

JEL Classification: Q01; Q16; Q42

DOI: https://doi.org/10.31521/modecon.V56(2026)-40

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Assessing SME Resilience: Development of a Five-Dimensional Strategic Evaluation Model

Abstract. Introduction. Against a backdrop of heightened global economic uncertainty, frequent supply chain disruptions, and rapid digital technology iteration, the external operational risks faced by small and medium-sized enterprises (SMEs) continue to escalate. Strengthening resilience has therefore become essential for maintaining stable operations and long-term competitiveness in the digital economy.

Purpose. This study aims to develop a scientific, systematic, and operational model for assessing SME resilience. It focuses on identifying the core dimensions that shape enterprises' shock resistance, adaptability, and recovery capacity, while constructing a strategic evaluation framework suited to SME characteristics.

Results. Drawing on enterprise resilience theory, digital transformation logic, and SME operational features, the study identifies five key dimensions of resilience: financial robustness, operational adaptability, technological flexibility, customer stickiness, and market agility. Based on these dimensions, a stratified weighting framework is established for comprehensive resilience assessment. The findings indicate that SME resilience is not a singular capability, but a dynamic strategic capacity formed through the interaction of multiple factors. The embedding of digital tools improves risk identification, resource allocation, supply chain coordination, and market agility, thereby enhancing overall resilience.

Conclusions. The proposed five-dimensional model captures both the structural characteristics and vulnerabilities of SME resilience. It provides a quantitative basis for strategic diagnosis, resource optimisation, and managerial decision-making, and offers an analytical tool for exploring resilience enhancement pathways for SMEs in the context of the digital economy.

Keywords: enterprise resilience; digital economy; resilience assessment; five-dimensional strategic evaluation model.

УДК 338.2

Шан Цзін, аспірант кафедри міжнародної економіки факультету менеджменту та маркетингу Національного технічного університету України «Київський політехнічний інститут імені Ігоря Сікорського», Україна

Оцінка стійкості малих та середніх підприємств: розробка п'ятивимірної моделі стратегічної оцінки

Анотація. На тлі посилення глобальної економічної невизначеності, частих перебоїв у ланцюгах постачання та стрімкого розвитку цифрових технологій зовнішні операційні ризики, з якими стикаються малі та середні підприємства (МСП), продовжують зростати. Тому підвищення стійкості стало ключовим фактором для їх стабільної діяльності та сталого розвитку. Розробка наукової, систематичної та практичної моделі оцінки стійкості, зосередженої на стійкості МСП до шоків, адаптивності та здатності до відновлення в складних умовах, має значну теоретичну цінність та практичну актуальність. Спираючись на теорію стійкості підприємств, логіку цифрової трансформації та операційні характеристики МСП, це дослідження визначає ключові фактори впливу на толерантність до фінансового стресу, оперативну адаптивність, технологічну реактивність, утримання клієнтів та реагування на ринок. Створено стратегічну систему оцінки, що складається з п'яти вимірів — фінансової стійкості, операційної гнучкості, технологічної адаптивності, стійкості клієнтів та реагування на ринок. Потім за допомогою методології стратифікованого зважування розроблено комплексну систему оцінки стійкості для МСП. Дослідження показують, що стійкість МСП — це не окрема здатність, а динамічний стратегічний потенціал, сформований завдяки синергетичній взаємодії багатовимірних факторів. Впровадження цифрових інструментів підвищує ефективність підприємств у виявленні ризиків, розподілі ресурсів, координації ланцюгів постачання та реагуванні на ринок, тим самим зміцнюючи загальний рівень стійкості. Створена п'ятивимірна модель комплексно визначає структурні характеристики та вразливі місця стійкості МСП. Вона надає кількісні дані для стратегічної діагностики, оптимізації ресурсів та прийняття управлінських рішень, а також пропонує аналітичний інструмент для дослідження шляхів підвищення стійкості МСП у контексті цифрової економіки.

