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Research on the Current Status and Influencing Factors of the Digital Transformation of Small and Micro Enterprises in Shanghai

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Abstract: Enterprise digitalization has become a key measure for enhancing corporate competitiveness and promoting the development of the digital economy. Drawing on questionnaire survey data, this paper quantitatively evaluates the degree of digital transformation of small and micro enterprises in Shanghai along multiple dimensions, including industry, development stage, and position in the industrial chain. On this basis, it constructs an evaluation index system and applies the fuzzy analytic hierarchy process to identify the influencing factors. The results show that, at the criterion level, the participant factor has the greatest impact on the digital transformation of small and micro enterprises in Shanghai, followed in descending order by organizational, task, and technological factors; at the indicator level, the factors with the greatest impact are customer satisfaction, strategic planning for digital transformation, market incentives, and information security and risk prevention and control. Accordingly, this paper puts forward policy recommendations on improving customer satisfaction, refining the market incentive mechanism, attaching greater importance to information security and risk prevention and control, and establishing a multi-dimensional collaborative support system, with a view to advancing the digital transformation of small and micro enterprises in Shanghai.

Keywords: Digital Economy, Small and Micro Enterprises, Digital Transformation, Shanghai Economy.

1. Introduction

In the new stage of development, the digital economy is regarded as an important guarantee for accelerating the construction of a modern industrial system [1]. In June 2022, the Ministry of Finance and the Ministry of Industry and Information Technology jointly issued the Notice on Carrying Out Pilot Work on the Digital Transformation of Small and Medium-sized Enterprises in Cities, which stated that "digital transformation should be taken as an opportunity to enhance the core competitiveness of small and medium-sized enterprises." In February 2023, the Central Committee of the Communist Party of China and the State Council issued the Overall Layout Plan for Building a Digital China, which emphasized the need to promote the deep integration of the digital economy and the real economy, to drive changes in production, life, and governance through digitalization, and to inject strong impetus into comprehensively advancing the great rejuvenation of the Chinese nation along the Chinese path to modernization. In March 2023, the Government Work Report stated that "we must vigorously develop the digital economy, accelerate the digital transformation of traditional industries and small and medium-sized enterprises, strive to raise the level of high-end, intelligent, and green development, and speed up the research, development, application, and promotion of frontier technologies." Digital transformation is therefore a key variable affecting the development of the digital economy and of the digital society [2]. The China Academy of Information and Communications Technology (CAICT) predicts that by 2025 the scale of China's digital economy will exceed RMB 60 trillion [3]. The 14th Five-Year Plan for the Development of the Digital Economy in Shanghai likewise proposes that Shanghai should strive to increase the added value of its digital economy to RMB 3 trillion by the end of 2025, accounting for more than 60% of the city's GDP. As micro-level actors in this great wave of digital transformation, enterprises play a pivotal role, and to achieve the top-level goal of building a Digital China they must carry out digital transformation. A survey reported in Accenture's China Enterprise Digital Transformation Index shows that in 2023 Chinese enterprises scored 44 points overall on a 100-point scale for digital transformation: only 11% of them achieved remarkable results, fewer than 30% had fully considered their digital transformation deployment, and more than 40% had no plans for digital investment. Small and micro enterprises, vast in number and widely distributed, still face the transformation dilemma of being "unwilling to transform, afraid to transform, and unable to transform" [4]. Understanding the current status of enterprise digital transformation and the pain points and difficulties that enterprises encounter in developing the digital economy has therefore become essential to advancing the digital economy.

Enterprises can also reap enormous benefits from digital transformation. Shanghai Yixiao Information Technology Co., Ltd. achieved a company-wide "chain-style" digital transformation and upgrading through enterprise digitalization, reducing enterprise security risks by 80% and raising production efficiency by 60%. Guangzhou Alibaba Cloud Computing Application Technology Co., Ltd., by developing a new "leading enterprise plus SME supply chain" model of digital transformation, shortened its order-taking cycle by 20% and greatly improved supply chain collaboration efficiency [5]. Small and micro enterprises are an important component of the business sector and play an important role in invigorating the market and promoting employment. However, owing to their small scale and weak capacity to withstand risks, they usually face problems such as insufficient awareness of digital transformation [6] and the

high cost of digital transformation [7]. The Shanghai Municipal Government has implemented a series of policy measures to promote the digital transformation of small and micro enterprises, for example by increasing the supply of digital capabilities, granting subsidies for enterprises' digital transformation contracts, and supporting vocational skills training for digital talent [8]. What, then, is the current status of the digital transformation of small and micro enterprises in Shanghai? Against the background of the new era, what measures can be adopted to provide effective and practical assistance for their digital transformation? These questions deserve attention.

