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Sustainable Development in Chinese SMEs: A Comprehensive Approach to Innovation and Management.

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Abstract

This research explores the intersection of sustainable performance, innovation, and management practices in Chinese small and medium-sized enterprises (SMEs), focusing on manufacturing firms. It delves into the historical context of sustainable development (SD) and its relevance to modern business, particularly highlighting the unique challenges and opportunities faced by Chinese SMEs. Key themes include sustainability-oriented innovation (SOI) amd knowledge management (KM). The study underscores the need for integrating innovative strategies into business practices to enhance environmental, social, and economic performance. It identifies gaps in existing literature, particularly the limited understanding of the impact of SOI on sustainable performance in Chinese manufacturing SMEs, and calls for further research to explore effective KM processes tailored to China's unique context. The research aims to provide a comprehensive understanding of how these elements can synergistically promote sustainable development and competitive advantage for Chinese SMEs

Keywords: *Sustainable Performance, Knowledge Management Practices, Sustainability-Oriented Innovation*

Introduction

Sustainable development (SD) has emerged as a fundamental principle guiding global efforts to address environmental and socio-economic challenges (Zhu & Hua, 2017). This principle emphasizes the need to balance economic growth, social inclusivity, and environmental conservation. In the context of China, small and medium-sized enterprises (SMEs) play a pivotal role in the economy, particularly in the manufacturing sector. Small and medium-sized Chinese manufacturing firms have played a vital part in expanding China's economy since they produce goods at lower costs than their international competitors (Dewi et al., 2020). However, producing goods by these small and medium-sized enterprises (SMEs) often leads to pollution, resource misuse, and other environmental challenges (Veronica et al., 2020). As a result, Chinese SMEs must expedite the implementation of a comprehensive green manufacturing strategy (Luo et al., 2019). The integration of sustainability-oriented innovation (SOI) and effective management practices to enhance sustainable performance in Chinese SMEs, highlighting the unique challenges and opportunities they face.

The concept of sustainable development was introduced by the World Commission on Environment and Development (WCED) in 1987, advocating for a harmonious balance between economic progress and environmental stewardship. Sustainable development is recognized globally for its potential to address critical environmental and socio-economic issues. However, the pursuit of economic growth often takes precedence, posing a significant challenge to achieving sustainable development goals. For SMEs, aligning resources with sustainable development is essential for long-term success and competitiveness in the global market.

Organizational ecological, social, and economic issues intersect across various dimensions, making them inseparable disciplines (Longoni & Cagliano, 2016; Martínez & Calvo-Amodio, 2017). Sustainable Performance (SP) integrates financial, social, and environmental outcomes, measured by achieving these

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goals both internally and externally (Cohen et al., 2008). Many SMEs are adopting eco-friendly practices to enhance their sustainable performance (Ali et al., 2021), essential for modern Chinese manufacturing SMEs to thrive globally (Haseeb et al., 2019). Achieving sustainable performance in manufacturing necessitates incorporating innovative strategies (Ali et al., 2021).

"Sustainability-Oriented Innovation" (SOI) merges social, economic, and environmental considerations into organizational innovation (Veronica et al., 2020). Research on sustainability-focused innovation is growing, emphasizing human survival (Adams et al., 2016; Arici & Uysal, 2022). Unlike eco-innovations that focus on ecological efficiency, SOI integrates environmental and social factors into products, processes, and structures (Klewitz & Hansen, 2014). SMEs must balance financial goals with environmental and social impacts to achieve strategic objectives (De et al., 2020). SOI helps Chinese SMEs meet the demand for sustainable products, gaining a competitive edge as consumers increasingly prefer sustainable goods (Ch'ng et al., 2021). It also helps meet regulatory requirements, benefiting from policies like China's Green Credit Policy (Klewitz & Hansen, 2014; Veronica et al., 2020).

KM enhances resource utilization, innovation, and productivity, helping SMEs adapt to digital technologies and globalization (Shahzad et al., 2020; Dethine et al., 2020). Effective knowledge management (KM) significantly impact SMEs'sustainable performance (Krawczyk, 2022).Integrating internal and external knowledge is vital for operational process innovation (Linder, 2019). Lean thinking, a method for value creation using fewer resources, is often overlooked in SMEs (Yadav et al., 2019). Successful lean adoption in SMEs requires effective KM, organizational structures, and financing (Yadav et al., 2019).

