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Article

The impact of coopetition strategy on the core competencies of Chinese SMEs under the background of digital transformation and empirical analysis

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Abstract: In the context of digital transformation, Chinese small and medium sized enterprises (SMEs) face significant challenges and opportunities in adapting to market dynamics and technological advancements. This study investigates the impact of coopetition strategy on the core competencies of SMEs, with a particular focus on marketing, technological, and integrative competencies. Data were collected from a sample of 300 SMEs in Anhui Province through an online survey, and reliability and validity were tested using SPSS and AMOS. The results indicate that dependency and trust significantly enhance the effectiveness of coopetition strategy from an external perspective, while managerial ambidexterity and strategic intent are critical internal factors driving the successful implementation of coopetition strategies. Both external and internal factors positively impact the core competencies of SMEs. Additionally, environmental uncertainty moderates the relationship between coopetition strategy and core competencies, underscoring the need for flexibility and adaptability in dynamic market environments. The findings suggest that SMEs can better integrate internal and external resources, optimize resource allocation, and improve operational efficiency through coopetition strategy, thereby enhancing their core competencies. This study provides valuable insights and practical guidance for policymakers and business practitioners aiming to support the digital transformation of SMEs.

Keywords: digital transformation; Chinese SMEs; coopetition strategy; core competencies

1. Introduction

In 2023, the digital transformation of Chinese small and medium sized enterprises (SMEs) progressed from the awareness enhancement phase (1.0) to the widespread implementation phase (2.0). Under the guidance of the "Mass Entrepreneurship and Innovation" policy, the number of SMEs exceeded 60 million, accounting for over 95% of all enterprises nationwide, providing 75% of urban employment, contributing over 60% to GDP, and accounting for over 40% of total exports. Despite challenges such as weak IT infrastructure, funding shortages, talent scarcity, and limited long term planning capabilities, SMEs possess advantages including flat organizational structures, rapid market response, strong innovation drive, and high utilization rates of digital platforms (Alrumiah and Hadwan, 2021; Alraja et al., 2022).

In today's highly competitive business environment, SMEs must adopt a strategic approach that engages stakeholders in both competition and cooperation to create new value (Alrumiah and Hadwan, 2021; Avotra et al., 2022)0. Coopetition is a strategy where firms collaborate and compete in different domains simultaneously. This

strategy transcends industry resource boundaries, enabling SMEs to find suitable development paths in digital transformation (Avotra et al., 2022). Cooperation helps firms mitigate risks, share resources, and achieve mutual growth, while competition drives innovation, enhances market responsiveness, and maintains competitive advantage. This dual strategy not only provides short term benefits but also ensures long term sustainability, enhancing the strategic flexibility and core competitiveness of SMEs (Barann et al., 2019).

Under the context of digital transformation, theoretical and empirical analyses reveal that Chinese small and medium sized enterprises (SMEs) can effectively integrate internal and external resources through coopetition strategies, enhancing innovation capabilities and optimizing operations to thrive in a highly competitive market. Studies indicate that coopetition strategies help SMEs find balance amidst environmental uncertainties, mitigate adverse impacts, and significantly boost core competitiveness (Bauer et al., 2021). This paper provides guidance for SMEs to adapt to market changes and achieve long term sustainable development.

2. Theoretical background and hypothesis

2.1. Dependency and coopetition strategy

Dependency, defined as the size of an organization's investment in a relationship with another organization (Baydukova and Bovkun, 2022; Crick et al., 2020), has become a subject of increasing interest in interfirm relationships. Dependency plays a crucial role in coopetition strategies. According to the resource dependence theory, enterprises must obtain external resources for survival and development, often necessitating reliance on external organizations, thereby forming dependency relationships. SMEs, in their quest for critical resources and capabilities, must rely on external partners, driving the formation and implementation of coopetition strategies. Close collaboration with suppliers, customers, and other partners allows SMEs to access more market information and technical support, enhancing their market responsiveness and innovation capabilities (Hameed and Naveed, 2019).

Some studies argue that dependency fosters resource sharing and technological exchange, enhancing the innovation capabilities of firms, allowing coopetitive partners to grow together while maintaining competition (Nambisan et al., 2017; Nahara, 2024). Additionally, research shows that when firms have high dependency on critical resources, they are more likely to establish cooperative relationships with competitors to reduce market uncertainties and risks. Highly dependent firms tend to adopt coopetition strategies to jointly develop markets with competitors, a strategy that not only improves the market position of both parties but also fosters a healthy competitive environment within the industry (Nambisan et al., 2017； Souza-Luz and Gavronski, 2020).

Research by various scholars highlights the complex yet positive interaction between dependency and coopetition strategies. Dependency intensifies the necessity for coopetition, enabling SMEs to find stable development paths in dynamic market environments (Turner et al., 2018). With limited resources, SMEs often need to collaborate with other firms to acquire necessary resources and technologies (Verhoef

et al., 2021). However, mere cooperation cannot fulfill the demands of intense market competition. The application of coopetition strategies allows SMEs to maintain market vitality and innovation through competition while still cooperating (Yingfei et al., 2021). Moreover, the establishment and maintenance of dependency relationships provide SMEs with greater opportunities for resource acquisition and market expansion. For instance, through coopetition strategies, SMEs can enter new markets and technological fields, leveraging resources and capabilities from various industries to enhance their competitiveness and market position (Zhu et al., 2023). This coopetitive relationship not only aids in the growth and development of SMEs but also drives innovation and progress across the entire industry chain.

Dependency and coopetition strategies play crucial roles in the digital transformation of SMEs (Marneros et al., 2021). Dependency fosters deeper cooperation, while coopetition provides a mechanism for balancing competition and collaboration, enabling SMEs to adapt flexibly to challenges and seize opportunities in a dynamic environment, thus achieving stable and sustainable development (Minz et al., 2023). Through this complex yet positive interaction, SMEs can more effectively integrate resources and enhance competitiveness, securing long term success in a highly competitive market. Therefore, this study concludes:

H1: Dependency has a significant positive effect on coopetition strategy.