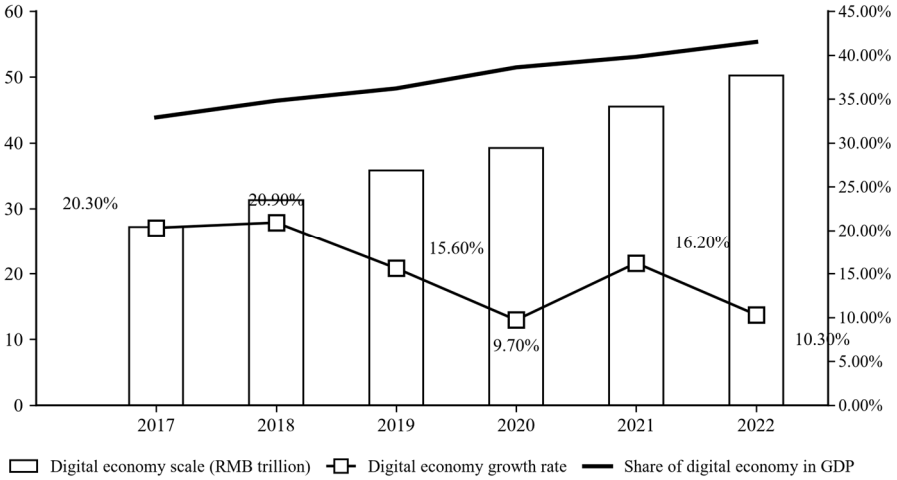


Figure 1. Scale, growth rate, and GDP share of the digital economy from 2017 to 2022.
Source: China Academy of Information and Communications Technology.

Against the background of Shanghai's current policy support for small and micro enterprises, this paper conducts an in-depth survey of a number of such enterprises. The survey focuses mainly on the current status of, and the factors influencing, their digital transformation, and applies the fuzzy analytic hierarchy process to determine the degree of influence of each factor. It attempts to provide a theoretical and practical basis for the digital transformation of small and micro enterprises in Shanghai, and to offer ideas for helping them achieve rapid and effective digital transformation.

2. Literature Review

The digital transformation of enterprises has attracted considerable attention, and many researchers have conducted in-depth studies on it. This paper classifies the relevant literature according to its different viewpoints, so as to better understand the underlying driving mechanisms and influencing factors.

2.1. The Impact of Digital Transformation on Enterprises

One stream of the literature holds that enterprises can obtain positive returns from digital transformation. By analyzing data on listed manufacturing companies from 2010 to 2019, Zhang Yun and Yin Yifei [1] concluded that digital transformation improves the coordination of equity checks and balances and of the personnel structure, helps raise management efficiency, optimizes decision-making procedures, and enables better resource allocation, thereby increasing enterprises' total factor productivity. Using data on A-share listed companies from 2012 to 2017, He Fan and Liu Hongxia [9] examined the issue empirically from the perspective of real-economy enterprise performance, and found that digital transformation improves the economic benefits of the real economy by reducing costs and expenses, improving the efficiency of asset utilization, and strengthening innovation capability. Sui Xiaoning et al. [10] found through empirical testing that digital transformation has a positive effect on enterprises' OFDI decisions and also helps expand the scale of OFDI to a certain extent. Drawing on data on listed manufacturing companies from 2010 to 2022, Liang Xiaotian and Wen Zongyu [11] found empirically that digital transformation can strengthen enterprises' customer information advantage and enable them to better satisfy customer needs. Tong Yan et al. [12] empirically examined the relationship between digital transformation and customer concentration and the channel mechanism involved; the results show that as the degree of enterprise digital transformation increases, customer concentration decreases significantly, which can further enhance enterprises' market position.

Another stream of the literature holds that misguided digital transformation brings negative returns to enterprises. Lü Tie and Li Zaichi [13] noted that digital transformation itself requires substantial investment, including the purchase of hardware and software and the training of employees, and that its evolutionary and uncertain nature further raises transformation costs, which particularly intensifies the funding pressure on small and medium-sized enterprises. Using the fuzzy-set qualitative comparative analysis method, Li Liwei and Huang Yihan [14] found that the threshold for digitalization is high, that digitalization alone cannot improve enterprise performance, and that multiple matching relationships exist among the different dimensions of digital technology application and organizational change: when organizational change lags behind digital technology application, or when the level of digitalization lags behind organizational change, a digitalization paradox arises. Li Zaichi and Lü Tie [15] argued that the compatibility of digital strategies is poor, that an inappropriate digital strategy will affect an enterprise's current strategy, and that in extreme cases it may even become the primary obstacle to the implementation of other strategies.