In summary, sustainable performance in manufacturing requires KM and SOI. These elements help SMEs transition to sustainable practices, ensuring long-term success and environmental stewardship.

Research Problem

Scholars and professionals have long been concerned about the impact of normative business practices on society (Asadi et al., 2020). Sustainable organizations focus on the triple bottom line, delivering economic, social, and environmental benefits (Büyüközkan & Karabulut, 2018). The business case for sustainability and the economic benefits of green innovations are well-documented (Ch'ng et al., 2021; Yildiz & Sezen, 2019; Dey et al., 2020; Geissdoerfer et al., 2017). However, integrating eco-friendly practices while maximizing profits and meeting stakeholder expectations remains challenging (Sroufe, 2017; Abdul-Rashid et al., 2017). Addressing climate change, social inequality, and environmental degradation is critical, especially under the 2030 Agenda (Samson & Umar, 2020).

Sustainability-oriented innovation is crucial for China, facing significant sustainability challenges due to its rapid development and resource constraints (Guo et al., 2016). However, there is insufficient evidence on the impact of these innovations on the sustainable performance of Chinese manufacturing SMEs, marking the first research gap (Wu, 2017).

Knowledge management (KM) is vital for sustainable organizational performance, particularly for SMEs needing to utilize external information (Skouloudis et al., 2020). Despite its benefits, there is limited understanding of effective KM processes in Chinese SMEs due to cultural and organizational barriers, marking the second research gap (Ali et al., 2021; Kun, 2022).

KM can indirectly impact sustainable performance through sustainability-oriented innovations. Effective KM can drive innovation and create a culture of sustainability (Shahzad et al., 2021; Abbas, 2020). Understanding these relationships is essential for enhancing the sustainable performance of Chinese SMEs, marking the third research gap (Geissdoerfer et al., 2017).

Nevertheless, the impact of these incentives on sustainable performance is debated, and there is limited empirical research on this topic, particularly in China's context. This constitutes the fourth research gap (Dimos & Pugh, 2016; De Blasio et al., 2015).

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Literature Review

Small and Medium-Sized Enterprises (SMEs)

The term "Small and Medium-Sized Enterprises" (SMEs) typically refers to businesses with a specific range of employees, although the exact definition varies by country and industry, encompassing factors such as the number of employees, annual sales, and total assets (Nguyen, 2021; Madani, 2018). SMEs are fundamental to the global economy, driving innovation, job creation, and economic growth (Faiza Manzoor et al., 2021; Naradda Gamage et al., 2020). They span various sectors, including manufacturing, services, technology, and retail, encompassing local shops, start-up companies, small manufacturers, and reputable service providers (De Marco et al., 2020).

A key characteristic of SMEs is their size, typically employing fewer than 250 people, with smaller revenues and total assets compared to larger enterprises (Auzzir et al., 2018; Dar et al., 2017). SMEs face unique benefits and challenges compared to large organizations. They often have limited resources and weaker trade power, struggle to obtain funding, adopt cutting-edge technologies, and compete with larger businesses (Naradda Gamage et al., 2020; Wonglimpiyarat, 2015). However, SMEs are praised for their innovation, adaptability, and agility, offering personalized service, quickly adjusting to market changes, and maintaining strong client relationships (Gherghina et al., 2020).

Conversely, some government actions and regulations, along with an unfriendly external business climate, can hinder the long-term growth of SMEs (Nyarku & Oduro, 2018). In developing nations, high tax burdens, complex legal systems, and time-consuming administrative processes are significant obstacles to corporate viability (Bouazza et al., 2015; Sitharam & Hoque, 2016). The World Bank (2020) also identified complicated tax laws, lack of confidence in the legal system, and access to public services driven by profit motives as major challenges for SMEs (Adian et al., 2020). These undesirable outcomes are often the result of poor government policy.

To promote the healthy and sustainable development of SMEs, governments should establish an efficient legal policy framework and a fair tax system to reduce administrative expenses (De Marco et al., 2020; Pu et al., 2021). Such measures would create a more favorable environment for SMEs, enabling them to contribute effectively to economic development and innovation.

SMEs in China: Catalysts for Economic Growth and Innovation

Small and Medium-Sized Enterprises (SMEs) play a pivotal role in driving the development and expansion of the Chinese economy across various sectors, including manufacturing, technology, retail, and services (Cai & Yang, 2008; Muriithi, 2018). Their contributions extend beyond economic output to fostering innovation, employment growth, and local development (Guo et al., 2016).

