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Navigating digital transformation challenges: The role of utilization and exploratory innovation in chinese logistics SMEs

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A B S T R A C T

This study investigates the high-quality development of Chinese logistics SMEs by analyzing the effects of digital technology adoption, organizational resilience, utilization innovation, and exploratory innovation. It explores how digital transformation improves operational efficiency and adaptability, while assessing the mediating role of utilization innovation in connecting technology adoption and resilience to enterprise success. Additionally, the study examines the moderating effect of exploratory innovation on these relationships. A survey of 340 logistics professionals and SMEs within China's supply chain sector was conducted, with hypotheses tested using SPSS and SmartPLS-4. The results reveal that digital technology adoption and organizational resilience significantly contribute to enterprise development, with utilization innovation playing a pivotal mediating role. Furthermore, exploratory innovation moderates the relationship between digital adoption and innovation, highlighting the importance of adaptability in dynamic markets. This study presents a comprehensive framework integrating digital adoption, resilience, and innovation, offering valuable insights into how SMEs can address the challenges of digital transformation. Policymakers and industry stakeholders are encouraged to implement supportive policies, financial incentives, and technological investments to enhance the competitiveness of SMEs.

1. Introduction

Digital transformation has emerged as a critical factor driving business sustainability and economic growth. Francisco and Linnér (2023) highlight that enterprises worldwide are integrating digital technologies to improve efficiency, enhance competition, and drive sustainable development. Yang et al. (2021) found that digital technology adoption enables companies to boost productivity, improve decision-making, and sustain long-term growth. While developed economies such as the United States and the European Union have extensively integrated digital technologies across industries, emerging economies, including China, are also undergoing rapid digital transformation (Jawad et al., 2021). The Chinese government's 14th Five-Year Plan (2021–2025) underscores the importance of digitalization as a core economic development strategy, urging enterprises to adopt digital technologies to remain competitive in the global market (Liu, 2022). The Chinese logistics sector, a key driver of economic activity, is undergoing substantial digital transformation. Logistics facilitates trade, strengthens supply chains, and enhances industrial competitiveness (Chang et al., 2020). Small and medium enterprises (SMEs) play a crucial role in China's logistics industry by fostering supply chain resilience. However, they face significant challenges, including rising operational costs, regulatory constraints, and competitive pressures (Caliskan et al., 2025). The China Logistics Development Goh and Ling (2003) highlight that many logistics SMEs

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struggle with digital transformation due to financial constraints, fragmented strategies, and unstable external conditions (L. Guo et al., 2024). Despite the potential benefits of digital technology adoption, these enterprises often find growth affected by a mix of internal capabilities and external influences (Yong et al., 2022). Garzoni et al. (2020) argue that while most logistics SMEs are embracing digitalization, many lack a structured development strategy, further complicating their transformation process.

Relevant research on fresh fruit supply and route selection includes several key studies. Panichakarn and Pochan (2023) identified Route R9 as the most efficient for international trade between Thailand and China, with the lowest transport cost (3.39 USD/km) and highest average speed (44.52 km/h). Border process costs for Routes R9, R8, and R12 accounted for approximately 40% of total costs, while border process times contributed 16–25% of total transit time. Pan et al. (2024) proposed a redesigned fresh fruit logistics network in Guangxi, China, considering economic, logistics, and industry factors. An index system assessed cities' logistics capabilities, with hub and spoke cities identified through cluster analysis and refined using the gravitational model. Additionally, Pan et al. (2023) applied the Boston Matrix model to analyze market competition in 14 Guangxi cities, categorizing markets into 'Dog' (Liuzhou, Yulin, Wuzhou, Fangchenggang, and Baise), 'Child' (Guigang, Baise, Hezhou, Hechi, Laibin, and Chongzuo), 'Star' (Nanning and Guilin), and 'Cash Cow' (Qinzhou). A key challenge in digital transformation is that adopting technology alone does not guarantee positive business returns. Organizational resilience is essential to help firms withstand market disruptions, economic fluctuations, and operational risks (Zhang, 2025). Resilient firms can respond effectively to crises, adapt to changing market conditions, and sustain business operations (Dovbischuk, 2022). However, the interplay between digital technology adoption, organizational resilience, and high-quality enterprise development remains underexplored. Additionally, utilization innovation, which involves leveraging existing resources and technologies for enhanced operational efficiency, serves as a crucial mediating factor in achieving digitally enabled sustainable business success (Fernando et al., 2019). Despite its significance, limited research has examined the impact of utilization innovation on the interrelation between technology adoption, resilience, and enterprise development (Ye et al., 2024).

