

Diversification Strategies for Suppliers in Small and Medium-Sized Manufacturing Enterprises: Pathway Selection and Performance Evaluation

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Abstract. Global supply chain fluctuations and geopolitical risks increasingly challenge small and medium-sized manufacturing enterprises (SMEs), particularly those with high supplier concentration and weak risk resilience. Drawing on resource dependence theory and industrial cluster theory, this study examines path selection and performance evaluation of supplier diversification strategies, employing case analysis to reveal the differential impacts of horizontal expansion and vertical integration on supply chain resilience in SMEs. Findings demonstrate that technology-collaborative diversification enhances synergistic efficiency while multi-regional decentralized procurement mitigates geopolitical risks, yet SMEs exhibit prevalent issues, including path homogenization and inadequate performance evaluation systems. These challenges reveal a fundamental tension: while diversification strengthens resilience, over-diversification may dilute relationship capital. A critical paradox emerges in balancing supplier relationship centralization versus diversification, coupled with a disconnect between theoretical applications and operational implementation of strategies. The proposed framework resolves this paradox by aligning theoretical rigor with operational feasibility, offering SMEs actionable strategies to balance diversification and centralization.

Keywords: Supplier Diversification Strategies, SME Supply Chain Resilience, Performance Evaluation, Industrial Cluster

1. Introduction

1.1. Research background

In recent years, global supply chain fluctuations have emerged as a critical challenge for small and medium-sized manufacturing enterprises. Data from the China Supply Chain Development Report in 2022 indicates that supply chain disruptions caused by geopolitical conflicts and natural disasters increased by 37% in 2022 compared to the previous year, with SMEs experiencing 40% longer average recovery cycles than large enterprises due to excessive supplier concentration [1]. In the electronics sector, 70% of domestic small and medium-sized enterprises rely on single-region suppliers, resulting in nearly half being forced to reduce or suspend production during the 2024

Southeast Asian chip shortage crisis. Meanwhile, DHL's 2024 Supply Chain Diversification Trends Report emphasizes that supply chain resilience has become a key competitiveness indicator, yet only a minority of SMEs have established systematic supplier diversification strategies [2].

This challenge transcends operational risk management, directly threatening organizational viability. For instance, Apple reduced AirPods supply chain disruption risks by 25% through its dual-region manufacturing strategy in India and Vietnam, though such success proves challenging to replicate for resource-constrained SMEs [3]. The supply chain vulnerability of SMEs not only jeopardizes their survival but also transmits systemic risks to regional economies through industrial clusters. In the Greater Bay Area, 60% of SMEs fail to leverage connectivity advantages between ASEAN and Hong Kong due to insufficient cross-regional collaboration capabilities. Therefore, developing SME-appropriate supplier diversification pathways constitutes both an imperative for risk resilience enhancement and a socioeconomic imperative for industrial cluster synergy. To decode these challenges, we must first reconcile conflicting findings in extant literature regarding SME-specific diversification strategies.

1.2. Literature review

Yu and Sun's mediation effect model revealed that supplier network technological diversification enhances corporate innovation performance through knowledge spillover effects, though this mechanism is significantly attenuated in SMEs with underdeveloped technological ecosystems [4]. Huang proposed that supply chain diversification is a core driver of corporate digital transformation, yet their research focused on large enterprises, neglecting to identify alternative pathways for SMEs under insufficient digital investment [5]. Huang, Tate, and Sordi, grounded in equity theory, identified buyer perceptions of fairness as critical for stabilizing diversified supplier relationships, but SMEs often fall into 'forced diversification' traps due to weak bargaining power [6]. Wang further quantified the risk mitigation effects of multi-regional procurement on supply disruptions, though their model excluded the dynamic, synergistic effects of industrial clusters [7]. Remko et al. demonstrated through Moët Hennessy's case that supplier diversity programs enhance innovation capacity, yet such initiatives rely on substantial resource investments misaligned with SME realities [8].

These studies collectively indicate that while theoretical frameworks for supply chain diversification have matured, significant implementation gaps persist in SME contexts.

1.3. Knowledge gaps and theoretical tensions

Three interrelated gaps emerge when examining SME-focused diversification research: Subject limitation: Current studies predominantly analyze large enterprises, with only 12% of SSCI-indexed supply chain papers (2019-2024) specifically addressing SME constraints [9]. Strategic incompleteness: Even SME-focused research isolates horizontal expansion from vertical integration, ignoring their compounding effects in industrial clusters. Evaluation deficiency: Existing metrics like order fulfillment rates fail to capture dynamic resilience, particularly the ecosystem coordination critical for SMEs.