2.2. Trust and coopetition strategy

In inter firm relationships, trust is considered the most fragile and unstable component of relationship management. Factors such as conflicts of interest, unequal resource distribution, information asymmetry, and cultural differences can all lead to a high potential for conflict between partners (Lewis and Weigert, 1985). Resource dependence theory posits that when firms engage in resource exchanges with partners, trust can reduce transaction costs, lower uncertainty, and increase cooperation efficiency. Trust enables firms to better share information and resources, thereby enhancing the depth and breadth of their cooperation. Especially in situations characterized by resource scarcity and high environmental uncertainty, trust is regarded as a crucial relational capital that can foster closer cooperation between firms (Jin and Wang, 2020). This helps firms achieve optimal resource allocation and mutual development through coopetition strategies. Therefore, resource dependence theory emphasizes the importance of trust in inter firm cooperative relationships. By building stable relationships through trust, firms can effectively address issues related to conflicts of interest, unequal resource distribution, and information asymmetry, thereby enhancing overall competitiveness and adaptive capacity (Hameed and Naveed, 2019).

In coopetition strategies, trust plays a crucial role. Coopetition refers to the strategy where firms collaborate in certain areas while competing in others. Trust acts as a lubricant in this process, helping firms achieve a balance between cooperation and competition in dynamic market environments (Bouncken and Kraus, 2013). It effectively reduces friction between partners and enhances the stability and durability of cooperation. Establishing trust relationships also mitigates concerns over information sharing and resource integration, thereby improving cooperation

efficiency. Furthermore, trust not only ensures smooth cooperation but also significantly impacts the outcome of coopetition strategies (Bergh et al., 2018). Partners with high levels of trust are more likely to find win-win opportunities in competition, reducing the negative impacts of malicious competition and achieving higher corporate performance (Bharadwaj et al., 2013).

Companies with high levels of trust place greater emphasis on establishing and maintaining solid relationships, which further promotes the development of coopetition strategies and enhances partner satisfaction (Bouncken and Fredrich, 2016). Tamara Keszey notes that trust reduces the costs of controlling and supervising market information. In coopetition relationships, trust increases transparency and efficiency, alleviating tensions from potential competition and encouraging resource sharing. Research by Lisbet and colleagues indicates that high levels of trust enable firms to collaborate and innovate more effectively in uncertain and competitive market environments (Bouncken et al., 2015).

In the context of digital transformation, the application of digital technologies complicates the establishment and maintenance of trust while making information exchange and cooperation more frequent and complex (Duan et al., 2021). Although digital tools and platforms can reduce information asymmetry and improve collaboration efficiency, they also introduce new trust challenges, such as data security and privacy issues (Evayani et al., 2022). Therefore, SMEs must strengthen trust building during digital transformation to ensure the successful implementation of coopetition strategies. Trust not only enhances the close ties and satisfaction between SMEs and their customers but also encourages firms to actively use digital platforms to share data and resources with partners. This trust facilitates long term cooperation and joint development of new technologies and markets. Hence, this study concludes:

H2: Trust has a significant positive effect on Coopetition Strategy.

2.3. Managerial ambidexterity and coopetition strategy

Managerial Ambidexterity refers to the ability of managers to engage in both exploratory and exploitative innovations simultaneously (Fernández-Portillo et al., 2022). Exploratory innovation involves the capacity of an enterprise to innovate in uncertain environments by seeking new opportunities and developing new technologies, products, and markets (Fjaeran and Aven, 2020). Exploitative ability refers to the capability of an enterprise to enhance efficiency and effectiveness by optimizing and improving existing resources, technologies, and markets. Managerial ambidexterity requires balancing these two capabilities within the context of competition and cooperation to achieve long term development and competitive advantage for the enterprise (Ge et al., 2023).

In the implementation of coopetition strategies, exploration ability enables firms to better collaborate with partners to develop new markets and technologies, creating new cooperative opportunities (Gebayew et al., 2018). For instance, by engaging in joint R&D projects with competitors, firms can more rapidly enter emerging markets and sectors, thereby gaining a competitive advantage. Exploration ability also assists firms in continuously adjusting and optimizing their coopetition strategies to adapt to rapidly changing market environments, seizing new market opportunities. According

to Manlio, successful managers can effectively balance resource allocation, driving firms to find equilibrium between exploring new markets and exploiting existing ones. Through ambidexterity, managers can flexibly adjust their coopetition strategies across different market environments (Gehman et al., 2017). Moreover, exploration ability further facilitates knowledge sharing and technological exchange in coopetition activities. By sharing innovative resources and technologies with partners, firms can jointly develop new solutions and enhance overall competitiveness (Guo and Huang, 2023).

In the implementation of coopetition strategies, exploitative ability enables firms to more effectively leverage their partners' resources, optimize internal processes, reduce costs, and improve operational efficiency (Hameed and Naveed, 2019). Exploitative ability also helps firms consolidate their advantages in existing markets and technological domains. By cooperating and sharing market information and customer resources with competitors, firms can optimize their market strategies and increase market share (Hervas-Oliver et al., 2021). Research suggests that managers' exploitative ability is crucial for achieving innovation and efficiency, allowing firms to maintain competitiveness in constantly changing market conditions. Additionally, exploitative ability drives firms to enhance short term performance by optimizing existing resources and capabilities. Through short term collaborative projects, such as joint marketing activities and co development of products, firms can quickly achieve market returns and performance growth (Högberg and Willermark, 2022).

During the period of digital transformation, the combination of exploration and exploitation capabilities enables SMEs to achieve a dynamic balance between competition and cooperation (Jin and Wang, 2020). According to dynamic capabilities theory, this balance allows firms to remain forward looking while maintaining their current market position and performance. By effectively combining exploration and exploitation capabilities, SMEs can find the optimal balance point in coopetition strategies, achieving the best allocation of resources (Keszey, 2018). Managerial ambidexterity allows SMEs to foster innovation through cooperation, enhancing overall competitiveness through knowledge sharing and technological exchange. Simultaneously, by leveraging existing resources to optimize operations, firms can remain efficient and flexible in competition. This balance not only ensures short term market performance but also lays a solid foundation for the long term sustainable development of the firm. Therefore, this study concludes:

H3a: Exploration Ability has a significant positive effect on Coopetition Strategy.

H3b: Exploitative Ability has a significant positive effect on Coopetition Strategy.

2.4. Strategic intent and coopetition strategy

Strategic intent refers to the ambitious long term goals set by an enterprise, guiding continuous resource investment and effort to achieve these objectives (Minz et al., 2023). It emphasizes the ability of a firm to address market competition and environmental changes with a clear vision and strong determination, even under resource and capability constraints. According to Hamel and Prahalad (1989), strategic

intent encompasses not only clear objectives but also the pathways and methods to achieve them (Mom et al., 2007).