Economic and Employment Contributions: SMEs are major employers in China, offering millions of job opportunities and contributing significantly to reducing unemployment, particularly in rural areas by absorbing surplus agricultural labor (Beckmann et al., 2023; F. Manzoor et al., 2021). Known for their flexibility and adaptability, SMEs quickly respond to market shifts, technological advancements, and changing consumer preferences, enabling them to seize opportunities, launch innovative products, and drive industry transformation (Su et al., 2020). This adaptability not only supports their growth but also enhances China's global reputation as an innovator and technological leader (Khan et al., 2020).

Regional Development and Inclusive Growth: SMEs are essential drivers of regional development in China, contributing to job creation, income generation, and improved living standards in both urban and rural areas (Xu et al., 2019; Jia et al., 2020). They play a crucial role in reducing economic inequality and promoting inclusive growth, particularly in less developed regions (Sajjad et al., 2020; Tang et al., 2020). Moreover, SMEs bolster China's export-oriented economy by serving as suppliers and subcontractors to larger industrial firms, thereby enhancing China's competitiveness in global value chains (Lin et al., 2021; Su et al., 2020).

Government Support and Challenges: Recognizing the strategic importance of SMEs, the Chinese government has implemented supportive policies and initiatives. These include reducing administrative burdens, providing

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financial support, offering tax incentives, simplifying regulatory processes, and facilitating access to financing (S. S. Wang et al., 2021). Entrepreneurship training and innovation projects are also promoted to foster a conducive ecosystem for SME growth (Petti et al., 2017). Despite these efforts, SMEs in China face challenges such as limited access to capital, complex regulatory environments, and intense competition (Luo et al., 2019; Senadjki et al., 2023). Nevertheless, ongoing government commitments to improving the business climate are critical in creating an environment where SMEs can thrive (Jia et al., 2020).

Technological Innovation and Global Engagement: SMEs in China are pivotal in technological advancements, particularly in the high-tech manufacturing sector. Recent increases in the registration of SMEs with a technological focus underscore their role in driving innovation and economic modernization (Khan et al., 2020). Moreover, China's SME sector attracts significant interest from foreign investors seeking access to its vast market potential (Fornes et al., 2012; Liu et al., 2023). Collaboration with foreign corporations under initiatives like the "One Belt One Road" further enhances SMEs' opportunities for international expansion and integration into global markets (J. Li et al., 2022).

Manufacturing SMEs in China: Driving Innovation and Economic Development

Manufacturing Small and Medium-Sized Enterprises (SMEs) in China are critical players in the nation's industrial landscape, contributing significantly to job creation, innovation, export competitiveness, and regional development (Zameer et al., 2022; Mei et al., 2019). Spanning diverse sectors such as electronics, machinery, textiles, vehicles, and chemicals, these SMEs provide specialized manufacturing services and cater to niche markets with agility and adaptability (L. Liu et al., 2022).

Adaptability and Market Responsiveness: One of the key strengths of Chinese manufacturing SMEs lies in their ability to swiftly adapt to market demands and technological advancements. They excel in customization and low-volume production, serving as crucial suppliers and subcontractors within global supply chains (Yu et al., 2015). This flexibility enables them to adjust production processes rapidly, meet varying product specifications, and deliver customized solutions, thereby enhancing their competitiveness in international markets (Müller & Voigt, 2018).

Innovation Drivers: Manufacturing SMEs in China are not only responsive but also proactive in driving innovation within their sectors (Xu et al., 2008). They invest in new technologies, products, and manufacturing methods, often bridging the gap between research institutions and commercial applications. This entrepreneurial spirit allows them to identify market gaps swiftly, test novel concepts, and introduce innovative solutions that contribute to sectoral growth and competitiveness (F. Yu et al., 2020).

Export Competitiveness and Global Integration: Integral to China's export-driven economy, manufacturing SMEs play vital roles as suppliers of raw materials and intermediate goods to larger manufacturers, thereby bolstering China's export competitiveness (Tang et al., 2020). By providing high-quality inputs at competitive prices, these SMEs contribute significantly to maintaining China's position as a global manufacturing hub (Lin et al., 2021). Their participation in international trade and integration into global value chains further enhances China's economic footprint on the global stage (Charoenrat & Amornkitvikai, 2021; Li & Li, 2023).