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1.4. Contingency framework development

This study aims to address the aforementioned gaps through a tripartite approach bridging theoretical rigor with practical feasibility: First, a composite strategy framework of 'horizontal expansion (multi-regional procurement) + vertical integration (technological collaboration)' is constructed based on resource dependence theory and dynamic capability theory, elucidating how industrial cluster resource sharing reduces implementation costs for SMEs; Second, a multidimensional evaluation model incorporating 'supply stability', 'dynamic response capability', and 'ecosystem coordination' is designed to assess the performance of supplier diversification in SMEs comprehensively; Finally, a case study of supply chain linkage between the Greater Bay Area and ASEAN demonstrates how industrial cluster collaboration enables SMEs to overcome resource constraints, offering practical pathways for theoretical implementation.

2. Case description

Recent profound transformations in global supply chain patterns have driven small and medium-sized manufacturing enterprises to accelerate supplier diversification strategies, with industry practices exhibiting a “leadership-driven, tiered differentiation” characteristic. Data from the China Supply Chain Development Report (2022) reveals that manufacturers adopting industrial internet platforms achieved 20%-30% improvements in supply chain collaboration efficiency, yet SMEs show less than 15% digital penetration, indicating substantial implementation gaps, compared to 42% in large enterprises, revealing a structural digital divide [1]. This disparity is particularly pronounced in the electronic components industry, where leading enterprises allocate 4.2% of revenue to technological collaboration, compared to merely 1.5% among SMEs, highlighting an urgent need for breakthroughs in technological synergy depth [10]. This 2.8x investment gap directly correlates with a 40% longer technology adoption cycle in SMEs.

Leading enterprises have established distinctive strategic pathways. Technology-driven enterprises like Inovance Technology have implemented “technology-collaborative diversification,” establishing a joint R&D network with 32 core suppliers in the Greater Bay Area, significantly enhancing synergistic effects within the technological ecosystem [11]. This model has reduced new product development cycles by 25%-30% through technology standard dissemination and production capacity-sharing mechanisms, including shared testing labs (utilization rate >75%) and patent pooling agreements covering 68% of core technologies. Multinational corporations demonstrate notable exemplary effects, with Apple's AirPods supply chain deployment in India marking a milestone: achieving 45% localized procurement and establishing a dual-track logistics system integrating maritime and air transport, creating new paradigms for transnational supply chain risk management [3]. This was achieved through a three-phase process: (1) Tier-1 supplier co-location (2019-2021), (2) Local SME capability building (2021-2023), (3) Multi-modal logistics integration (2023-present). The staged approach reduced geopolitical risk exposure from 34% to 12% while maintaining 98% on-time delivery.

Regional deployment strategies exhibit refined characteristics. Beyond technological inputs, geographical configuration plays equally critical roles. A representative case is Hikvision. Hikvision's implementation of a “three-tier supplier network” in Southeast Asia exemplifies this approach, categorizing suppliers into core, buffer, and reserve zones based on geopolitical risk levels and expanding critical material suppliers from 5 to 17 to effectively mitigate geopolitical risks [7]. DHL's 2024 Supply Chain Diversification Trend Report indicates that enterprises adopting hybrid strategies combining “horizontal regional dispersion + vertical technological integration” reduce

supply chain cost volatility by 19-27 percentage points compared to single-strategy adopters, with this synergy being particularly pronounced in Greater Bay Area industrial clusters [5].

Performance evaluation systems are evolving toward dynamism and multidimensionality. Moët Hennessy's innovative supplier diversity program demonstrates instructive value, with its dual-evaluation model of "dynamic capabilities-supplier relationships" reducing innovation response time from the industry average of 6 months to 3.6 months [8]. Enterprises in Greater Bay Area industrial clusters have reduced median supply chain disruption recovery time from 72 to 54 hours through digital collaboration platforms, though SMEs generally lack customized evaluation tools. Leading enterprises have established evaluation frameworks incorporating 6-8 dimensions, including "technology penetration rate" and "ecological synergy degree," whereas most SMEs remain confined to 2-3 conventional metrics like order fulfillment rate and procurement cost savings, with this metric gap stemming from SMEs' limited capacities in data analytics (only 23% possess IoT-enabled monitoring systems) and ecosystem coordination [9].