Strategic intent sets clear innovation goals and directions for the enterprise, motivating employees and management to continually explore new technologies, markets, and business models (Monticelli et al., 2022). Through coopetition strategies, firms can acquire external innovation resources and technologies, thereby driving internal innovation development. Additionally, strategic intent clarifies the core objectives of the enterprise, enabling it to better integrate internal and external resources, creating synergy and achieving optimal resource allocation (Nahara, 2024). Under the guidance of clear strategic intent, firms can more swiftly respond to market changes, timely adjust their competition and cooperation strategies, and quickly seize market opportunities through coopetition strategies, thus enhancing market competitiveness (Nayak et al., 2024).

According to dynamic capabilities theory, the ability to effectively combine exploration and exploitation capabilities enables firms to adapt and thrive in dynamic market environments. O'Shannassy posited that strategic intent reflects the firm's commitment to the future, inspiring individuals at all levels of the organization to translate long term goals into daily actions (O'Shannassy, 2016). Particularly in high uncertainty environments, strategic intent guided by dynamic capabilities helps firms overcome challenges by continuously reconfiguring and realigning resources to maintain competitive advantage and ensure sustainable development (Pfeffer and Salancik, 1978).

In the context of digital transformation, the relationship between strategic intent and coopetition strategies becomes more complex and important. Firstly, digital transformation accelerates market and technological changes, requiring SMEs to have stronger strategic intent to address uncertainties and competitive pressures (Rof et al., 2020). Firms with clear strategic intent can more effectively integrate internal and external resources through coopetition strategies during digital transformation, achieving optimal resource allocation and capability enhancement (Seepana et al., 2020).

Strategic intent provides clear direction and motivation for a firm's coopetition strategies. In a digital environment, SMEs need to continuously innovate and adjust their competitive and cooperative strategies to adapt to rapidly changing market demands and technological advancements (Turner et al., 2018). The presence of strategic intent ensures that firms do not deviate from their long term goals while implementing coopetition strategies, thus finding a balance between competition and cooperation and achieving sustainable development.

H4: Strategic Intent has a significant positive effect on Coopetition Strategy.

2.5. Coopetition strategy and core competencies

In the context of digitalization, coopetition strategy is not only a means for SMEs to achieve short term goals but also a key to enhancing long term competitiveness and sustainable development (Usman et al., 2024). By combining elements of competition and cooperation, SMEs can collaborate based on mutual interests while maintaining their core competitiveness. Digital transformation not only changes the operational

models of enterprises but also introduces more uncertainty and complexity. In such a highly dynamic and competitive market, coopetition strategies have been widely adopted (Verhoef et al., 2021).

Also in the digital context, core competencies refer to the critical capabilities and resources that enable a company to sustain competitive advantages (Wang et al., 2023). These capabilities and resources typically include technological innovation, market responsiveness, organizational flexibility, and brand value (Yingfei et al., 2021). During digital transformation, SMEs need to continuously upgrade and integrate these core competencies to meet rapidly changing market demands and technological advancements (Zahoor et al., 2021).

Different academic perspectives offer various emphases and interpretations of core competencies (Srisathan et al., 2023). Meyer and Utterback (1993) highlight the importance of R&D, manufacturing, and marketing capabilities (Turner et al., 2018). Leonard-Barton (1992) emphasizes the complexity of core competencies, including employee skills and learning, technical and managerial systems, and value systems (Park et al., 2023). Hamel and Prahalad (1994) categorize core competencies into market access capabilities, loyalty related capabilities, and operational capabilities (O'Shannassy, 2016). Bogner and Thomas (1994) and Hall (1992) analyze core competencies from the perspectives of value systems, corporate culture, and managerial skills (Minz et al., 2023). Spanos and Liukas (2001) and Fowler et al. (2000) reflect core competencies through descriptions of a company's marketing and technical capabilities. Despite varying terms and focuses, these studies commonly view core competencies as effective means to express a company's resources and performance (Marneros et al., 2021).

Based on an analysis and synthesis of existing literature, this paper posits that core competencies should encompass three dimensions: technical capabilities, marketing capabilities, and integrative capabilities (Lakshmanan et al., 2023). First, from the perspective of digital transformation, technical capabilities form the foundation for innovation and competition in a rapidly changing market environment, particularly in the use of digital tools and platforms. Second, the widespread use of the internet and social media has fundamentally altered how companies interact with customers. Firms need precise marketing capabilities to understand customer needs and market trends, formulating effective marketing strategies to enhance brand influence and customer loyalty. Finally, integrative capabilities involve a company's ability to integrate resources, optimize processes, and facilitate cross departmental collaboration, ensuring flexibility and competitiveness in a complex and dynamic digital environment (Keszey, 2018).

In the era of digital transformation, technical capabilities, marketing capabilities, and integrative capabilities complement each other, collectively enhancing a company's market performance and innovation capacity, thereby forming the core competitiveness of SMEs (Jin and Wang, 2020). The interplay of these capabilities not only increases the flexibility of enterprises in responding to market changes but also promotes their sustained development in a competitive environment (Heubeck, 2023).

2.5.1. Coopetition strategy and technological competencies

In today's rapidly changing digital environment, technological competencies are crucial for a company's competitive advantage (Guo et al., 2023). Through coopetition strategies, firms can not only gain external technological support but also leverage the technological strengths of their partners to foster their own technological development and innovation. When adopting coopetition strategies, firms need to master resources within specific technological domains while integrating multiple technological fields to enhance their technological capabilities and effectively strengthen their core competencies (Guo and Huang, 2023).

In the context of digital transformation, technological competencies are a critical component of core competencies, reflecting a company's excellence in technology development, application, and innovation. Coopetition strategies enable SMEs to acquire more technological knowledge, effectively integrate and apply it, and share technological resources and R&D outcomes with partners to enhance their own technological capabilities (Gehman et al., 2017). High tech products and services are manifestations of a company's core competitiveness. Coopetition strategies drive SMEs to adopt advanced technologies and conduct cutting edge research during the R&D process, securing a leading technological position in the market. Moreover, SMEs can import and integrate external technological knowledge to enhance the technological content of their products and services, meeting high tech market demands (Gebayew et al., 2018).

Agility and rapid response capabilities in technological change are also key aspects of core competencies. Coopetition strategies help firms quickly adjust and optimize their technological strategies through technological collaboration, swiftly responding to market changes (Fjaeran and Aven, 2020). Therefore, this study concludes that through coopetition strategies, firms can effectively enhance their technological capabilities, strengthen market competitiveness, and achieve sustainable development.

H5a: coopetition Strategy has a significant positive effect on Technological Competencies.