This study focuses on logistics SMEs within China's New International Land-Sea Trade Corridor, an area experiencing accelerated industrial and digital transformation. These enterprises are actively integrating digital technologies into their operations (Rai et al., 2006). However, they must balance digital technology with operational efficiency to achieve sustainable growth (Fareed et al., 2024). This study examines the challenges SMEs face in adopting digital technologies, enhancing resilience, and fostering innovation. Unlike previous research that tends to focus on digital adoption or resilience in isolation, this study integrates both dimensions and investigates how they collectively influence enterprise success. Additionally, it introduces exploratory innovation as a moderating factor to provide a more comprehensive analysis of competitive factors affecting Chinese logistics SMEs at both domestic and international levels (Gao et al., 2023). This study has a remarkable impact on the literature by combining the processes of digital technology adoption and organizational resilience within one framework on advanced enterprise development (Xie et al., 2022). The literature lacks attention to the fostering utilization boundary innovation and intervention approach which this study undertakes by empirically analyzing the extent to which firms deploy digital technology in their business operations (Ibidunni, 2024). This research also emphasizes how firms strategically use innovation to aid the adoption of digital technologies and organizational resilience, thereby sustaining the firm, which promotes enduring organizational sustainability (Benjamin & Foye, 2022). In addition, this study shifts from conventional methods by incorporating exploratory innovation as a moderating variable, which accounts for why firms strive to formulate new policies that facilitate the speeding up of digital transformation and enterprise development (Liang & Li, 2024). This study is significant because limited literature considers the issue of digital transformation within the context of Chinese logistics SMEs. The previous literature deals with components individually such as the phenomena of digital adoption, resilience, or innovation. This study tackles enterprise development by unifying all components into a single framework (Hokmabadi et al., 2024). Placing greater emphasis on innovation as a driver of business growth for an enterprise, the application of "utilization innovation" as a novel middle construct exerts impact strategies toward enterprise development. Specifically, this study builds on Önsel Ekici et al. (2019) suggested by constructing policy proposals intended to enhance the competitiveness and the sustainability of Chinese logistics SMEs. An internal assessment of the level of digital adoption, resilience, competitiveness, and the environment brings together external factors to cover a broader picture highlighted in Razavi Hajiagha et al. (2024) of the high-quality enterprise development dynamics. This study helps bridge the gap on how firms strategize navigating the complexities of digital transformation in uncertain markets. This study reveals an alternative approach to enterprise development through the lens of policy design, offering evidence aimed at supporting logistics SMEs to build resilience, increase their reliance on digital processes, and sustain operations over prolonged periods.

2. Theoretical Foundation and Hypothesis development

2.1 Dynamic Capabilities Theory and Resource-Based View

The Dynamic Capability Theory (DCT) is the foundation of the adoption of digital technologies, organizational resilience and even Innovation by means of technology use. DCT emphasizes the importance of emerging technological adoption in competition and survival. Firms that are undergoing digital transformation are able to improve their effectiveness, speed, and long-term market

position (Li, 2022). For example, Chinese logistics SMEs struggle with optimizing their supply chains, and business processes, and strengthening their resilience to disruptions, but the adoption of digital technologies greatly improves these functions (Sun et al., 2024). Also, the combination of digital technologies, AI, IoT, and cloud-based logistics is noted to foster innovation through utilization, which creates new models and products, thereby driving enterprise development (Ding et al., 2021). DCT seems to overlap here with the Resource Based View (RBV) in regard to Exploratory Innovation and High Quality Development of an Enterprise which constitutes the primary supporting variables. Exploratory Innovation, as defined by RBV, normally includes the internal resource mobilization of high potential growth with low external risk alterations, promoting organizational resilience and growth (Do et al., 2022). Furthermore, Gupta et al. (2022) argue that high calibre value added features enterprise development is the result of human resource, technology, and infrastructure employed as primary competing resources for the logistics industry because these operational resources are valuable, rare, costly, and inimitable.

2.1 Hypothesis Development

2.1.1 Digital Technology Adoption, Organizational Resilience and Utilization Innovation.

As per Dynamic Capabilities Theory (DCT) and the Resource-Based View (RBV), the adoption of digital technology in organizations is critical for improving innovation and resilience. According to DCT, the adoption of new technologies facilitates a firm's ability to reorganize its resources, automate activities, and adapt to changing market conditions (Ezcan et al., 2020). The reconfiguration and adaptation of resources enhances the utilization innovation as AI, IoT, and cloud computing allow firms to more effectively deploy resources multifold, increasing operational efficiency and competitive edge (Sjödin et al., 2023). These discussions support the assumption of DTA and Utilization Innovation having a positive relationship (Rindfleisch & Moorman, 2001). Organizational Resilience, the ability to adapt to and recover from disruptive conditions on innovation for efficiency (McCarthy et al., 2017). DCT observes that such resilient firms find themselves smoother when shifting to adoption of change and new ideas, which allow them to continually progress toward external directions (Awad et al., 2024). Chapman et al. (2003) noticed that these firms are paying attention to advanced technologies directed towards recovery and improvement of business models. Therefore, the assertion on organizational resilience having a positive relation to utilization innovation as stated by Chatterjee et al. (2015). The integration of DCT and RBV suggests that the implementation of digital technology enhances innovation and organizational resilience while enabling the company to evolve and grow sustainably amidst the competition.