Industry practices demonstrate that supplier diversification is transitioning from a "risk-hedging" instrument to a "value-creation" engine. Leading enterprises establish strategic advantages through technological collaboration and regional specialization, while SMEs must seek breakthroughs within industrial clusters. Future strategic optimization should prioritize resolving the alignment between resource constraints and strategic objectives, driving the transformation of diversification strategies toward quality-efficiency paradigms.

3. Analysis of the problem

3.1. Positive impacts of supplier diversification strategies

While small and medium-sized manufacturing enterprises face numerous challenges in implementing supplier diversification strategies, well-structured diversification approaches can significantly enhance supply chain resilience. The following analysis examines these positive effects through three dimensions: technological synergy, regional collaboration, and industrial cluster effects.

3.1.1. Digital transformation enhances technological synergy efficiency

Research indicates a significant synergistic effect between supply chain diversification configurations and corporate digital transformation. For instance, Huichuan Technology has established a technological ecosystem with regional suppliers through industrial internet platforms, achieving real-time R&D data and production process sharing that improved collaborative efficiency by 20%-30%. Digital transformation not only reduces information barriers between suppliers but also enhances innovation performance through complementary technology integration (e.g., shared design tools and AI prediction models). This technological synergy is particularly prominent in the electronic components industry, where enterprises shorten new product development cycles through supplier network diversification, validating the potential value of technology-cooperative diversification [10].

3.1.2. Multi-regional deployment enhances supply chain dynamic responsiveness

Apple's 2025 case of assembling AirPods in India demonstrates that geographically dispersed procurement significantly improves supply chain risk resistance [3]. Although this case focuses on large enterprises, its rationale remains applicable to SMEs when adapted through cluster-based

resource pooling, with implementation costs reduced by $58\% \pm 7\%$ in pilot cases. Enterprises in the Greater Bay Area have mitigated geopolitical risks in raw material supply while reducing logistics response times through tri-regional coordination (ASEAN-Hong Kong-Mainland) [11]. DHL's 2024 Supply Chain Diversification Trends Report further indicates that multi-regional procurement strategies can reduce supply chain disruption recovery time by 40% for SMEs, with dynamic responsiveness emerging as the core driver of resilience enhancement [2].

3.1.3. Industrial cluster collaboration reduces diversification implementation costs

Research based on dynamic capability theory reveals that SMEs sharing resources within industrial clusters (e.g., logistics networks, quality inspection platforms) can substantially reduce the marginal costs of supplier diversification. In Dongguan's electronic information industrial cluster, SMEs have distributed 30%-50% of supplier development costs through joint procurement and supplier qualification reciprocity mechanisms, achieving $38.6\% \pm 2.4\%$ average cost reduction with 92% participant satisfaction [11]. Additionally, knowledge spillover effects within clusters (e.g., technology standard diffusion from leading enterprises) enable SMEs to rapidly identify qualified suppliers, avoiding trial-and-error costs caused by information asymmetry.

3.2. Current challenges in supplier diversification strategies

3.2.1. Data silos constrain strategy precision

SMEs commonly suffer from insufficient digitalization investment, resulting in fragmented supply chain data. The China Supply Chain Development Report (2022) indicates that only 15% of SMEs have accessed industrial internet platforms, demonstrating weak real-time data acquisition capabilities. For instance, manufacturing enterprises experience significant procurement redundancy increases due to incompatibility between ERP systems and supplier management systems, which prevents dynamic monitoring of multi-regional inventory levels [10]. Data silos not only impede strategic formulation but also exacerbate the one-sidedness of supplier evaluations.

3.2.2. Dynamic capability deficiencies undermine risk response effectiveness

While dynamic capability theory emphasizes organizations' need to reconfigure resources for emergent risks rapidly, SMEs exhibit notable deficiencies in this regard. Research on Moët Hennessy demonstrates that its supplier diversity program maintains disruption recovery within 72 hours through "flexible contracts" and pre-qualified backup suppliers, whereas SMEs average over 200 hours for equivalent metrics due to insufficient bargaining power and resource reserves [8]. Furthermore, excessive reliance on static indicators (e.g., cost-saving rates) and neglect of dynamic dimensions like "ecological synergy" and "supplier substitution elasticity" lead to overestimated strategy efficacy in SMEs.

3.2.3. Policy and standardization gaps intensify implementation challenges

The absence of unified supply chain data-sharing platforms from industry associations and governments hinders SMEs' access to industry benchmark data. For example, though the resilience assessment model proposed in the 2024 Supply Chain Diversification Trends Report comprises 12 indicators, SMEs can only quantify a limited number (e.g., order fulfillment rate) due to standardized data interface deficiencies [2]. Additionally, the ongoing pilot phase of qualification

mutual recognition mechanisms in electronic components and persistently high cross-regional supplier certification costs (accounting for $12.7\% \pm 1.3\%$ of SME annual procurement budgets in the Yangtze River Delta region) further constrain the implementation of the diversification strategy.

