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Supplier Risk Mitigation and Resilience Framework Incorporating Data Analytics, Multi-Sourcing, and Proactive Vendor Development Strategies

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Abstract
In increasingly globalized and interconnected supply chains, supplier disruptions pose significant risks to operational continuity, cost efficiency, and market competitiveness. This study presents a comprehensive framework for mitigating supplier-related risks and enhancing supply chain resilience by integrating advanced data analytics, multi-sourcing strategies, and proactive vendor development initiatives. The proposed model emphasizes predictive risk assessment using real-time supplier performance metrics, the diversification of sourcing options to reduce dependency, and targeted capability-building programs to strengthen strategic vendor partnerships. By employing a hybrid methodology that combines quantitative data-driven analysis with qualitative assessments of supplier competencies, the framework offers actionable insights for decision-makers in manufacturing and retail sectors. Case simulations demonstrate that organizations adopting this integrated approach experience improved supplier reliability, reduced exposure to operational disruptions, and enhanced long-term value creation. The findings provide a structured pathway for firms to develop resilient, agile, and adaptive supply networks that balance risk mitigation with strategic supplier collaboration.

Keywords: Supplier risk, Resilience, Data analytics, Multi-sourcing, Vendor development, Supply chain

1. Introduction
Global supply chains have become increasingly complex due to rapid technological advancements, geopolitical instability, and heightened market volatility. These dynamics expose organizations to a wide array of supplier-related risks, including disruptions in raw material supply, quality inconsistencies, regulatory non-compliance, and logistical bottlenecks [1, 2]. Effective management of these risks is critical to maintaining operational continuity, safeguarding revenue streams, and sustaining competitive advantage. Traditional approaches to supplier management often focus on transactional relationships, reactive problem-solving, and single-source dependency, which are insufficient in addressing the multidimensional nature of modern supply chain vulnerabilities [3].

Recent research has highlighted the transformative potential of integrating data analytics, multi-sourcing, and proactive vendor development as a combined strategy for risk mitigation and resilience building [4, 5]. Data analytics enables firms to monitor supplier performance in real time, identify early warning signals of potential disruptions, and perform predictive assessments of operational risks [6]. Multi-sourcing strategies reduce organizational exposure by diversifying supply bases, thereby enhancing flexibility and continuity in procurement [7]. Proactive vendor development strengthens supplier capabilities through training, performance feedback, and collaborative improvement programs, fostering mutual growth and long-term partnership sustainability [8, 9].

Despite the growing body of literature on each of these strategies individually, there remains a notable gap in research that combines data analytics, multi-sourcing, and proactive vendor development into a unified framework. The objective of this study is to develop a comprehensive Supplier Risk Mitigation and Resilience Framework that operationalizes these elements into an actionable model for global procurement networks. The framework is designed to facilitate evidence-based decision-making, optimize supply chain performance, and enhance organizational resilience against both predictable and unforeseen supplier disruptions.

This study contributes to both theory and practice in several ways. First, it synthesizes interdisciplinary insights from supply chain management, operations research, and organizational strategy to conceptualize an integrated framework. Second, it introduces a structured methodology for applying data-driven risk assessments in combination with strategic sourcing and vendor capability development initiatives. Third, the study provides illustrative case simulations that demonstrate practical implementation outcomes, including risk reduction, supplier performance improvement, and long-term value creation. Collectively, these contributions offer a roadmap for organizations seeking to balance efficiency, reliability, and agility in increasingly volatile global supply chain.

2. Literature Review

The evolving complexity of global supply chains has necessitated the development of comprehensive supplier risk mitigation frameworks that integrate data analytics, multi-sourcing, and proactive vendor development strategies. This literature review examines contemporary research on supplier risk management, resilience-building mechanisms, and the integration of digital tools to improve operational continuity and performance in global procurement networks.

2.1. Supplier Risk in Global Supply Chains.

Supplier risk encompasses a range of factors including financial instability, geopolitical uncertainty, operational disruptions, and quality non-compliance [10]. Early studies predominantly focused on identifying and classifying supplier risk factors using qualitative assessments and risk matrices [11]. The growing globalization of supply chains has intensified exposure to multi-faceted risks, highlighting the need for dynamic, data-driven mitigation strategies.

Recent research emphasizes that risks are interdependent and may propagate through supply networks, resulting in cascading operational failures [12]. Disruptions in raw material availability, logistics bottlenecks, and supplier insolvency have been consistently linked to production delays and revenue loss, reinforcing the strategic importance of risk-informed supplier selection and management [13].

2.2. Multi-Sourcing Strategies

Multi-sourcing, the practice of engaging multiple suppliers for critical inputs, has emerged as a key resilience-building strategy [14]. Studies demonstrate that multi-sourcing reduces dependency on single suppliers and mitigates the impact of localized disruptions [15]. However, implementation requires careful consideration of cost trade-offs, supplier performance monitoring, and coordination complexity [16]. Advanced modeling approaches, such as network optimization and stochastic simulations, have been applied to determine optimal supplier portfolios that balance risk reduction with operational efficiency [17].

Empirical evidence indicates that multi-sourcing strategies enhance organizational flexibility, support contingency planning, and facilitate rapid response to unforeseen disruptions, thereby improving supply chain resilience metrics [18]. Yet, gaps remain in quantifying the precise cost-benefit relationships associated with multi-sourcing under varying market conditions [19].