Ключові слова: стійкість підприємства; цифрова економіка; оцінка стійкості; п'ятивимірна модель стратегічної оцінки.

JEL Classification: D81, L25, L26, M15, O33

¹Стаття надійшла до редакції: 24.03.2026

Received: 24 March 2026

Formulation of the problem. Against a backdrop of mounting global economic uncertainty, the external operating environment facing small and medium-sized enterprises (SMEs) is becoming increasingly complex. Geopolitical conflicts, supply chain disruptions, climate change, energy price volatility, financing constraints and the rapid evolution of digital technologies are constantly reshaping the conditions for business survival and the logic of competition. Compared to large enterprises, SMEs are typically weaker in terms of capital reserves, technological capabilities, organisational redundancy and risk diversification, and are therefore more vulnerable to external shocks. However, SMEs are also a vital pillar of international trade, employment growth, regional innovation and industrial chain stability; their ability to survive, adapt and recover in complex environments is directly linked to the stability and long-term vitality of the economic system.

Against this backdrop, resilience has gradually emerged as a core concept for explaining SMEs' ability to withstand shocks and maintain continuous operations. Resilience is manifested not only in a firm's capacity to sustain basic functions during a crisis, but also in its ability to undertake structural adjustments, reorganise resources and restore functionality following a shock. For SMEs, resilience is not merely a single risk-response capability, but rather a comprehensive set of characteristics comprising financial stress tolerance, operational adaptability, technological responsiveness, customer retention, and market reallocation capabilities. With the development of the digital economy, business operations have become increasingly reliant on platform systems, data flows, supply chain coordination and online customer interactions; consequently, the concept of resilience has expanded from traditional risk-resistance to a multidimensional, dynamic and assessable strategic capability.

Digital transformation has further underscored the importance of resilience research. Technologies such as cloud computing, artificial intelligence, big data, blockchain and the Internet of Things have enhanced enterprises' efficiency in information gathering, resource allocation, operational monitoring and risk early warning, whilst also strengthening their ability to detect and respond to fluctuations in demand, logistics disruptions and external crises. However, for small and medium-sized enterprises (SMEs), digitalisation does not automatically translate into a resilience advantage. In reality, many SMEs still face challenges such as weak digital foundations, insufficient investment in technology, a shortage of specialist talent, rising cybersecurity risks and inadequate management systems, making it difficult for them to effectively enhance their shock resistance and resilience. Consequently, establishing an evaluation model that accurately reflects the resilience levels of SMEs has become a significant issue of both theoretical and practical importance.

Analysis of recent research and publications. A systematic examination of organisational resilience within business administration research begins with an analysis of its intellectual lineage and core issues. Existing reviews indicate that research on resilience has gradually expanded from its early focus on crisis response and survival to encompass areas such as organisational learning, strategic adjustment, dynamic adaptation and long-term competitive advantage, demonstrating a clear trend towards interdisciplinary integration [1]. A further systematic literature review suggests that organisational resilience should not be viewed merely as the outcome of recovery following a shock, but rather understood as a dynamic process spanning pre-shock anticipation, shock absorption and post-shock reconstruction [2]. Building on this, research from a capabilities perspective defines organisational resilience as a 'meta-capability' comprising foresight, response and adaptation, thereby providing a theoretical foundation for the multidimensional measurement of resilience [3].

In research on small and medium-sized enterprises (SMEs), the issue of resilience has gradually shifted from general organisational theory to an analysis of the specific constraints faced by SMEs. Relevant studies indicate that SME resilience involves not only crisis response but is also closely linked to strategic renewal, preventive planning and formalised management practices, with significant differences emerging between enterprises in terms of strategic growth and defence against disruptions [4]. Empirical research on SMEs in the context of economic crises further indicates that cash flow, investment and financing, relationship networks, strategic flexibility and operational adaptability are key antecedent variables influencing SME resilience [5]. Surveys of small businesses affected by the pandemic reveal that SMEs generally suffer from financial fragility, insufficient cash reserves and high risks of business disruption, thereby highlighting the practical necessity of resilience assessment in SME research [6].