H_{1a}: *Digital Technology Adoption is positively associated with Utilization Innovation.*

H_{1b}: *Organizational Resilience is positively associated with Utilization Innovation.*

2.1.2 Utilization Innovation and High-Quality Development of Enterprises

Utilization Innovation helps drive an enterprise's High-Quality Development, which is critical for Chinese logistics SMEs. Digital technologies assist these companies in using resources, helping to improve operational efficiency, service quality, and overall performance (Huang et al., 2016). Dynamic Capabilities Theory (DCT) supports this idea, arguing that changing resources to fit processes is crucial for a business's competitiveness in a rapidly changing and disruptive environment (Aghimien et al., 2023). For example, the Chinese logistics SMEs (small and medium-sized enterprises) enhance Innovation Utilization with the AI, IoT, and cloud computing digital technologies in supply chain optimization, cost control, and market responsiveness (J. Guo et al., 2024). Also, Newbert (2008) highlights the Resource-Based View (RBV) theory that asserts an organization is more likely to achieve high-quality growth and development if it possesses rare and valuable resources. The Chinese logistics SMEs have digitally enhanced underperforming technologies – the tools not only add value but also deepen their competitiveness. These resources significantly improve the adaptability, efficiency, and overall development of the SMEs. Hence for Chinese Logistics SMEs, innovation and improvement of processes are directly proportional to High-Quality Development (Zhang & Bai, 2024).

H_2: *Utilization Innovation is positively associated with High-Quality Development of Enterprises.*

2.1.3 Mediating Role Utilization Innovation

Utilization Innovation is key to understanding the relationships between digital technology adoption, organizational resilience, and the high-quality development of enterprises. According to Dynamic Capabilities Theory (DCT), a firm's competition, growth, and value creation relies on how a firm's resources are continually restructured about technology and the market (Pan et al., 2022). In this case, high resource usage and promoting efficiency leads to what is referred to as 'High Quality Development'. Regarding Chinese logistics SMEs, AI, IoT, and cloud computing as Digital Technologies transform into innovative resources, operational and service efficiency and market competitiveness (Fan et al., 2025). This means that Utilization Innovation acts as a mediator between the adoption of Digital Technology and High-Quality Development because Chinese logistics SMEs transition from the adoption of digital technologies to performance and sustainability enhancement in operations (Saqib & Qin, 2024). As mentioned before, the ability to adapt to disruption and changing environments, Organizational Resilience has also an impact on high quality development (Musa & Enggarsyah, 2024). RBV highlights that more resilient firms that possess valuable and rare resources are

able to leverage more Increased utilization innovation for better development outcomes (Huang et al., 2023). In the situation of Chinese logistics SMEs, operational resilience enables constructive change for the adoption of innovative practices and optimization of business processes to meet high value standards even in rapidly changing environments. In this regard, Liang and Li (2024) explains that in the phenomena of organizational resilience and high-quality development, innovation utilization acts as an intermediary variable that propels the firms toward sustainable development and enhanced operational performance. Chinese logistics SMEs demonstrate that the relationship between digital technology adoption and organizational resilience interacts with high-quality development through innovation utilization (J. Zhang et al., 2024), underscoring the importance of innovation on organizational effectiveness, strategic performance and sustained global competitiveness (Önsel Ekici et al., 2016).

H_{3a}: *Utilization innovation plays a mediating role in the relationships between Digital Technology Adoption and the High-Quality Development of Enterprises*.

H_{3b}: *Utilization innovation plays a mediating role in the relationships between Organizational Resilience and the High-Quality Development of Enterprises.*

2.2.4 Moderating role of Exploratory Innovation

Exploratory Innovation serves as a critical moderating variable in the interaction between the constructs of Digital Technology Adoption, Organizational Resilience and utilization innovation. As stated in the Dynamic Capabilities Theory (DCT), organizations not only need to implement new technologies, but they must also proactively innovate resource leveraging methods to sustain competitive advantage (Shan et al., 2019). The effect of digital technology adoption on innovation in utilization is augmented by exploratory innovation through adoption because of engaging with new technologies and business models (Urbinati et al., 2020). In the context of Chinese logistics SMEs, the dual approach of exploratory innovation with digital AI, IoT, and cloud services facilitates resource enablement and realignment enhancing operational efficiency and agility (G. Zhang et al., 2024). From this, we infer that Exploratory Innovation acts as a moderating variable to the relationship between the adoption of digital technologies and innovation in utilization, allowing firms to optimally reorganize their activities within the market (Hou et al., 2019; Muhammad Javid et al., 2024). Moreover, Exploratory Innovation influences organizational support and resilience directly, which is the ability of a firm to adapt, endure and thrive after experiencing different disruptions (Kyrdoda et al., 2023). A firm that adopts the Resource Based View (RBV) theory is presumed to stimulate 'Utilization Innovation' because the resources available and valuable, in this case, regions strategically harnessed to maintain resiliency (Julienti Abu Bakar & Ahmad, 2010). Resilient firms, like Chinese logistics SMEs, can rely on Exploratory Innovation to drive long-term operational improvement and withstand process deviation. Exploratory Innovation also moderates the relationship between organizational resilience and utilization innovation as it enables firms to achieve exemplary benchmarks of competitive performance and growth (Mehmood et al., 2024). It appears that in the case of Chinese logistics SMEs, exploratory innovation moderates the relationships between digital technology adoption, organizational resilience (Lu et al., 2024), and utilization innovation towards growth and flexibility in a changing environment (Zhang et al., 2021).