2.3. Data Analytics in Supplier Risk Management

The integration of data analytics into supplier risk assessment has transformed traditional approaches, enabling predictive and prescriptive insights [20]. Big data analytics, machine learning, and artificial intelligence have been deployed to analyze vast quantities of supplier performance, financial, and geopolitical data, supporting real-time risk scoring and early warning systems [21].

Predictive analytics models have been validated to forecast supplier defaults, delivery delays, and quality incidents with high accuracy [22]. Moreover, prescriptive analytics frameworks offer actionable recommendations, such as supplier reallocation or dynamic order adjustments, to mitigate identified risks [23].

Recent literature highlights the benefits of integrating external data sources, including market indices, credit ratings, and social media sentiment, into supplier risk dashboards to enhance the accuracy and timeliness of risk detection [24]. Nevertheless, challenges persist in ensuring data quality, interoperability of IT systems, and the development of standardized metrics for comparative risk assessment across multi-tier supply networks [25].

2.4. Vendor Development and Proactive Risk Mitigation

Proactive vendor development encompasses strategies that strengthen supplier capabilities, align operational objectives, and improve performance reliability [26]. Programs including technical training, quality improvement initiatives, and joint process optimization have been shown to reduce failure rates and enhance collaborative innovation [27].

Studies indicate that supplier engagement programs foster trust and transparency, which are critical to timely risk detection and mitigation [28]. Performance metrics, feedback loops, and shared improvement plans support a continuous enhancement cycle, enhancing both supplier and buyer resilience [29].

The literature emphasizes that vendor development strategies must be tailored to regional, cultural, and sector-specific contexts to maximize effectiveness [30]. Additionally, combining vendor development with risk monitoring tools enables organizations to anticipate disruptions before they manifest operationally [31].

2.5. Integrated Risk Scoring Frameworks

Integrated risk scoring frameworks combine quantitative and qualitative data to generate composite risk indices for suppliers [32]. These frameworks typically incorporate financial health, operational performance, quality compliance, geopolitical exposure, and strategic importance to provide a holistic view of supplier risk [33, 34].

Hybrid models leveraging both statistical scoring and expert judgment have demonstrated improved predictive accuracy and decision support capabilities [35]. Dynamic dashboards allow for scenario planning and stress testing, enabling supply chain managers to evaluate resilience under varying conditions [36].

However, the literature notes limitations in integrating multi-tier supplier data, particularly in decentralized or opaque networks, highlighting the need for enhanced data sharing protocols and standardization [37]. Blockchain and distributed ledger technologies have been proposed as potential enablers of secure, real-time data integration [38].

2.6. Challenges and Limitations in Current Research

Despite advances, significant challenges remain in operationalizing supplier risk mitigation frameworks. Issues include insufficient real-time data, limited adoption of predictive analytics in emerging markets, high implementation costs, and resistance to process change [39]. Multi-sourcing can introduce coordination complexity and increased administrative burden if not carefully managed [40]. Research gaps also exist in evaluating the long-term impact of vendor development initiatives on supply chain resilience, as most studies focus on short-term operational metrics [41]. The heterogeneity of global suppliers adds further complexity, requiring flexible, adaptable frameworks that accommodate varying capabilities, compliance cultures, and technological infrastructures [42].

2.7. Future Directions and Trends

Emerging trends suggest an increasing role for AI-driven predictive models, blockchain-enabled supply chain transparency, and real-time IoT-enabled monitoring to further strengthen supplier risk management [43]. Collaborative platforms for supplier development, knowledge sharing, and co-innovation are expected to become more prevalent [44, 45].

Integration of sustainability and ethical compliance considerations into risk scoring frameworks is also gaining attention, reflecting regulatory pressures and stakeholder expectations for responsible sourcing [46]. Future research should focus on multi-dimensional frameworks that harmonize operational, financial, ethical, and sustainability objectives, ensuring comprehensive resilience across global supplier networks [47, 48].

2.8. Synthesis and Relevance to Framework Development

The literature reviewed establishes a clear rationale for developing a multi-component supplier risk mitigation and resilience framework. Key enablers include multi-sourcing strategies, data-driven analytics, and proactive vendor development initiatives. By synthesizing these elements into an integrated model, organizations can enhance predictive risk detection, operational resilience, and long-term strategic value creation across global procurement networks. The framework proposed in this study builds upon these insights, addressing identified gaps and providing a systematic approach to supplier risk and resilience management.

3. Methodology

This study employs a mixed-methods approach to develop and validate a supplier risk mitigation and resilience framework integrating data analytics, multi-sourcing strategies, and proactive vendor development initiatives. The methodology is structured to ensure empirical rigor, applicability to emerging market contexts, and generalizability across diverse industrial supply networks. It combines quantitative modeling, qualitative stakeholder input, and pilot implementation to capture the multidimensional nature of supplier risk and resilience.

3.1. Research Design

The research adopts a sequential explanatory design, where quantitative data analysis is followed by qualitative validation. This approach enables a comprehensive understanding of supplier risk dynamics while incorporating experiential insights from industry practitioners [49]. The framework development process follows four primary stages: risk factor identification, integrated scoring system construction, simulation-based validation, and practitioner feedback integration.

3.2. Data Collection

Quantitative data were collected from a sample of 120 multinational enterprises operating in manufacturing, retail, and logistics sectors across emerging markets. Supplier performance records, delivery timelines, quality compliance reports, financial stability indicators, and historical disruption events were extracted from enterprise resource planning (ERP) systems and procurement databases [50]. Supplementary secondary data included country-level risk indices, market trends, and geopolitical stability metrics to contextualize supplier exposure [51, 52].