In the context of the digital economy, research on SME resilience is increasingly linked to digital transformation. OECD research indicates that digitalisation is continuously reshaping SMEs' business models, management processes and competitive strategies, with technologies such as platform access, data analytics, artificial intelligence and blockchain providing new pathways for SMEs to enhance efficiency and shock-resilience [7]. Another OECD policy report further indicates that the COVID-19 pandemic significantly accelerated the digitalisation process of SMEs, with policy support from different countries playing a crucial role in helping enterprises adapt to the new environment and resume operations [8]. An OECD study using South Korea as a case study also points out that government-led digital support programmes can enhance SMEs' resilience to external shocks and help them improve their resilience levels through digital tools [9].

From the perspective of business operational mechanisms, resilience research has clearly expanded to encompass supply chains, platform ecosystems and network synergies. Ivanov and Dolgui argue that, under conditions of extreme shocks, the analysis of the resilience of individual supply chains is no longer sufficient to explain business survival; the 'survivability' of supply networks must be incorporated into a broader analytical framework [10]. Comparative studies based on data from European SMEs indicate that digital transformation can significantly enhance the capacity and flexibility of SMEs to cope with customer acquisition, competitive pressures, financing constraints, rising costs and external crises [11]. A systematic review focusing on SMEs and start-ups highlights the close link between digital transformation, market capabilities and marketing capabilities, which collectively influence a firm's ability to anticipate, adapt to and respond to uncertainties in the business environment [12].

At the empirical research level, the relationship between digitalisation and resilience is gradually being validated. A study of Spanish SMEs found that digital transformation can significantly enhance corporate resilience through organisational learning and innovation mechanisms, demonstrating that digital technology is not merely a tool for efficiency but a key driver of organisational capability restructuring [13]. Research based on panel data from Chinese enterprises further indicates that digital transformation has a significant positive impact on supply chain resilience, enhancing corporate stability during shocks by increasing supply chain power and transparency [14]. A recent systematic literature review notes that research on SME resilience has established a relatively clear theoretical framework, yet there remains a lack of a unified evaluation framework capable of simultaneously integrating financial, operational, technological, customer and market dimensions [15].

A synthesis of existing research reveals that studies on corporate resilience have evolved from conceptual discussions to capability analysis, and are gradually integrating with topics such as digital transformation, supply chain collaboration and platform ecosystems. However, existing research remains primarily focused on conceptual clarification, case studies or single-dimension analysis, with insufficient attention paid to comprehensive evaluation frameworks for SME resilience. Particularly in the context of the digital economy, the degree of platform dependency, the efficiency of customer interaction, technological flexibility and market agility have become key variables influencing SME resilience; yet these factors have not yet been systematically incorporated into a unified quantitative evaluation model.

Formulation of research goals. Against the backdrop of the digital economy, how can a five-dimensional strategic evaluation model be developed that comprehensively reflects the resilience of small and

medium-sized enterprises (SMEs), thereby addressing the shortcomings of existing research in terms of evaluation dimensions, indicator integration and application tools?

In light of this issue, the research objectives are set as follows: starting from the practical characteristics of SMEs' business operations, to construct a five-dimensional strategic evaluation model comprising financial robustness, operational adaptability, technological flexibility, customer stickiness and market adaptability, to be used to systematically measure enterprises' shock resistance, adaptability and resilience in complex external environments.

To achieve this objective, the following tasks must be completed: Firstly, to review the main theoretical implications of SME resilience and clarify its core components under the conditions of the digital economy; Second, by integrating the operational characteristics of SMEs with the platform-based operational environment, identify the key dimensions influencing enterprise resilience and their representative indicators; third, establish a weighting structure for the multi-dimensional indicators and a comprehensive evaluation methodology to form a practical resilience measurement model; fourth, enhance the model's applicability in strategic diagnosis, optimisation of resource allocation, and management decision-making support, thereby providing a quantitative basis for enhancing the resilience of SMEs.