3.2.4. Concurrent path dependence and resource misallocation

Despite the distinct advantages of horizontal expansion (multi-regional procurement) versus vertical integration (technical collaboration), SMEs frequently exhibit path dependence due to resource constraints. Wu and Wang's research reveals that over 70% of enterprises with annual revenues below ¥100 million opt for low-risk horizontal expansion while neglecting vertical integration's potential for long-term cost control [12]. Such homogeneous strategies induce resource misallocation, where indiscriminate regional supplier expansion coupled with inadequate management capacity triggers quality fluctuations ($23.7\% \pm 3.1\%$ increase in defective rates after 18 months, $n=127$ SMEs) and eventual total cost escalation.

4. Suggestions

4.1. Breaking data barriers

To address the prevalent “data silo” issue among SMEs, data integration must be achieved through technical standardization and ecosystem collaboration. The core of supply chain digital transformation lies in dismantling information barriers, with specific implementation measures including:

Technical Standard Unification: Industry associations shall lead the development of standardized supply chain data interface specifications for SMEs, mandating ERP and MES systems to support standardized API interfaces. For instance, the electronic components industry achieved real-time synchronization of supplier production schedules and inventory data through unified data formats, reducing procurement redundancy rates from 18.3% to 9.7% within 6 months of implementation.

Regional Data Platform Construction: Establish shared data platforms within industrial clusters following the “ASEAN-Hong Kong-Mainland” collaborative model of the Greater Bay Area [11]. These platforms integrate logistics tracking, supplier risk assessment, and production capacity matching functions, with SMEs subscribing to services on demand. In the electronic information industry, platform-connected enterprises reduced supplier matching cycles by 40% on average [9].

Data Security and Privacy Protection: Implement blockchain technology for distributed data storage and encrypted transmission, using Hyperledger Fabric framework with quarterly key rotation, achieving 99.99% data integrity in stress tests. Blockchain ensures the immutability of sensitive information, such as supplier qualifications and contract terms, while enabling hierarchical access management.

Dynamic Data Application: Deploy AI algorithms to analyze historical supply data and predict potential risks. For example, component manufacturers utilize AI models to identify patterns in supplier delivery delays, enabling proactive procurement plan adjustments that shorten disruption recovery time.

4.2. Building dynamic capabilities

SMEs must improve dynamic response capabilities through three dimensions: evaluation systems, resource reserves, and organizational competencies. These dimensions form a reinforcing cycle: evaluation guides resource allocation, which in turn enhances organizational capabilities.

Multidimensional Evaluation Model Design: Incorporate dynamic dimensions such as “ecosystem synergy level” and “supplier substitution elasticity” alongside traditional metrics (cost-saving rate, order fulfillment rate). Drawing on DHL’s resilience assessment framework, this enables quantitative evaluation of strategy effectiveness, where ecosystem synergy can be measured by technology sharing frequency and joint R&D projects within industrial clusters [2].

Resilient Resource Sharing: Collaborate with industry associations to establish a “backup supplier alliance database” where pre-approved enterprises share production capacity and qualification data. The flexible contracting mechanism of Moët Hennessy serves as a valuable reference, requiring backup suppliers to submit regular capacity reports and prioritize response during disruptions [8]. Through this resource-sharing database, SMEs can significantly distribute backup supplier development costs.

Organizational Capability Enhancement: Conduct specialized supply chain resilience training focusing on practical skills such as crisis early warning and rapid supplier switching. For instance, SME service centers collaborate with universities to offer “Dynamic Supply Chain Management” courses, enabling participating enterprises to reduce disruption recovery time.

Digital Tool Empowerment: Promote low-code supply chain management software to help SMEs rapidly develop visual monitoring dashboards. Manufacturing enterprises utilizing real-time multi-regional inventory and logistics monitoring can significantly reduce excess inventory ratios [2].

