among managerial personnel of Specialized and Special New enterprises in Guangxi. Three managers from each

selected company are interviewed, totaling 21 interviews across 7 companies. Specifically, 3 companies are selected from Nanning, and 2 each from Guilin and Liuzhou.

Table 1. Distribution of Specialized and Special New Enterprises (SSNEs) in Guangxi

No.	Distribution of SSNEs in Guangxi	National-Level "Little Giant" Enterprises	Regional-Level SSNEs	Municipal-Level SSNEs	Total
1	Nan Ning	29	165	337	531
2	Liu Zhou	29	137	289	455
3	Gui Lin	25	128	257	410
4	Other 11 prefecture-level cities	20	237	317	574
	total	103	667	1200	1970

Research Methodology

In this study, semi-structured interviews were conducted using a predetermined outline of questions, where interviewees responded to each question sequentially. The authors arranged interviews via telephone based on recommendations from acquaintances, confirming schedules and conducting face-to-face interviews accordingly. Managers from various departments of different enterprises were selected, allowing them to freely express personal views and suggestions in response to the questions. Post-interview, the authors deeply analyzed the intrinsic relationship and influencing factors of digital leadership affecting competitive advantages within companies. The primary questions covered in this interview are listed in Table 2. Textual analysis in this study employed content analysis, a widely used method capable of systematically quantifying non-structured data such as texts and images (Krippendorff, 1980).

Table 2: Summary of Semi-Structured Interview Questions

Number	Question
1	How do you understand digital leadership?
2	Do you believe digital leadership can influence a company's competitive advantage? Please provide examples.
3	Do you think digital leadership affects digital capabilities? Please provide examples.
4	Do you think digital capabilities affect a company's competitive advantage? Please provide examples.
5	Do you think digital leadership affects a company's innovation-oriented strategy? Please provide examples.
6	Do you think an innovation-oriented strategy affects a company's competitive advantage? Please provide examples.
7	Do you think digital leadership affects a company's knowledge management strategy? Please provide examples.
8	Do you think a knowledge management strategy affects a company's competitive advantage? Please provide examples.
9	Do you think digital leadership affects ambidextrous learning? Please provide examples.
10	Do you think ambidextrous learning affects a company's competitive advantage? Please provide examples.

Text Processing

After organization and summarization, the interviews yielded a manuscript of 20,924 words in English, with the part-of-speech analysis shown in Figure 1. To obtain a well-structured and processed textual corpus suitable for subsequent sentiment analysis and semantic network analysis, this study employed the Chinese AI open-source tool "Micro Word Cloud" for English tokenization. The tokenization principle of "Micro Word Cloud" adopts the English tokenization algorithm based on "spacy, en_core_web_md." The deep learning technology of "spacy, en_core_web_md" is currently an advanced natural language processing tool in the field of machine learning, capable of efficiently and accurately tokenizing English texts. Micro Word Cloud text analysis and comparison model data sources include OntoNotes 5, ClearNLP Constituent-to-Dependency Conversion, and WordNet 3.0. These data sources provide rich linguistic information and semantic knowledge for text analysis and data mining, enhancing the performance and accuracy of English tokenization algorithms through handling diversity and context associations effectively (see Figure 1).
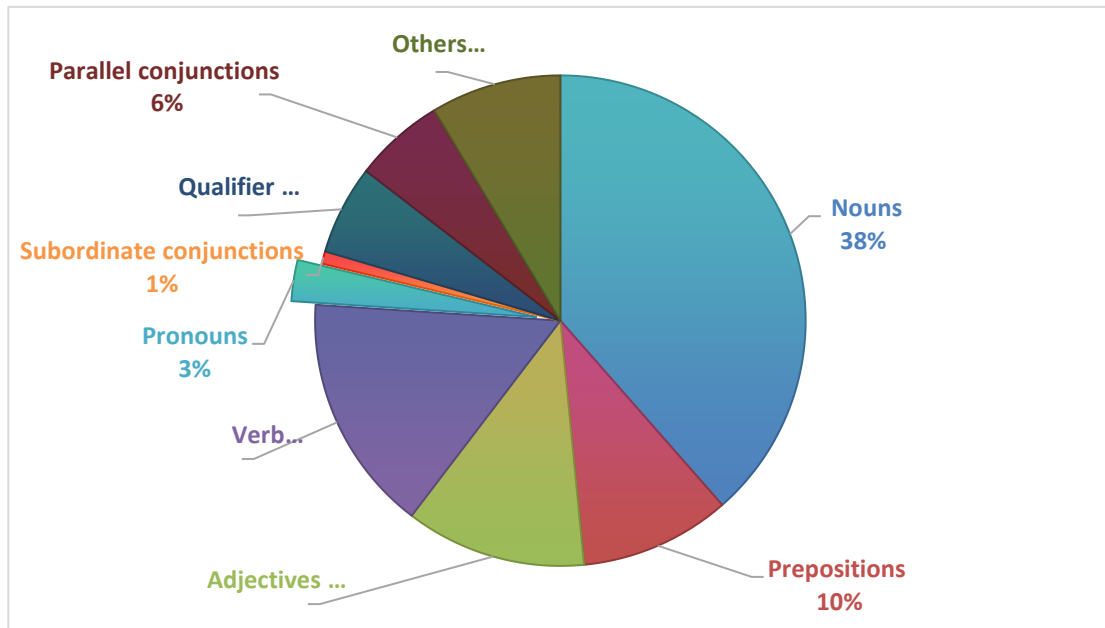
Figure 1. Classification of the interview text