H_{4a}: *Exploratory Innovation significantly moderates the relationship between Digital Technology adoption and utilization innovation*.

H_{4b}: *Exploratory Innovation significantly moderates the relationship between Organizational Resilience and utilization innovation.*

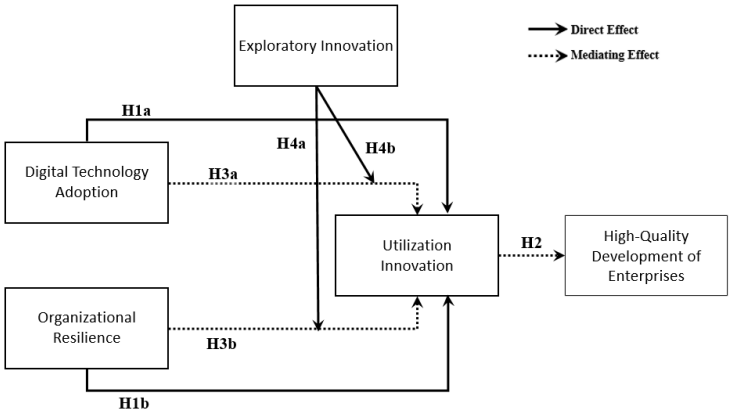

Fig. 1. Research framework

3. Methodology

3.1 Research Design, Sampling & Data Collection Procedures

In this study, a cross-sectional survey was conducted among logistics managers and supply chain coordinators working in Chinese logistics SMEs (Hunziker & Blankenagel, 2024). Respondents were chosen through an arbitrary sampling method using the filter of having a minimum of five years of experience dealing with the digitization of logistics activities and meeting legal obligations for braided reliability. Out of 1072 survey invitations that were sent out to industry specialists, 398 completed the questionnaires. However, only 340 cleaned and validated their data, which then enabled them to undergo the subsequent analysis. Data collection lasted six weeks using an online survey platform, resulting in a 37.12% response rate (Kurzhals, 2021). These were useful to collect the feedback in China's logistics SMEs sector on the role of the adoption of digital technologies, organizational resilience, exploratory innovation, and environmental uncertainty and enterprise development.

3.2 Data Analysis Technique and Ethical Considerations

We utilized IBM SPSS Statistics, which calculated central measures and variation in the data, specifically within the boundaries of hypothesis testing, and SEM with Smart PLS 4 for more intricate inter variable relationships (Hair Jr et al., 2021). Prior to the commencement of the data-gathering tasks, everyone was provided relevant information concerning the intent of the study along with a consent form. Steps that were followed to privacy and confidentiality included file encryption and data anonymization as part of the ethical considerations of research conduct (Iversen et al., 2006).

3.3 Measuring Instruments

In this study, the survey questionnaire included a seven-point Likert scale ranging from 1 = Totally disagree; 2= disagree; 3= Somewhat disagree; 4 = Neutral; 5 = Somewhat agree; 6 = Agree; 7 = Strongly Agree for Chinese logistics professionals and SMEs. The measuring scale was adapted and digital technology adoption used thirteen item scale was assessed (Yang et al., 2021) with integration of digital technologies into logistics and supply chain operations. Organizational Resilience used a nine items scale to measure SMEs' capacity to adapt to Hillmann and Guenther (2021) supply chain disruptions. Exploratory Innovation was measured and adapted (Jansen et al., 2006) through a seven-item scale capturing firms' attempts towards implementing innovative logistics practices. Utilization Innovation was assessed and adapted Jansen et al. (2006) with a six-item scale regarding the changes of the market and government policies related to the China supply chain. Lastly, High-Quality Enterprise Development was measured and adapted Luo et al. (2023) using a seven-item scale, ensuring sustainable growth and operational excellence within logistics SMEs.

3.4 Common Method Bias

In this study, we will employ certain procedural and statistical methods to minimize the impact of Common Method Bias (CMB). First steps will include ensuring that all items in the questionnaire are as straightforward and direct as possible in order to minimize participant misunderstanding. Also, to improve reliability and reduce response pattern biases, reverse-coded items will be added and spaced throughout the questionnaire. Statistically, I will utilize Harman's single-factor test and the partial correlation method, as (Kock, 2015), recommends, to account for CMB effects. These strategies will guarantee that the results of the study will be accurate and unbiased by systematic measurement errors.

4. Analysis and Results

A comprehensive quantitative analysis employs an investigation to explore the relationships shown in Figure 1 of the theoretical framework by statistical analysis and emphasizing data-driven rigor.