Presentation of the main research material. The operational models of e-commerce enterprises are characterised by a strong emphasis on platform-based, data-driven and networked approaches. Their business performance depends not only on their financial health but is also influenced by a combination of supply chain coordination, platform technical capabilities, the quality of customer interactions, and the speed of market response. Compared to traditional enterprises, e-commerce firms are more sensitive to changes in the external environment and are particularly vulnerable to fluctuations in demand, logistics disruptions, technical failures, platform risks and shifts in consumer preferences. Based on these characteristics, the resilience evaluation framework comprises five dimensions: financial robustness, operational adaptability, technological flexibility, customer stickiness and market adaptability. These five dimensions correspond respectively to the key capabilities required for enterprises to maintain operations, adjust structures and restore growth under various stress scenarios. Financial robustness reflects an enterprise's ability to maintain operational stability amidst revenue fluctuations, profit variations and capital constraints; Operational adaptability demonstrates a company's responsiveness in supply chain adjustments, inventory allocation, order fulfilment and returns processing; technological flexibility reflects platform stability, the intensity of digital investment, user experience optimisation and cybersecurity capabilities; customer

stickiness measures a company's sustained ability to retain customers, maintain consumer loyalty and ensure satisfaction; whilst market adaptability demonstrates a company's dynamic adjustment capabilities in product expansion, market entry, marketing innovation and brand recognition.

Each dimension is further broken down into quantifiable indicators to enhance the comparability and practicality of the evaluation results. The financial robustness dimension includes the current ratio, revenue stability, profit margin volatility and self-financing ratio, focusing on measuring a company's liquidity, the stability of its earnings and its ability to self-finance. The operational adaptability dimension includes the supply chain diversification index, delivery efficiency, inventory coverage ratio and returns processing time, reflecting a company's ability to make flexible adjustments in supply chain organisation and operational execution. The technological flexibility dimension comprises platform reliability, investment in digital innovation, user experience scores and cybersecurity response times, emphasising the role of technological systems in supporting business continuity. The customer stickiness dimension includes customer retention rates, average order value growth rates, return rates and customer satisfaction, serving to measure the stability of customer relationships and the ability to convert value. The Market Adaptability dimension comprises the product diversity index, market expansion rate, marketing innovation and brand awareness, reflecting a company's capacity for

expansion and adjustment amidst changes in the competitive environment.

Building upon this indicator structure, the evaluation model employs a hierarchical weighting approach. First, the indicators within each dimension are standardised; subsequently, dimension scores are calculated based on indicator weights; and finally, these are aggregated according to dimension weights to form the comprehensive corporate resilience index. The weights for each dimension are set as follows: financial robustness 30%, operational adaptability 25%, technological flexibility 20%, customer stickiness 15%, and market adaptability 10%. This weighting reflects the hierarchical relationship underlying the resilience of e-commerce enterprises, wherein financial stability and operational execution form the foundational support, whilst technological capability, customer relationships and market expansion capacity constitute the factors that reinforce adaptability.

A Model for Assessing Corporate Resilience (Using E-commerce as an Example). Given the unique characteristics of e-commerce enterprises in terms of their business models, technological dependence and market environment, assessments of their resilience should focus on the following aspects: financial resilience, operational flexibility, technological adaptability, customer loyalty and market responsiveness. The following is a detailed resilience assessment model specifically designed for e-commerce enterprises. The indicators and their respective weightings are summarised in Table 1.