Regional Development and Employment: Beyond economic contributions, manufacturing SMEs play a crucial role in regional development by creating employment opportunities and supporting economic diversification, particularly in rural and less developed areas (Jia et al., 2020). They contribute to poverty alleviation and help narrow regional income disparities by fostering local economic activities and providing specialized employment opportunities (Rehman et al., 2022).

Government Support and Strategic Initiatives: The Chinese government's support for manufacturing SMEs is evident through various policies aimed at enhancing their operational efficiency and technological capabilities. Initiatives such as the "Made in China 2025" strategy highlight key areas for technological breakthroughs and global competitiveness (Agarwala & Chaudhary, 2021). Efforts to modernize industrial sectors and promote intelligent manufacturing (IM) underscore the government's commitment to advancing SME capabilities in line with global technological trends (Zhou, 2015).

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Challenges and Future Directions: Despite their pivotal role, manufacturing SMEs in China face challenges such as limited access to financing, regulatory complexities, and intensifying competition (CEIC). Addressing these challenges requires continued government support through policies that facilitate access to resources, promote innovation, and streamline regulatory processes (C. Yu et al., 2020). The development of intelligent manufacturing parks and shared production platforms represents strategic efforts to support SMEs in adopting advanced technologies and enhancing productivity (Shahzad et al., 2023).

Theoretical Background

Knowledge Management Theory

Knowledge Management (KM) focuses on managing and leveraging organizational knowledge assets for competitive advantage and innovation (Nonaka & Takeuchi, 1995). Chinese SMEs utilize KM to enhance sustainability through knowledge audits, knowledge transfer, and fostering a knowledge-sharing culture (Hu et al., 2019). Embracing technologies and fostering a supportive environment for continuous learning are critical for KM success in these SMEs (Abbas & Sağsan, 2019).

Knowledge Management Process

The Knowledge Management Process (KMP) is crucial for Chinese SMEs, focusing on knowledge acquisition, creation, sharing, and utilization to enhance competitiveness and organizational performance (Rubel et al., 2021). SMEs acquire knowledge through market research, partnerships, and internal expertise, fostering a culture of continuous learning and innovation. Challenges include resource limitations and cultural barriers to knowledge sharing, exacerbated by rapid technological advancements (Begum et al., 2020). Empirical research underscores the importance of understanding both technological and social aspects of KMP, emphasizing its impact on organizational strategy, leadership, and effectiveness in storing, retrieving, and transmitting knowledge (Di Vaio et al., 2022).

Sustainability-Oriented Innovation (SOI)

Sustainability-Oriented Innovation (SOI) has become essential for Chinese SMEs, integrating sustainability principles into their development processes to enhance competitiveness and address environmental and social challenges (Indriastuti, 2021). By adopting SOI practices, SMEs aim to improve environmental performance, meet customer demands, and comply with regulations. Challenges include financial constraints, lack of expertise in sustainability issues, and the need for partnerships to support SOI initiatives (Di Vaio et al., 2022). Empirical research highlights the positive environmental and social impacts of SOI, emphasizing the role of organizational culture, external collaborations, regulatory frameworks, and consumer preferences in driving sustainable innovation and enhancing firm performance (Begum et al., 2020).

Sustainable Performance (SP)

Sustainable performance refers to a company's ability to achieve long-term success while minimizing negative environmental and social impacts (Lee et al., 2022). It involves integrating sustainable practices into operations to create value for stakeholders while addressing environmental, social, and governance (ESG) risks and opportunities (Javed et al., 2022). Key motivators for adopting sustainable practices include combating climate change, meeting regulatory requirements, and gaining competitive advantages like improved brand awareness and market access. Frameworks like the Sustainable Development Goals (SDGs), SASB, and GRI help businesses measure and report sustainability performance systematically (Hu et al., 2019).

Proposition Development

Knowledge Creation and Sustainability-Oriented Innovations

Knowledge creation refers to the process by which organizations generate new ideas, solutions, and innovations through the transformation of existing knowledge or the acquisition of new knowledge (Abbas & Sağsan, 2019).