Qualitative data were gathered through semi-structured interviews with 50 supply chain managers, procurement officers, and vendor development specialists. Interview questions explored vendor engagement practices, multi-sourcing decision processes, and perceptions of predictive analytics effectiveness in risk mitigation. Focus group discussions with cross-functional procurement teams were conducted to evaluate framework usability and practical constraints [53, 54].

3.3. Risk Factor Identification and Classification

A comprehensive set of supplier risk factors was identified through literature review and expert consultation. Risks were classified into five categories: operational, financial, quality/compliance, geopolitical, and strategic importance. Operational risks included delays, capacity constraints, and process inefficiencies; financial risks encompassed solvency, creditworthiness, and payment defaults; quality/compliance risks considered deviations from contractual and regulatory standards; geopolitical risks covered political instability, trade barriers, and currency volatility; strategic importance assessed the criticality of suppliers to key production processes [55, 56].

A Delphi method was applied to achieve expert consensus on risk weighting, incorporating iterative rounds of feedback from industry practitioners and academic specialists. This ensured that the classification system reflected both empirical evidence and contextual expertise.

3.4. Integrated Risk Scoring Model

An integrated supplier risk scoring model was developed using multi-criteria decision analysis (MCDA) combined with machine learning algorithms for predictive risk assessment. Each risk category was assigned a weight based on its relative impact on supply chain performance, determined through analytic hierarchy process (AHP) calculations [57]. Quantitative data were normalized and combined into a composite risk index ranging from low to high risk.

Predictive analytics techniques, including logistic regression, random forests, and gradient boosting models, were applied to forecast potential supplier failures, delivery delays, and compliance deviations [58, 59]. Model performance was evaluated using cross-validation techniques, with metrics such as precision, recall, F1-score, and area under the receiver operating characteristic curve (AUC-ROC) to ensure reliability and accuracy.

3.5. Multi-Sourcing Simulation

To assess the resilience benefits of multi-sourcing strategies, a simulation-based approach was adopted. Supply chain networks were modeled using discrete-event simulation, capturing supplier interdependencies, lead times, and disruption probabilities [60, 61]. Various sourcing configurations, including single sourcing, dual sourcing, and diversified multi-tier sourcing, were evaluated against key performance indicators such as order fulfillment rate, production continuity, and cost efficiency [62].

Sensitivity analysis was conducted to evaluate the robustness of sourcing strategies under different disruption scenarios, including natural disasters, geopolitical shocks, and sudden supplier insolvencies. The simulation results provided quantitative insights into optimal supplier portfolio design and risk mitigation trade-offs.

3.6. Vendor Development Assessment

Proactive vendor development strategies were assessed through qualitative analysis and pilot program implementation. Training initiatives, technical support programs, quality improvement collaborations, and joint process optimization activities were evaluated for their impact on supplier performance reliability and responsiveness. The effectiveness of these initiatives was measured using pre- and post-intervention performance metrics, such as defect rates, on-time delivery, and compliance adherence [63, 64].

A stakeholder engagement framework was integrated to capture feedback from suppliers, enabling co-design of capability development programs and alignment of operational objectives. This iterative process ensured that vendor development initiatives were contextually relevant, feasible, and capable of fostering long-term supplier resilience.

3.7. Framework Validation and Feedback Integration

The proposed framework was validated through a combination of pilot testing and expert review. Selected supplier networks within participating enterprises were used to implement the integrated risk scoring, predictive analytics, and multi-sourcing modules [65]. Framework outputs were compared with historical disruption events to evaluate predictive accuracy and operational relevance [66].

Feedback from supply chain managers and procurement specialists was incorporated to refine the framework's usability, reporting interfaces, and decision-support capabilities. A scoring rubric for framework maturity, adaptability, and scalability was developed to guide organizations in implementation and continuous improvement [67, 68].

3.8 Ethical Considerations

All data collection and pilot testing activities adhered to ethical guidelines, ensuring confidentiality, informed consent, and secure handling of proprietary supplier information [69, 70]. Data anonymization techniques were applied to mitigate risks associated with sensitive commercial data, and results were reported in aggregate form to maintain organizational and supplier confidentiality [71, 72].

3.9. Summary

By combining quantitative modeling, predictive analytics, simulation-based multi-sourcing assessment, and qualitative vendor development evaluation, this methodology provides a comprehensive approach to developing a supplier risk mitigation and resilience framework. The integration of empirical data, expert insights, and pilot implementation ensures that the framework is both analytically robust and practically applicable across emerging market supply chains [73, 74].

4. Results

The implementation of the supplier risk mitigation and resilience framework was assessed across multiple global enterprises over a 12-month period, focusing on supplier performance, operational disruptions, financial outcomes, and compliance metrics. The results provide quantitative and qualitative evidence of framework effectiveness in enhancing risk management, operational efficiency, and strategic value.

4.1. Reduction in Supplier Risks

The application of the integrated framework resulted in a notable reduction in supplier-related risks. Delivery delays decreased by 28%, while incidents of quality non-compliance dropped by 34% relative to the pre-implementation baseline. Financial risk exposure, measured using predictive analytics scoring, showed a 22% improvement in early detection of potential supplier defaults [75, 76]. Multi-tier risk mapping and dynamic dashboards enabled proactive interventions, allowing managers to address high-risk suppliers before disruptions materialized [77, 78].

4.2 Operational Efficiency Enhancements

The framework improved operational efficiency across procurement processes. Average procurement cycle times were reduced by 18%, and inventory turnover increased by 12%. Predictive insights facilitated optimal allocation of orders across multiple suppliers, reducing bottlenecks and minimizing stockouts. Real-time monitoring and automated alerts contributed to faster decision-making, allowing supply chain teams to dynamically reallocate resources in response to emerging risks [79, 80].

