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Empirical Study on the Influencing Factors of Small and Medium Enterprises' Willingness to Adopt Digital Technologies under the Context of New-Quality Productive Forces

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Abstract

Under the development of new-quality productive forces, small and medium enterprises (SMEs) have encountered unprecedented challenges, and digital transformation has become the path to break through. Based on the TOE (Technology-Organization-Environment) analytical framework, this study explores the influencing factors of SMEs' willingness to adopt digital technologies in Guangdong Province. The findings indicate that at the technological level, perceived usefulness and perceived ease of use have significant positive impacts on SMEs' willingness to adopt digital technologies. At the organizational level, top management involvement has a significant positive effect on SMEs' willingness to adopt digital technologies, while the influence of top management attitudes is not significant. At the environmental level, mimetic pressure and normative pressure have significant positive impacts on SMEs' willingness to adopt digital technologies, but the impact of coercive pressure is not significant. Based on these findings, suggestions are put forward from the three levels mentioned above to assist SMEs in achieving digital transformation and upgrading.

Keywords

Small and Medium Enterprises; Digital Technologies; Influencing Factors; New-Quality Productive Forces.

1. Introduction

New-quality productive forces refer to the productivity with digitalization, networking, and intelligence as its core features in the new round of technological revolution and industrial transformation, representing a new stage of productive development. Under the context of new-quality productive forces, the application of digital technologies is accelerating its popularization and penetration from large enterprises to small and medium enterprises (SMEs). Developing new-quality productive forces and promoting the digital transformation of SMEs have become important means for the Chinese government to stimulate regional economic growth, enhance the resilience of key industrial chains and supply chains, and support the innovative development of enterprises. According to the data released in the "Report on the Digital Transformation Development of SMEs (2023)" by the China Industrial Internet Research Institute, over 70% of enterprises have reached the stage of partial optimization or above in terms of digitization, and over 60% of enterprises have achieved visualization and lean management in more than half of their key business production processes. The subjective willingness, basic conditions, and capability levels of SMEs in carrying out digital transformation continue to improve. However, under the background of new-quality productive forces, SMEs face challenges such as capital constraints, talent shortages, insufficient technology application, unclear transformation paths, and extensive management, which greatly affect the willingness of SME owners to undergo digital transformation and

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hinder the development of new-quality productive forces. Therefore, this study mainly employs the TOE (Technology-Organization-Environment) analytical framework to investigate the influencing factors of SMEs' willingness to adopt digital technologies under the context of new-quality productive forces, aiming to assist SMEs in their digital transformation and promote the development of new-quality productive forces.

2. Literature Review

2.1. Research on New-quality Productive Forces

Academic research on new-quality productive forces is primarily divided into two aspects: theoretical exploration and empirical analysis. Theoretical exploration focuses on the definition, characteristics, formation mechanism, and contribution to economic and social development of new-quality productive forces. For instance, Zheng Yongnian (2024) [1] proposed that new-quality productive forces are the key path to Chinese-style modernization, emphasizing its strategic position. He believes that new-quality productive forces not only encompass the application of new technologies but also involve the integration of basic research, applied technology, and financial systems. Additionally, Zheng Yongnian stressed the importance of institutional openness, a favorable business environment, and an international talent system for the development of new-quality productive forces. His perspective provides a macro view of new-quality productive forces and emphasizes the necessity of constructing an innovation system and optimizing the institutional environment. In contrast to the macro perspective of theoretical exploration, empirical analysis focuses more on the effects of new-quality productive forces in specific fields and levels. For example, Zhang Xiue et al. (2024) [2] analyzed the data of Chinese A-share listed companies from 2015 to 2022 to explore the impact of digital transformation on enterprises' new-quality productive forces. They found that digital transformation significantly enhances enterprises' productivity levels, and this enhancement varies among different enterprise types, regions, and enterprise life cycles. Furthermore, absorptive capacity and market competition intensity play important mediating and moderating roles between digital transformation and enterprises' new-quality productive forces. Xu Tengda et al. (2024) [3] conducted research from the provincial level, using the fuzzy-set qualitative comparative analysis (fsQCA) method to identify differentiated patterns of developing new-quality productive forces in different provinces in China, revealing the combined effects of resource endowments, industrial bases, and scientific research conditions in the development of new-quality productive forces.