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In the context of sustainability, knowledge creation plays a crucial role in driving sustainability-oriented innovations (SOI) in small and medium-sized enterprises (SMEs). SOI refers to new products, processes, methods, or practices that expressively enhance an organization's ability to operate in an environmentally, socially, and economically sustainable manner (Adams et al., 2016). Through knowledge creation, SMEs can expressively enhance their capacity to achieve SOI. Especially under resource constraints, knowledge management practices can compensate for the limitations in the scope and scale of innovation activities, enabling SMEs to identify, develop, and implement sustainable solutions that would otherwise be beyond their research (Al Koliby et al., 2022). Knowledge creation not only fosters a culture of learning and innovation within manufacturing SMEs but also enhances their absorptive capacity, enabling them to better understand market trends, emerging technologies, and sustainability-related regulations, thereby aligning innovations with sustainability goals (Shahzad et al., 2020).

Knowledge creation can also optimize operational efficiencies by reducing waste, conserving energy, and minimizing greenhouse gas emissions (Hu et al., 2019; Skouloudis et al., 2020). For example, by applying green initiatives and environmentally friendly production cycles, SMEs can reduce their carbon footprint and mitigate negative impacts on the climate. In terms of business model innovation, knowledge creation helps SMEs restructure their business strategies to support sustainable practices. This may involve adopting circular economy principles or developing revenue models that leverage sustainability as a selling point. Additionally, knowledge of customer preferences for sustainable products and insights into sustainable supply chain practices can play a key role in crafting business models that attract environmentally conscious consumers, thereby promoting long-term business sustainability.

As well as internal and external collaboration in knowledge creation allows SMEs to integrate a broader range of perspectives, skills, and expertise to address the complex, systemic challenges inherent in SOI. External collaborations, such as those with academic institutions, industry partners, and governmental organizations, are particularly important as they provide SMEs with opportunities to access complementary resources, knowledge bases, and capabilities (Chopra et al., 2021; López-Torres et al., 2019). Through these collaborations, SMEs can learn and adopt circular economy action plans, such as product life extension, reuse, and remanufacturing, which help reduce waste and create a more sustainable production and consumption cycle. Finally, knowledge creation can also help SMEs align their sustainability practices with government initiatives, including SOI supported by research funding and subsidies (Torres De Oliveira et al., 2022). Thus, we can hypothesize that knowledge creation has a positive impact on the sustainability-oriented innovations of Chinese SMEs (Abbas & Sağsan, 2019).

Proposition1: Knowledge creation has a positive impact on Chinese SMEs' sustainability-oriented innovations.

Knowledge Sharing and Sustainability-Oriented Innovations

In today's competitive and environmentally conscious business environment, sustainability-oriented innovations (SOIs) are increasingly vital for manufacturing SMEs (Aamir et al., 2021). Knowledge sharing plays a key role in enabling these SMEs to achieve SOIs by fostering a collaborative learning culture, utilizing diverse knowledge resources, and optimizing resource utilization. By encouraging collaboration, SMEs can leverage collective expertise to address sustainability challenges, leading to the identification of new opportunities for integrating sustainability into their innovation processes (Al Koliby et al., 2022). This process also enhances their absorptive capacity, allowing them to assimilate external knowledge from customers, suppliers, and industry networks, which is crucial for transforming past experiences into actionable strategies (Gamble, 2020).

Furthermore, knowledge sharing drives the development of environmentally friendly products and processes by giving SMEs access to ideas and technologies beyond their limited R&D capabilities (Abbas & Sağsan, 2019). It enables the optimization of manufacturing processes, leading to reduced waste, lower energy consumption, and a minimized environmental footprint (Diugwu, 2011). By sharing best practices in areas like lean manufacturing and circular economy strategies, such as recycling and remanufacturing, SMEs can significantly decrease their environmental impact and enhance operational efficiency (López-Torres et al., 2019). Furthermore, knowledge sharing fosters business innovation, allowing SMEs to adopt sustainable business models aligned with circular economy principles, while avoiding redundant efforts and streamlining innovation pathways (Yao et al., 2019; Marjerison et al., 2022).

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In the context of Chinese SMEs, knowledge sharing is crucial for improving asset utilization and sustainable practices (Wang et al., 2022). Through exchanging best practices in sustainability initiatives, SMEs has the ability to enhance asset utilization, lower costs, and boost sustainability performance. (Shahzad et al., 2020). Additionally, knowledge sharing promotes partnerships and collaborative efforts, enabling SMEs to co-create sustainability-oriented innovations and share resources effectively (Rubel et al., 2021). This collaboration not merely enhances SMEs' overall sustainability performance but even could strengthens their social capital and collective sustainability efforts across the industry (Diugwu, 2011; Games & Rendi, 2019). These benefits highlight the significant role of knowledge sharing in driving SOIs and fostering long-term business sustainability for manufacturing SMEs.