Table 1
Descriptive Statistics and Correlations for the Variables

					Correlations									
	Mean	SD	Kurtosis (-7 to +7)	Skew-ness (-2 to +2)	1	2	3	4	5	6	7	8	9	10
1.Company Location	1.14	0.26	6.312	1.832	1									
2.Poistion	1.23	0.62	1.121	-1.612	0.117	1								
3.Comany Ownership	2.16	0.57	5.898	1.941	0.042	0.381	1							
4. Certified Company	3.67	0.42	4.876	-1.765	0.051	0.443	0.079	1						
5.Logistics Types	2.99	0.49	1.891	1.006	0.098	0.211	0.166	0.083	1					
6.Digital Tech-nology Adop-tion	4.67	0.47	-2.725	-1.155	0.126	0.262	0.026	0.072	0.049	1				
7.Organiza-tional Resili-ence	4.12	0.39	3.199	-1.919	0.157	0.166	0.108	0.056	0.038	0.678	1			
8.Exploratory Innovation	4.09	0.48	-4.188	1.051	0.022	0.205	0.102	0.087	0.107	0.598	0.575	1		
9.Utilization Innovation	3.13	0.5	3.197	1.892	0.013	0.539	0.063	0.108	0.152	0.503	0.498	0.523	1	
10.High-Qual-ity develop-ment of Enter-prises	2.86	0.56	-4.985	-1.625	0.087	0.199	0.141	0.147	0.029	0.423	0.487	0.386	0.443	1

Note: Sample size (n) = 340; α: Cronbach's alpha; SD: Standard deviation; AVE: Average Variance Extracted; CR: Composite Reliability.
1Company Location: Guangxi (Total=70, 20.59%); Chongqing (Total=43, 12.65%); Guizhou (Total=78, 22.94%); Sichuan (Total=149, 43.82%)
2 Position: Senior managers (Total=9, 2.65%); Middle managers (Total=68, 20%); Professional and technical personnel (Total=73, 21.47%); General employee (Total=190, 55.88%)
3Company Ownership: State-owned or state-holding (Total=37, 10.88%); Privately owned (Total=281, 82.62%); Foreign-owned or joint venture (Total=22, 6.47%)
4Certified Company: Yes (Total=197, 58.53%); No (Total=37, 10.88%); Applying (Total=99, 29.12%); Not considering yet (Total=7, 2.06%)
5Logistic type: Transportation logistics enterprises (Total=111, 32.65%); Warehousing logistics enterprises (Total=57, 16.76%); Comprehensive logistics enterprises (Total=172, 50.59%)

4.1 Measurement Model

Before conducting hypothesis testing, we ensured measurement accuracy by first assessing the reliability and validity of the constructs. All items achieved the necessary criteria, meeting construct reliability and validity, AVE > 0.5, Cronbach's alpha & Rho-C > 0.7 Bonett and Wright (2015), which is illustrated in Table 2 and Figure 2. Strong internal consistency is indicated by the range of Cronbach's alpha values of 0.804 to 0.849. In addition, the range of composite reliability (CR) and rho-C values of 0.872 to 0.894 confirmed the reliability of the constructs. The AVE values ranging from 0.556 to 0.680 also surpassed the benchmark value of 0.5, illustrating that the constructs were able to adequately capture the variance in their items. As well, all factor loadings greater than 0.7 proved a strong relationship exists between the items and their constructs (Hair Jr et al., 2021). VIF values were calculated as a means to check for multicollinearity, and all values were below the threshold of 3, validating the absence of multicollinearity issues (Fornell & Bookstein, 1982). This finding confirms the boundaries of the theoretical framework and prepares the groundwork for the following structural model analysis.

Table 2
Construct robustness of measurement model

Constructs	Items	Factor Loadings	VIF	Cronbach's alpha	CR (rho_c)	AVE
Digital technology adoption	DTA1	0.78	2.744	0.849	0.891	0.621
	DTA2	0.791	2.945			
	DTA3	0.754	1.684			
	DTA4	0.813	2.072			
	DTA5	0.8	1.951			
Organizational Resilience	OR1	0.867	2.286	0.842	0.894	0.680
	OR2	0.874	2.549			
	OR3	0.784	1.701			
	OR4	0.769	1.549			
Utilization Innovation	UI1	0.741	1.553	0.833	0.882	0.600
	UI2	0.801	1.925			
	UI3	0.787	1.924			
	UI4	0.782	1.712			
	UI5	0.759	1.663			
Exploratory Innovation	EI1	0.758	1.495	0.804	0.872	0.631
	EI2	0.828	1.904			
	EI3	0.756	1.522			
	EI4	0.831	1.753			
High-Quality Development of Enterprises	HQDE1	0.727	1.511	0.841	0.883	0.556
	HQDE2	0.732	1.765			
	HQDE3	0.747	2.074			
	HQDE4	0.779	1.129			
	HQDE5	0.728	1.578			
	HQDE6	0.759	1.819			