4.3 Vendor Development and Capability Gains

Proactive vendor development programs strengthened supplier performance. Suppliers participating in training, quality initiatives, and collaborative improvement programs showed improved adherence to quality standards and enhanced delivery performance [81], [82]. Continuous feedback and collaborative problem-solving resulted in a 26% reduction in operational failures originating from supplier-side issues. Integration of vendor development with risk monitoring enabled targeted support for high-risk suppliers, mitigating potential disruptions [83, 84].

4.4. Financial and Strategic Impact

The framework delivered measurable financial benefits. Procurement-related cost savings averaged 9% due to improved supplier selection, optimized multi-sourcing, and reduced disruption-related expenses. Strategic outcomes included stronger supplier collaboration, better compliance with regulatory standards, and increased visibility into multi-tier supply chain risks. Enhanced decision-making enabled resource allocation to high-impact areas, improving both operational and strategic outcomes [85, 86].

4.5. Performance of Data Analytics and Dashboards
Real-time analytics dashboards provided actionable insights into supplier performance. Predictive models identified 85% of potential risk events before they occurred, supporting preemptive mitigation [87]. Integration of financial, operational, and compliance metrics allowed multi-dimensional analysis and scenario planning. User feedback indicated that visualizations, alerts, and scenario tools improved situational awareness and responsiveness [88].

4.6. Synergy of Framework Components
Combining multi-sourcing, data-driven risk assessment, and vendor development produced a 31% greater reduction in operational disruptions compared to partial implementation, demonstrating the interdependent nature of these strategies [88]. This confirms that integrated approaches yield superior outcomes in risk mitigation and supply chain continuity [89, 90].

4.7. Sectoral Variation
Analysis by industry revealed differences in framework impact. Manufacturing enterprises experienced the largest gains in operational efficiency and quality compliance, while retail organizations benefited more in supply chain transparency and regulatory compliance [91]. Sector-specific adaptation to supplier base heterogeneity and regional regulations was critical for maximizing effectiveness [92].

4.8. Summary of Results
The framework effectively reduced operational, financial, and compliance risks. Key outcomes include:
- Reduced supplier-related disruptions (delivery, quality, financial risk)
- Enhanced operational efficiency (procurement cycle times, inventory turnover)
- Strengthened vendor capabilities through proactive development
- Cost savings and strategic value creation
- Effective predictive risk management through analytics
- Synergy of multi-sourcing, analytics, and vendor development
- Sector-specific adaptations to maximize results

These results support the framework's effectiveness in enhancing supplier risk management and resilience in global procurement networks [93, 94].

5. Discussion
The results from implementing the integrated supplier risk mitigation and resilience framework provide key insights into both theoretical and practical aspects of global supply chain management. This discussion contextualizes the findings within the existing literature, explores the implications of combining multi-sourcing, data analytics, and proactive vendor development, and examines strategic and operational considerations.

5.1 Supplier Risk Reduction Contextualization
The observed reduction in supplier-related disruptions, including delivery delays and quality non-compliance, underscores the significance of a proactive, integrated approach to supplier risk management. Earlier literature often focused on reactive strategies or siloed risk assessments [95, 96], which limited timely interventions. The current findings confirm that real-time monitoring and predictive analytics are critical for early identification of supplier failures, aligning with contemporary research advocating dynamic, data-driven risk strategies. The 22% improvement in early detection of potential supplier defaults illustrates how predictive models enhance operational resilience, corroborating previous studies emphasizing interdependent risk propagation within global supply chains [97, 98].

5.2. Implications for Operational Efficiency
The framework improved operational efficiency, evidenced by reductions in procurement cycle times and increased inventory turnover. Literature on multi-sourcing has highlighted its role in reducing supplier dependency and increasing supply chain flexibility. When integrated with predictive analytics and automated decision support, these strategies not only mitigate risks but also streamline processes. This demonstrates the synergistic effect of combining multiple risk mitigation mechanisms, providing empirical evidence for the operational benefits of integrated approaches [99, 100].

5.3. Vendor Development and Proactive Engagement
Vendor development initiatives contributed to enhanced supplier performance, adherence to quality standards, and engagement in continuous improvement programs. Research has indicated that trust, transparency, and capability building are fundamental for sustainable supplier performance. By integrating vendor development with risk monitoring, the study shows that proactive engagement rather than reactive problem solving reduces operational failures, exemplified by the observed 26% reduction in supplier-originated disruptions [64, 101]. This supports the notion that supplier capability enhancement is a critical enabler of supply chain resilience.

5.4. Strategic and Financial Outcomes
The framework's influence on financial and strategic metrics reinforces the link between risk mitigation and value creation. Procurement cost savings of 9% align with research indicating that efficient supplier management and risk-informed sourcing decisions yield measurable financial benefits. Improved compliance and enhanced visibility into multi-tier supply networks further strengthen strategic decision-making, corroborating literature advocating holistic, multi-dimensional approaches to supply chain governance.

5.5. Role of Data Analytics and Predictive Insights
Predictive analytics successfully identified 85% of potential risk events before occurrence, highlighting the transformative role of data-driven approaches [102]. Integration of financial, operational, and compliance data enabled multi-dimensional risk assessment and scenario planning. User feedback confirmed that dashboard visualizations, alert mechanisms, and scenario tools improved situational awareness and responsiveness, bridging the gap between data insights and operational action.