Table 1 Comprehensive Indicator System and Weightings for E-commerce Enterprise Resilience Assessment

| Dimension | Indicator | Weight | Calculation Method |
|---------------------------|--------------------------------|--------|--|
| Financial Robustness | Liquidity Position | 30% | Ratio of current assets to current liabilities |
| | Revenue Consistency | 25% | Standard deviation of monthly revenue divided by its mean |
| | Earnings Margin Variability | 25% | Fluctuation in net profit growth rate |
| | Internal Financing Ratio | 20% | Equity capital as a proportion of total capital |
| Operational Adaptability | Supplier Diversification Index | 30% | Proportion of core suppliers among total suppliers |
| | Order Fulfilment Efficiency | 25% | Mean order completion time (hours) |
| | Inventory Sufficiency Rate | 20% | Inventory days divided by the average replenishment cycle |
| | Returns Handling Time | 25% | Mean time required to process returns (hours) |
| Technological Flexibility | System Stability | 30% | Mean annual platform downtime (hours) |
| | Digital Innovation Expenditure | 25% | Technology R&D spending as a share of total revenue |
| | User Experience Rating | 25% | Mean score from user experience surveys (0–5) |
| | Cyber Incident Response Time | 20% | Mean time taken to resolve vulnerabilities (hours) |
| Customer Stickiness | Customer Continuity Rate | 30% | Ratio of annual active users to total users |
| | Growth in Average Order Value | 25% | Rate of increase in average order value |
| | Order Return Ratio | 20% | Proportion of returned orders out of total orders |
| | Customer Approval Score | 25% | Survey-based rating (0–100) |
| Market Adaptability | Product Variety Index | 25% | Proportion of product categories available on the platform relative to total possible categories |
| | Pace of Market Expansion | 25% | Ratio of newly entered markets to the number of markets at the beginning of the year |
| | Promotional Innovation | 25% | Ratio of annual marketing campaigns to total campaigns |
| | Brand Recognition Level | 25% | Survey-based brand recognition score (0–100) |

Source: built by the author

The Resilience Composite Index (RRI) is used to measure a company's overall level of resilience. The raw values of each indicator are first converted into standardised scores within the range [0, 1] to eliminate differences in units; the standardised scores are then multiplied by their respective weights and summed to form a dimension score; Finally, the scores for each dimension are weighted and aggregated according to their respective weights to produce a composite index. The calculation formula is as follows

$$RRI = \sum_{j=1}^5 W_j \left(\sum_{i=1}^{n_j} w_{ij} S_{ij} \right) \quad (1)$$

Here, (W_j) denotes the weight of the j th dimension, (w_{ij}) denotes the weight of the i th indicator within that dimension, and (S_{ij}) denotes the standardised indicator score. This index not only reflects the overall level of a company's resilience but also reveals structural differences between the various dimensions.

The data required for the assessment is primarily sourced from multiple information systems within the

company's business operations. The Order Management System (OMS) provides operational data such as order fulfilment efficiency and return processing times; the Customer Relationship Management System (CRM) provides data on customer retention rates, satisfaction levels and purchasing behaviour; the Supply Chain Management System (SCM) provides information on supplier structure, inventory turnover and replenishment cycles; financial statements provide data on liquidity, profit margins and capital structure; whilst market research and brand research data are used to measure brand awareness, market expansion rates and levels of marketing innovation. The integration of data from multiple sources enables the resilience assessment to cover key aspects of business operations and enhances the authenticity and completeness of the metrics.

Based on the above model, an evaluation is conducted of the leading companies in the e-commerce sector (Amazon, Alibaba, JD.com, Shopify, Mercado Libre, eBay, Rakuten, Flipkart and Lazada), the results are as follows (rounded to the nearest whole number) (figure 1):