In general, the impact of digital transformation on enterprises is multi-dimensional: there are positive returns,

such as improved management efficiency and economic benefits, as well as negative risks, such as increased costs and funding pressure. Enterprises should therefore pursue digitalization appropriate to their own circumstances.

2.2. Factors Driving the Digital Transformation of Enterprises

The current literature mainly explores the factors driving the digital transformation of enterprises from the perspectives of the market, government support, the development of new technologies, and internal enterprise factors. Specifically:

From the market perspective, Yang Shuyan et al. [16] took survey data on the digital transformation of 287 manufacturing enterprises as a sample and, using a structural equation model, found that as market competition intensifies, the dominant values and successful practices existing in an industry push traditional enterprises toward digital transformation, and that enterprises' digital transformation is based more on market requirements. Based on the TOE framework, Bai Xuejie et al. [17] explored the factors influencing enterprises' digital transformation and, through an empirical test using data on Chinese listed companies from 2010 to 2020, likewise found that the "bandwagon effect" generated by the digital transformation of peer enterprises is the main external factor driving enterprises' digital transformation.

From the government perspective, Wu Fei et al. [18], drawing on data sets of A-share listed companies and macroeconomic data, verified empirically that fiscal expenditure on science and technology can significantly drive the digital transformation of enterprises. Yu Dianfan et al. [19] likewise used data on listed companies to verify empirically that subsidies to digital enterprises at the city level can, through transmission across industries, empower the digital transformation of other industries, with particularly significant effects on enterprises in the growth and decline stages. Based on enterprise growth theory, Su Yi et al. [20] found empirically that government digitalization incentives significantly promote enterprise innovation, and that the level of enterprise digitalization plays a mediating role between the two.

From the perspective of new technology development, He Ying [21] found that the development of digital technology confronts small and medium-sized enterprises with unprecedented challenges and places new demands on them with regard to high-quality development. Through tests of the underlying mechanisms, Huang Qunhui et al. [22] found that the development of Internet technology has raised manufacturing productivity by reducing transaction costs, mitigating resource misallocation, and promoting innovation. Pagani and Pardo [23] proposed that the new generation of digital technology endows information structures with timeliness, continuity, refinement, and completeness, and that enterprises have truly entered the digital era. Using Shanghai and Shenzhen A-share listed companies from 2007 to 2021 as a sample, Sui Xiaoning [10] found empirically that artificial intelligence, cloud computing, big data, and digital technology applications all have significant positive effects on enterprises' OFDI.

From the perspective of internal enterprise factors, Li Zaichi and Lü Tie [15] summarized factors such as organizational structure, organizational strategy, and human resources. Based on the TOE framework, Bai Xuejie et al. [17] found that the proportion of technical staff, R&D investment, and the educational background of senior executives are the key internal factors in enterprises' digital transformation. Based on socio-technical systems theory, Wu Jiang and Chen Ting [24] also identified and summarized new influencing factors at the participant level and the organizational level.

Synthesizing the above viewpoints, the current status of enterprises' digital transformation is influenced by many factors, and these viewpoints contribute to a more comprehensive understanding of that process. However, there is little relevant research on small and micro enterprises, especially research focusing on the Shanghai region. Therefore, investigating the current status of, and the factors influencing, the digital transformation of small and micro enterprises in Shanghai has important practical significance and research value.

3. Current Status of the Digital Transformation of Small and Micro Enterprises in Shanghai

3.1. Survey Method

3.1.1. Data Acquisition

This study employs a questionnaire survey to investigate small and micro enterprises in Shanghai. The questionnaire is designed to cover basic information about the enterprise, the current status of its digital transformation, the factors influencing that transformation, the obstacles encountered, and the stages of digital transformation.

Table 1. Survey questionnaire on the digital transformation of small and micro enterprises.

Survey item	Questionnaire items
Basic survey information	Industry to which the enterprise belongs
	Development and scale of the enterprise
	Position of the respondent
Digital transformation survey	Current status of digital transformation
	How employees view digital transformation
	Objective problems in digital transformation
	How to promote the digital transformation of the enterprise
Survey on the stages of digital transformation	Emphasis on the upstream, midstream, and downstream segments
	How difficulties are overcome at each stage of digital transformation

Source: compiled by the authors.