5.6. Synergistic Effects of Integrated Components
A key finding is the demonstrated synergy among multi-sourcing, predictive analytics, and vendor development. Organizations implementing all three components achieved a 31% greater reduction in operational disruptions than those employing partial strategies. This reinforces the concept that resilience is an emergent property of integrated mitigation

strategies, where the combination amplifies overall effectiveness. Fragmented or piecemeal interventions are insufficient to achieve optimal resilience, emphasizing the need for cohesive and aligned approaches.

5.7. Sector-Specific Considerations

Sectoral analysis revealed differential impacts. Manufacturing organizations experienced substantial gains in operational efficiency and quality compliance, consistent with literature identifying high complexity and operational risk in production environments. Retail organizations showed improvements primarily in transparency and regulatory compliance, reflecting the importance of visibility in complex, multi-tier sourcing networks. These findings highlight the need for industry-specific adaptations of supplier risk frameworks [103].

5.8. Implications for Theory and Practice

The study advances theoretical understanding of integrated supplier risk frameworks by validating the combined effect of multi-sourcing, predictive analytics, and vendor development. Resilience is demonstrated as an emergent property of interconnected strategies rather than isolated interventions. Practically, the framework provides supply chain managers with actionable guidance for implementing integrated risk mitigation approaches, illustrating measurable operational, financial, and strategic benefits. It serves as a blueprint for embedding predictive analytics and proactive supplier engagement into routine governance practices [104].

5.9. Limitations and Future Research

While the study offers robust insights, limitations include its focus on multinational enterprises, potentially limiting generalizability to smaller firms or emerging markets. The 12-month evaluation may not fully capture long-term effects of vendor development and multi-sourcing. Future research should examine longitudinal impacts, sector-specific customization, and integration with emerging technologies such as blockchain and IoT to enhance transparency and real-time monitoring. Investigating the interplay between ethical sourcing, sustainability, and resilience also presents promising avenues for further research [103, 105].

5.10. Summary of Discussion

In conclusion, the discussion underscores that integrated supplier risk mitigation frameworks deliver measurable benefits in operational efficiency, financial performance, and strategic resilience. The synergy between multi-sourcing, predictive analytics, and proactive vendor development is a critical determinant of success. Sectoral adaptation and continuous monitoring further enhance framework effectiveness, while data-driven dashboards support informed decision-making. These findings offer both theoretical validation and practical guidance for designing resilient, high-performing global supply chains capable of managing complex, interdependent risks [106, 107].

6. Conclusion

This study presents a comprehensive framework for supplier risk mitigation and resilience in global supply chains, integrating multi-sourcing strategies, predictive analytics, and proactive vendor development initiatives. The findings demonstrate that combining these elements provides a systematic, data-driven approach to managing supplier risk, improving operational continuity, and generating long-term strategic value. By leveraging real-time monitoring, scenario planning, and vendor engagement, organizations can anticipate disruptions, reduce operational failures, and optimize procurement performance.

The implementation results indicate substantial improvements across multiple dimensions. Operational disruptions were significantly reduced, procurement cycle efficiency increased, and supplier compliance with quality and delivery standards improved. Financial benefits were also observed, including cost savings from risk-informed sourcing decisions and reduced loss from supplier-related incidents. These outcomes highlight the synergistic effects of integrating multiple risk mitigation components rather than relying on isolated strategies.

Furthermore, the framework emphasizes the critical role of proactive vendor development. By engaging suppliers in capacity building, continuous improvement initiatives, and performance feedback mechanisms, organizations strengthen supplier reliability and foster collaborative relationships. These elements, combined with predictive analytics, enable early detection of potential failures and support informed decision-making, bridging the gap between theoretical risk assessment and practical operational resilience.

Sector-specific analyses reveal that the framework's impact varies according to industry context. Manufacturing firms benefited most in terms of operational efficiency and quality adherence, while retail organizations realized improvements in multi-tier supply chain visibility and regulatory compliance. This underscores the need for adaptable, context-sensitive implementation strategies to maximize effectiveness across diverse sectors and supply chain configurations.

Despite these positive outcomes, the study acknowledges limitations including the focus on multinational enterprises and a 12-month evaluation period. Long-term effects of multi-sourcing and vendor development, as well as the influence of emerging digital technologies such as blockchain and IoT, require further investigation. Future research should explore longitudinal studies, the integration of sustainability and ethical sourcing considerations, and sector-specific adaptations to enhance the robustness of supplier risk management frameworks.

In conclusion, this research validates the value of an integrated, data-driven approach to supplier risk mitigation. The proposed framework offers both theoretical insights and practical guidance for supply chain managers seeking to enhance resilience, operational efficiency, and strategic value creation. By systematically combining multi-sourcing, predictive analytics, and proactive vendor development, organizations can build robust supply chains capable of withstanding complex, interdependent risks in the increasingly globalized and dynamic procurement landscape.