High-Frequency Word Cloud and Semantic Network Analysis Visualization
Analysis of High-Frequency Word Cloud

To visually reflect interviewees' perceptions of digital leadership and mechanisms for competitive advantage in enterprises, researchers conducted a word cloud visualization analysis using "Micro Word Cloud." The size of words in the cloud reflects their frequency of occurrence, indirectly indicating the key influencing factors recognized and acknowledged by interviewees within this complex framework. According to the high-frequency word cloud displayed in Figure 2 and Table 3, 21 respondents generally believe that digital leadership positively impacts the competitive advantage of enterprises. After excluding the high-frequency words "digital leadership" and "competitive advantage," respondents commonly agreed that digital leadership, through digital technology innovation and analytics capabilities, effective knowledge management strategies, ambidextrous learning, optimized processes and operations, as well as advancing resource reallocation and restructuring, can establish a corporate culture conducive to knowledge sharing among teams and employees, stimulate employee innovation, attract and develop corporate talent, enhance customer satisfaction, and ultimately improve company efficiency and competitive advantage. This clarifies the first conclusion that digital leadership significantly promotes corporate competitive advantage. It also confirms that certain high-frequency mediating factors indeed play a role in this operational mechanism, such as digital capabilities, knowledge management strategies, ambidextrous learning, and innovation-oriented strategies. Interviewees believe that digital leadership is a result of managers adapting to the digital economy era. It empowers enterprises throughout their management processes with digital technological capabilities, driving the formation of innovation-oriented strategies. Utilizing technologies such as big data and digital platforms promotes a conducive environment for internal and external knowledge sharing within enterprises. This fosters a knowledge

management strategy based on digital informationization, facilitating comprehensive organizational transformation with seamless internal-external collaboration. This transformation not only prepares enterprises for change but also accelerates the formation of competitive advantages, facilitating high-quality development. Specialized and special new enterprises, as pioneers in digitalization, constitute the mainstay of new productive forces. Under the guidance of digital leadership, they will further enhance the modern layout of enterprises and industries, promoting adjustments in industrial organization and forms. This advancement aims to achieve intelligent product production and business development, thereby propelling the progression of the digital economy.

Figure 2. Answer Cloud Diagram

Table 3. List of Top 30 High-Frequency Phrases

No.	Noun Phrase	Frequency	Count	TF-IDF	Word Count
1	digital leadership/digital leaders	271	230	0.008225723	2
2	a company's competitive advantage(edge)	183	124	0.007722654	4
3	digital tools/data analytic tools/new technology/technology/emerging technologies/technological innovation/technological advancements	139	136	0.006973383	16
4	knowledge management strategy/effective knowledge management	116	56	0.004724842	9
5	innovation	112	94	0.00564459	90
6	ambidextrous learning	87	56	0.003964225	2
7	operations/operational excellence/operational efficiency/operational efficiency improvements	79	57	0.00513197	13
8	development/growth/continuous improvement	69	66	0.003453874	6
9	a culture	68	64	0.003134007	2
10	new knowledge/knowledge sharing	62	56	0.006710157	13
11	digital capabilities	62	55	0.004900867	6
12	cross functional/team collaboration	50	50	0.003978126	11
13	processes/finance production or operational processes/process optimization	48	48	0.002158383	17
14	cross-functional teams/teams	43	30	0.002454161	5
15	innovation oriented strategic direction	39	36	0.002554792	39
16	data/data analysis	39	38	0.003941487	10
17	top talent/talents/talent development	39	36	0.002187878	6
18	competitors/competitiveness	37	36	0.001853587	3
19	efficiency/improved efficiency	33	33	0.001983639	6
20	digital transformation/digital transformation initiatives	31	31	0.000980435	22

