International Journal of Research Studies in Management
2023 Volume 11 Number 13, 49-66

Refinement system, market competitiveness and innovation capability: Inputs to small medium enterprises high-quality development framework

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ISSN: 2243-7770
Online ISSN: 2243-7789

Received: 30 November 2023 **Revised**: 20 December 2023 **Accepted**: 31 December 2023 OPEN ACCESS
Available Online: 31 December 2023 **DOI**: 10.5861/ijrsm.2023.1163

Abstract

The purpose of this paper is to clarify the relationship among refinement system, market competitiveness and innovation capability by combining the relevant literature and investigating and analyzing the development status of small and medium-sized enterprises (SMEs), and then recommending specific strategies to promote the healthy and sustainable development of SMEs. Through questionnaire survey and SPSS 28.0 statistical analysis software, this paper discusses the relationship among refinement system, market competitiveness and innovation capability. Based on the results of literature evaluation and the conclusion of investigation and analysis, this paper designs three scales: refinement system, market competitiveness and innovation capability, and then completes the questionnaire design. The study revealed that in the development process of SMEs, refinement system can significantly affect market competitiveness. That is to say, the level of digitalization, quality management and advanced management can have obvious positive influence on cost leadership, product quality and process flexibility. Meanwhile, refinement system can significantly affect innovation capability. That is to say, the level of digitalization, quality management and advanced management can have obvious positive influence on process innovation, product innovation, business model innovation and organizational innovation. In addition, market competitiveness can significantly affect innovation capability. That is to say, cost leadership, product quality and process flexibility can have obvious positive influence on process innovation, product innovation, business model innovation and organizational innovation. On this basis, this paper constructs a high-quality enterprise development framework, and provides corresponding suggestions for the high-quality development of small and medium-sized enterprises.

Keywords: Small and medium-sized enterprises (SMEs), refinement system, market competitiveness, innovation capability

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1. Introduction

In recent years, Chinese small and medium-sized enterprises (SMEs) have taken a leading position in the fierce competition, dared to innovate, accelerated their development pace, and steadily increased their scale and economic. At the end of 2022, the number of SMEs in China exceeded 52 million, and the operating income of industrial SMEs above designated size exceeded 80 trillion yuan. The innovation ability has been significantly enhanced, with a total of over 80000 specialized, refined, and innovation enterprises cultivated, as well as 9000 specialized, refined, and innovation "little giants" enterprises. Vibrant SMEs are an important guarantee of China's economic resilience, as well as an important foundation and new force for achieving common prosperity. On the one hand, the role of SMEs in stabilizing and strengthening the chain is prominent. Over 40% of specialized and specialized innovation "little giants" enterprises focus on the fields of new materials, next-generation information technology, new energy vehicles, and intelligent connected vehicles. Over 60% are deeply involved in the industrial infrastructure field, and over 90% are supporting suppliers for well-known domestic and foreign large enterprises. They play an important role in supporting stable economic growth and maintaining the stability of the global industrial and supply chains. On the other hand, SMEs are the basic cells of the national economy, providing over 50% of taxes, creating over 60% of GDP, completing over 70% of invention patents, providing over 80% of employment opportunities, and accounting for over 90% of the total number of enterprises (Hu Xi and Shuhua Zhong, 2022). SMEs play a unique role in prospering the economy, stabilizing employment, and promoting innovation. In order to build a high-quality common prosperity society, whether it is to continue promoting economic growth and expanding the cake, or to adjust inventory and improve distribution, the continued development of SMEs is a crucial lever.

SMEs play an important role in the current economic development, and their level of development is directly related to the sustained and healthy development of the national economy. Under the construction of a new development pattern and the trend of digital economy development, it is necessary to re-examine the high-quality development of SMEs. At present, problems such as high performance fluctuations, inadequate management systems, weak independent innovation capabilities, and insufficient core competitiveness, arise gradually, which restrict the high-quality development of SMEs (Gao, W., 2009). Hence, guiding the SMEs to the path of "specialization, refinement, and innovation" development and improving the overall quality, is necessary to achieve the upgrading of China's industrial organizational structure, enhance traditional industries, cultivate emerging industries, and to develop new formats and innovative models. The Ministry of Industry and Information Technology of China, together with relevant departments, recently launched the "Three Empowerments" action, which indicates the digital empowerment, technological achievement empowerment, and quality standard brand empowerment. These special policies for SMEs act as a "combination punch" to improve their innovation ability and core competitiveness, and are important measures to promote the high-quality development. More importantly, with the strong support of national policies, SMEs should also exert their subjective initiative (Xie, X., & Bai, A., 2006), and assist in high-quality development of enterprises through refined management (Zhang, J., 2020), continuously improving their innovation ability and market competitiveness. Refined management can help SMEs establish a scientific and efficient management system, and improve their operational capabilities and business management level. Through refined data analysis and monitoring, SMEs can timely identify and solve problems, improve risk management and decision-making capabilities. At the same time, a refined system can also provide comprehensive services and support, strengthen the relationship between enterprises and customers, enhance the customer satisfaction and loyalty, and promote sustainable development of enterprises (Cui, J., & Chen, Z., 2012).

The practice and path of refined management in enterprises has been widely explored (Zhao, S., 2016; Hong, Q., 2016). However, less attention has been paid to the impact of refined management systems on the innovation ability and market competitiveness of SMEs. Firstly, this paper suggests that a refined management system can enhance the market competitiveness of SMEs. As SMEs often face challenges such as limited resources and small scale in market competition, they can better manage resources, improve efficiency, reduce costs, and enhance competitiveness by establishing a refined system (Chen, M., 2018). For example, through refined supply chain management, SMEs can better grasp the links of raw materials, production processes, and product distribution. Furthermore, they can improve the transparency and efficiency of the supply chain, reduce production costs, improve product quality and delivery speed, and thus win the advantage of market competitive. Secondly, a refined management system can enhance the innovation capabilities of SMEs. As is known that, the Innovation is the key for SMEs to stand out in market competition. A refined system can provide a better innovation environment and support for SMEs. For example, by establishing a good internal communication mechanism and knowledge sharing platform, the communication and cooperation among employees can be promoted, which further improves the innovation motivation and efficiency (Liu, T., 2023). At the same line, through close cooperation with external resources such as suppliers, partners, and research institutes, SMEs can also obtain broader innovation resources and technical support, promoting innovation in products, services, and business models. Finally, there is a natural internal connection between the enterprise innovation capability and market competitiveness. Actually, innovation is the foundation and key to forming and cultivating enterprise competitiveness, which can effectively promote innovation and enterprise development. The ultimate manifestation of a company's competitiveness lies in maximizing its profits. If a company wants to seize the market and obtain higher profits, it must form a differentiated advantage. In this respect, innovation is the most effective way to achieve this strategic goal. Therefore, innovation ability plays a crucial role in the company's market competitiveness.