Proposition 2: Knowledge sharing has a positive impact on Chinese SMEs'sustainable-oriented innovation.

Knowledge Creation and Sustainable Performance

Amid the changing global business landscape, sustainability has become a crucial concern for manufacturing SMEs, as they face growing pressure to adopt sustainable practices to meet regulatory obligations and consumer demand for eco-friendly products (Al Koliby et al., 2022). A key factor that substantially impacts the sustainable performance of these SMEs is knowledge creation (Abubakar et al., 2019). Knowledge creation involves generating new ideas, techniques, and insights within an organization, which enables SMEs to access innovative concepts and best practices related to sustainable business models, eco-friendly technologies, and ethical resource management (Chopra et al., 2021). This process is essential for developing solutions that reduce waste, improve energy efficiency, and minimize the environmental impact of production processes (Grzegorczyk & Ghiorghiță, 2017).

By promoting an environment where new ideas are continuously generated and shared, SMEs can more successfully adjust to stringent environmental standards and shifting market conditions (Cerchione et al., 2016). Encouraging employees to develop innovative approaches to sustainability challenges enhances the operational efficiency of SMEs. Continuous learning allows these companies to streamline processes, reduce waste, and optimize resource use, as employees apply the latest knowledge and best practices in sustainable manufacturing to identify and address inefficiencies (Massingham & Al Holaibi, 2017). Moreover, knowledge creation strengthens SMEs' adaptive capabilities, enabling them to not only respond to environmental and social challenges but also anticipate and shape future sustainability trends, leading to improved environmental, economic, and social outcomes (Gamble, 2020).

Knowledge creation also fosters a culture of continuous improvement within manufacturing SMEs, promoting ongoing development and refinement of processes and products that are vital for achieving long-term sustainability goals (Diugwu, 2011). This ensures that SMEs besides comply with sustainability standards also strive to exceed them. Empirical evidence supports the positive relationship between knowledge creation and sustainability performance, showing that firms investing in activities like research and development, training programs, and collaborative projects tend to exhibit better sustainability outcomes (Shahzad et al., 2020; Al Koliby et al., 2022). Knowledge creation aids in the dissemination of resource-saving techniques, waste-reduction strategies, and eco-friendly technologies, which contribute to overall sustainability (Martins et al., 2019). Moreover, the advancement of knowledge related to social responsibility enhances SMEs' social performance, improving community involvement, employee welfare, and ethical business practices (Siltaoja, 2014; Shahzad et al., 2020).

Proposition 3: Knowledge creation has a positive impact on Chinese SMEs' sustainable performance.

Knowledge Sharing and Sustainable Performance

Sustainable development has gained significant attention recently, and SMEs are increasingly recognizing the importance of adopting sustainable business practices. Sustainable performance is defined as the ability of a company to balance economic growth, environmental responsibility, and social concerns (Dey et al., 2020). Knowledge sharing, which involves the exchange and dissemination of knowledge, ideas, and expertise, is a crucial mechanism that can greatly improve the sustainability outcomes of SMEs (Chopra et al., 2021). Adapted by effective knowledge sharing, SMEs can utilize collective knowledge to enhance decision-making and problem-solving for sustainability issues. This shared knowledge often includes vital information on environmental regulations, energy-efficient processes, waste minimization techniques, and sustainable supply chain management.

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In resource-limited manufacturing SMEs, knowledge sharing helps optimize operations by streamlining processes and reducing redundancies, which is essential for maintaining competitiveness and ensuring sustainability (Abubakar et al., 2019; Grzegorczyk & Ghiorghiţă, 2017).

Moreover, the collaborative nature of knowledge sharing can drive innovation within manufacturing SMEs by fostering the exchange of ideas and the integration of diverse expertise. This dynamic can lead to the development of new sustainable technologies and processes, positioning SMEs to meet the growing market demand for sustainable products and services (Abbas & Sağsan, 2019; Shahzad et al., 2020). Knowledge sharing also encourages both internal and external collaboration, allowing SMEs to work together on sustainability initiatives, share research findings, and form partnerships with suppliers, customers, and local communities (Gamble, 2020). Such collaboration helps ensure that supply chains align with the firm's sustainability goals, resulting in more sustainable procurement practices that contribute positively to broader sustainable development objectives (Massingham & Al Holaibi, 2017).