2.5.2. Coopetition strategy and marketing competencies

Coopetition strategy is a complex strategic choice that integrates elements of competition and cooperation, aiming to enhance market capabilities through collaboration with competitors. Marketing competencies, as a crucial part of a firm's core competencies, are key factors in achieving sustained advantage in market competition (Duan et al., 2021). These include capabilities in brand management, market promotion, and customer relationship management. In the digital context, marketing competencies are particularly important because digital technologies provide more channels and tools for precise customer targeting, market demand analysis, and strategy formulation (Dethine et al., 2020).

Marketing competencies, through dimensions such as brand management, market promotion, customer relationship management, market insight and analysis, and innovation capabilities, directly reflect a firm's core competitiveness (Del Giudice et al., 2021). In the digital context, firms can further enhance these marketing competencies through coopetition strategies, thereby gaining sustained advantage in a

highly competitive market environment. Effective marketing competencies not only satisfy customer needs but also create new market opportunities, enhancing the firm's competitiveness and market position (Crick et al., 2020).

During digital transformation, implementing coopetition strategies can significantly enhance SMEs' marketing competencies (Bouncken and Kraus, 2013). By collaborating with competitors, firms can share market information, customer resources, and marketing technologies, thereby improving the efficiency and effectiveness of market promotion. For example, shared market data and analytical tools can help partners more accurately identify market trends and customer needs, optimizing market strategies. Additionally, joint market promotion activities and brand collaborations can expand market influence and enhance brand awareness and reputation (Bouncken et al., 2015). Therefore, this study concludes that through coopetition strategies, firms can effectively enhance their marketing competencies in the digital context, achieving sustained competitive advantage.

H5b: Coopetition Strategy has a significant positive effect on Marketing Competencies.

2.5.3. Coopetition strategy and integrative competencies

While unique marketing and technological capabilities are strategically significant for corporate performance, possessing these capabilities alone does not ensure success. In practice, firms must have integrative competencies to thrive in fierce market competition (Bauer et al., 2021). Integrative competencies, a key component of core competencies, reflect a company's ability to effectively integrate and coordinate internal and external resources, technologies, and knowledge. This ability is particularly important in highly competitive and rapidly changing market environments, as it promotes positive interaction among core competency components, improves strategic coordination, and enhances adaptability to environmental changes, thereby influencing firm development (Baydukova and Bovkun, 2022).

Coopetition strategies particularly emphasize the importance of integrative competencies in dynamic and constantly changing market environments. Companies need to respond to internal knowledge and resources and integrate external capabilities and knowledge (Bello et al., 2020). Firms with strong integrative competencies can identify and integrate a wide range of market opportunities and information, create new market opportunities, develop new strategies, and build new capabilities in both internal and external environments (Benton, 2016).

With the rapid development of digital technology, the relationships between cooperation and competition among firms have become more complex and dynamic, placing higher demands on integrative competencies (Bharadwaj et al., 2013). First, digital technologies provide SMEs with powerful tools and platforms, enabling them to integrate and utilize internal and external resources more efficiently, make precise resource allocations and decisions, and enhance market responsiveness and competitive advantage (Gnyawali and Park, 2011). Second, the application of digital technologies allows SMEs to achieve real time information sharing and dynamic adjustments along the supply chain, optimizing supply chain processes, increasing response speed and efficiency, thereby enhancing integrative competencies (Gehman

et al., 2017). Lastly, coopetition strategies help SMEs jointly explore new markets and expand their customer base. Through joint marketing and cooperative development, providing personalized products and services, customer satisfaction and loyalty are improved, further enhancing integrative competencies (Evayani et al., 2022).

Therefore, this study concludes that by enhancing integrative competencies, firms can effectively implement coopetition strategies in the digital context, improving market competitiveness and achieving sustainable development.

H5c: Coopetition Strategy has a significant positive effect on Integrative Competencies.

2.6. Environmental uncertainty

Environmental uncertainty refers to unpredictable changes and fluctuations in the external environment, manifesting as market demand changes, technological advancements, policy and regulatory changes, etc (Jin and Wang, 2020). During the period of digital transformation, environmental uncertainty becomes more pronounced due to accelerated technological development and intensified market competition, presenting more uncertain factors for SMEs to navigate (Keszey, 2018).

In an uncertain environment, coopetition strategies can enhance market flexibility and responsiveness, improving SMEs' ability to acquire and maintain market share. However, excessive environmental uncertainty may lead to difficulties in effectively coordinating competitive and cooperative relationships, thus reducing the effectiveness of market capability enhancement (Lakshmanan et al., 2023).

During digital transformation, the variability and complexity of digital technologies are significant. In such an environment, coopetition strategies can help firms quickly acquire external technological resources and knowledge, enhancing technological capabilities. However, high levels of uncertainty may also present greater risks and challenges in technological cooperation, affecting the improvement of technological capabilities (Marneros et al., 2021).

Additionally, in uncertain environments, firms can better integrate internal and external resources through coopetition strategies, enhancing resource utilization efficiency and integrative capabilities. Nevertheless, environmental uncertainty may increase the difficulty of resource integration, limiting the effectiveness of coopetition strategy implementation (Rof et al., 2020).

Therefore, this study concludes that despite the challenges posed by environmental uncertainty during the digital transformation period, SMEs can still leverage coopetition strategies to enhance market and technological capabilities and achieve sustainable development through appropriate strategic adjustments and resource integration.

H6: Environmental uncertainty plays a moderating role in coopetition strategies and Core Competencies.

3. Measures and data

3.1. Measure

Based on the analysis of the variables, this paper proposes several hypotheses and designs a research framework, as shown in **Figure 1**. To test these hypotheses, the study selects SMEs in Anhui Province, China, as the research subjects. Anhui Province, known as an innovative province in China, actively responds to national initiatives and leads the way in digital transformation nationwide. SMEs hold a significant position in China's economy, spanning a wide range of industries from manufacturing to services. This diversity aids in assessing the strategic and performance differences across various industries in addressing digital challenges. SMEs are generally more flexible than large enterprises in adapting to market changes and adopting new technologies, providing practical strategic insights into how they can accelerate digital transformation through coopetition strategies (Worimegbe et al., 2022).

The data was collected through the online platform "Wenjuanxing." A total of 1083 questionnaires were returned. To ensure effective survey distribution, stratified random sampling was employed to guarantee the representativeness and coverage of the sample. The questionnaire design utilized a seven point Likert scale, ranging from "strongly disagree" to "strongly agree," to quantify respondents' perceptions and attitudes towards various variables. After thorough screening and review, 300 valid questionnaires were selected, accounting for approximately 27.7% of the total number of questionnaires. This sample size is sufficient to ensure the statistical significance and reliability of the research results.