Therefore, the construction of a refined management system for SMEs is of great significance in enhancing their market competitiveness and innovation capabilities. Establishing a refined system benefit to improve the operational efficiency of enterprises, reduce costs, enhance innovation capabilities, and gain advantages in fierce market competition, which lays a solid foundation for the sustainable development of enterprises. This paper focuses on technology-based SMEs in Shaanxi Province, China. It investigates the current development status of enterprises in the refinement system, market competitiveness, and innovation ability. By exploring the relationship between the refinement system, market competitiveness, and innovation ability of SMEs, the impact of refinement management on the market competitiveness and innovation ability of SMEs is verified, and the high-quality enterprise development framework and corresponding countermeasures and suggestions are proposed to provide theoretical basis and practical guidance for the high-quality development of SMEs.

Objectives of the Study - This paper aims to investigate the current development status of SMEs in China in terms of refinement system, market competitiveness, and innovation capability. Furthermore, a framework and some recommendations for the development of SMEs are provided. Specifically, main contents are summarized as follows: Evaluate the refinement system of SMEs in terms of digital level, quality management level, and advanced management level; Evaluate the market competitiveness of SMEs in terms of cost leadership, product quality, and process flexibility; Examine the innovation capability of SMEs in terms of process innovation, product innovation, business model innovation, and organizational innovation; Analyze the interrelationships among refinement system, market competitiveness, and innovation capability; Develop a high-quality enterprise development framework for SMEs and propose relevant recommendations.

2. Methods

Research Design - This study adopts a descriptive research design to fully and accurately explain the research results. According to Rahi (2017), a descriptive research method is a study that obtains facts, data, and information related to the current state, providing precise contours of situations, characters, or events. Polit and Beck (2014) also shared descriptive research aimed at studying and monitoring an arising sensation which

cannot be recognized by an impartial factor. Researchers attempt to collect information from respondents by providing survey questionnaires and distributing them. This descriptive research helps to effectively collect data from respondents in order to achieve specific research objectives.

Research Participants - This study uses a questionnaire survey to collect data from SMEs of science and technology in Shaanxi Province, China, to examine the relationship between refinement system, market competitiveness and innovation ability. In the end, a total of 400 questionnaires were issued and 375 questionnaires were recovered. Through manual inspection, 73 questionnaires with all answers as a single option and many missing values were deleted, and 302 valid questionnaires were obtained. The basic characteristics of 302 sample enterprises are shown in Table 1. On the basis of referring to the "Measures for the Division of Small, medium-sized and Micro Enterprises in Statistics (2017)" issued by the National Bureau of Statistics and combining with the actual situation of the survey enterprises, the study classifies enterprises with fewer than 30 employees as small and micro enterprises, enterprises with 30-100 employees as small enterprises, and enterprises with more than 100 employees as medium-sized enterprises.

Table 1

Basic Characteristics of Sample Enterprises

Category	Number of samples N=302	Scale
Enterprise size		
Small and micro enterprises (Less than 30 employees)	84	27.81%
Small enterprises (30-100 employees)	125	41.39%
Medium-sized enterprises (More than 100 employees)	93	30.79%
Enterprise development stage		
Initial stage	57	18.87%
Growth stage	155	51.32%
Maturity stage	90	29.80%
Decline stage	0	0

As can be seen from the table above, among the 302 technology-based SMEs participating in the survey, from the perspective of enterprise size, small enterprises account for the largest proportion (41.39%), medium-sized enterprises account for 30.79%, and small and micro enterprises account for the smallest proportion, 27.81%.From the perspective of enterprise development stage, enterprises in the growth stage accounted for the largest proportion, 51.32%, enterprises in the mature stage accounted for 29.80%, and enterprises in the initial stage accounted for the smallest proportion, 18.87%.

Data Gathering Instrument - The questionnaire is developed on the basis of a large number of literature collation, and most of the questionnaire items are from the existing literature. In addition, we have designed some new questions to measure variables that lack existing scales. Some questions refer to original questionnaires in English, which are then translated into Chinese for easy understanding and answers. Finally, these Chinese questionnaires are translated back to English to ensure semantic consistency in the process of cross-cultural translation (Berry, 1980). In January 2023, we selected 10 local enterprises to conduct a pre-survey, and determined the form and content of the formal survey questionnaire according to the results of the survey interviews. In the process of the pre-survey, the questions reflected in the questionnaire that are difficult to understand and easy to misunderstand are recorded. After the suggestions of experts, the questions in this research questionnaire were modified and deleted, which helped the respondents effectively complete the survey when the questionnaire was formally issued.

The formal survey was conducted from March 2023 to July 2023 by means of face-to-face visits and electronic questionnaires. Each enterprise issues one questionnaire, and each questionnaire is filled out independently by the middle-level or above management of the enterprise, which can effectively ensure the authenticity and accuracy of the obtained enterprise information. In the end, a total of 400 questionnaires were issued and 375 questionnaires were recovered. Through manual inspection, 73 questionnaires with all answers as a single option and many missing values were deleted, and 302 valid questionnaires were obtained.