| 21	customer satisfaction/increased customer satisfaction	26	24	0.001978406	11
22	resources/resource allocation	25	24	0.00252572	14
23	a crucial role	24	24	0.001222716	3
24	continuous learning	23	23	0.001190994	2
25	sustainable growth	15	15	0.000901263	2
26	agility	15	15	0.000901263	1
27	creativity	14	14	0.000859679	1
28	product development	13	13	0.000816638	2
29	market trends /market demands	13	13	0.001116638	4
30	decision-making	13	13	0.000812028	1

Semantic Network Analysis

Semantic network analysis, also known as relational content analysis, is a method of textual content analysis. This approach uses high-frequency words as nodes and the co-occurrence of high-frequency word combinations as relationships between nodes. By constructing a semantic network, it analyzes the meaning and importance of high-frequency word combinations in the text. Based on Figure 3's semantic network, we observe four central themes: innovation, digital leadership, competitiveness, and ambidextrous learning. Innovation is most closely related, with digital leadership, talent development, collaboration, sustainable competitive advantage, technology, and knowledge being the most frequently co-occurring terms. Digital leadership is closely associated with terms like innovation, collaboration, digital capabilities, sustainable competitive advantage, and development. Competitiveness-related high-frequency co-occurring terms include sustainable competitive advantage, digital leadership, sustainable growth, knowledge, innovation, technology, and strategy. Terms frequently co-occurring around ambidextrous learning include knowledge, collaboration, development, culture, innovation, and digital leadership. Combining these themes, interviewees generally believe that strategies of innovation and collaboration between digital leadership and corporate competitive advantage, alongside the digital leadership's capabilities, ambidextrous learning fostering knowledge renewal, can effectively enhance talent development, create a positive corporate culture, and provide opportunities for sustainable competitive advantage and growth. By analyzing co-occurring terms in interview texts, researchers found consensus among respondents in two key areas:

Firstly, digital leadership empowers the emergence and development of specialized and special new enterprises. Interviewees universally acknowledged the thriving digital economy, supported by foundational infrastructures such as the internet, artificial intelligence, and big data. These digital technologies drive innovation and digital transformation within specialized and special new enterprises, enabling intelligent product production and business development. Enterprises with higher levels of digital leadership can swiftly adjust production and operational strategies, demonstrate rapid market responsiveness, and sustain research and development capabilities. Specialized and special new enterprises, as pioneers of digital transformation,

optimize management processes through digital technologies, crucially facilitating high-quality development.