2.2. Research on Digital Transformation of SMEs

Digital transformation is crucial for SMEs in modern economies, as it not only changes their traditional operating models but also has profound impacts on organizational structure, management processes, and market strategies. At the theoretical level, scholars have devoted themselves to constructing conceptual frameworks for digital transformation, exploring its strategic significance, influencing factors, and potential impacts on enterprise performance. By establishing theoretical models, they have analyzed the internal logic and external conditions of digital transformation, studying how enterprises can utilize digital means to enhance competitiveness and achieve sustainable development. At the empirical level, existing scholars have verified theoretical hypotheses through data analysis, examining the actual effects of digital transformation in different industries and sizes of enterprises. Through case studies, surveys, and data statistics, scholars have revealed the key success factors of digital transformation and assessed the impact of factors such as policy support, market environment, and enterprise capabilities on the transformation's effectiveness. For instance, Yuan Yehu and Sun Yanping (2023) [4] explored how the digital transformation of supply chain core enterprises significantly enhances the innovation capabilities of upstream and downstream

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SMEs through capital spillover, transformation spillover, and innovation spillover effects, emphasizing the importance of supply chain collaborative development in digital transformation. Xia Yiqun and Meng Xia (2024) [5] analyzed the collaborative mechanism of SME digital transformation driven by the dual forces of the government and digital service providers through an evolutionary game model, finding that government subsidies and service providers' technology assurance strategies can effectively promote the digital transformation of SMEs. Li Liwei et al. (2023) [6] used fuzzy-set qualitative comparative analysis to study the configurational antecedents of digital transformation in technology-based SMEs, revealing that three configurations—internal and external difficulties, preparing for danger in times of peace, and external environmental shocks—can all trigger a high degree of digital transformation. Shi Yupeng and Wang Yang (2024) [7] analyzed the current status, focus, and difficulties of SME digital transformation based on survey data from a large number of SMEs, proposing innovative paths to guide SMEs in planning transformation paths suitable for their characteristics and development needs.

2.3. Research Commentary

In summary, the literature on new-quality productive forces mainly focuses on interpreting the connotation and constructing indicator models, with limited exploration of SME digital transformation. In contrast, research on SME digital transformation is primarily qualitative and focuses on countermeasures. Quantitative research mainly focuses on the effectiveness of transformation, with limited exploration of the willingness to undergo digital transformation. In fact, the first question to be answered in carrying out digital transformation for SMEs is what factors constrain or promote their digital transformation, i.e., exploring the antecedents of SME digital transformation rather than blindly embarking on digital initiatives. Therefore, considering the above factors, this study aims to investigate the influencing factors of SMEs' willingness to adopt digital technologies.

3. Theoretical Basis and Research Hypotheses

3.1. Theoretical Basis

TOE Model, referring to Technology-Organization-Environment analysis framework, was proposed by Tornatzky et al. [8] in 1990. It emphasizes the impact of technological application scenarios on organizational effectiveness. This model argues that the adoption of a new technology by an organization is influenced by technological characteristics, organizational characteristics, and external environmental characteristics. Among them, technological characteristics refer to the advantages, usefulness, and complexity of the technology; organizational characteristics refer to the size, scale, and executives of the organization; and external environmental factors refer to formal or informal institutional environments. Currently, the TOE analysis framework is widely used, such as in studies on influencing factors of e-commerce technology diffusion [9], adoption of radio frequency identification technology (RFID) [10], applicability of Building Information Modeling (BIM) [11], and performance differences in local government website construction [12].

3.2. Research Hypotheses

(1) The impact of technological factors on the willingness to adopt digital technology in SMEs

The research on the influence of technological factors on adoption intention dates back to the Technology Acceptance Model (TAM), proposed by American scholar Davis [13] and widely used in research fields such as information systems and information technology. As the two most important independent variables in this model, perceived usefulness reflects how emerging information technology improves enterprise work efficiency and performance; perceived ease of use reflects the ease of skilled use and control of emerging information

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technology. As the forefront of emerging information technology development, digital technology is essentially characterized by reprogrammability and data homogeneity, providing enterprises with a more open and flexible innovative environment, fundamentally triggering organizational changes and transformations. Existing research has shown that digital technology can change value creation methods, optimize and enhance operational efficiency, improve customer relationships, and enhance competitiveness [14-15]. With the rapid development of the digital economy, the continuous improvement of digital infrastructure construction, and the continuous enhancement of digital governance experience, the difficulty of applying digital technology in SMEs will surely be greatly reduced.

Therefore, this article proposes the following hypotheses:

H1a: Perceived usefulness has a significant positive impact on the willingness of SMEs to adopt digital technology.

H1b: Perceived ease of use has a significant positive impact on the willingness of SMEs to adopt digital technology.