A targeted approach to questionnaire distribution was adopted, drawing on the university's resources, industry associations, government departments, and online channels. The survey covered more than 80 small and micro enterprises; a total of 234 questionnaires were distributed and 234 were collected. After screening, 100 valid questionnaires were retained for analysis in accordance with the research requirements, and the Cronbach's α coefficient of the questionnaire was 0.810, indicating good reliability.

3.1.2. Sample Composition

In this survey, the industries of the small and micro enterprises were divided into five categories, and the enterprises' digitalization process was divided into four stages: the awareness stage, the exploration stage, the preliminary application stage, and the large-scale application stage. At the same time, attention was paid to distinguishing the positions of the respondents, so as to explore the differentiated performance of small and micro enterprises from multiple perspectives. The sample therefore covers a relatively diverse range of enterprise types, and the data adequately reflect the state of digital application among small and micro enterprises.

The industry distribution of the enterprises where the respondents work is diverse. The education, culture, and entertainment sector accounts for 35%; the wholesale, retail, and catering sector for 20%; information technology, finance, and real estate for 17%; agriculture, industry, and construction for 17%; and other sectors for 11%. Most of the respondents' enterprises have an annual turnover of less than RMB 5 million, and those established for 4-6 years account for the highest proportion. In addition, most of the enterprises have fewer than 500 employees, and among them those with 20 to 100 employees account for the highest proportion, reaching 39%.

The respondents are mainly middle-level managers and non-managerial employees. Middle-level managers are responsible for organizing and coordinating the work of various departments; they have a unique perspective on the enterprise's operations, problems, and challenges, and can provide insight into management-level needs and expectations regarding digital transformation. Non-managerial employees, who participate directly in business processes, have an in-depth understanding of existing working methods and processes. Their answers can reflect the impact of digital transformation on employees' work efficiency, work environment, and work experience, as well as their acceptance of digital tools and systems.

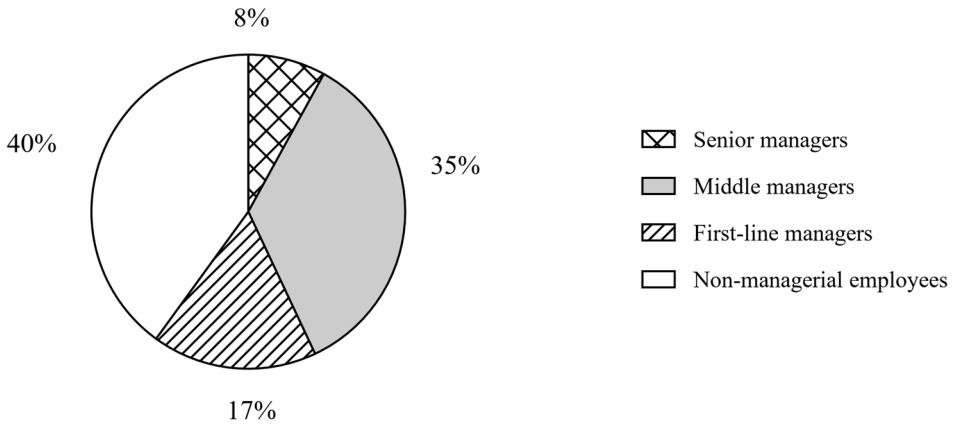


Figure 2. Distribution of the respondents by position
Source: compiled by the authors.

3.2. Analysis Based on the Full Sample

According to the survey data, 79% of the enterprises have already begun digital transformation, but the largest proportion remain at the initial awareness and exploration stages, while fewer have entered the application stage: the awareness stage accounts for 27%, the exploration stage 39%, the preliminary application stage 24%, and the large-scale application stage 10%. Nearly 80% of the enterprises have established a department or designated staff responsible for digital transformation. Among the enterprises that have set up digital transformation departments, those with fewer than five people account for the largest share, at 44%.

83% of the respondents believe that digital transformation is necessary for their enterprises. They believe that digital transformation can not only improve enterprise efficiency (72%), expand market scale (70%), improve customer satisfaction (78%), and reduce costs (62%), but also enhance their own work efficiency, strengthen personal capabilities, and make work processes more convenient. At the same time, digital transformation also places some pressure on employees, including learning new skills and knowledge (78%), the risk of position adjustment or layoffs (61%), and information security and privacy risks (72%); this pressure reduces employees' willingness to embrace digital transformation. The objective problems existing in enterprises include weak capability in acquiring and analyzing data resources (67%), scarcity of human resources (63%), tight capital and limited investment capacity (63%), and hidden risks in information and data security (40%), among others.