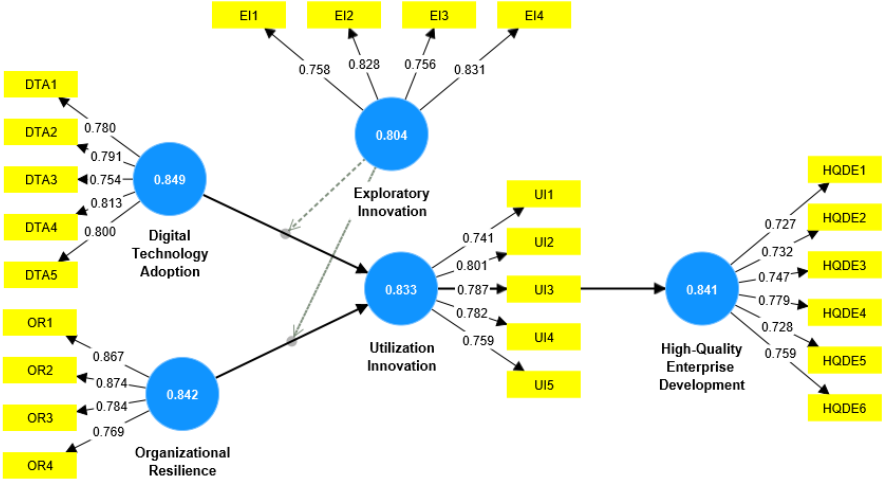

Fig. 2. Confirmatory factor analysis
Source: Author's constructed

4.2 Discriminant Validity

To test the discriminant validity, we used the Heterotrait-Monotrait (HTMT) ratio and the guidelines from Henseler et al. (2015), As stated in Table 3, all of the HTMT values are below 0.85, which means that discriminant validity has been achieved. Also, the Fornell-Larcker criterion confirmed that the HTMT values were below 0.85, which enhances the validity of the model that has been proposed. These results affirm that the constructs are well-defined, conceptually distinct, and part of a robust measurement model**.** The findings ensure that there is no significant overlap between constructs, confirming that each variable uniquely contributes to the model's overall explanatory power.

Table 3
Discriminant Validity

Variables	DTA	EI	HQDE	OR	UI
Discriminant Validity (HTMT) ratio					
Digital Technology Adoption					
Exploratory Innovation	0.884				
High-Quality Enterprise _Development	0.709	0.781			
Organizational Resilience	0.729	0.745	0.724		
Utilization Innovation	0.809	0.667	0.701	0.713	
Fornell-Larcker criterion					
Digital Technology Adoption	0.788				
Exploratory Innovation	0.716	0.794			
High-Quality Enterprise _Development	0.803	0.809	0.746		
Organizational Resilience	0.625	0.618	0.619	0.825	
Utilization Innovation	0.792	0.806	0.796	0.607	0.774

Note: DTA= Digital Technology Adoption, EI= Exploratory Innovation, UI= Utilization Innovation, HQDE=High-Quality Development of Enterprises, OR= Organizational Resilience.

4.3 Model Fitness

We assessed model fitness using chi-square, Goodness of Fit Index (GFI), Adjusted GFI (AGFI), Comparative Fit Index (CFI), and RMSEA. The results show $p < 0.05$ (0.000), Chi-square/df = 2.71 (acceptable), and RMSEA = 0.067 (<0.08), confirming a strong model fit. GFI (0.76), AGFI (0.74), SRMR (0.062), and CFI (0.70) further support model robustness (Goretzko et al., 2024).

4.4 Hypotheses Testing

Using PLS-SEM, we examined the structural model relationships among the study's constructs (Kock, 2016).

Table 4
Hypothesis Result

						Confidence Interval		
Hypothesis	**Relationship**	**β**	**STDEV**	**t**	**p**	**2.50%**	**97.50%**	**Status**
H1a	DTA→UI	0.364	0.062	5.871	0.000	0.242	0.486	Accepted
H1b	OR→UI	0.425	0.049	8.673	0.000	0.329	0.521	Accepted
H2	UI→HQDE	0.697	0.068	10.25	0.000	0.564	0.830	Accepted
H3a	DTA→UI→HQDE	0.327	0.048	6.813	0.000	0.233	0.421	Accepted
H3b	OR→UI→HQDE	0.512	0.043	11.91	0.000	0.428	0.596	Accepted
H4a	EI* DTA→UI	0.236	0.057	4.140	0.045	0.124	0.348	Accepted
H4b	EI* OR→UI	0.201	0.052	3.865	0.003	0.099	0.303	Accepted

Note: DTA= Digital Technology Adoption, EI= Exploratory Innovation, UI= Utilization Innovation, HQDE=High-Quality Development of Enterprises, OR= Organizational Resilience

Table 4 provides a detailed analysis of the hypotheses, assessing statistical significance through path coefficients (β), standard deviation (SD), t-values, p-values, and confidence intervals (CI). The findings validate all proposed hypotheses, highlighting the critical role of digital technology adoption, organizational resilience, exploratory innovation, and utilization innovation in driving high-quality enterprise development, particularly within Chinese logistics SMEs. H1a confirms a strong positive relationship between Digital Technology Adoption and Utilization Innovation (β=0.364, t=5.871, p=0.000), emphasizing that Chinese logistics SMEs investing in AI-driven automation, cloud-based logistics, and digital platforms experience enhanced operational performance and market agility. H1b supports the notion that Organizational Resilience strengthens utilization innovation (β=0.425, t=8.673, p=0.000), suggesting that resilient firms better navigate supply chain disruptions, market volatility, and regulatory