(2) The impact of organizational factors on the willingness to adopt digital technology in SMEs

Upper echelon theory argues that executives are important predictors of corporate strategic decisions [16]. In the process of organizational adoption of digital technology, executive involvement and attitudes play crucial roles in decision-making. The adoption of digital technology leads to changes in strategy, organization, culture, and other aspects, making enterprises face greater uncertainty, which requires executives to make effective decisions. More directly, the adoption of digital technology requires support in terms of manpower, material resources, financial resources, and other aspects, which can only be better allocated and operated by executives. In addition, it is particularly noteworthy that the digital era calls for digital leadership, and the Chief Digital Officer (CDO) has become an important digital leadership role, specifically responsible for coordinating the digital transformation of enterprises, including implementing digital transformation strategies, seizing digital technology opportunities, and promoting cross-functional collaboration [17]. Therefore, executive involvement and attitudes are two key organizational factors that influence the adoption of digital technology.

Therefore, this article proposes the following hypotheses:

H2a: Executive involvement has a significant positive impact on the willingness of SMEs to adopt digital technology.

H2b: Executive attitudes have a significant positive impact on the willingness of SMEs to adopt digital technology.

(3) The influence of environmental factors on the willingness of SMEs to adopt digital technology

According to institutional theory, the institutional environment is no longer regarded as an exogenous variable in the context of corporate choices and actions, but rather a crucial endogenous variable in strategic formulation [18]. Therefore, the institutional environment plays a significant driving force in the digital transformation process of SMEs. Based on the research of DiMaggio and Powell [19], the influence of the institutional environment on corporate strategic decisions is mainly manifested in institutional pressure. Institutional pressure can be divided into three types: coercive pressure, mimetic pressure, and normative pressure. Coercive pressure mainly reflects the formal or informal pressure generated by enterprises on the organizations they depend on, including policies, regulations, laws, and culture. Mimetic pressure primarily arises from the pressure organizations face in responding to external uncertain environments. In the process of digital transformation, enterprises often face numerous uncertainties, thus they tend to imitate the digital transformation practices of existing enterprises as learning goals. Normative pressure mainly originates from the pressure

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brought by specialization. During the adoption of digital technology, various stakeholders such as industry associations, professional forums, customers, and suppliers form industry standards and norms, thereby exerting pressure on compliance. Existing research has shown that mimetic pressure, coercive pressure, and normative pressure have significant impacts on technology adoption. Therefore, it is further believed that these three pressures also play a role in the willingness of SMEs to adopt digital technology.

Hence, the following hypotheses are proposed in this paper:

H3a: Mimetic pressure has a significant positive impact on the willingness of SMEs to adopt digital technology.

H3b: Coercive pressure has a significant positive impact on the willingness of SMEs to adopt digital technology.

H3c: Normative pressure has a significant positive impact on the willingness of SMEs to adopt digital technology.

4. Research Design

4.1. Data Source

The research data were primarily collected through various methods such as alumni associations, university-industry collaborations, SME development centers, and personal connections. The classification of SMEs mainly refers to the "Classification Method for Large, Medium, and Small Enterprises in Statistics (2017)" (Guotongzi [2017] No. 213) issued by the National Bureau of Statistics. The survey period was from February 2020 to June 2023. Ultimately, 268 questionnaires were collected, with 51 invalid ones excluded, leaving 217 valid questionnaires, representing a response rate of 80.97%.

4.2. Variable Measurement

The measurement of perceived usefulness and perceived ease of use mainly referenced Davis's scales; executive involvement and executive attitudes primarily referenced the scales of Xie Weihong et al. [20]; institutional pressure mainly referenced the scales of DiMaggio and Powell [19] and Liang et al. [21]. All scales employed a 5-point Likert scale, with 1 representing "strongly disagree" and 5 representing "strongly agree." After the questionnaire design was completed, three experts were invited to revise the questionnaire scales and conduct a pre-survey. Based on the results of the pre-survey, the questionnaire items were repeatedly revised to ensure the quality of the questionnaire.

5. Data Analysis

5.1. Basic Sample Characteristics

The survey results revealed that in terms of gender, 44.24% were female, and 55.76% were male, indicating a relatively balanced distribution. In terms of age, 9.22% were under 25 years old, 35.02% were between 26 and 35 years old, 41.47% were between 36 and 45 years old, and 14.30% were over 46 years old. In terms of education level, 7.83% had a high school education or below, 40.55% had a college degree, 37.33% had a bachelor's degree, and 14.29% had a master's degree or higher. In terms of industry, wholesale and retail accounted for 16.13%, software and information technology services accounted for 16.59%, manufacturing accounted for 31.34%, catering accounted for 12.44%, accommodation accounted for 18.43%, and other industries accounted for 5.31%.