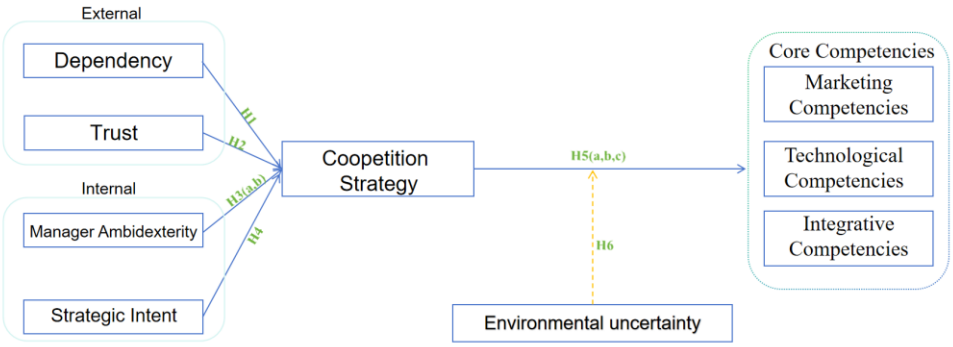

Figure 1. Model structure diagram.

3.2. Data analysis

In **Table 1**, the measurement of dependency references the studies of Avotra et al. (2022). This part measures the dependency between a company and its partners through five specific questions, covering the partners' relative status in negotiations, perceived product differentiation, compliance with partners' needs, and mutual dependence between the two parties. Trust measurement is also based on Avotra et al. (2022), consisting of five questions measuring the level of trust between partners, including fairness in negotiations, credibility, fulfillment of commitments, mutual trust, and innovation.

The assessment of manager ambidexterity mainly cites the studies of Duan et al. (2020). The scale is divided into two sub sections: managers' exploratory ability and exploitative ability, each containing five questions. Questions on exploration

capabilities focus on finding new technological ideas, seeking new possibilities for products/services or markets, and updating products/services or processes. Questions about leveraging capabilities cover leveraging existing experience, servicing existing customers, clear operating methods, leveraging existing knowledge, and activities consistent with current company policies.

The assessment of strategic intent draws on the study of Seepana et al. (2021). The scale consists of four questions that measure a firm's aggressiveness in pursuing strategic goals, competitive dominance, ambitious strategic goals, and market winning focus. These questions are designed to capture the initiative and aggressiveness in a company's strategic positioning and decision making process, thereby understanding how companies seek market leadership and competitive advantage by setting and implementing challenging strategic goals.

The evaluation of coopetition strategy is based on the studies of Avotra et al. (2022). This part measures the coopetition relationship between the company and its partners through four questions, including the degree of close coopetition between the company and its partners, cooperation to jointly achieve goals, the importance of coopetition, and how coopetition becomes the core competency of the enterprise.

The evaluation of marketing competencies is based on the research by Qu et al. (2021) and Rohit Lakshmanan et al. (2023). The scope of the study includes several key capabilities: the ability to obtain real time changes in customer needs, the ability to communicate with customers regarding their potential and current needs, the ability to involve customers in the product testing and evaluation process, the ability to respond quickly to customer needs and deliver products or services in a timely manner, the ability to obtain real time information on the evolution of competitors' strengths and weaknesses, and the ability to benchmark the product and service practices of key competitors.

The evaluation of technical competencies is based on the research by Qu et al. (2021) and Rohit Lakshmanan et al. (2023). The survey on technical competencies covers the company's level of investment in R&D activities, the accumulation of technical skill diversity, frequent on the job training to improve employees' technical skills, the ability to attract and motivate talents, the accuracy of predicting future technology trends, skills in applying new technologies to problem solving, leadership in establishing and updating technology standards in major industries, and leading technological innovation in the major industries in which they operate.

The evaluation of integrative competencies is based on the research by Qu et al. (2021) and Rohit Lakshmanan et al. (2023). The assessment of integrative competencies is mainly based on cross functional communication within the enterprise, the sharing and leveraging of market and technical knowledge, the integration of external and internal resources, the sharing of competitor strategic information, and the coordination and integration of the activities of various functions/business units in the enterprise strategy.

The evaluation of environmental uncertainty is based on the research by Waldman et al. (2001). The assessment of environmental uncertainty mainly measures severe fluctuations in demand, production volume, product mix, and supply requirements (including volume and variety), as well as the frequency of product technology modifications. Through these measurements, we can explore more deeply

how environmental uncertainty serves as a moderating variable that affects the implementation of corporate coopetition strategies and the development of corporate core competencies, thereby providing theoretical support and empirical basis for companies to formulate more effective strategies in uncertain environments.

Table 1. Summary of hypotheses and supporting literature.

Variables	Sources	Questions
Dependency	Avotra et al. (2022)	Our partners related to cooperation has solid comparative negotiating position with us.
		Our partners related to cooperation observe minor difference among our products as well as those of our competitors.
		Our company must obey with various demands of our partners, even if they seem unsuitable
		Our partners are dependent on us.
		Our company are dependent on our partners.
Trust	Avotra et al. (2022)	Our partner has always been evenhanded in its negotiations with us.
		Our partner is trustworthy.
		Our partners related to cooperation keeps up with their promises.
		Our partners trust us.
		Our partners are innovative.
Manager Ambidexterity （MA） Exploration Ability	Duan et al. (2020)	Our company looks for new technology ideas by thinking “outside the box”
		Our company searches for new possibilities regarding products/services, processes or markets.
		Our company focuses on vigorous innovation of products/services or processes.
		Activities requiring quite some adaptability of Our company.
		Activities requiring our company to learn new skills or knowledge.
Manager ambidexterity （MA） Exploitation Ability	Duan et al. (2020)	Activities of which a lot of experience has been accumulated by our company.
		Activities which serve existing (internal) customers with existing services/products.
		Activities of which it is clear to our company how to conduct them.
		Activities which our company can properly conduct by using our present knowledge.
		Activities which clearly fit into existing our company policy.
Strategic intent	Seepana et al. (2021)	Is strategically aggressive
		Seeks competitive dominance
		Focuses on ambitious strategic targets and goals
		Focuses attention of winning in the market place
Coopetition strategy	Avotra et al. (2022)	Our company are in close coopetition with our partners
		Our company collaborate with our partners to achieve a common goal.
		An active coopetition with our partners is important to our company.
		Coopetition provides a Core Competency.
Core competencies Marketing competencies	Qu et al. (2021)/ Rohit Lakshmanan et al. (2023)	Our company’s capability in obtaining real time information about changes of customer needs is very strong.
		Our company’s capability in communicating with customers about their potential and current demands is very strong.
		Our company have strong capability of involving customers in the process of product testing and assessment.
		Our company’s capability enable us to respond quickly to customers’ requirements and deliver offerings in time.