After the questionnaire collection is completed, the data is analyzed using statistical software of SPSS 28.0 (Cronbach's Alpha). Cronbach (1951) believed that the minimum standard value of Cronbach's αcoefficient is 0.6. When the αcoefficient is greater than 0.7, it indicates that the reliability of the question meets the research standards. Based on the opinions of the instructor, expert evaluation and modifications were made, and items that did not meet the requirements were deleted, and items with α coefficients above 0.7 and good reliability were retained. Therefore, Cronbach's α coefficients all meet the standard values and can be used for formal survey samples. The reliability analysis of the prediction questionnaire is shown in Table 2.

Table2

Reliability Analysis of Refinement System, Market Competitiveness and Innovation Capability

Indicators	Cronbach Alpha	Remarks
Digitalization level	0.744	Acceptable
Quality management level	0.858	Good
Advanced management level	0.831	Good
Cost leadership	0.726	Acceptable
Product quality	0.933	Excellent
Process flexibility	0.891	Good
Product innovation	0.855	Good
Business model innovation	0.706	Acceptable
Process innovation	0.937	Excellent
Organizational innovation	0.875	Good

Data gathering procedure - This study employed the frequency distribution and weighted mean for descriptive statistical analysis, in order to quantitatively obtain the overview of the relevant variables. The second tool used was Pearson correlation test for all variables to verify the correlation between the variables, which provides a preliminary basis for the subsequent regression analysis. Finally, after the previous descriptive statistics and correlation statistics analysis, research used multiple regression.

Data analysis - Weighted mean and rank were used to determine SMEs' refinement system in terms of digitalization level, quality management level and advanced management level; to assess market competitiveness in terms of cost leadership, product quality and process flexibility; and to investigate the innovation capability of enterprises through four aspects: process innovation, product innovation, business model innovation, and organizational innovation. The result of Shapiro-Wilk Test showed that p-values of all variables were less than 0.05 which means that the data set was not normally distributed. Therefore, Spearman rho was used as part of the non-parametric tests to determine the significant relationship. All analyses were performed using SPSS v. 28.

Ethical Considerations - The researcher adopted the process of informed consent and ethical measures such as equal treatment, understand what respondents are worried about, what risks do they think, what are the main risks, that is, to understand the difference pattern of risks constructed by respondents, then try every means to solve these risks, analyze and study the risks that may be brought to the respondents as objectively as possible, and inform the respondents of the protective measures the researcher have taken (such as confidentiality), so as to reduce the risk assessment, responsibility burden and actual risks of the respondents, and urge the respondents to open their hearts as much as possible. The three basic ethical principles were followed by the respecting individuals, benefiting each other and fairness. This principle is widely used by international medical and social science circles. After adjusting and synthesizing these principles and applying them to practical operation, it is considered that the investigation should at least achieve informed consent, respect and equality, and no harm.

3. Results and discussion

Table 3 describes the assessment on SMEs' refinement system. As reflected in the table, the respondents agree on the cited indicators with a composite mean of 2.95. In the three dimensions of the enterprise refinement system, the advanced management level ranks first, with a weighted average score of 2.99, which indicates that in the construction of the current enterprise refinement system, the most concerned is the improvement of the enterprise advanced management level. There exists a close-knit relationship between an enterprise's advanced

management level and its pursuit of refinement. These elements complement each other, contributing significantly to enhancing organizational performance and competitiveness. Key facets of refined management encompass an efficient management system, managerial efficacy, information analysis and decision-making capabilities, organizational structure, and human resource management. Refined management enhances these elements' capabilities by providing real-time data and tools, thereby facilitating the attainment of advanced management objectives and bolstering organizational performance and competitiveness.

Table 3

Assessment on SMEs' Refinement System

Key Result Areas	Composite Mean	VI	Rank
1. Digitalization Level	2.89	Agree	3
2. Quality Management Level	2.98	Agree	2
3. Advanced Management Level	2.99	Agree	1
Grand Composite Mean	2.95	Agree	

Legend:3.50-4.00=Strongly Agree;2.50-3.49=Agree;1.50-2.49=Disagree;1.00-1.49=Strongly Disagree

The quality management level ranks second with a weighted average score of 2.98, which indicates that the improvement of quality management level plays an important role in the construction of the current enterprise refinement system. There exists a strong nexus between an enterprise's quality management level and its pursuit of refinement. Quality management constitutes a pivotal facet of refined management, as it is indispensable for augmenting efficiency and quality. These two components mutually support each other, working in synergy to enhance an organization's efficiency and quality.

Among the three dimensions of the refinement system, the lowest ranking is the digitalization level, with a weighted average score of 2.89, which indicates that although the improvement of the digitalization level plays a certain role in the construction of the current enterprise refinement system, relatively speaking, enterprises pay little attention to it. Digitalization has the potential to empower refined management and serves as a critical dimension in evaluating the refinement system's level in small and medium-sized enterprises (SMEs). Traditional modes of enterprise management and governance are no longer suitable for the future requirements of refined management. Leveraging cutting-edge technologies such as big data, cloud computing, blockchain, and artificial intelligence is imperative to drive innovation in the means, models, and philosophies of managing SMEs. Digitally empowering enterprise management, operations, production, and talent development is a necessary pathway to elevate the refinement system's level within enterprises (Qi and Xiao, 2020). Refined management is a data-centric and real-time monitoring approach aimed at precision control and optimization of various aspects of an enterprise. Li (2021) advocates strengthening the development of an advanced quality culture in "small giants" enterprises and promoting refined management through information technology and digital technologies. With improved digitalization levels, enterprises can more easily implement refined management. Digital tools offer real-time data, visualized analysis, and intelligent decision support, facilitating more precise management of processes, resources, and quality. Digitalization levels also support the scalability of refined management. When an enterprise has a high degree of digitalization, it can more readily expand digital tools and systems to encompass a wider range of business areas and achieve comprehensive refined control.