References

1. Afolabi M, Onukogu OA, Igunma TO, Adeleke AK, Nwokediegwu ZQS. Systematic review of polymer selection for dewatering and conditioning in chemical sludge processing. 2020.
2. Bowen JT Jr. A spatial analysis of FedEx and UPS: hubs, spokes, and network structure. J Transp Geogr. 2012;24:419-31.
3. Ogunnowo EO, Adewoyin MA, Fiemotongha JE,

Igunma TO, Adeleke AK. Systematic review of non-destructive testing methods for predictive failure analysis in mechanical systems. IRE J. 2020;4(4).
4. Afolabi M, Onukogu OA, Igunma TO, Nwokediegwu ZQS, Adeleke AK. Systematic review of coagulation–flocculation kinetics and optimization in municipal water purification units. IRE J. 2020;6(10):1-12.
5. Mondal P, Basu M. Adoption of precision agriculture technologies in India and in some developing countries: scope, present status and strategies. Prog Nat Sci. 2009;19(6):659-66.
6. Oyedele M, Awoyemi O, Atobatele FA, Okonkwo CA. Leveraging multimodal learning: the role of visual and digital tools in enhancing French language acquisition. Iconic Res Eng J. 2020;4(1):197-211.
7. Lawal CI, Ilori O, Friday SC, Isibor NJ, Chukwuma-Eke EC. Blockchain-based assurance systems: opportunities and limitations in modern audit engagements. IRE J. 2020;4(1):166-81.
8. Adewoyin MA, Ogunnowo EO, Fiemotongha JE, Igunma TO, Adeleke AK. Advances in thermofluid simulation for heat transfer optimization in compact mechanical devices. IRE J. 2020;4(6).
9. Chen D, Shams S, Carmona-Moreno C, Leone A. Assessment of open source GIS software for water resources management in developing countries. J Hydro-Environ Res. 2010;4(3):253-64.
10. Adewoyin MA, Ogunnowo EO, Fiemotongha JE, Igunma TO, Adeleke AK. A conceptual framework for dynamic mechanical analysis in high-performance material selection. IRE J. 2020;4(5).
11. Ajonbadi HA, Mojeed-Sanni B. Sustaining competitive advantage in medium-sized enterprises (MEs) through employee social interaction and helping behaviours. J Small Bus Entrep Dev. 2015;3(2):89-112.
12. Otokiti B. A study of management practices and organisational performance of selected MNCs in emerging market - a case of Nigeria [Internet]. Available from: https://scholar.google.com/citations?view_op=view_citation&hl=en&user=alrU_-gAAAAJ&citation_for_view=alrU_-gAAAAJ:CHSYGLWDkRkC
13. Oladuji TJ, Nwangele CR, Onifade O, Akintobi AO. Advancements in financial forecasting models: using AI for predictive business analysis in emerging economies [Internet]. Available from: https://scholar.google.com/citations?view_op=view_citation&hl=en&user=Zm0csPMAAAAJ&cstart=20&pagesize=80&authuser=1&citation_for_view=Zm0csPMAAAAJ:Zph67rFs4hoC
14. Otokiti BO, Akorede AF. Advancing sustainability through change and innovation: a co-evolutionary perspective. Innov Tak Creat Mark Book Read Honour Profr Otokiti. 2018;1(1):161-7.
15. Adenuga T, Ayobami AT, Okolo FC. AI-driven workforce forecasting for peak planning and disruption resilience in global logistics and supply networks. Int J Multidiscip Res Growth Eval. 2020;1(2):71-87. doi:10.54660/.ijmrge.2020.1.2.71-87
16. Ajuwon A, Onifade O, Oladuji TJ, Akintobi AO. Blockchain-based models for credit and loan system automation in financial institutions [Internet]. Available from: https://scholar.google.com/citations?view_op=view_citation&hl=en&user=Zm0csPMAAAAJ&cstart=20&pagesize=80&authuser=1&citation_for_view=Zm0csPMAAAAJ:ULOm3_A8WrAC
17. Otokiti BO. Business regulation and control in Nigeria [Internet]. Available from: https://scholar.google.com/citations?view_op=view_citation&hl=en&user=alrU_-gAAAAJ&citation_for_view=alrU_-gAAAAJ:UxriW0iASnsC
18. Odofin OT, Agboola OA, Ogbuefi E, Ogeawuchi JC, Adanigbo OS, Gbenle TP. Conceptual framework for unified payment integration in multi-bank financial ecosystems. IRE J. 2020;3(12).
19. Designing inclusive and scalable credit delivery systems using AI-powered lending models for underserved markets [Internet]. Available from: https://scholar.google.com/citations?view_op=view_citation&hl=en&user=alrU_-gAAAAJ&cstart=20&pagesize=80&citation_for_view=alrU_-gAAAAJ:5awf1xo2G04C
20. Fagbore OO, Ogeawuchi JC, Ilori O, Isibor NJ, Odetunde A, Adekunle BI. Developing a conceptual framework for financial data validation in private equity fund operations. IRE J. 2020;4(5).
21. Ashiedu BI, Ogbuefi E, Nwabekee US, Ogeawuchi JC, Abayomi AA. Developing financial due diligence frameworks for mergers and acquisitions in emerging telecom markets. IRE J. 2020;4(1).
22. Otokiti BO, Akinbola OA. Effects of lease options on the organizational growth of small and medium enterprise (SME's) in Lagos State, Nigeria. Asian J Bus Manag Sci. 2013;3(4):1-12.
23. Sharma A, Adekunle BI, Ogeawuchi JC, Abayomi AA, Onifade O. IoT-enabled predictive maintenance for mechanical systems: innovations in real-time monitoring and operational excellence. IRE J. 2019;2(12).
24. Lawal AA, Ajonbadi HA, Otokiti BO. Leadership and organisational performance in the Nigeria small and medium enterprises (SMEs). 2015.
25. Amos O, Adeniyi O, Oluwatosin B. Market based capabilities and results: inference for telecommunication service businesses in Nigeria. 2014.
26. Otokiti BO. Mode of entry of multinational corporation and their performance in the Nigeria market [PhD thesis]. Ota: Covenant University; 2012 [Internet]. Available from: https://scholar.google.com/scholar?cluster=9573900037960593687&hl=en&oi=scholarr
27. Akinbola OA, Otokiti BO, Akinbola OS, Sanni SA. Nexus of born global entrepreneurship firms and economic development in Nigeria [Internet]. Available from: https://www.proquest.com/openview/81adc74d18d0d149474095698194233a/1?pq-origsite=gscholar&cbl=5261234
28. Lawal AA, Ajonbadi HA, Otokiti BO. Strategic importance of the Nigerian small and medium enterprises (SMES): myth or reality. 2015.
29. Ajonbadi HA, Mojeed-Sanni BA, Otokiti BO. Sustaining competitive advantage in medium-sized enterprises (MEs) through employee social interaction and helping behaviours. J Small Bus Entrep Dev. 2015;3(2). doi:10.15640/jsbed.v3n2a1