Secondly, digital leadership empowers specialized and special new enterprises through its operational mechanisms. The digital economy integrates traditional industries with information technology to enhance production efficiency and drive industrial upgrading. Digital technologies, including artificial intelligence and big data, empower digital leadership by promoting technological innovation within enterprises, integrating the digital economy with the real economy, and fostering bidirectional interaction between digital technologies and digital leadership. This synergy accelerates enterprise digital transformation, thereby stimulating the flourishing of the digital economy.
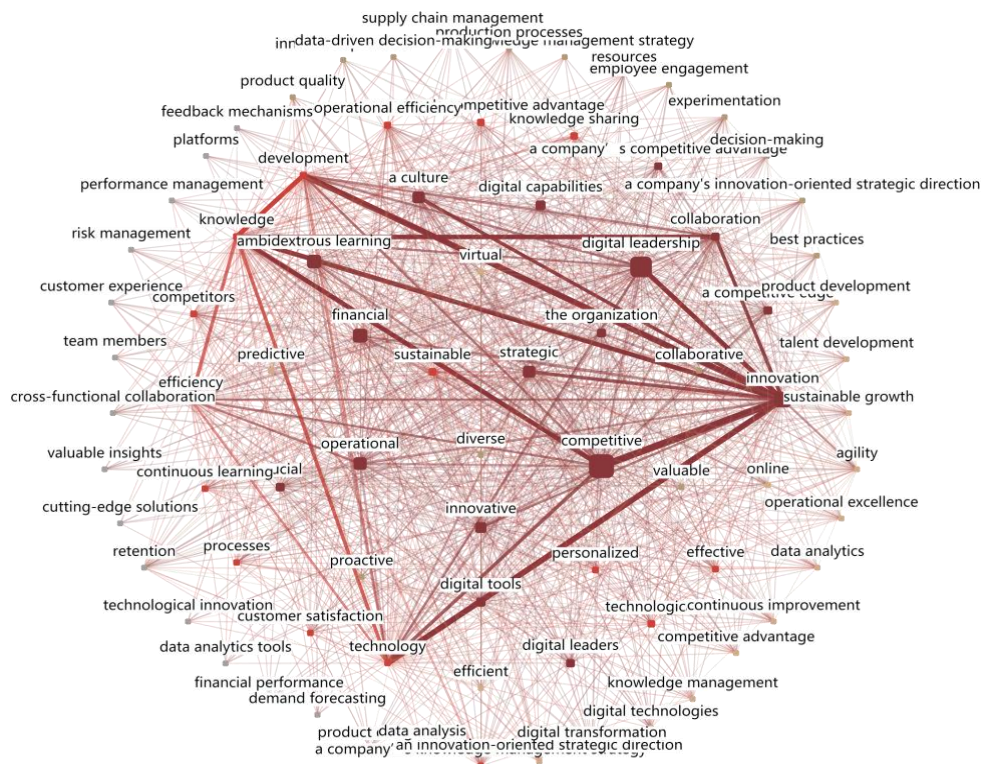

Figure 3. Answer Semantic Network Diagram

Sentiment Analysis

Text sentiment analysis, also known as sentiment tendency analysis, is the process of analyzing, processing, summarizing, and inferring subjective texts with emotional tendencies (Zhang et al., 2022). Current popular sentiment tendency analysis categorizes sentiments into three levels: positive appreciation, negative criticism, and neutral words without explicit emotional orientation (Dong & Wang, 2022).

4.1 Overall Sentiment Analysis

Using the VADER sentiment analysis feature provided by the micro-word cloud, VADER is a commonly used emotional analysis tool that includes additional semantic information, contextual relevance, and emotional patterns. It effectively captures emotional expressions and tendencies in large amounts of text. This study categorizes the corpus into three emotional categories: positive (emotion score > 0), neutral (emotion score = 0), and negative (emotion score < 0). The semantic construction features and content theme distribution were then analyzed. Results show that 95.35% (287 instances, 780 sentences) of the sentiments were positive, 1.3% (4 instances, 16 sentences) were negative, and approximately 3.32% (10 instances, 149 sentences) were neutral. This indicates that interviewees generally acknowledge the positive impact of digital leadership on corporate competitive advantage. Positive sentiment reviews reflect interviewees' affirmation and recognition of the influence of digital leadership, suggesting that government and enterprises should prioritize the cultivation and development of digital leadership. The few negative or neutral sentiment reviews regarding this impact mechanism highlight areas that require more attention. Analysis of a few negative and neutral sentences reveals uncertainty among respondents regarding several issues: whether digital capabilities enhance competitive advantages for enterprises, the relationship between digital leadership and enterprise knowledge management strategies, and whether knowledge management strategies and ambidextrous learning promote competitive advantages for enterprises. Through a thorough examination of sentences expressing negative sentiments, it was found that digital leadership remains a nascent professional term in China. Managers from specialized and special new enterprises in Guangxi Province do not yet have a clear understanding of this concept. Some respondents believe that digital leadership may lead to indiscriminate digital intelligence adoption, resulting in significant financial burdens and risks for enterprises due to high investments in digital intelligent scenarios. Given that many specialized and special new enterprises are small to medium-sized enterprises, they may struggle to bear substantial investments in digitalization, thereby facing risks of failed digital transformation. A minority of respondents suggested that both knowledge management and ambidextrous learning require platforms such as personnel training and knowledge sharing platforms, which are more suitable for large enterprises. However, many specialized and special new enterprises are newly established businesses, operating for 5-10 years, focusing on technological and hardware upgrades with limited personnel, thus hindering a comprehensive evaluation of how knowledge management strategies and ambidextrous learning could impact competitive advantages for these enterprises.
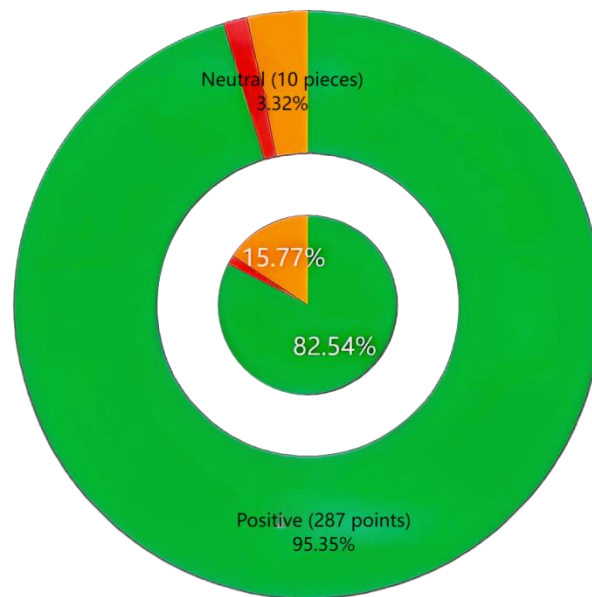
Figure 4. Pie Chart of the Proportional Distribution for Sentiment Analysis