3.3. Analysis Based on Sub-samples

3.3.1. Analysis by Enterprise Industry

In terms of industry differences, the "information technology, finance, and real estate" sector has made the fastest progress in digital transformation: 76% of its enterprises have begun digital transformation, of which 38% have already entered the application stage, and more than 40% of the enterprises have digital transformation departments with teams of more than 20 people. By contrast, enterprises in the "wholesale, retail, and catering" sector exhibit a higher

participation rate: 80% of them have launched the digital transformation process, 50% have entered the exploration stage, and 31% have entered the application stage; the scale of their digital transformation departments is relatively small, with most having 5-20 people. Enterprises in the "education, culture, and entertainment" sector are mostly at the awareness and exploration stages of digital transformation, and their digital transformation departments mostly have 5-20 people. The "agriculture, industry, and construction" sectors lag relatively far behind in digital transformation: 72% of their enterprises have digital transformation departments with fewer than 5 people.

3.3.2. Analysis by Enterprise Development Stage

Based on the enterprises' years of establishment and turnover, the enterprises were divided into three stages: the start-up stage, the growth stage, and the mature stage. Among enterprises in the start-up stage, 77% have begun digital transformation, of which 33% are at the awareness stage, 42% at the exploration stage, and 21% have begun preliminary application, while only 4% have entered the large-scale application stage. Enterprises in the growth stage are progressing faster in digital transformation: 82% of them have carried out digital transformation, with 67% at the exploration stage, 11% having entered the preliminary application stage, and 22% having entered the large-scale application stage. Among enterprises in the mature stage, 83% have carried out digital transformation, with the proportions at the awareness and exploration stages being 6% and 27% respectively, and those at the preliminary application and large-scale application stages being 40% and 27% respectively. Overall, there is a trend in which the degree of digital transformation gradually increases as enterprises develop.

3.3.3. Analysis by Position in the Industrial Chain

According to their position in the industrial chain, the enterprises were divided into three categories: upstream, midstream, and downstream enterprises. Among upstream enterprises, 73% have begun digital transformation, of which 30% are at the awareness stage, 40% at the exploration stage, 24% have begun preliminary application, and 6% have entered the large-scale application stage; 70% of these enterprises have established digital transformation departments, of which those with fewer than 5 people account for 40%. Among midstream enterprises, 76% have begun digital transformation, of which 25% are at the awareness stage, 46% at the exploration stage, 24% have begun preliminary application, and 5% have entered the large-scale application stage; 80% of these enterprises have established digital transformation departments, of which those with 5-20 people account for the largest proportion, at 40%. Among downstream enterprises, 85% have begun digital transformation, of which 32% are at the awareness stage, 36% at the exploration stage, 24% have begun preliminary application, and 8% have entered the large-scale application stage; 85% of these enterprises have established digital transformation departments, of which those with more than 20 people account for the largest proportion, at 45%. The digital transformation process of enterprises shows a trend of gradual acceleration from upstream to downstream along the industrial chain.

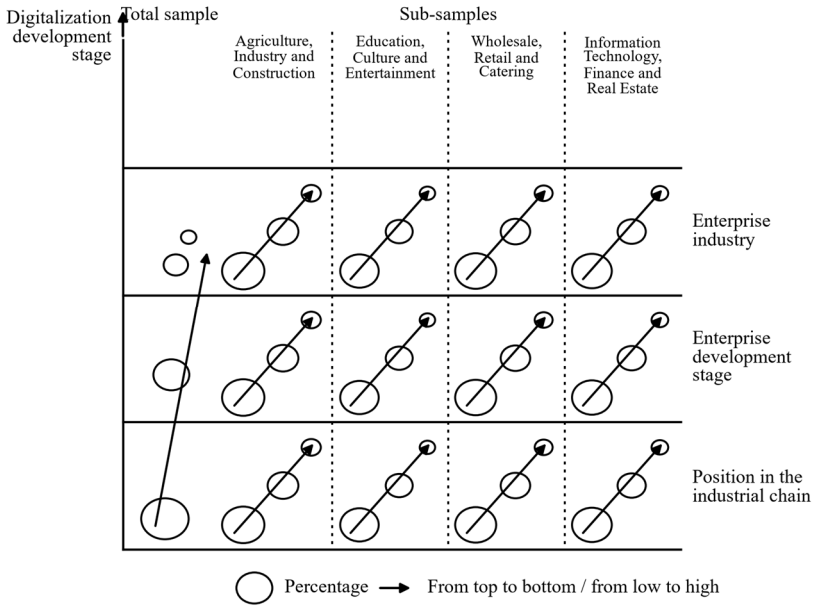


Figure 3. Overview of the digital transformation of small and micro enterprises in Shanghai
Source: compiled by the authors.