Table 4

Assessment on SMEs' Market Competitiveness

Key Result Areas	Composite Mean	VI	Rank
1. Cost Leadership	2.88	Agree	3
2. Product Quality	3.21	Agree	1
3. Process Flexibility	3.06	Agree	2
Grand Composite Mean	3.05	Agree	

Legend:3.50-4.00=Strongly Agree;2.50-3.49=Agree;1.50-2.49=Disagree;1.00-1.49=Strongly Disagree

Table 4 describes the assessment on SMEs' market competitiveness. As reflected in the table, the respondents agree on the cited indicators with a composite mean of 3.05. In the three dimensions of the SMEs' market competitiveness, the product quality ranks first, with a weighted average score of 3.21, which indicates that in the construction of the current market competitiveness, the most concerned is the improvement of product

quality. It is well-established that product quality serves as an intrinsic driver for elevating an enterprise's market competitiveness (Li, 2022). High-quality products yield benefits such as enhanced customer satisfaction, trust, and loyalty, reduced costs related to maintenance and quality issues, increased market share, and support for pricing strategies. Consequently, businesses often regard product quality as a pivotal strategic component to augment market competitiveness and long-term performance.

The process flexibility ranks second with a weighted average score of 3.06, which indicates that the improvement of process flexibility plays an important role in the construction of the current enterprise market competitiveness. It enables companies to adeptly respond to market fluctuations, evolving customer demands, competitive pressures, and emerging technological trends, thus bolstering efficiency, quality, and innovation capabilities. By fostering highly adaptable processes, enterprises can swiftly meet customer requirements, strengthen market share, and distinguish themselves in fiercely competitive markets. Hence, organizations frequently view process flexibility as a strategic investment to enhance market competitiveness and long-term performance.

Among the three dimensions of the SMEs' market competitiveness, the lowest ranking is the cost leadership, with a weighted average score of 2.88, which indicates that although the cost leadership plays a certain role in the construction of the current enterprise market competitiveness, relatively speaking, enterprises pay little attention to it. Cost leadership stands as a pivotal factor in boosting an enterprise's market competitiveness. It implies that businesses can offer products or services at lower costs, thus gaining a competitive edge in the market. Achieving cost leadership involves measures such as reducing operational production costs, establishing cost-effective marketing channels, minimizing marketing expenses, and optimizing supply chain management (Yue and Gu, 2022). However, enterprises must also ensure that, while pursuing cost leadership, they maintain product or service quality and value to meet heightened customer demands.

Table 5

Assessment on SMEs' Innovation Capability

Key Result Areas	Composite Mean	VI	Rank
1. Process Innovation	3.19	Agree	1
2. Product Innovation	3.15	Agree	2
3. Business Model Innovation	3.09	Agree	4
4. Organizational Innovation	3.14	Agree	3
Grand Composite Mean	3.14	Agree	

Legend:3.50-4.00=Strongly Agree;2.50-3.49=Agree;1.50-2.49=Disagree;1.00-1.49=Strongly Disagree

Table 5 describes the assessment on SMEs' Innovation capability. As reflected in the table, the respondents agree on the cited indicators with a composite mean of 3.14. In the four dimensions of the SMEs' innovation capability, the process innovation ranks first, with a weighted average score of 3.19, which indicates that respondents agreed that in the construction of the current innovation capability, the most concerned is the improvement of process innovation. Process innovation constitutes a pivotal component of corporate innovation, involving enhancements in methods and procedures for product manufacturing or service provision. It facilitates gains in production efficiency, product quality, fosters the development of new products and solutions, reduces production costs, and harnesses price advantages to enhance competitiveness (Jiang et al., 2023). By continually refining process workflows, exploring novel technologies, collaborating with external partners, and encouraging employee involvement in innovation activities, enterprises can achieve sustained innovation, adapt to evolving market dynamics, and distinguish themselves in intensely competitive environments.

The product innovation ranks second with a weighted average score of 3.15, which indicates that respondents agreed that the improvement of product innovation plays an important role in the construction of the current enterprise innovation capability. Product innovation holds paramount importance in corporate innovation endeavors, as it facilitates enhancements in product characteristics, performance, and quality, thus elevating the user experience and satisfying evolving market demands, thereby gaining a competitive edge in the marketplace. By continuously introducing new products, improving existing ones, engaging users, and addressing market

needs, enterprises can sustain innovation, bolstering their long-term sustainability and competitive positioning (Wang and Kang, 2023).

The organizational innovation ranks third with a weighted average score of 3.14, which indicates that the improvement of organizational innovation plays an important role in the construction of the current enterprise innovation capability. Organizational innovation plays an important role in enterprise innovation (Zhao et al., 2023). It involves how to build flexible organizational structures, effectively manage innovation processes, integrate resources and technologies, and adapt quickly to change. Through effective organizational innovation, enterprises can better promote innovative activities, achieve competitive advantage in the market, and achieve long-term success.

Among the four dimensions of the SMEs' innovation capability, the lowest ranking is the business model innovation, with a weighted average score of 3.09, which indicates that although the business model innovation plays a certain role in the construction of the current enterprise innovation capability, relatively speaking, enterprises pay little attention to it. Business model innovation has become increasingly important for enterprises to navigate today's highly dynamic and complex market environments (Liu and Xing, 2023). It pertains to how value is created and delivered, as well as revenue generation. Business model innovation encompasses various facets, including products, markets, resources, and revenue streams. By continuously adjusting and refining their business models, enterprises can adapt to market changes, enhance competitiveness, and achieve sustained innovation and growth.

Table 6

Relationship Between Refinement System and Market Competitiveness

Variables	rho	p-value	Interpretation
Digitalization Level			
Cost Leadership	0.518**	0.000	Highly Significant
Product Quality	0.457**	0.000	Highly Significant
Process Flexibility	0.585**	0.000	Highly Significant
Quality Management Level			
Cost Leadership	0.602**	0.000	Highly Significant
Product Quality	0.601**	0.000	Highly Significant
Process Flexibility	0.612**	0.000	Highly Significant
Advanced Management Level			
Cost Leadership	0.597**	0.000	Highly Significant
Product Quality	0.596**	0.000	Highly Significant
Process Flexibility	0.644**	0.000	Highly Significant

**. Correlation is significant at the 0.01 level

As seen in the table, the computed rho-values ranging from 0.457 to 0.644 indicate a moderate to strong direct relationship among the sub variables of refinement system and market competitiveness. There was a statistically significant relationship between refinement system and market competitiveness because the obtained p-values were less than 0.01. In the development process of SMEs, refinement system can significantly affect market competitiveness. That is to say, the level of digitalization, quality management and advanced management can have obvious positive influence on cost leadership, product quality and process flexibility.