Interview Word Cloud and Emotion Score Distribution Based on Sentiment Polarity Classification

Building upon sentiment polarity classification, interview texts were categorized to extract high-frequency words representing two different emotions, creating word clouds for positive and negative comments to visually highlight the focal points of interviewees. From Figure 6, it is evident that core high-frequency words for positive emotions include "innovation," "competitive advantage," "create," "optimization," "proactive," "talent," and "share." This indicates that interviewees recognize digital leadership's role in fostering innovation, enhancing creativity, optimizing operational decision-making processes, and proactive capabilities. They believe digital leadership enhances enterprise strategies and decision-making through data capabilities, optimizes production and operational processes, establishes digital platforms, and promotes knowledge sharing. Conversely, core high-frequency words for negative comments include "lack," "failure," "risk," "critical," and "pay."

Further analysis of sentiment scores based on interview text (see Figures 5 and 6) reveals that interviewees mostly assign positive sentiment scores to digital leadership's impact on competitive advantage, with very few assigning negative scores. Through detailed textual analysis, researchers identified that respondents' negative sentiments primarily focus on three areas:

Firstly, enterprises exhibit low levels of collaboration. In the era of the digital economy, the replicability and non-consumption of data, along with the dissemination and sharing of information, necessitate the establishment of an "open cooperation, mutual trust, and win-win" digital ecosystem as an inevitable choice for enterprises. However, during the process of digital leadership promoting the development of specialized and special new enterprises in Guangxi, overall collaborative levels within enterprises still require improvement. Issues include insufficient internal collaboration, inadequate digital awareness among some managers, inadequate understanding of digital transformation, slow pace of digital transformation, and

lack of tight collaboration within the organization in digital production, digital business, and digital management.

Secondly, weak industrial chain collaboration. Enterprise development predominantly focuses on products and services, with specialized and special new enterprises concentrating on niche markets. Insufficient communication and cooperation among enterprises along the industrial chain, coupled with low levels of digital management in the supply chain, result in inadequate coordination within the industrial ecosystem and a weak industrial value chain.

Insufficient innovation capability remains a challenge despite the enhanced innovation vitality observed in specialized and special new enterprises. Digital leadership's facilitation of innovation encounters issues stemming from inadequate internal driving forces. Firstly, achieving breakthroughs in critical core technologies poses significant challenges. Although managers encourage innovation and there is an increase in patent applications, patent quality varies, and some enterprises still need to achieve breakthroughs in crucial core technologies. Limited resources and capabilities lead some managers to perceive high costs in developing high-tech products, contributing to product homogenization. Secondly, the failure to establish new industry ecosystems around core technologies hampers technology transformation. Effective collaboration between upstream and downstream enterprises is crucial, yet managerial shortcomings result in "breakpoints" and "bottlenecks" in the innovation chain, leading to poor outcomes in core technology transformation. Lastly, there is an urgent need to strengthen talent attraction, training, and retention. Enterprises face high demand for highly specialized talent, but inadequate team-building goals and plans from managers lead to ineffective talent reserves and incomplete talent development, exacerbating talent shortages.