4. Analysis of the Factors Influencing the Digital Transformation of Small and Micro Enterprises in Shanghai

4.1. Establishment of the Evaluation Index System

Drawing on the survey data, and with reference to Wu Jiang and Chen Ting [24] and the relevant research on the factors influencing the digital transformation of enterprises summarized on the basis of socio-technical systems theory, this paper constructs an evaluation index system for the factors influencing the digital transformation of small and micro enterprises, comprising a total of 14 measurement indicators in four aspects: the technological level, the task level, the participant level, and the organizational level.

Table 2. Evaluation index system of the factors influencing the digital transformation of small and micro enterprises.

Goal level	Criterion level	Indicator level
Indicator system of factors influencing the digital transformation of small and micro enterprises	Technological level	Information technology investment
		Depth of technology application
		Degree of integration of information systems
		Information security and risk prevention and control
	Task level	Policy guidance and promotion intensity
		Legal restraint mechanism
		Market incentives
	Participant level	Leaders' digital awareness
		Employees' acceptance of digital transformation
		Employees' digital skills
		Customer satisfaction
	Organizational level	Strategic planning for digital transformation
		Adaptability of corporate culture
		Effective utilization of organizational resources

Source: compiled by the authors.

4.2. Research Method

The Delphi method is used to obtain the relative importance of each indicator, and a fuzzy judgment matrix is then constructed to calculate the relative weights of the indicators of the factors influencing the digital transformation of small and micro enterprises in Shanghai. The general steps of the fuzzy analytic hierarchy process are as follows.

Step 1: Establish the fuzzy complementary judgment matrix. Based on pairwise comparisons between factors, the relative importance of each pair of factors with respect to their upper-level indicator (criterion) is expressed quantitatively, as shown in Table 3. The fuzzy complementary matrix $R = (r_{ij})_{n\times n}$ $(i, j = 1, 2, \ldots, n)$ is then obtained.

Table 3. The 0.1-0.9 scale and its meaning.

Scale	Definition	Explanation
0.5	Equally important	The two factors are equally important when compared
0.6	Slightly important	When the two factors are compared, the row factor is slightly more important than the column factor
0.7	Obviously important	When the two factors are compared, the row factor is obviously more important than the column factor
0.8	Much more important	When the two factors are compared, the row factor is much more important than the column factor
0.9	Extremely important	When the two factors are compared, the row factor is extremely more important than the column factor
0.1, 0.2, 0.3, 0.4	Reverse comparison	If the judgment obtained by comparing factor r_i with factor r_j is r_{ij}, then the judgment obtained by comparing factor r_j with factor r_i is $r_{ji} = 1 - r_{ij}$

Source: compiled by the authors.

Step 2: Weight calculation. If $R = (r_{ij})_{n\times n}$ is a fuzzy complementary judgment matrix and $W = (w_1, w_2, \ldots, w_n)$ is the weight vector of R, then formula (1) is used to derive the weights of the fuzzy complementary judgment matrix, where W_i is the weight of factor r_i.

$$W_i = \frac{\sum_{i,j=1}^{n} r_{ij}^{\frac{n}{2}-1}}{n(n-1)} \quad (1)$$

Step 3: Consistency test. To determine whether the weight values calculated by formula (1) are reasonable, a consistency test of the comparison judgment process is required.

$$I(A,B) = \frac{1}{n^2}\sum_{i,j=1}^{n} |a_{ij} + b_{ji} - 1| \quad (2)$$

$$A = \left((a_{ij})\right)_{n\times n} \qquad B = \left((b_{ij})\right)_{n\times n}$$

$$W^* = \left((W_{ij})\right)_{n\times n} \quad (3)$$

$$W_{ij} = \frac{w_i}{w_i + w_j}, \qquad \forall i, j = 1,2,\cdots,n$$

where A and W^* are both fuzzy complementary judgment matrices. If the compatibility index value $I(A, B)$ is less than a specified threshold α (taken as 0.1 in this paper), the judgment matrix can be regarded as a satisfactory consistent matrix. For ease of statistical processing, the weight values are normalized.