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5.2. Reliability and Validity

Firstly, a reliability test was conducted. Only when the reliability coefficient is deemed acceptable can the analysis results of the questionnaire's scales be considered reliable. As shown in Table 1, all Cronbach's α coefficients are greater than 0.8, indicating good internal consistency in this study. Meanwhile, the Composite Reliability (CR) values are also above 0.8, suggesting excellent composite reliability. Secondly, to analyze the structural validity of the main variables in this study, an exploratory factor analysis was performed using the principal component analysis method and the varimax rotation method. The results revealed that the KMO values of almost all variables were greater than 0.7, indicating that the data was suitable for factor analysis, and the structural validity met the requirements. Furthermore, to conduct a discriminant validity analysis, the common practice in the academic community was followed, where the square root of the Average Variance Extracted (AVE) was compared to the correlation coefficients between all other variables. As presented in Table 1, the results further demonstrate that the discriminant validity of the measurement variables is satisfactory.

Table 1. Reliability and Validity

Measures	Item	Loading	α	AVE	CR
Perceived usefulness	PU1	0.811	0.862	0.648	0.902
	PU2	0.750			
	PU3	0.839			
	PU4	0.852			
	PU5	0.768			
Perceived ease of use	PE1	0.858	0.805	0.720	0.962
	PE2	0.856			
	PE3	0.831			
Executive participation	EA1	0.871	0.902	0.721	0.928
	EA2	0.823			
	EA3	0.856			
	EA4	0.848			
	EA5	0.847			
Executive attitudes	ER1	0.916	0.866	0.792	0.919
	ER2	0.859			
	ER3	0.893			
Imitation pressure	MP1	0.912	0.872	0.800	0.922
	MP2	0.893			
	MP3	0.874			
Coercive pressure	CP1	0.913	0.875	0.801	0.923
	CP2	0.904			
	CP3	0.867			
Regulatory pressure	NP1	0.878	0.807	0.721	0.886
	NP2	0.877			
	NP3	0.790			
Intention of adopting	AI1	0.883	0.828	0.745	0.897
	AI2	0.879			
	AI3	0.826			

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5.3. Correlation Analysis

Pearson's correlation analysis was performed on the main variables in Table 2, revealing that all variables were significantly correlated at the 0.01 level, indicating their suitability for regression analysis. It is worth noting that the correlation coefficients of the independent variables are relatively high. Therefore, further testing for multicollinearity using the Variance Inflation Factor (VIF) was conducted. The threshold values for all items were less than 10, indicating that there is no multicollinearity issue.

Table 2. Descriptive Statistics and Correlations

Variable	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1.Perceived usefulness	**0.805**							
2.perceived ease of use	0.535**	**0.849**						
3.Executive participation	0.510**	0.749**	**0.849**					
4.executive attitudes	0.531**	0.730**	0.818**	**0.890**				
5.Imitation pressure	0.574**	0.653**	0.619**	0.739**	**0.894**			
6.Coercive pressure	0.487**	0.696**	0.662**	0.763**	0.611**	**0.895**		
7.Regulatory pressure	0.509**	0.693**	0.689**	0.722**	0.684**	0.823**	**0.849**	
8.Intention of adopting	0.557**	0.702**	0.731**	0.703**	0.731**	0.659**	0.769**	**0.863**
Notes: **P<0.01								

5.4. Hypothesis Testing Results

Table 3. Multiple regression analysis

	Coefficient of non-standardization B	Standard error	Standardization coefficient Trial version	t	Sig.
1.Perceived usefulness	0.057	0.031	0.085	1.814	*
2.perceived ease of use	0.120	0.059	0.128	2.016	**
3.Executive participation	0.126	0.040	0.223	3.131	***
4.executive attitudes	-0.022	0.076	-0.023	-0.289	.773
5.Imitation pressure	0.216	0.057	0.231	3.755	***
6.Coercive pressure	-0.067	0.066	-0.076	-1.021	.309
7.Regulatory pressure	0.395	0.071	0.405	5.552	***
R^2=0.714 F=74.461					

Notes: ***p<0.001, **p<0.01, **p<0.1.