Table 1. (*Continued*).

Variables	Sources	Questions
Core competencies Marketing competencies	Qu et al. (2021)/ Rohit Lakshmanan et al. (2023)	Our company have strong capability to acquire real time information of competitors' evolution of strength and weakness.
		Our company's capability in benchmarking the product and service practices of major competitors is very strong.
		Our company have strong capability of building and enhancing large-scale marketing channels.
		Our company have strong capability of managing close customer relationship effectively for long term
Core competencies Technological competencies	Qu et al. (2021)/ Rohit Lakshmanan et al. (2023)	Our company always make relatively heavy investment in R&D activities
		Our company have accumulated stronger and various technological skills
		On job raining is provided frequently in Our company to improve the technical skills of employees
		Our company are qualified to attract and motivate talented experts
		Our company have the ability to accurately predict future technological trends
		Our company are skillful in apply new technology to problem solving
		Our company are one of the leaders in our primary industry to establish and upgrade technology standards
		Our company always lead technology innovation of the principal industry in which we operate
Core competencies Integrative competencies	Qu et al. (2021)/ Rohit Lakshmanan et al. (2023)	Our company's capability in communication among functions in the process of product and service design is very strong
		Our company have strong capability to share and leverage marketing and technology knowledge among functions/business units
		Our company have strong capability to integrate external resources with the in house resources of our firm
		Our company have strong capability to share and leverage information about competing strategies of major competitors
		Our company have strong capability to coordinate and integrate activities of functions/business units in our corporate strategy
		Our company are good at embedding of the newly achieved technological findings in new products and services
		Our company have strong skills in integrating customers' innovative ideas into final products and services
		Our company have strong capability to deliver superior value to customers by integrating different processes
		Our company have strong capability to coordinate effectively in the implementation process of corporate strategy
Environmental Uncertainty	Waldman et al. (2001)	Demand fluctuates drastically from week to week
		Total manufacturing volume fluctuates drastically from week to week
		Mix of products you produce changes drastically from week to week
		Supply requirements (volume and mix) vary drastically from week to week
		Products are characterized by a lot of technical modifications
		Suppliers frequently need to carry out modifications to the parts/components they deliver to your plant

4. Analysis of the empirical results

4.1. Reliability and validity test

SPSS 21.0 and Amos 17.0 were used to test the reliability and validity of the variables, and the test results were shown in **Table 2**.

(1) KMO = 0.774, Bartlett sphericity test Sig. = 0.000, so the variable is suitable for factor analysis;

If the KMO value is greater than 0.8; the accuracy is good. Between 0.7 and 0.8 is better; between 0.6 and 0.7 is within the acceptable range, and anything less than 0.6 is a wrong problem. As can be seen from the table, the KMO value is greater than 0.7 and the Bartlett depth (Sig.) is significant, indicating a good fit and suitable for factor analysis, indicating that the questionnaire is valid and should not be changed.

(2) Cronbach's α of each variable is greater than 0.7, indicating good internal consistency and high reliability of the variables as a whole;

(3) The standardized coefficients of each factor were obtained by confirmatory factor analysis, all of which were greater than 0.5, and had good validity;

(4) GFI, IFI, CFI, etc. were all above 0.9, SRMR = 0.047 < 0.08, and the model fit was good.

In summary, through the reliability and validity analysis, the corresponding measurement variables have strong interpretability, and the internal quality and construction validity of the model are good.

Table 2. Reliability and validity analysis.

VARIABLES	items	λ	α	KMO and Bartlett sphericity test
Coopetition strategy	Our company are in close coopetition with our partners	0.79	0.741	KMO = 0.774 Bartlett sphericity test: Chi square = 1360.28 Sig. = 0.000 The total variance explained is 67.621%
	Our company collaborate with our partners to achieve a common goal.	0.72		
	An active coopetition with our partners is important to our company.	0.81		
	Coopetition provides a Core Competency.	0.77		
Dependency	Our partners related to cooperation has solid comparative negotiating position with us.	0.63	0.744	
	Our partners related to cooperation observe minor difference among our products as well as those of our competitors.	0.74		
	Our company must obey with various demands of our partners, even if they seem unsuitable	0.78		
	Our partners are dependent on us.	0.69		
	Our company are dependent on our partners.	0.75		
Trust	Our partner has always been evenhanded in its negotiations with us.	0.66	0.752	
	Our partner is trustworthy.	0.72		
	Our partners related to cooperation keeps up with their promises.	0.69		
	Our partners trust us.	0.73		
	Our partners are innovative.	0.77		
Exploration Ability	Our company looks for new technology ideas by thinking "outside the box"	0.84	0.836	
	Our company searches for new possibilities regarding products/services, processes or markets.	0.71		
	Our company focuses on vigorous innovation of products/services or processes.	0.79		
	Activities requiring quite some adaptability of Our company.	0.66		
	Activities requiring our company to learn new skills or knowledge.	0.72		

Table 2. (*Continued*).