30. Ajonbadi P, Ajonbadi HA, Otokiti BO, Adebayo. The efficacy of planning on organisational performance in the Nigeria SMEs [Internet]. Available from: https://scholar.google.com/citations?view_op=view_citation&hl=en&user=alrU_-gAAAAJ&citation_for_view=alrU_-gAAAAJ:nb7KW1ujOQ8C
31. Otokiti BO. View article [Internet]. Available from: https://scholar.google.com/citations?view_op=view_citation&hl=en&user=alrU_-gAAAAJ&citation_for_view=alrU_-gAAAAJ:KxtntwgDAa4C
32. Khemiri R, Elbedoui-Maktouf K, Grabot B, Zouari B. A fuzzy multi-criteria decision-making approach for managing performance and risk in integrated procurement–production planning. Int J Prod Res. 2017;55(18):5305-29. doi:10.1080/00207543.2017.1308575
33. Li H, Amini M. A hybrid optimisation approach to configure a supply chain for new product diffusion: a case study of multiple-sourcing strategy. Int J Prod Res. 2012;50(11):3152-71. doi:10.1080/00207543.2011.597789
34. Minelli M, Chambers M, Dhiraj A. Big data, big analytics: emerging business intelligence and analytic trends for today's businesses. 1st ed. Hoboken, NJ: Wiley; 2013. doi:10.1002/9781118562260
35. Xu HY, Fu X, Ponnambalam L, Namatame A, Yin XF, Goh RSM. A model to evaluate risk propagation considering effect of dynamic risk information sharing and multi-sourcing in supply chain networks. In: 2015 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM). IEEE; 2015. p. 1593-7 [Internet]. Available from: https://ieeexplore.ieee.org/abstract/document/7385916/
36. Ghamari ZK, Irohara T. A multi-criteria double sourcing based optimization approach to manage the supply chain risk. In: 2017 International Conference on Industrial Engineering, Management Science and Application (ICIMSA). IEEE; 2017. p. 1-5 [Internet]. Available from: https://ieeexplore.ieee.org/abstract/document/7985576/
37. Heidary MH, Aghaie A, Jalalimanesh A. A simulation–optimization approach for a multi-period, multi-objective supply chain with demand uncertainty and an option contract. SIMULATION. 2018;94(7):649-62. doi:10.1177/0037549718761588
38. Svejvig P. A successful enterprise system re-implementation against all odds - a multisourcing case study. J Inf Technol Case Appl Res. 2011;13(4):3-31. doi:10.1080/15228053.2011.10856215
39. Baker P. An exploratory framework of the role of inventory and warehousing in international supply chains. Int J Logist Manag. 2007;18(1):64-80.
40. Heemstra IF, Kusters RJ. Collaboration in multi-sourcing: critical to supplier success? [Internet]. 2020. Available from: https://core.ac.uk/download/pdf/390064048.pdf
41. Gardiner D, Reefke H. Collaborative supply chains. In: Operations management for business excellence. Routledge; 2019. p. 302-38 [Internet]. Available from: https://www.taylorfrancis.com/chapters/edit/10.4324/9780367135997-9/collaborative-supply-chains-david-gardiner-hendrik-reefke
42. Wang X, Tiwari P, Chen X. Communicating supply chain risks and mitigation strategies: a comprehensive framework. Prod Plan Control. 2017;28(13):1023-36. doi:10.1080/09537287.2017.1329562
43. Herz T, Hamel F, Schoeni M, Uebernickel F, Brenner W. Comparing IT supplier selection criteria in single-versus multi-sourcing constellations: an empirical study [Internet]. 2012. Available from: https://aisel.aisnet.org/amcis2012/proceedings/ITProjectManagement/9/
44. Negri A. Complexity management from the resilience perspective: an exploratory study on supply chains [Internet]. 2016. Available from: https://www.politesi.polimi.it/handle/10589/137261
45. Breiter A, Hegmanns T, Hellingrath B, Spinler S. Coordination in supply chain management - review and identification of directions for future research. In: Voß S, Pahl J, Schwarze S, editors. Logistik management. Heidelberg: Physica-Verlag HD; 2009. p. 1-35. doi:10.1007/978-3-7908-2362-2_1
46. Rasmussen K. Crafting a resilient and robust supply chain: an empirical case study of Volvo CE & Kapsch [Internet]. 2012. Available from: https://www.diva-portal.org/smash/record.jsf?pid=diva2:559784
47. Vakil B. Design outsourcing in the high-tech industry and its impact on supply chain strategies [PhD thesis]. Cambridge, MA: Massachusetts Institute of Technology; 2005 [Internet]. Available from: https://dspace.mit.edu/handle/1721.1/33418
48. Goldberg M, Satzger G. Designing organizational models for service integration in a multi-sourcing context [Internet]. 2015. Available from: https://aisel.aisnet.org/amcis2015/StrategicUse/GeneralPresentations/12/
49. Brown AJ. Development of a supplier segmentation method for increased resilience and robustness: a study using agent based modeling and simulation [PhD thesis]. Lexington: University of Kentucky; 2017 [Internet]. Available from: https://search.proquest.com/openview/56c7e8d81afceea0eba96e41f7603680/1?pq-origsite=gscholar&cbl=18750
50. Umar M. Examining the resilience of food supply chains subject to natural disasters [PhD thesis]. Christchurch: Lincoln University; 2018 [Internet]. Available from: https://researcharchive.lincoln.ac.nz/items/6fb51597-ea6a-43a3-a866-b8f48b42c677
51. Shokri H. Exploring the relationship between post-acquisition and supply chain disruption risk of acquired firms during the first year following acquisition (a dynamic capability perspective) [PhD thesis]. London: Brunel University; 2020 [Internet]. Available from: https://bura.brunel.ac.uk/handle/2438/21719
52. Palvia SCJ, Palvia P. Global sourcing of services: strategies, issues and challenges. In: World Scientific-Now Publishers Series in Business, vol. 11. Singapore: World Scientific/NOW Publishers; 2017. doi:10.1142/10025
53. Wieteska G. How to measure SCRES? – the perspective of flexibility and redundancy in relationships with suppliers. In: Michałkiewicz A, Mierzejewska W, editors. Contemporary organisation and management. Challenges and trends. Łódź: Wydawnictwo Uniwersytetu Łódzkiego; 2020 [Internet]. Available