Lastly, management practices lag behind. Some enterprises have yet to establish modern corporate systems, relying instead on family-style management that lacks scientific rigor and standardization. Organizational structures are rigid, and enterprises exhibit poor capabilities in data and knowledge management, relying heavily on personal experience and emotions in management. Consequently, they struggle to respond promptly to unforeseen events, and their incentive systems fail to fully leverage digital technologies.

Figure 5. Word cloud of emotional word analysis.
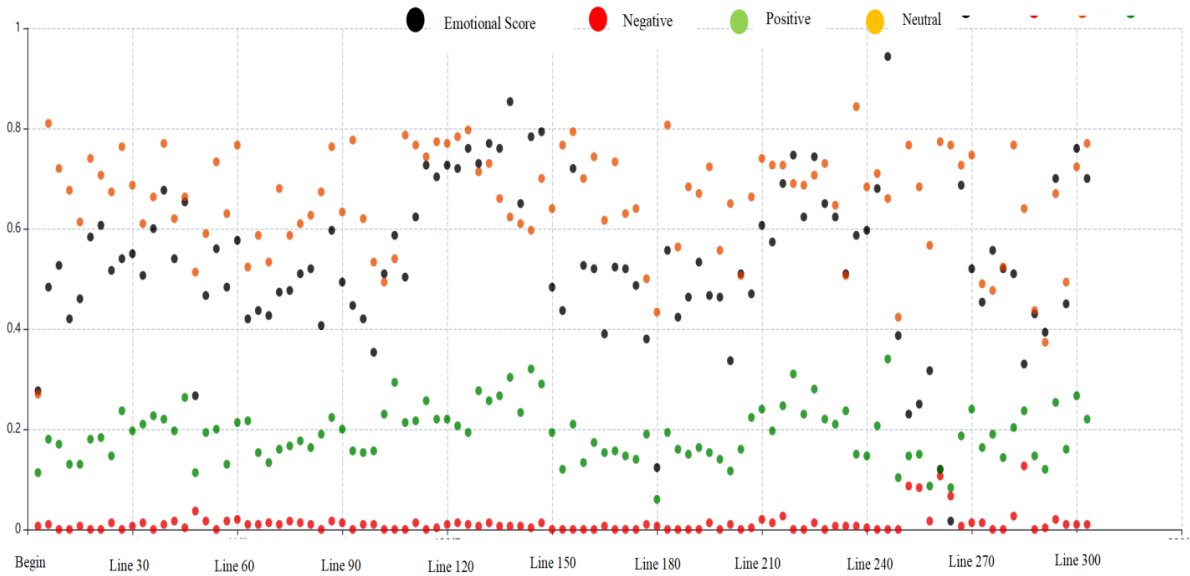
Figure 6. Distribution of Text Sentiment Scores.
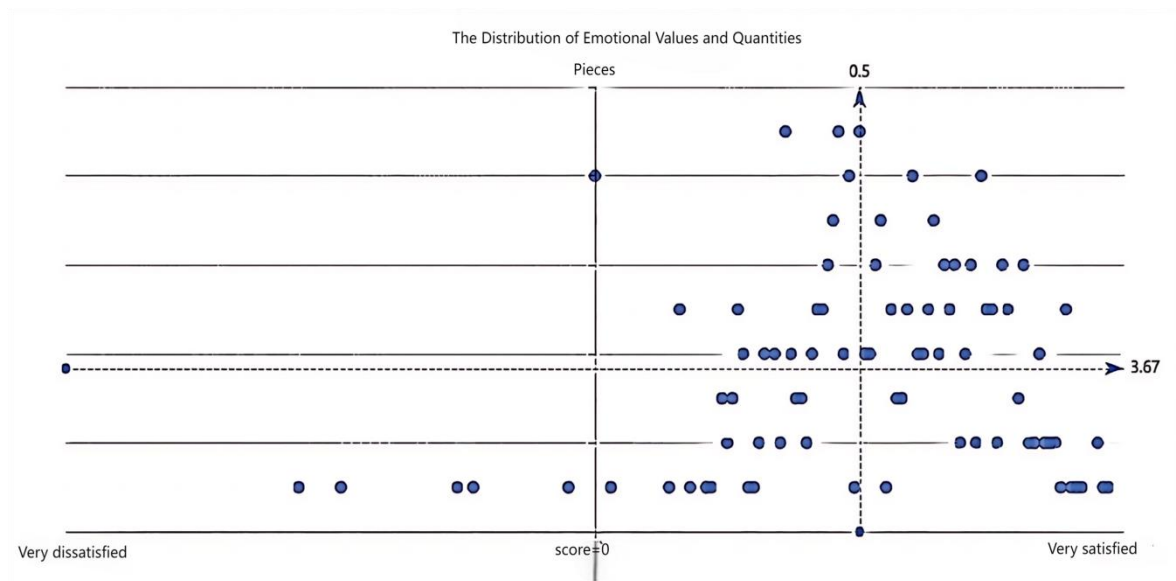
Figure 7. Distribution of Sentiment Values and Quantities