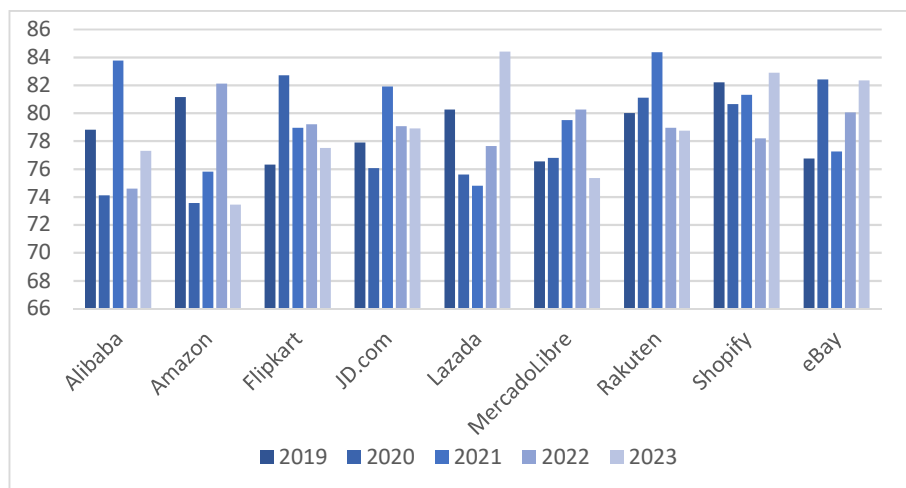


Figure 1 –Resilience Trends (2019-2023)

Source: built by the author

The analysis reveals that, from 2020 to 2022, the resilience levels of most e-commerce enterprises were adversely affected to varying extents. Notably, Amazon and Alibaba, as industry leaders, experienced especially pronounced impacts. However, by 2022 or 2023, the resilience levels of most enterprises had recovered to approximately 2019 levels, with some enterprises even achieving further improvements, indicating that these enterprises possess strong overall risk resistance, adaptability and recovery capabilities.

In terms of trends in corporate resilience, the resilience levels of individual enterprises fluctuated to some extent during the study period, but generally showed an upward trend. Comparative results indicate

that enterprise size is not necessarily fully positively correlated with resilience levels; that is, larger enterprises do not necessarily exhibit greater resilience. Some relatively smaller enterprises have also demonstrated high levels of resilience. These variations may be linked to factors such as the policy environment of the country or region in which the enterprise operates, the extent of digital tool adoption, and the support provided by platform ecosystems; the underlying mechanisms of these influences require further investigation.

Specifically, Amazon has consistently maintained a high resilience score over the five-year period, reflecting its distinct advantages in financial stability, technological

flexibility and market agility. The resilience levels of JD.com and Alibaba have generally shown a steady upward trend. Shopify and Flipkart have demonstrated relatively significant growth in resilience, indicating strong development potential and adaptability. Mercado Libre has shown good adjustment and recovery capabilities within the highly volatile market environment of Latin America. In contrast, the resilience

scores of eBay and Lazada are generally low, placing them in a relatively weak position among their peers.

To further reveal the multidimensional structural characteristics of each company's resilience in 2023, the study produced a radar chart to compare their performance across different dimensions of resilience. The results of the comparison of the main dimensions of e-commerce companies' resilience in 2023 are shown in Figure 2.