First of all, digitalization level has obvious positive correlation with cost leadership, product quality and process flexibility, and its rank correlation coefficients are 0.518, 0.457 and 0.585, respectively, with a significant level less than 0.01. A higher level of digitalization typically facilitates cost leadership for businesses. Digital technologies enhance production efficiency, reduce operational costs, and optimize resource utilization. Through automation, data analysis, and real-time monitoring, enterprises can exercise better cost control, consequently offering more competitive prices and bolstering their market competitiveness. Wu et al. (2022) contend that investments in digital infrastructure can lower operational costs by substituting some human capital inputs. Additionally, Meng and Li (2021) demonstrate that the sharing economy, exemplified by platforms such as Uber, Didi Chuxing, and Airbnb, can concurrently reduce organizational and transaction costs. In the context of digital transformation, knowledge spillovers become more accessible, making it more likely for firms to

coexist in an "ecosystem" fashion, significantly reducing the costs associated with learning and imitation. Furthermore, the level of digitalization positively influences the enhancement of product quality. Digital technologies enable the monitoring and control of production processes, reducing human errors and variability. This contributes to improved product quality, reduced defect rates, assurance that products align with customer expectations, and heightened market competitiveness.

Research by Du et al. (2022) suggests that digital transformation within enterprises facilitates the upgrading of product quality for export. Mechanism analysis indicates that digital transformation within firms promotes the improvement of export product quality through three channels: enhanced innovation capabilities, the conversion of export products, and the enhancement of the quality of intermediate inputs. Further analysis reveals that the resource reallocation effects induced by digital transformation can raise the overall export product quality within the industry. Finally, a higher level of digitalization enhances a company's process flexibility and agility. Digital tools and systems enable the rapid adjustment of production processes according to demand. This empowers enterprises to swiftly adapt to market changes, customize products, provide more flexible solutions, and increase competitiveness. Qian et al. (2021) argue that digital technology has had a profound impact on traditional organizational models, necessitating organizations to constantly align with the dynamic external environment, with agility increasingly becoming the organizational DNA of the digital era. Research by Hu et al. (2022) finds that digitalization, by increasing work flexibility and reducing contact between employees and between employees and customers, enhances a firm's resilience during times of crisis.

Secondly, quality management level has obvious positive correlation with cost leadership, product quality and process flexibility, and its rank correlation coefficients are 0.602, 0.601 and 0.612, respectively, with a significant level less than 0.01. Enhanced quality management typically contributes to achieving cost leadership. Effective quality management can mitigate product recalls and maintenance costs, lower defect rates, and increase product quality, resulting in reduced scrap and rework expenses, ultimately enhancing profitability. Xing (2019) suggests that modern quality management leverages advanced management principles and information technology to coordinate business processes, reduce costs, and improve efficiency. The application of information technology in quality management primarily focuses on office software, computer-aided inspection systems (CAI), computer-aided quality assurance (CAQ) systems, and enterprise resource planning (ERP) or manufacturing resource planning (MRP II) systems. The integration of information technology in quality management processes ensures timely quality information dissemination, facilitates remote audits and assessments, reduces quality costs, adapts to changing environments, enhances decision accuracy, and improves product quality. Furthermore, quality management level directly influences product quality. Stringent quality control and monitoring can ensure compliance with standards and specifications, reduce product defects, improve customer satisfaction, and enhance market competitiveness.

Xing (2019) asserts that quality management has evolved into Total Quality Management (TQM), where enterprises focus primarily on product quality, establish a comprehensive quality assurance system, and rigorously control production processes, incorporating various technologies to achieve the goal of "low cost, high quality." Chen and Zhang (2023) argue that innovations in quality management have an optimizing effect on product quality improvement and operational performance. Finally, the level of quality management can also affect process flexibility. Effective quality management can reduce the uncertainty in the production process and improve the predictability of the process. This helps to improve production efficiency and ensure product consistency, thus enhancing market competitiveness. Zhao et al. (2022) believe that the implementation of fine control has achieved "manageable without losing flexibility" of quality management, achieved good application results, and played a strong guarantee and support role for project approval.

Thirdly, advanced management level has obvious positive correlation with cost leadership, product quality and process flexibility, and its rank correlation coefficients are 0.597, 0.596 and 0.644, respectively, with a significant level less than 0.01. Advanced management models and philosophies assist organizations in more effectively allocating resources, managing costs, and optimizing processes, thereby facilitating cost leadership

and reducing operational expenses, ultimately enhancing profitability. Zhang (2019) posits that modern hospital management must integrate advanced management models to ensure the healthy development of hospitals. Cost management, as a critical aspect of hospital management, requires the adoption of advanced and effective management models to implement comprehensive cost management, which is conducive to reducing operational costs and ensuring the economic efficiency of hospitals. Furthermore, advanced management models emphasize quality management and continuous improvement, leading to increased product quality, lower defect rates, and higher customer satisfaction.

High-level management ensures that products meet customer requirements and standards, thereby enhancing market competitiveness. Wu (2023) argues that for the sustained and stable development of the intelligent manufacturing industry, it is necessary to improve product quality management using advanced management methods and concepts to ensure the quality of intelligent manufacturing products and promote the continuous and healthy development of intelligent manufacturing in China. Finally, advanced management models often incorporate considerations for process improvement and flexibility. Through process optimization and adaptive management, organizations can better respond to market changes, improve response times, and enhance market competitiveness. Hu et al. (2023) contend that core enterprises can enhance flexibility in managing different types of complementary assets by building complementary management mechanisms, thereby promoting the development of complex product innovation ecosystems.