VARIABLES	items	λ	α	KMO and Bartlett sphericity test
Exploitation Ability	Activities of which a lot of experience has been accumulated by our company.	0.68	0.772	KMO = 0.774 Bartlett sphericity test: Chi square = 1360.28 Sig. = 0.000 The total variance explained is 67.621%
	Activities which serve existing (internal) customers with existing services/products.	0.82		
	Activities of which it is clear to our company how to conduct them.	0.73		
	Activities which our company can properly conduct by using our present knowledge.	0.79		
	Activities which clearly fit into existing our company policy.	0.81		
Strategic Intent	Is strategically aggressive	0.71	0.812	
	Seeks competitive dominance	0.82		
	Focuses on ambitious strategic targets and goals	0.63		
	Focuses attention of winning in the market place	0.77		
Marketing Competencies	Our company's capability in obtaining real time information about changes of customer needs is very strong.	0.88	0.842	
	Our company's capability in communicating with customers about their potential and current demands is very strong.	0.84		
	Our company have strong capability of involving customers in the process of product testing and assessment.	0.72		
	Our company's capability enable us to respond quickly to customers' requirements and deliver offerings in time.	0.76		
	Our company have strong capability to acquire real time information of competitors' evolution of strength and weakness.	0.77		
	Our company's capability in benchmarking the product and service practices of major competitors is very strong.	0.86		
	Our company have strong capability of building and enhancing large scale marketing channels.	0.83		
	Our company have strong capability of managing close customer relationship effectively for long term.	0.79		
Technological Competencies	Our company always make relatively heavy investment in R&D activities	0.81	0.833	
	Our company have accumulated stronger and various technological skills	0.77		
	On job raining is provided frequently in Our company to improve the technical skills of employees	0.79		
	Our company are qualified to attract and motivate talented experts	0.69		
	Our company have the ability to accurately predict future technological trends	0.88		
	Our company are skillful in apply new technology to problem solving	0.87		
	Our company are one of the leaders in our primary industry to establish and upgrade technology standards	0.74		
	Our company always lead technology innovation of the principal industry in which we operate	0.80		
Integrative Competencies	Our company's capability in communication among functions in the process of product and service design is very strong	0.75	0.797	
	Our company have strong capability to share and leverage marketing and technology knowledge among functions/business units	0.72		
	Our company have strong capability to integrate external resources with the in house resources of our firm	0.73		
	Our company have strong capability to share and leverage information about competing strategies of major competitors	0.70		

Table 2. (*Continued*).

VARIABLES	items	λ	α	KMO and Bartlett sphericity test
Integrative Competencies	Our company have strong capability to coordinate and integrate activities of functions/business units in our corporate strategy	0.78	0.797	KMO = 0.774 Bartlett sphericity test: Chi square = 1360.28 Sig. = 0.000 The total variance explained is 67.621%
	Our company are good at embedding of the newly achieved technological findings in new products and services	0.74		
	Our company have strong skills in integrating customers' innovative ideas into final products and services	0.76		
	Our company have strong capability to deliver superior value to customers by integrating different processes	0.77		
	Our company have strong capability to coordinate effectively in the implementation process of corporate strategy	0.79		
Environmental uncertainty	Demand fluctuates drastically from week to week	0.69	0.715	
	Total manufacturing volume fluctuates drastically from week to week	0.73		
	Mix of products you produce changes drastically from week to week	0.81		
	Supply requirements (volume and mix) vary drastically from week to week	0.64		
	Products are characterized by a lot of technical modifications	0.73		
	Suppliers frequently need to carry out modifications to the parts/components they deliver to your plant	0.72		
CMIN/DF = 136.481/115 = 1.1867，GFI = 0.915，AGFI = 0.932，NEI = 0.902，IFI = 0.947，CFI = 0.947 RMSEA = 0.024，SRMR = 0.047				

4.2. Descriptive analysis and correlation analysis

The mean value and standard deviation of each variable are shown in **Table 3**.

Table 3. Descriptive statistical analysis.

VARIABLES	Mean Value	Standard deviation
Coopetition strategy	5.841	0.845
Dependency	5.325	1.027
Trust	4.915	0.873
Exploration Ability	6.771	0.988
Exploitation Ability	5.492	1.033
Strategic Intent	5.866	0.994
Marketing Competencies	6.727	0.749
Technological Competencies	6.142	1.015
Integrative Competencies	5.877	0.831
Environmental uncertainty	5.711	0.718

The correlation analysis of each variable is shown in **Table 4**. Among them, Dependency, Trust, Exploration Ability, Exploitation Ability, Strategic Intent, Core Competence Marketing Competencies, Core Competence Technological Competencies, Core Competence Integrative Competencies are significantly positively related to Coopetition strategy ($p < 0.01$); Environmental uncertainty is related to others The variables are all significantly negatively correlated; Marketing

Competencies, Technological Competencies and Integrative Competencies are significantly related to Cooperation strategy. It is basically consistent with the hypothesis direction of this study and provides a preliminary basis for hypothesis testing.

Table 4. Pearson correlation coefficient matrix.

VARIABLES	1	2	3	4	5	6	7	8	9	10
Coopetition strategy	1.000									
Dependency	0.315**	1.000								
Trust	0.147**	0.357**	1.000							
Exploration Ability	0.418**	0.416**	0.313**	1.000						
Exploitation Ability	0.562**	0.525**	0.362**	0.511**	1.000					
Strategic Intent	0.379**	0.354**	0.407**	0.403**	0.325**	1.000				
Marketing Competencies	0.206**	0.227**	0.319**	0.199**	0.373**	0.411**	1.000			
Technological Competencies	0.375**	0.411**	0.523**	0.431**	0.555**	0.492**	0.259**	1.000		
Integrative Competencies	0.197**	0.321**	0.476**	0.551**	0.475**	0.479**	0.544**	−0.246*	1.000	
Environmental uncertainty	−0.394**	−0.125*	−0.517**	−0.471*	−0.364**	−0.391*	−0.547	−0.319*	−0.401*	1.000

Note: * means significance level $p < 0.05$, * * means significance level $p < 0.01$, * * * means significance level $p < 0.001$

4.3. The influence of coopetition strategy on core competencies

The test results of the impact of coopetition strategy on core competencies are shown in **Table 5**. Coopetition strategy has a significant positive impact on marketing competencies, with a 95% confidence interval of (0.026, 0.178), excluding 0, and an effect size of r = 0.154, which is positive. Coopetition strategy also has a significant positive impact on technological competencies, with a 95% confidence interval of (0.017, 0.139), excluding 0, and an effect size of r = 0.182, which is positive. Furthermore, coopetition strategy has a significant positive impact on integrative competencies, with a 95% confidence interval of (0.039, 0.201), excluding 0, and an effect size of r = 0.203, which is positive.

Table 5. Influence of Coopetition strategy on core competencies.

		Effect Size	SE	95% Confidence Interval
Coopetition strategy	Marketing Competencies	0.154	0.056	(0.026，0.178)
	Technological Competencies	0.182	0.041	(0.017，0.139)
	Integrative Competencies	0.203	0.049	(0.039，0.201)

4.4. Analysis of moderating effects of environmental uncertainty

As shown in **Table 6**, coopetition strategy has a significant positive impact on core competencies. Specifically, coopetition strategy has a 95% confidence interval of (0.037, 0.286) for marketing competencies, excluding 0. The effect size r = 0.347 is positive, $p < 0.001$. Coopetition strategy has a 95% confidence interval of (0.018, 0.277) for technological competencies, excluding 0, with an effect size of r = 0.255,

which is positive, $p < 0.01$. For integrative competencies, coopetition strategy has a 95% confidence interval of (0.052, 0.148), excluding 0, with an effect size of $r = 0.207$, which is positive, $p < 0.01$.