changes. H2 supports the notion that utilization innovation strengthens high quality development enterprises (β=0.697, t=10.25, p=0.000). The study further validates the mediating role of utilization Innovation (H3a and H3b), showing that SMEs leveraging digital adoption and resilience through innovation-driven strategies achieve superior long-term growth (β=0.327, t=6.813, p=0.000) and (β=0.512, t=11.91, p=0.000). Additionally, H4a and H4b confirm the moderating effect of Exploratory innovation, indicating that firms investing in the latest technologies to enhance digital transformation, and operational performance (β=0.236, t=4.140, p=0.045) and (β=0.201, t=3.865, p=0.003). These results underscore the importance of digital transformation, organizational resilience, and innovation-driven adaptability in ensuring sustainable growth and long-term competitiveness of Chinese logistics SMEs.

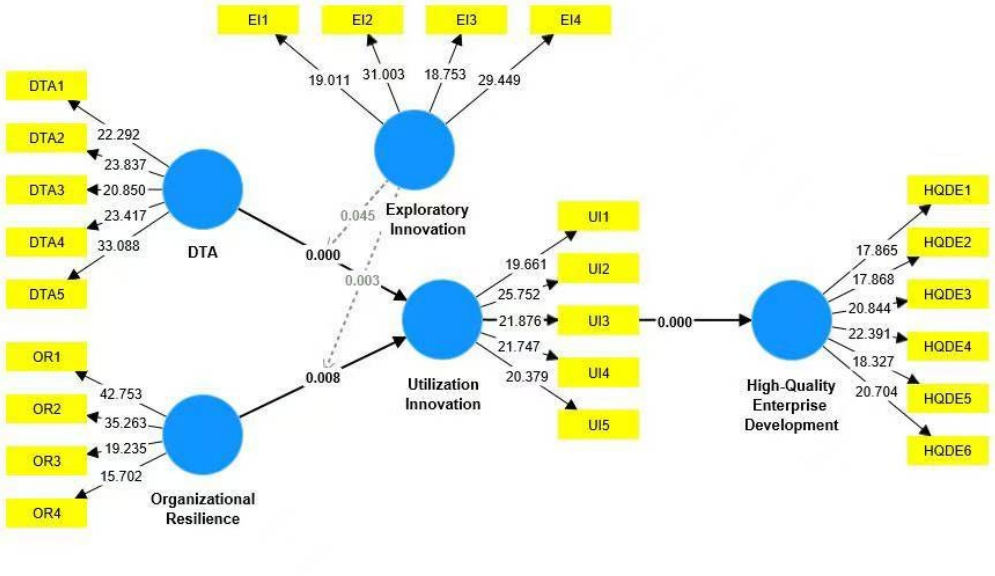

Fig. 3. Hypothesis Testing
Source: Author's constructed

5. Discussion

This study examines the effects of Digital Technology Adoption, Organizational Resilience, and Utilization Innovation on the high-quality development of Chinese logistics SMEs. The results support H1a, confirming that Digital Technology Adoption positively impacts Utilization Innovation. The adoption of automation, cloud computing, and AI technologies enhances the flexibility of logistics SMEs' resources, operations, and business systems. This aligns with Dynamic Capability Theory (DCT), which suggests that organizations must continuously adapt and transform resource configurations to survive (Abdullahi et al.). For Chinese logistics SMEs, digital technologies are crucial for optimizing decision-making, controlling logistics processes, and boosting market competitiveness (Zhou et al., 2023). The relationship between Digital Technology Adoption and Utilization Innovation underscores that modern digital technologies are vital for enhancing innovation capabilities (Ramilo & Embi, 2014).

Moreover, H1b is supported, as Organizational Resilience is significantly and positively related to Utilization Innovation (Do et al., 2022). Resilient firms, adaptable to both disruptive and prevailing changes, can shift focus to innovation, thereby increasing their capacity for innovation development (Akgün & Keskin, 2014). For Chinese logistics SMEs, Organizational Resilience enables firms to withstand external pressures while continuously innovating (Demmer et al., 2011). This aligns with Resource-Based View (RBV), which asserts that firms with unique, valuable, and inimitable resources, such as resilience, experience growth through sustained innovation (Cheng & Lu, 2017). The link between innovation and resilience further supports the idea that resilient organizations are more inclined to adopt digital technological development strategies (Garrido-Moreno et al., 2024).

The study also confirms that Innovation Utilization positively influences High-Quality Development, supporting the second hypothesis. The findings indicate that leveraging digital solutions for resource management enhances efficiency and firm-level improvement (Zhang & Chen, 2024). Innovation Utilization enables firms to transform business processes to be more efficient, flexible, and adaptable to environmental changes, fostering high-quality development (Kim et al., 2012; Liao & Barnes, 2015). For Chinese logistics SMEs, technologies like smart logistics, real-time tracking (Feng & Ye, 2021), and automated warehouses contribute to better business outcomes and sustainable development (Hao et al., 2020).