Table 7

Relationship Between Refinement System and Innovation Capability

Variables	rho	p-value	Interpretation
Digitalization Level			
Process Innovation	0.506**	0.000	Highly Significant
Product Innovation	0.551**	0.000	Highly Significant
Business Model Innovation	0.589**	0.000	Highly Significant
Organizational Innovation	0.540**	0.000	Highly Significant
Quality Management Level			
Process Innovation	0.621**	0.000	Highly Significant
Product Innovation	0.624**	0.000	Highly Significant
Business Model Innovation	0.657**	0.000	Highly Significant
Organizational Innovation	0.636**	0.000	Highly Significant
Advanced Management Level			
Process Innovation	0.620**	0.000	Highly Significant
Product Innovation	0.635**	0.000	Highly Significant
Business Model Innovation	0.641**	0.000	Highly Significant
Organizational Innovation	0.664**	0.000	Highly Significant

**. Correlation is significant at the 0.01 level

As seen in the table, the computed rho-values ranging from 0.506 to 0.664 indicate a moderate to strong direct relationship among the sub variables of refinement system and innovation capability. There was a statistically significant relationship between refinement system and innovation capability because the obtained p-values were less than 0.01. In the development process of SMEs, refinement system can significantly affect innovation capability. That is to say, the level of digitalization, quality management and advanced management can have obvious positive influence on process innovation, product innovation, business model innovation and organizational innovation.

First of all, digitalization level has obvious positive correlation with process innovation, product innovation, business model innovation and organizational innovation, and its rank correlation coefficients are 0.506, 0.551, 0.589 and 0.540, respectively, with a significant level less than 0.01. To begin with, a high level of digitalization facilitates process innovation. Digital tools and technologies enhance the monitoring, analysis, and optimization capabilities of production processes, thereby aiding organizations in identifying opportunities for process improvements and implementing new production methods and technologies to drive process innovation. Lou et al. (2023) suggest that for small and medium-sized enterprises to advance towards specialization, refinement, distinctiveness, and novelty, they should strengthen their technological and economic connections with leading

enterprises in the industry value chain through government-market collaboration. Simultaneously, they should promote design and process innovation through digital transformation, increasing the penetration and integration of digital technology into the manufacturing industry. Zhang and Liu (2023) found that digital investments stimulate green process innovation and green product innovation, subsequently enhancing the complexity of green technology exports. Secondly, the level of digitalization plays a crucial role in product innovation. Digital technologies are instrumental in product design, simulation, prototyping, and testing, expediting the development of new products.

Additionally, real-time data analysis and feedback facilitated by digitalization assist organizations in adjusting product features and specifications flexibly, meeting customer demands, and promoting product innovation. In complex and dynamic digital environments, Jiang et al. (2023) highlight the importance of capability reconstruction for digital enterprises to effectively utilize emerging digital technologies for integrated product innovation. Li and Luo (2023) demonstrate that leveraging digital technology to transform data into knowledge for guiding product innovation leads to precise product innovation directions and customer acceptability. This reveals the process of service innovation through knowledge transfer that contributes to product innovation in the digital environment, aligning with the innovation development patterns of manufacturing enterprises in the digital economy. Finally, the level of digitization can promote organizational innovation. Digital tools can improve internal collaboration, knowledge management and decision-making processes. This helps create an organizational culture that is more flexible and responsive to market changes, encourages employees to come up with new ideas, and drives organizational innovation. Xie et al. (2023) found that digital leadership plays a significant role in promoting organizational innovation; Digital leadership drives organizational innovation by enhancing the capabilities of digital platforms. Xie et al. (2022) found that enterprises can achieve organizational innovation and improve organizational capability and organizational agility by reshaping organizational structure and processes, improving the digitalization capability of IT infrastructure, and promoting human resource optimization and corporate culture change under the overall digitalization strategy framework.

Secondly, quality management level has obvious positive correlation with process innovation, product innovation, business model innovation and organizational innovation, and its rank correlation coefficients are 0.621, 0.624, 0.657 and 0.636, respectively, with a significant level less than 0.01. Firstly, high-level quality management can promote process innovation. Through rigorous quality control, enterprises can reduce variability in processes, ensuring a stable production process. This provides a more reliable foundation for process innovation, reducing unnecessary variables. A study by Shi and Li (2019) found that both basic and core practices of quality management have a significant positive impact on product innovation performance and process innovation performance. Knowledge transfer plays a partial mediating role between basic and core practices and product innovation performance as well as process innovation performance. Secondly, the quality management level of a company also has a significant impact on product innovation. High-quality standards can ensure that new products meet customer expectations and requirements. Additionally, through quality management, companies can reduce product defects and recall risks, thereby increasing the success rate of product innovation.

Research by Chen and Zhang (2023) found that overall, quality management innovation has a significant promoting effect on product innovation. In terms of the influencing mechanism, quality management innovation promotes product innovation through the pull effect on investment in product innovation and the spillover effect based on tacit knowledge but also inhibits product innovation through the efficiency suppression effect. Based on the organizational learning theory, Sun et al. (2021) reclassified quality management practices and subdivided enterprise innovation into product innovation and process innovation, considering both the influence of internal and external factors in the organization and the types of applied and exploratory learning related to innovation. It is found that quality management practice has a significant positive effect on enterprise innovation performance. Compared with applied quality management practice, exploratory quality management practice has a stronger positive effect on enterprise innovation performance. Thirdly, quality management can support business model

innovation. Reliable product quality and reputation can increase customer trust, facilitating the successful adoption of new business models (Xu and Song, 2021) and providing a solid foundation for new business models. Gong and Lv (2018) argue that quality management capability is a core capability in the initial stages of the evolution of enterprise business models. Finally, high-level quality management can also promote organizational innovation. The quality management process emphasizes continuous improvement and problem-solving, cultivating an innovative culture within the organization. Moreover, data-driven decision-making and methods for improving quality management can stimulate innovation thinking within the organization. Research by Zhang et al. (2021) found that Total Quality Management (TQM) has different impacts on various types of innovation, and through the mediating role of organizational cultural intelligence, TQM has a significant influence on both incremental innovation and radical innovation."