Environmental uncertainty has a significant negative impact on core competencies. Specifically, environmental uncertainty has a 95% confidence interval of (−0.434, −0.211) for marketing competencies, excluding 0. The effect size $r = -0.172$ is negative, $p < 0.001$. Environmental uncertainty has a 95% confidence interval of (−0.103, −0.084) for technological competencies, excluding 0, with an effect size of $r = -0.171$, which is negative, $p < 0.01$. For integrative competencies, environmental uncertainty has a 95% confidence interval of (−0.097, −0.013), excluding 0, with an effect size of $r = -0.166$, which is negative, $p < 0.01$.

The interaction term between coopetition strategy and environmental uncertainty was generated. The results are as follows: The interaction term has a significant negative impact on core competencies. Specifically, the interaction term has a 95% confidence interval of (−0.288, −0.064) for marketing competencies, excluding 0. The effect size $r = -0.154$ is negative, $p < 0.001$. The interaction term has a 95% confidence interval of (−0.301, −0.111) for technological competencies, excluding 0, with an effect size of $r = -0.167$, which is negative, $p < 0.01$. For integrative competencies, the interaction term has a 95% confidence interval of (−0.297, −0.091), excluding 0, with an effect size of $r = -0.158$, which is negative, $p < 0.001$.

In summary, the coefficients of the main effects have opposite signs to the corresponding interaction term coefficients, indicating that the moderating effect of environmental uncertainty weakens the main effect.

Table 6. Analysis of regulatory effects of environmental uncertainty.

	Marketing Competencies	**Technological Competencies**	**Integrative Competencies**
Coopetition strategy	0.347***(0.037，0.286)	0.255**(0.018，0.277)	0.207**(0.052，0.148)
Environmental Uncertainty	−0.172***(−0.434，−0.211)	−0.171**(−0.103，−0.084)	−0.166**(−0.097，−0.013)
Interaction Term	−0.154***(−0.288，−0.064)	−0.167***(−0.301，−0.111)	−0.158***(−0.297，−0.091)

4.5. The influence of internal and external factors on coopetition strategy

As shown in **Table 7**, dependency has a significant positive impact on coopetition strategy. The 95% confidence interval is (0.019, 0.167), excluding 0, with an effect size of $r = 0.143$, which is positive. Trust has a significant positive impact on coopetition strategy, with a 95% confidence interval of (0.116, 0.325), excluding 0, and an effect size of $r = 0.248$, which is positive. Exploration ability has a significant positive impact on coopetition strategy, with a 95% confidence interval of (0.083, 0.214), excluding 0, and an effect size of $r = 0.137$, which is positive. Exploitation ability has a significant positive impact on coopetition strategy, with a 95% confidence interval of (0.211, 0.476), excluding 0, and an effect size of $r = 0.251$, which is positive. Strategic intent has a significant positive impact on coopetition strategy, with a 95% confidence interval of (0.184, 0.362), excluding 0, and an effect size of $r = 0.196$, which is positive. Both internal and external factors have a positive impact on coopetition strategy.

Table 7. Test of the effect of Coopetition strategy.

Coopetition strategy	Effect size	SE	95% confidence interval
Dependency	0.143	0.018	(0.019，0.167)
Trust	0.248	0.032	(0.116，0.325)
Exploration Ability	0.137	0.022	(0.083，0.214)
Exploitation Ability	0.251	0.037	(0.211，0.476)
Strategic Intent	0.196	0.036	(0.184，0.362)

5. Conclusion

This study explores the key impact of coopetition strategies on the core competitiveness of Chinese SMEs in the digital era, especially in the framework of Made in China 2025 and the ongoing digital transformation plan. By combining theoretical and empirical analysis, we identify how external factors such as dependence and trust, as well as internal factors such as management flexibility and strategic intent, affect the effectiveness of coopetition strategies.

The results show that coopetition strategies significantly improve the marketing, technical and comprehensive capabilities of SMEs, which are essential for maintaining competitive advantages. With the increasing complexity of technological innovation, it is difficult for enterprises to achieve efficient innovation through a “closed” model. Coopetition strategies have become the key to sustainable innovation in the context of open innovation. When participating in standardization practices, SMEs need to absorb complementary resources through close cooperation with stakeholders such as suppliers, customers, and competitors, promote innovation and improve their ability to profit from cooperation. Enterprises should attach importance to their position and relationship quality in the standard alliance network, and promote the standardization process by acquiring resources. Enterprises at the center of the network can better discover innovation opportunities and reduce competitive pressure. Improving cooperative relationships with alliance members is conducive to the formulation and promotion of technical standards. In order to improve performance, enterprises need to cultivate strategic flexibility, improve the ability to utilize, transform and reconfigure resources, and flexibly respond to changes in the external environment. By designing a loosely coupled organizational structure, strengthening internal resource sharing, and improving learning capabilities, enterprises can better utilize resources within the alliance, promote innovation and achieve long term competitive advantages. However, there are still some limitations in the study. In terms of research factors, the success of the coopetition strategy is affected by environmental uncertainty, which indicates that SMEs must dynamically adapt to market changes and technological progress to maintain growth; in terms of research objects, this study is limited to SMEs in Anhui Province, which limits the extrapolation of research results to other regions or enterprises of different sizes and types. The economic development level, industrial structure, and policy environment of Anhui Province may be different from those of other provinces, and the conclusions of future studies will be further verified nationwide; for respondents, some respondents will exaggerate or underestimate the strategic implementation effects and performance of their

companies based on social expectations and their own interests. This self reporting bias will cause the research results to deviate from the actual situation. In order to mitigate this effect, future studies consider combining multiple data collection methods to improve the accuracy of the data and the reliability of the research results.

This study provides actionable insights for policymakers and business leaders who aim to enhance the competitiveness of SMEs through coopetition strategies. Future research should focus on longitudinal research, conduct follow up surveys on enterprises based on different standardization stages, and explore the dynamic evolution of the competitive and cooperative strategies of SMEs. Secondly, the problem can be explored in depth through a variety of testing methods to improve the representativeness of the sample, so as to further verify these findings and explore the long term sustainability of competitive and cooperative strategies under different market conditions.

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