A critical aspect of sustainable performance is compliance with environmental regulations and standards, where knowledge sharing plays a vital role. As manufacturing SMEs face increasing regulatory pressures, the dissemination of information about regulatory requirements and industry best practices ensures these enterprises remain compliant with laws and standards (Yao et al., 2019). This not merely helps SMEs avoid legal penalties and associated costs but also enhances their reputation as responsible and environmentally conscious businesses (Xu et al., 2014). Knowledge sharing equips employees with the necessary understanding and skills to implement compliant and sustainable practices, further enabling SMEs to make informed decisions and implement sustainable initiatives (Rubel et al., 2021). Studies have shown that active knowledge sharing on sustainable best practices leads to improved sustainability outcomes, including better financial performance and the adoption of green technologies and circular economy principles (Marjerison et al., 2022; Russ, 2022; Wang et al., 2014; Yousaf et al., 2022).

Proposition 4: Knowledge sharing has a positive impact on Chinese SMEs' sustainable performance

Sustainability-Oriented Innovations and Sustainable Performance

Sustainability-oriented innovations (SOIs) play a crucial role in boosting the sustainable performance of manufacturing SMEs by embedding sustainability principles into their core operations. SOIs involve developing innovative solutions that address environmental and social challenges while promoting economic development (Adams et al., 2016). These innovations span across products, processes, and business models, each contributing to the environmental, social, and economic pillars of sustainability. For example, SOIs help companies sharpen their competitive edge, improve operational efficiency, and cultivate a positive corporate reputation, ultimately enhancing their sustainable performance (Klewitz & Hansen, 2014). The integration of sustainability through SOIs supports SMEs in aligning with market demands and regulatory expectations, enabling them to thrive in a rapidly evolving business environment.

Product innovations aimed at sustainability are central to reducing environmental impacts. By designing eco-friendly products or rethinking existing ones, companies can minimize resource usage and decrease emissions throughout the product's lifecycle (Zameer et al., 2022). Likewise, process innovations that focus on sustainability enhance resource efficiency by optimizing material use and integrating eco-efficient technologies. These process adjustments allow SMEs to reduce waste, cut energy consumption, and lower their overall environmental footprint (Ch'ng et al., 2021). By embracing sustainability within their processes, SMEs not only contribute to environmental preservation but also benefit from cost savings and improved resource management.

Business model innovations that incorporate sustainability principles offer additional pathways to achieving sustainable performance. Such models encourage the adoption of circular economy practices, the development of collaborative networks, and the improvement of supply chain responsibility (De et al., 2020). Research shows that these innovations, when implemented by SMEs, deliver significant economic, environmental, and social benefits. For example, SMEs can experience better financial performance, including improved profitability and returns on investment, while also achieving enhanced social outcomes such as employee well-being and ethical sourcing (Zhang et al., 2022). In essence, SOIs are essential for ensuring long-term growth, competitiveness, and resilience

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in an increasingly sustainability-driven market (Heimonen, 2012).

Proposition 5: Sustainability-oriented innovations have a positive impact on Chinese SMEs'sustainable performance.

Sustainability-Oriented Innovations, Knowledge Creation and Sustainable Performance

As businesses face enhancing global awareness of sustainability challenges, the integration of sustainable practices and innovation has become essential to operations. Obtaining fresh knowledge and expertise is a crucial driver of sustainable performance, enabling firms to explore fresh sources of innovation (Shahzad et al., 2020). Knowledge acquisition provides the foundation for identifying pathways to sustainability (Al Koliby et al., 2022), empowering organizations to innovate in ways that enhance environmental and social outcomes while driving economic growth (Auernhammer & Hall, 2014). Recent research emphasizes the importance of knowledge creation in business sustainability, showing its direct impact on improved sustainable performance (Abbas & Sağsan, 2019). This ongoing pursuit of knowledge and its application is vital for businesses aiming to thrive in an increasingly sustainability-conscious world.

Sustainability-oriented innovations (SOIs) represent a crucial link between knowledge management and sustainable performance. SOIs involve the development of creative solutions that address both environmental and social challenges while contributing to economic development (Adams et al., 2016). These innovations consider the entire lifecycle of products and services, seeking to reduce their environmental impact while delivering social and economic benefits. SOIs enable firms to translate acquired knowledge into practical applications that positively influence sustainability outcomes (Shahzad et al., 2020). By embedding sustainable practices within innovation processes, businesses can create products, services, and operational methods that are both economically viable and environmentally responsible (De et al., 2020).