Thirdly, advanced management level has obvious positive correlation with process innovation, product innovation, business model innovation and organizational innovation, and its rank correlation coefficients are 0.620, 0.635, 0.641 and 0.664, respectively, with a significant level less than 0.01. In the first place, advanced management practices drive process innovation. Advanced management methodologies emphasize efficiency, effectiveness, and continuous improvement, principles that can be applied to process innovation. Effective management ensures the smooth implementation of process innovation projects, thereby increasing the success rate of process innovation. Cheng and Yuan (2020) found that the use of robots in production management leads to process innovation, including the application of new processing methods, production processes, and testing methods, ultimately improving the quality of enterprises. Secondly, advanced management practices, which emphasize customer orientation, market orientation, and innovation culture, aid in better understanding market demands and trends, driving the development and innovation of new products. Furthermore, they emphasize continuous improvement, a critical aspect of product innovation.

Li et al. (2022) argue that strategic human resource management affects product innovation, while Zhang (2023) posits that knowledge management enhances product innovation. Thirdly, advanced management practices also support business model innovation. Efficient resource allocation, strategic planning, and risk management contribute to the successful implementation of new business models. Chang et al. (2021) suggest that dynamic resource management serves as a core component of communication management's cognition and business model innovation. Lastly, advanced management practices underscore collaboration, communication, and knowledge sharing, fostering an innovative culture within organizations and stimulating internal innovation and knowledge management, thereby driving organizational innovation. Moreover, advanced management practices emphasize leadership and change management, promoting reform and innovation within organizations. Zhao et al. (2023) conducted a configuration analysis of organizational innovation based on transformational human resource management and leadership change behaviors, considering the influence of external threats. Their research found both substitutive and synergistic effects in the impact of transformational human resource management and leadership change behaviors on organizational innovation at the component level.

In conclusion, the levels of digitalization, quality management, and advanced management all directly influence process innovation, product innovation, business model innovation, and organizational innovation, thereby determining a company's innovation capabilities. Therefore, a comprehensive improvement in a company's levels of digitalization, quality management, and advanced management can promote innovation and achieve sustained growth.

As seen in the table, the computed rho-values ranging from 0.567 to 0.715 indicate a moderate to strong direct relationship among the sub variables of market competitiveness and innovation capability. There was a statistically significant relationship between market competitiveness and innovation capability because the obtained p-values were less than 0.01. In the development process of SMEs, market competitiveness can significantly affect innovation capability. That is to say, cost leadership, product quality and process flexibility can have obvious positive influence on process innovation, product innovation, business model innovation and organizational innovation.

Table 8
Relationship Between Market Competitiveness and Innovation Capability

Variables	rho	p-value	Interpretation
Cost Leadership			
Process Innovation	0.567**	0.000	Highly Significant
Product Innovation	0.590**	0.000	Highly Significant
Business Model Innovation	0.625**	0.000	Highly Significant
Organizational Innovation	0.588**	0.000	Highly Significant
Product Quality			
Process Innovation	0.715**	0.000	Highly Significant
Product Innovation	0.699**	0.000	Highly Significant
Business Model Innovation	0.638**	0.000	Highly Significant
Organizational Innovation	0.691**	0.000	Highly Significant
Process Flexibility			
Process Innovation	0.685**	0.000	Highly Significant
Product Innovation	0.685**	0.000	Highly Significant
Business Model Innovation	0.674**	0.000	Highly Significant
Organizational Innovation	0.694**	0.000	Highly Significant

**. Correlation is significant at the 0.01 level

First of all, cost leadership has obvious positive correlation with process innovation, product innovation, business model innovation and organizational innovation, and its rank correlation coefficients are 0.567, 0.590, 0.625 and 0.588, respectively, with a significant level less than 0.01. Firstly, cost-leading enterprises typically leverage process innovation to reduce production costs. Process innovation can enhance production efficiency and reduce resource wastage, consequently lowering costs. This cost reduction enables enterprises to offer more competitive pricing in the market, thereby enhancing their market share. Research by Feng and Gu (2018) found that process innovation leads to reduced marginal production costs, providing capital and space for product innovation. Jiang et al. (2023) argue that the choice between process and model innovation as an innovation strategy is determined jointly by production costs, market structure, and model innovation costs. Secondly, cost-leading enterprises can allocate some of the cost savings towards product innovation. Lower production costs free up funds for developing new products or enhancing existing ones (Feng and Gu, 2018). Moreover, cost leadership can enable more competitive pricing, attracting a larger customer base, which, in turn, supports product innovation (Shi et al., 2023). Furthermore, cost-leading enterprises can capitalize on their cost advantage to innovate their business models. For instance, they may offer value-added services at lower prices or develop subscription-based models. Innovating the business model can open new markets and enhance market share, as proposed by Shi et al. (2017), emphasizing the importance of cost-effective sharing of intelligent production technology for sustainable value creation and driving business model innovation. Lastly, cost leadership enterprises generally prioritize efficiency and process optimization, which contribute to improved organizational operations and foster organizational innovation (Xie et al., 2022). Optimized organizational structures and processes enhance a firm's flexibility and responsiveness, thereby strengthening its competitiveness in the market.

Secondly, product quality has obvious positive correlation with process innovation, product innovation, business model innovation and organizational innovation, and its rank correlation coefficients are 0.715, 0.699, 0.638 and 0.691, respectively, with a significant level less than 0.01. Firstly, high product quality can be achieved through process innovation. Improving process flows helps reduce product defects and enhances consistency. Additionally, high-quality products improve customer satisfaction, maintain reputation, and reduce post-sale maintenance costs, thereby accumulating resources for process innovation (Feng and Gu, 2018). Secondly, high product quality provides a foundation for product innovation. Customers are more willing to try new products if they trust the company's product quality, making them potential users of new products. High-quality products also increase customer loyalty, encouraging them to purchase new products (Yu et al., 2023). Furthermore, high product quality helps maintain a company's reputation and enhances customer trust and loyalty, which are crucial for successful business model innovation. Reliable product quality can help a company establish a solid market position and support the implementation of new business models (Xu and Song, 2021;

Gong and Lv, 2018). Finally, effective quality management and control are required for product quality, which may involve improving and innovating organizational processes. Stringent quality management aids in establishing an organizational culture that encourages employees to propose improvements and innovative process solutions (Zhang et al., 2021).