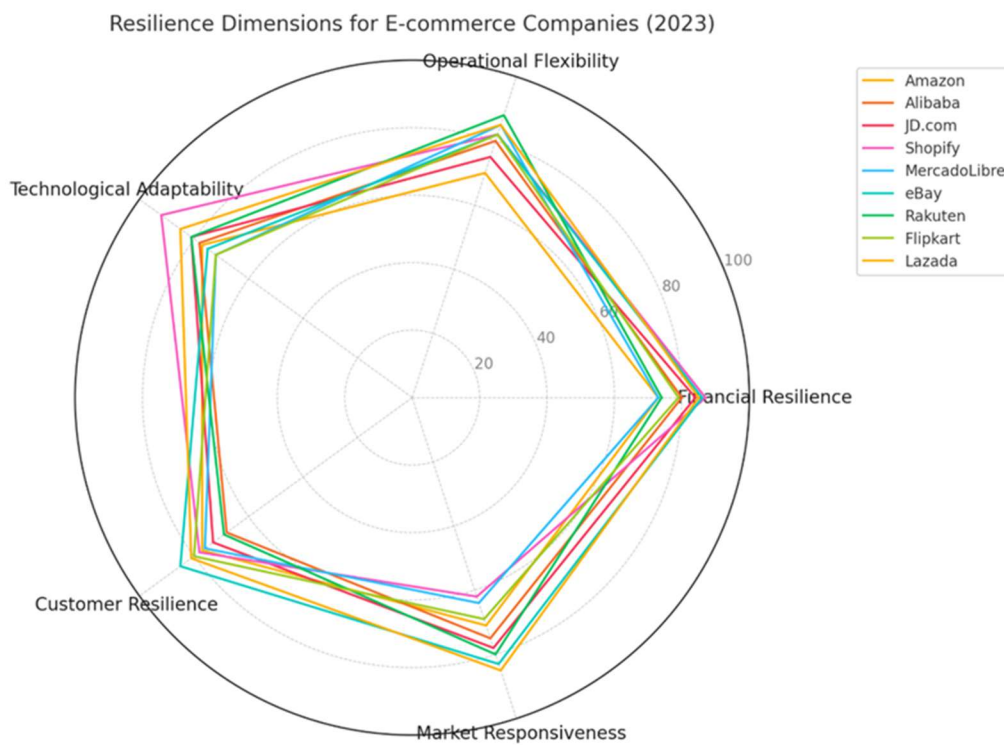


Figure 2 – Resilience dimensions of e-commerce companies (2023)

Source: built by the author.

Conclusions. Against a backdrop of mounting global economic uncertainty, resilience has become a key capability for small and medium-sized enterprises (SMEs) to ensure their survival, adaptability and sustainable development. Research indicates that the resilience of SMEs should not be simplistically understood as a passive capacity to withstand external shocks, but rather viewed as a multidimensional and dynamic strategic capability. This capability is primarily manifested in financial stress management, operational adjustments, technological adaptation, customer retention and market agility, and collectively determines whether an enterprise can maintain basic operations during a crisis, absorb external shocks and return to a growth trajectory.

Research further indicates that digital transformation has become a core driver for enhancing the resilience of SMEs. Digital technologies such as cloud computing, big data, artificial intelligence, the Internet of Things and blockchain not only enhance enterprises' ability to identify risks and monitor business processes, but also

strengthen their capacity for supply chain coordination, optimised resource allocation and rapid market response. Although SMEs are typically at a disadvantage in terms of capital, technological infrastructure and organisational redundancy, digital technologies can to some extent compensate for these shortcomings, helping enterprises improve information acquisition efficiency, shorten decision-making chains and enhance operational adaptability. Consequently, the enhancement of resilience increasingly depends on whether SMEs can embed digital capabilities into their core business processes.

The five-dimensional strategic evaluation model provides a relatively clear analytical framework for the systematic measurement of SME resilience. By integrating financial stability, operational adaptability, technological flexibility, customer engagement and market agility into a unified structure, it can more comprehensively reveal the internal composition of SME resilience and its vulnerabilities. This evaluation

approach overcomes the limitations of traditional single-dimensional financial or risk perspectives, ensuring that resilience is no longer confined to a conceptual level but possesses greater practical applicability and diagnostic functionality.

Research also indicates that truly resilient SMEs are not merely those that recover after a crisis, but rather those capable of proactively adjusting resource allocation, optimising business strategies and restructuring their market positioning in response to changes in the external environment. Resilience implies not only the ability to withstand shocks and return to normality, but also the capacity to achieve adaptive transformation under conditions of uncertainty. SMEs that continuously strengthen their digital infrastructure, optimise supply chain structures, enhance customer

relationship management capabilities, bolster cybersecurity safeguards and maintain flexibility in market strategies tend to possess greater sustainability and risk-resilience.

The resilience of SMEs should be regarded as a vital component of corporate competitiveness in the digital economy era. Enhancing this resilience is not only crucial for the stable operation of individual enterprises but also for the sustainability of employment, industrial chain coordination and the overall stability of the economic system. Adopting a resilience-based perspective facilitates a more accurate understanding of the development logic of SMEs within a complex international environment, whilst also providing a more realistic and effective analytical basis for strategic optimisation and policy support.

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