However, knowledge creation alone does not guarantee improved sustainability performance—it is through the application of this knowledge via SOIs that meaningful progress is achieved (Wang et al., 2022). For instance, a firm may acquire insights about its carbon footprint, but it is the innovations that reduce emissions or develop lower-carbon products that lead to tangible improvements. Similarly, knowledge about supply chain social conditions must be followed by innovations in ethical supplier engagement to enhance social performance (Wang et al., 2022). Studies have shown that effective management of resources, including workforce skills and expertise, strengthens the connection between knowledge acquisition and sustainable performance (De Marchi & Grandinetti, 2013). Shahzad et al. (2020) further investigated that SOIs mediate the relationship between knowledge acquisition and sustainable performance, reinforcing the critical role of innovation in achieving sustainability.

Proposition 6: Sustainability-oriented innovations mediate the relationship between knowledge creation and sustainable performance of Chinese SMEs.

Sustainability-Oriented Innovations, Knowledge Sharing and Sustainable Performance

Over the past few years, the link between sustainability practices and business performance has garnered increased attention from both scholars and practitioners. Organizations, particularly SMEs, are beginning to understand the importance of embedding sustainable practices within their operations to not only improve performance but also reduce their environmental and social impact (Muhammed & Zaim 2020). Manufacturing SMEs, which often face limitations in resources and capabilities, depend heavily on effective knowledge-sharing mechanisms to achieve sustainable performance (Russ 2022). Knowledge sharing helps these businesses generate, spread, and apply valuable insights, best practices, and experiential knowledge regarding sustainability challenges and opportunities (Aamir et al. 2021).

Knowledge sharing plays a critical role in fostering collaboration, learning, and problem-solving across different functions within organizations. By encouraging a culture of innovation and continuous improvement, it allows manufacturing SMEs to better identify and implement sustainability-oriented innovations (SOIs) that tackle environmental issues, improve efficiency, and fulfill stakeholder demands (Games & Rendi 2019; Grzegorczyk & Ghiorghiță 2017). SOIs are designed to address environmental and social issues without compromising economic

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viability. For SMEs, SOIs Serve as a strategic approach to growing pressures from regulations, consumer demands, and competitive forces (Shahzad et al. 2020). Empirical studies suggest that SOIs act as a bridge between knowledge sharing and sustainable performance outcomes by transforming shared knowledge into actionable innovations (Klewitz & Hansen 2014).

Furthermore, knowledge sharing boosts the absorptive capacity of SMEs, allowing them to recognize and apply external knowledge more productively (Gamble 2020). This capability is essential for SOIs, which often involve integrating knowledge from diverse fields such as environmental science and engineering. By enhancing their absorptive capacity, SMEs can more efficiently leverage external insights to drive SOIs, bridging the gap between shared knowledge and sustainable performance (Abbas & Sağsan 2019). Research has demonstrated that organizations with strong knowledge-sharing practices tend to develop and implement more impactful sustainability initiatives, leading to improved sustainable performance (Games & Rendi 2019; Shahzad et al. 2020).

Proposition 7: Organizational sustainability-oriented innovations mediate the relationship between knowledge sharing and sustainable performance.

Conclusion

This proposition paper emphasizes the vital importance of sustainability-oriented innovation (SOI) for enhancing the sustainable performance of Chinese SMEs, especially within the manufacturing sector. By proposing a comprehensive framework that integrates knowledge management. It highlights the potential pathways through which SMEs can achieve significant improvements in their environmental, social, and economic performance.

Our proposition suggests that leveraging effective knowledge management can drive continuous innovation, essential for sustainable development. This paper propose that for Chinese manufacturing SMEs to remain competitive and viable in the global market, sustainability must be integrated into their core business strategies. This integration is not just beneficial for environmental stewardship but also enhances long-term competitiveness. Our framework underscores the need for ongoing research to explore these dynamics further and to develop tailored practices that address the unique challenges faced by Chinese SMEs.

In conclusion, this paper proposes a multifaceted approach to drive sustainable performance in Chinese SMEs. By focusing on knowledge management, SMEs can achieve a harmonious balance between economic success and sustainable development. Future research should aim to validate this framework and provide actionable insights for policymakers and business leaders dedicated to promoting sustainability in the SME sector.

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