Thirdly, process flexibility has obvious positive correlation with process innovation, product innovation, business model innovation and organizational innovation, and its rank correlation coefficients are 0.685, 0.685, 0.674 and 0.694, respectively, with a significant level less than 0.01. To begin with, enterprises with high process flexibility are more adept at adjusting and improving process flows to accommodate new technologies and methods, facilitating process innovation (Cheng and Yuan, 2020). Chen et al. (2019) found that increased flexibility in employment forms enables efficient mobility of talent and cutting-edge innovation resources, promoting rapid integration of new innovation resources for independent innovation. Secondly, process flexibility can expedite the development and production of new products. Rapidly adapting processes to support new products is pivotal for innovation, allowing enterprises to swiftly respond to changes in market demand and accelerate new product launches (Hu et al., 2023). Furthermore, process flexibility supports quick adjustments to business models. Flexible processes can facilitate new sales channels, delivery methods, and customer interaction approaches, aiding in the implementation of new business models (Wang et al., 2023). Lastly, process flexibility fosters organizational innovation. Flexible processes make it easier for organizations to adapt to new methods and practices. Simultaneously, employees are encouraged to suggest improvements and new process innovation solutions, driving organizational innovation (Zhang et al., 2021).

In summary, cost leadership, product quality, and process flexibility directly influence process innovation, product innovation, business model innovation, and organizational innovation, thus determining a company's innovation capability. Therefore, enhancing a company's capabilities in cost leadership, product quality, and process flexibility can promote innovation and enable sustained growth.

The High-quality Enterprise Development Framework

This paper proposes a framework to promote the high-quality development of SMEs by guiding SMEs to identify the key factors of sustainable development and formulate corresponding development plans. A feasible enterprise development framework can speed up the construction of a refinement system, thereby improving SMEs' innovation ability and market competitiveness. This framework can help Chinese SMEs to clarify the relationship between the refinement system, market competitiveness and innovation capacity that are the inevitable requirement of high-quality development. It provides practical tools for the smooth transformation and healthy development of SMEs, which is conducive to the survival and prosperity of enterprises in the era of digital economy.

As shown in Figure 1, refinement system, market competitiveness and innovation capacity are essential elements for a high-quality enterprise development framework. In the whole framework, as proved by the data results in the empirical study, refinement system has a positive impact on market competitiveness and innovation capacity respectively. And high innovation ability and high market competitiveness will also have a positive impact on the construction of the refinement system. Innovation ability is positive related to market competitiveness and so does market competitiveness on Innovation ability as the results show a significantly strong correlation between the two variables. In this paper, the objects explained for this framework are mainly composed of SMEs of science and technology in Shaanxi Province, China.

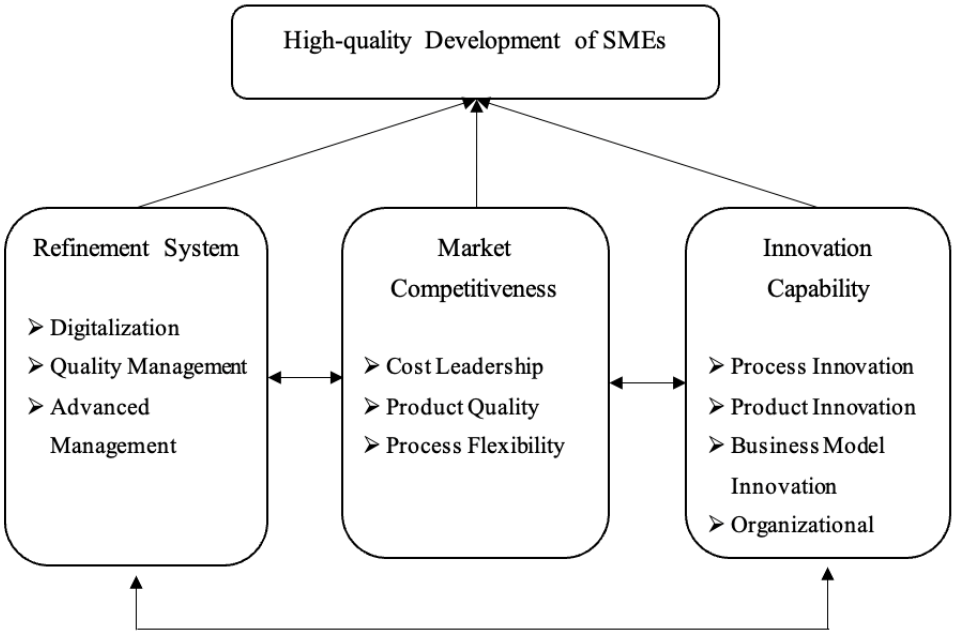

Figure 1: The High-quality Enterprise Development Framework for SMEs

4. Conclusions and Recommendations

Based on the empirical research, the author draws the process of constructing the refinement system of SMEs, respondents agreed with the role of digitalization level, quality management level and advanced management level. In the process of constructing the market competitiveness of SMEs, respondents agreed with the role of cost leadership, product quality and process flexibility. In the process of constructing the innovation capability of SMEs, respondents agreed with the role of process innovation, product innovation, business model innovation and organizational innovation. Highly significant and positive correlations were proved between refinement system and market competitiveness, refinement system and innovation capability, market competitiveness and innovation capability in this study. A research framework of linking refinement system, market competitiveness and innovation ability is proposed, which can help SMEs establish competitive advantages and achieve sustainable development.

According to the results and conclusions of the empirical research, the author recommended SMEs may focus on strengthening the construction of digital infrastructure, improving the digital knowledge and skills of employees, so as to improve the level of refinement of production and operation, and accelerate the construction of a refinement system. SMEs may improve resource utilization and production efficiency through automation, process optimization and smart production to reduce production and operating costs. Meanwhile, enterprises need to balance the relationship with cost under the premise of meeting product quality standards. SMEs may strengthen business model innovation through providing customers with customized and personalized solutions and creating market differentiation to meet the different needs of customers, so as to improve their innovation ability. SMEs may make use of the high-quality enterprise development framework proposed in this paper to enhance their innovation ability and market competitiveness by speeding up the construction of a refinement system. Finally, future research may analyze and explore other factors that affect the high-quality development of SMEs, such as organizational culture and leadership.

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