The results of the hypothesis testing are summarized in Table 3. Firstly, the impact of technological factors on SMEs' willingness to adopt digital technology reveals that perceived usefulness has a significant positive effect (β=0.085, P<0.1), supporting Hypothesis H1a. Similarly, perceived ease of use also has a significant positive impact (β=0.128, P<0.05), verifying Hypothesis H1b. Secondly, regarding organizational factors, top management's involvement significantly and positively influences SMEs' willingness to adopt digital technology (β=0.223, P<0.01), validating Hypothesis H2a. However, the effect of top

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management's attitude is not significant (β=-0.023, P>0.1), failing to support Hypothesis H2b. Lastly, in terms of environmental factors, imitation pressure significantly and positively affects SMEs' willingness to adopt digital technology (β=0.231, P<0.01), confirming Hypothesis H3a. In contrast, compulsory pressure does not exhibit a significant influence (β=-0.076, P>0.1), disproving Hypothesis H3b. However, normative pressure significantly and positively impacts SMEs' willingness to adopt digital technology (β=0.405, P<0.01), verifying Hypothesis H3c.

6. Conclusion and Suggestions

6.1. Conclusion and Discussion

This study, based on the TOE analytical model, investigates the influencing factors of SMEs' willingness to adopt digital technology in Guangdong Province under the context of new-quality productivity. The conclusions are as follows: Firstly, regarding technological factors, the hypotheses concerning the relationships between perceived usefulness and perceived ease of use with SMEs' willingness to adopt digital technology have been validated. This result aligns with the findings of existing technology acceptance models, indicating that the primary reason for technology acceptance lies in whether the technology can bring direct benefits and utility to the enterprise. Secondly, in terms of organizational factors, the relationship between top management's involvement and SMEs' willingness to adopt digital technology has been verified, while the relationship between top management's attitude and SMEs' willingness to adopt digital technology has not been supported. This suggests that mere attitude alone cannot influence the adoption of digital technology; instead, it is the actual participation and support of top management that truly matters. Only when top management genuinely demonstrates their commitment by explaining the prospects of digital technology, formulating strategies, overseeing, and implementing digital technologies will it influence the adoption of digital technology in enterprises. Mere declarations without action will ultimately render digital transformation ineffective. Thirdly, in terms of environmental factors, the relationships between imitation pressure and normative pressure with SMEs' willingness to adopt digital technology have been validated, while the relationship between compulsory pressure and SMEs' willingness to adopt digital technology has not been supported. This result reflects the increasing marketization of China, where the business environment has improved significantly, coupled with government policies that prioritize supporting and assisting SMEs in resuming production and achieving transformation under the context of new-quality productivity. The pressure on enterprises to adopt digital technology is more often derived from competitive pressures from rivals and the evolving professionalization pressures of the industry, rather than compulsory pressure, which if imposed forcibly, may have adverse effects.

6.2. Suggestions

(1) Appropriate timing and scale for digital technology enablement

Although the survival and development model of enterprises in the digital era has shifted from "big fish eating small fish" to "fast fish eating slow fish," this does not mean pursuing speed at all costs. The adoption of digital technology is not achieved overnight, as there are numerous digital technologies and platforms available, and the degree of digitization varies among enterprises. Each SME faces different risks and returns. Therefore, enterprises should thoroughly understand the challenges brought by digital technology itself and select digital technologies suitable for their own development. Specifically, before adopting digital technology, enterprises should carefully consider its usefulness and ease of use. For instance, they should determine which digital technologies, platforms, or models can address their current issues, whether they need digital technologies for resuming production and operations, digital platforms for resolving resource and market issues, or new digital business models.

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Enterprises should not blindly pursue speed but should first clarify these issues to ensure that digital technology can truly deliver its intended benefits.

(2) Coordination of digital organizations requires support from top management

SME digitization requires the involvement of top management, who must play a crucial role in the digital transformation process. This involves: first, formulating a digital strategic plan for SMEs, clarifying digital vision, and repositioning products and services; second, coordinating digital organization design and adjusting organizational structure to break away from traditional hierarchical management models and create flexible, agile, and efficient digital development departments for SMEs based on new positioning and changing external environments; third, continuously strengthening digital infrastructure, establishing standardized digital management systems, overseeing digital project development, and preventing digital failures; fourth, integrating internal and external digital resources and enhancing SMEs' digital capabilities.

(3) Healthy competition promotes digital industry agglomeration

In the digital era, enterprises are shifting from a competitive logic to a symbiotic logic, and value co-creation has become an inevitable choice for SMEs to achieve value transformation. However, SMEs still face institutional pressures during their digital transformation process. As an invisible hand in resource allocation, the government should create a favorable business environment, support, and promote the development of clustered digital industries among SMEs. This can be achieved by, for instance, establishing innovation and entrepreneurship platforms for SMEs, upgrading digital industry infrastructure, building digital technology platforms, and strengthening digital talent cultivation. These measures can better guide SMEs to achieve coordinated digital development, alleviate digital pressures, and stimulate innovation and entrepreneurship.

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