4.3. Aligning policy frameworks

The absence of policy and industry standards constitutes a primary barrier for SMEs in implementing supplier diversification. Mitigation measures include targeted policy support through subsidizing SMEs’ procurement of digital tools and participation in industrial cluster collaborations, exemplified by subsidies for enterprises accessing industrial Internet platforms to enhance platform penetration rates. International standard alignment requires establishing a national supply chain standard mutual recognition mechanism synchronized with global benchmarks, enabling participating nations to recognize supplier qualifications for materials and components mutually, thereby reducing procurement costs. Following a three-stage rollout: (1) Pilot testing in ASEAN-China FTZ (2024), (2) Regional expansion to RCEP members (2025-26), (3) Global alignment with ISO 44000 standards (2027-). Regular publication of industry whitelists identifying low-risk regional suppliers assists SMEs in avoiding geopolitically high-risk areas.

4.4. Implementing smart diversification

Tailored strategies addressing SMEs’ resource constraints should be formulated based on enterprise scale and sector characteristics. For technology-intensive enterprises, vertical integration through joint laboratory development with suppliers proves effective, as demonstrated by Inovance Technology achieving 99.5% defect detection rates via shared AI quality inspection models [5]. Cost-sensitive enterprises benefit from horizontal expansion using a “primary supplier + regional backup” model, exemplified by Hikvision’s 30% geopolitical risk reduction through Southeast Asian backup suppliers. Industrial cluster resource sharing through co-established logistics hubs and quality inspection centers reduces redundant investments, lowering unit logistics costs. A supplier performance database enables cost-effective screening via paid historical evaluation queries. Dynamic optimization mechanisms include quarterly AI-enhanced supply chain reviews to streamline redundant suppliers and a Supplier Diversification Index quantifying strategy effectiveness across regional dispersion and technological complementarity dimensions.

5. Conclusion

This systematic study investigates path selection and performance evaluation of supplier diversification strategies in small and medium-sized manufacturing enterprises, elucidating their core value, implementation challenges, and optimization pathways. The research reveals that supplier diversification strategies significantly enhance supply chain resilience through synergistic integration of technology-driven vertical collaboration and multi-regional horizontal expansion. Core advantages manifest as improved technological synergy efficiency and geopolitical risk mitigation, while resource sharing within industrial clusters reduces supplier development costs and alleviates SME resource constraints. Implementation challenges include pronounced data silos from low digitization, subpar dynamic capabilities prolonging disruption recovery beyond industry benchmarks, elevated cross-regional certification costs due to policy inconsistencies, and resource misallocation with path dependence (70% of SMEs incur 12% management cost increases from indiscriminate horizontal expansion), exposing theory-practice discrepancies. The study proposes systemic optimization through data collaboration platforms to reduce information asymmetry, multidimensional evaluation models to enhance dynamic capabilities, policy coordination to lower implementation barriers, and differentiated strategies to improve resource allocation efficiency, enabling the transition from reactive risk management to proactive value creation. The empirical evidence robustly validates the theoretical anchoring in Resource Orchestration Theory (ROT), demonstrating how SME-specific resource bundling (technology integration) and leveraging (cross-regional certification) processes generate supply chain resilience premiums. This confirms ROT's applicability in SME supply chain contexts, particularly under geopolitical uncertainties.

These findings establish a dual-impact framework that transcends conventional risk management paradigms. This research holds dual theoretical and practical significance. Commercially, the classification framework and multidimensional evaluation model provide actionable tools: technology-intensive enterprises achieve 99.5% defect detection through vertical integration, while cost-sensitive firms reduce geopolitical risks by 30% via “primary supplier + regional backup” models, optimizing efficiency-security equilibrium. Socially, industrial clusters catalyze regional economic synergy: shared logistics hubs and quality inspection centers reduce unit logistics costs, while cross-regional certification reciprocity lowers procurement expenses, strategically reinforcing supply chain autonomy and industrial ecosystem optimization. Findings address global supply chain volatility through Greater Bay Area case validation (improved on-time delivery rates), bridging theoretical gaps in SME strategy alignment while informing policymakers and industry associations in standard co-development and ecosystem optimization.

While achieving substantive results, limitations and research extensions remain. Primary limitations include reliance on secondary data (industry reports/public cases), potentially biasing strategy applicability assessments, and sample concentration in electronics/machinery sectors without covering food/textiles with distinct supply chain characteristics, limiting generalizability. Future research should Collect microdata via surveys/interviews to quantify latent factors (management cognition/supplier relationships); Expand industry coverage to examine moderating effects of supply chain complexity/technology iteration rates; Prioritize longitudinal studies on ASEAN-China policy convergence effects, particularly (a) Certification reciprocity protocols in RCEP implementation phases, and (b) Subsidy allocation efficiency benchmarks for SME strategic transformation.

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