When multiple experts participate in the evaluation, each expert provides, according to Table 3, a fuzzy complementary judgment matrix for the same factor set, and the corresponding weight set can be calculated by formula (1). If the compatibility indices between each judgment matrix and its corresponding characteristic matrix, as well as those between any two judgment matrices, are all less than the specified threshold α (taken as 0.1 in this paper), it can be considered reasonable and reliable to take the mean of all weight sets as the weight allocation vector of the factor set.

4.3. Calculation Results

The relative weights of the indicators of the factors influencing the digital transformation of small and micro enterprises in Shanghai, obtained through calculation (all values rounded to four decimal places), are shown in Table 4. With regard to the indicator system of factors influencing the digital transformation of small and micro enterprises (goal level), the weight of the participant level is the highest, at 0.2709, followed in turn by the organizational level (0.2646), the task level (0.2374), and the technological level (0.2271). At the criterion level, the highest weight within the participant level belongs to customer satisfaction (0.2979), within the organizational level to strategic planning for digital transformation (0.3459), within the task level to market incentives (0.3709), and within the technological level to information security and risk prevention and control (0.2843).

Based on the empirical data, this paper finds that the participant level is the most important factor influencing the digital transformation of small and micro enterprises, and that the remaining levels, in descending order of influence, are the organizational level, the task level, and the technological level. This also confirms the soundness of the indicator system established in this paper.

Table 4. Summary of the comprehensive weight values of each indicator and the single-factor evaluation matrices.

Goal level	Criterion level	Weight	Rank	Indicator level	Weight	Rank
Indicator system of factors influencing the digital transformation of small and micro enterprises	Technological level	0.2271	4	Information technology investment	0.2548	2
				Depth of technology application	0.2355	3
				Degree of integration of information systems	0.2254	4
				Information security and risk prevention and control	0.2843	1
	Task level	0.2374	3	Policy guidance and promotion intensity	0.3125	3
				Legal restraint mechanism	0.3166	2
				Market incentives	0.3709	1
	Participant level	0.2709	1	Leaders' digital awareness	0.2271	3
				Employees' acceptance of digital transformation	0.2542	2
				Employees' digital skills	0.2208	4
	Organizational level	0.2646	2	Customer satisfaction	0.2979	1
				Strategic planning for digital transformation	0.3459	1
				Adaptability of corporate culture	0.3208	3
				Effective utilization of organizational resources	0.3333	2

Source: calculated by the authors.

4.4. Summary of This Section

In this section, this paper constructs an evaluation index system for the factors influencing the digital transformation of small and micro enterprises based on four major levels — technology, organization, task, and participants — and 14 measurement indicators, and applies the fuzzy analytic hierarchy process to calculate the weight of each indicator on the basis of the data obtained and expert recommendations. This paper finds that among the four major aspects of the criterion level, the participant level has the highest weight, followed in turn by the organizational level, the task level, and the technological level; and that among the indicators corresponding to the four aspects of the criterion level, the ones with the highest weight in each aspect are customer satisfaction, strategic planning for digital transformation, market incentives, and information security and risk prevention and control. Therefore, this paper concludes that, among the factors influencing enterprises' digital transformation, participant-level factors are the most important, and that in the process of enterprises' digital transformation the factors at all levels should be continuously coordinated, a multi-dimensional collaborative support system should be established, and emphasis should be placed on improving such important indicators as customer satisfaction, strategic planning for digital transformation, market incentives, and information security and risk prevention and control.

5. Policy Recommendations

Customer satisfaction, strategic planning for digital transformation, market incentives, and information security and risk prevention and control are the four most important factors influencing enterprises' digital transformation. With regard to how these factors can be addressed, this paper puts forward the following recommendations:

5.1. Improve Customer Satisfaction

The participant level has the greatest degree of influence, and customer satisfaction is the most important indicator within it. Digital transformation provides customers with more channels for interaction and feedback; small and micro enterprises should actively make use of these channels to understand customer needs and provide personalized services and solutions, so as to enhance customer satisfaction. The government can provide relevant training and resource support to help small and micro enterprises improve their customer service, for example by providing customer service skills training and establishing customer service standards.