Hypotheses H3a and H3b further confirm that Utilization Innovation mediates the relationship between Digital Technology Adoption and High-Quality Development, as well as between Organizational Resilience and High-Quality Development. The results indicate that Utilization Innovation strengthens both Digital Technology Adoption and Organizational Resilience toward achieving high-quality development (He et al., 2023). For Chinese logistics SMEs, the integration of new technologies and resilient practices through Utilization Innovation improves operational efficiency (Kumar et al., 2019), product quality, and customer satisfaction (da Silva & Cardoso, 2024). As firms develop new ways to utilize resources, they achieve sustainable success (Halme et al., 2014).

The study also validates H4a and H4b, confirming the moderating role of Exploratory Innovation. It reveals that Exploratory Innovation moderates the relationships between Digital Technology Adoption and Utilization Innovation, as well as between Organizational Resilience and Utilization Innovation. The adoption of digital technologies, particularly through Exploratory Innovation, supports enterprise development and business sustainability (Xia et al., 2024). The Integrative Framework for Business Resilience highlights that resilient entities face new challenges and enhance their operational capabilities through Exploratory Innovation, driving them toward advanced technological solutions (Annamalah et al., 2023). Such firms are change initiators, progressing toward advanced development (Lewrick et al., 2010). In the context of Chinese logistics SMEs, this transformation aligns with recovery models under dynamic, evolving conditions (Sindhwani et al., 2024), fostering improvements in technology, productivity, and operational efficiency (Teece, 2007), while adjusting strategies to create emerging businesses (London & Hart, 2004). This adaptability and responsiveness are key to enhancing competitiveness and successfully navigating technological changes (Abukalusa & Oosthuizen, 2025; Bernardes et al., 2009).

Overall, the study confirms the relationships among Digital Technology Adoption, Organizational Resilience, Utilization Innovation, and Exploratory Innovation, demonstrating how these factors drive the high-quality development of Chinese logistics SMEs. It highlights the crucial role of digital technologies, resilience, and innovation in fostering growth and sustainability.

6. Conclusion

This study advances knowledge on Digital Technology Adoption, Organizational Resilience, Exploratory Innovation, and the logistics of small and medium enterprises (SMEs) in China undergoing high-quality development. The findings confirm that the integration of digital technologies enhances international business activities, driving improvements in operational productivity, market share, competitiveness, and overall organizational performance. Organizational Resilience also plays a crucial role in business growth. Additionally, Exploratory Innovation moderates the relationship between Digital Technology Adoption and Organizational Resilience, highlighting the importance of advanced innovation for maintaining a competitive edge and market leadership. These findings support Dynamic Capabilities Theory (DCT) and Resource-Based View (RBV), which emphasize the importance of resource realignment through innovation for sustained value. Future research should explore emerging technologies and the impact of global market conditions on the development and competitiveness of China's logistics SMEs.

7. Implications

7.1 Theoretical Implications

This study presents novel theoretical insights into the intersection of Digital Technology Adoption, Organizational Resilience, and High-Quality Development in Chinese logistics SMEs. It extends Dynamic Capabilities Theory (DCT) by emphasizing utilization innovation as a key mechanism in transforming digital adoption into sustainable business growth. This underscores the necessity of continuous resource and capability reconfiguration for long-term development. Furthermore, the study contributes to the Resource-Based View (RBV) by identifying resilience and innovation capabilities as critical internal resources that enable SMEs to strategically leverage technology for competitive advantage. Additionally, the moderating role of exploratory innovation highlights the importance of fostering innovation for sustained progress. These findings enhance the understanding of the dynamic relationship between technology, resilience, and innovation in driving high-quality development.

7.2 Practical Implication

Policymakers and business leaders in Chinese logistics SMEs can enhance operational efficiency by leveraging this study's findings. The research underscores the strategic importance of adopting advanced technologies such as Automation, Cloud Computing, and AI to remain competitive in the digital marketplace. Digital technologies are essential for seamless supply chain integration, while Organizational Resilience must be prioritized to navigate disruptions and market shifts effectively. Strengthening resilience requires a focus on Exploratory Innovation and modern technological advancements from both business and policy perspectives. By fostering innovation-driven strategies, executives can enhance technological and service proficiency, maintaining a

competitive edge. Thus, logistics SMEs in China must prioritize resilience building and digital capability development to adapt to evolving market dynamics.

8. Limitations and Future Research Directions

While this study addresses gaps in Digital Technology Adoption, Organizational Resilience, and Utilization Innovation in Chinese logistics SMEs, it has several limitations. First, its scope is restricted to SMEs within the Chinese logistics industry, which may limit its applicability to other sectors or regions with different market dynamics. However, the study's framework may also be relevant to the construction industry, particularly in assessing the impact of sustainable construction on project success in alignment with sustainable development goals. External factors, such as environmental regulations and government support, contribute to the adoption of sustainable construction practices, while green innovation and collaborative activities enhance project sustainability. Research in sustainable construction could explore these factors to assess their influence on project outcomes. Additionally, expanding the analysis to other industries would provide insights into the effects of digital adoption and resilience on sustainable development. Future research should also examine the role of emerging technologies, such as Blockchain, IoT, and AI, in promoting sustainability across various sectors, including construction.

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