Research Scope

Specialized and Special New Enterprises (SSNEs) were introduced by the Chinese government in 2012 as a concept specifically referring to small and medium enterprises characterized by specialization, refinement, distinctiveness, and novelty. They represent the initial form of hidden champions in entrepreneurial endeavors, deeply embedded in critical segments of the global industrial chain. SSNEs continuously enhance their innovation capabilities, establishing core competitive advantages in niche markets (Ge et al., 2023). Addressing how digital leadership can invigorate SSNEs and enhance their competitive advantages is paramount in the digital transformation practices of Chinese small and medium enterprises (Feng & Shen, 2023).Currently, there is a dearth of research in the Chinese academic community regarding digital leadership behaviors among leaders of SSNEs, particularly how these behaviors influence the enhancement of digital skills and the development of innovation capabilities within enterprises (Zhou & Liu, 2023). Furthermore, literature on the specific application and effectiveness evaluation of knowledge management and ambidextrous learning strategies in SSNEs remains sparse (Lü et al., 2023).

Research Findings

Digital leadership deserves special attention during China's digital transformation phase. It plays a crucial role in the growth and enhancement of competitive advantage in specialized and innovative enterprises, thereby enriching qualitative research on digital leadership in China.

This study finds that digital leadership facilitates the establishment of competitive advantage in enterprises through digital capabilities, innovation orientation, knowledge management strategies, and ambidextrous learning.

Digital leadership serves as a catalyst for enterprise digital transformation, empowering specialized and special new enterprises from top management downward.

Discussion

(1) Promoting the Development of Specialized and Special New SMEs in Guangxi through Robust Development of Digital Leadership. China has recently introduced a series of measures to encourage and foster the development of specialized and special new enterprises. To facilitate digital transformation and reform, the government should implement corresponding policies and establish training mechanisms aimed at cultivating digital leadership traits among management personnel of these enterprises.

(2) Emphasizing Innovation in Specialized and Special New Enterprises through Digital Technology Adoption. Specialized and special new enterprises should prioritize innovation by leveraging digital technologies. This approach enhances digital capabilities throughout the industrial chain, facilitating gradual digital transformation and upgrading in production and operations. Managers can achieve optimal production factor allocation efficiency by overseeing data governance, restructuring digital capabilities, accurately predicting industry trends, aligning with market demands, optimizing business processes, and thereby enabling enterprises to gain competitive advantages and foster rapid growth.

(3) Enhancing Profitability through Improved Corporate Governance Structures. Improving corporate governance structures is crucial for enhancing profitability in specialized and special new enterprises. By promoting internal and external resource sharing, reorganization,

and enhancing knowledge management strategies and dual learning capabilities, enterprises can accelerate internal knowledge circulation efficiency, strengthen synergies between upstream and downstream enterprises, facilitate knowledge transfer, and co-create value.

Recommendations

This study explores the internal mechanisms of digital leadership and corporate competitive advantage from a leadership perspective. Researchers conducted in-depth interviews with 21 managers from specialized and innovative enterprises in Guangxi.China. Textual content from these interviews was extensively analyzed using the Chinese open-source tool "Wei Ciyun"for deep mining. High-frequency words from the interviews were visualized through word clouds and subjected to semantic network analysis. Additionally, emotional analysis was performed based on sentiment polarity classification. Summarizing the above research, recommendations are provided on how the government can promote the development of specialized and innovative enterprises in Guangxi. Suggestions include integrating digital leadership with specialized and innovative enterprises to optimize policies and providing insights for enterprises on leveraging digital leadership to enhance competitive advantage.

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