5.2. Formulate Strategic Plans

The organizational level is the second most influential factor, especially with regard to strategic planning. Small and micro enterprises should clarify the goals, paths, and resource requirements of digital transformation, so as to ensure that it is consistent with the long-term development goals of the enterprise. The government can provide guidance and support for strategic planning to help enterprises formulate realistic digital transformation strategies. For example, the government or third-party institutions can provide enterprise diagnostic services to assess enterprises' level of digitalization and identify their starting point. By regularly holding training sessions and seminars on digital transformation and sharing successful cases, they can help enterprises understand best practices. In addition, small and micro enterprises should be encouraged to participate in pilot projects of digital transformation, so as to provide them with practical opportunities and financial support.

5.3. Refine the Market Incentive Mechanism

The task level is the third most influential factor, especially with regard to market incentives. Measures such as encouraging market competition and cooperation, making market information more transparent, and promoting consumer participation and feedback can be implemented to help small and micro enterprises better understand market demand and respond quickly to changes. At the same time, the government should formulate fair rules of competition, support the innovation and entrepreneurship activities of small and micro enterprises, provide them with the necessary resources and support, lower the threshold for innovation, and enhance their market competitiveness. The role of the market in the incentive mechanism should be further harnessed to stimulate the market vitality of small and micro enterprises in digital transformation.

5.4. Attach Importance to Information Security and Risk Prevention and Control

Although the technological level ranks fourth in influence, the indicator of information security and risk prevention and control is relatively important within it. In terms of awareness, small and micro enterprises must attach greater importance to digital security and increase employees' professional security training so as to deepen their understanding of security threats. The government should establish unified data security standards and, with the help of laws and regulations such as the Data Security Law, assist enterprises in consolidating their data defenses. In terms of technology, small and micro enterprises can adopt a series of measures to protect sensitive data, for example by adopting encryption technology, using firewalls and intrusion detection systems, and implementing data backup and recovery plans. Meanwhile, the government or third-party institutions should provide technical support and guidance to assist small and micro enterprises in building a sound information security system, thereby enhancing their digital security capabilities.

5.5. Establish a Multi-dimensional Collaborative Support System

The government, enterprises, and society should work together to establish a multi-dimensional collaborative support system that provides all-round support and services for small and micro enterprises. For example, the government can establish a public digital transformation service platform to provide enterprises with one-stop services covering technology, training, and resources. Small and micro enterprises should be encouraged to cooperate with universities and research institutions to jointly carry out research and innovation projects on digital transformation. The establishment of relevant industry associations and alliances should be supported so as to strengthen exchanges and cooperation among enterprises and jointly solve common problems in digital transformation. In addition, the government can take measures such as setting up special funds for digital transformation and building digital transformation service platforms, so as to promote exchanges and cooperation among enterprises.

6. Conclusion

Taking small and micro enterprises in Shanghai as its research object, this paper describes the current status of their digital transformation on the basis of questionnaire survey data, from the perspectives of both the full sample and sub-samples defined by industry, development stage, and position in the industrial chain. It then constructs an evaluation index system comprising four criterion-level dimensions — the technological level, the task level, the participant level, and the organizational level — and 14 measurement indicators, and applies the fuzzy analytic hierarchy process to identify the factors that influence that transformation and to determine their relative weights.

The main conclusions are as follows. First, the digital transformation of small and micro enterprises in Shanghai is still at an early stage: although 79% of the surveyed enterprises have begun the process, most of them remain at the awareness and exploration stages, and the degree of transformation rises as enterprises grow and as one moves downstream along the industrial chain. Second, participant-level factors exert the greatest influence on digital transformation, followed by organizational, task, and technological factors, which indicates that the human and organizational dimensions, rather than technology alone, are the decisive drivers of transformation in small and micro enterprises. Third, among the individual indicators, customer satisfaction, strategic planning for digital transformation,

market incentives, and information security and risk prevention and control carry the greatest weight, and these four areas should therefore be the focus of policy support.

On this basis, the paper puts forward recommendations on improving customer satisfaction, formulating strategic plans, refining the market incentive mechanism, attaching greater importance to information security and risk prevention and control, and establishing a multi-dimensional collaborative support system involving the government, enterprises, and society.

This study also has some limitations. The sample is drawn only from Shanghai, and the analysis relies mainly on questionnaire data and expert judgment, so the findings may not be directly generalizable to other regions. Future research could expand the sample, incorporate longitudinal data, and compare small and micro enterprises across regions and industries, so as to provide a more comprehensive account of how digital transformation can be effectively advanced.

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