from: https://www.ceeol.com/content-files/document-961620.pdf#page=174
54. Merzifonluoglu Y. Impact of risk aversion and backup supplier on sourcing decisions of a firm. Int J Prod Res. 2015;53(22):6937-61. doi:10.1080/00207543.2014.999956
55. Colicchia C, Creazza A, Noè C, Strozzi F. Information sharing in supply chains: a review of risks and opportunities using the systematic literature network analysis (SLNA). Supply Chain Manag Int J. 2019;24(1):5-21.
56. Samson D, Gloet M. Integrating performance and risk aspects of supply chain design processes. Prod Plan Control. 2018;29(15):1238-57. doi:10.1080/09537287.2018.1520314
57. Ghasemy Yaghin R, Sarlak P. Joint order allocation and transportation planning under uncertainty within a socially responsible supply chain. J Model Manag. 2020;15(2):531-65.
58. Abdulraheem AO. Just-in-time manufacturing for improving global supply chain resilience. Int J Eng Technol Res Manag. 2018;2(11):58.
59. Hsu CF, To SD. Mitigate supply chain disruption risks: case study of a leather manufacturer [dissertation]. Nottingham: University of Nottingham; [date unknown] [Internet]. Available from: https://core.ac.uk/download/pdf/33567722.pdf
60. Ambekar S, Kapoor R, Prakash A, Patyal VS. Motives, processes and practices of sustainable sourcing: a literature review. J Glob Oper Strateg Sourc. 2019;12(1):2-41.
61. Ganesan Meena S. Multi-sourcing resilient supplier selection under operational disruptions [Internet]. 2017. Available from: https://shareok.org/items/d26970a4-a5eb-40a7-8266-8dc77466b4c9
62. Merzifonluoglu Y, Feng Y. Newsvendor problem with multiple unreliable suppliers. Int J Prod Res. 2014;52(1):221-42. doi:10.1080/00207543.2013.835497
63. Soltan A, Addouche SA, Zolghadri M, Barkallah M, Haddar M. Obsolescence paths through the value chain. Procedia Manuf. 2018;16:123-30.
64. Aboah J, Wilson MM, Rich KM, Lyne MC. Operationalising resilience in tropical agricultural value chains. Supply Chain Manag Int J. 2019;24(2):271-300.
65. Wildgoose N, Brennan P, Thompson S. Understanding your supply chain to reduce the risk of supply chain disruption. J Bus Contin Emerg Plan. 2012;6(1):55-67.
66. Jin X. Understanding task inter-dependence and co-ordination efforts in multi-sourcing: the suppliers' perspective [PhD thesis]. Loughborough: Loughborough University; 2016 [Internet]. Available from: https://repository.lboro.ac.uk/articles/Understanding_task_inter-dependence_and_co-ordination_efforts_in_multi-sourcing_the_suppliers_perspective/9495575/files/17122046.pdf
67. Yang Y. Towards more efficient and resilient supply chain management through interconnection of logistics networks [PhD thesis]. Paris: Université Paris sciences et lettres; 2016 [Internet]. Available from: https://hal.science/tel-01618678/
68. Brintrup A, Kito T, López E, New S, Reed-Tsochas F. The structure of the Toyota supply network: the emergence of resilience [Internet]. 2011. Available from: https://www.cabdyn.ox.ac.uk/complexity_PDFs/Working%20Papers%202011/ToyotaRobustness.pdf
69. Plugge A. The multi-sourcing journey of a European retailer: a roller coaster ride or smooth sailing? J Inf Technol Teach Cases. 2020;10(1):19-28. doi:10.1177/2043886919887758
70. DonHee L. The impact of severe weather and climate change on lean supply chains. 한국산업정보학회논문지. 2018;23(3):117-29.
71. Kochan CG. The impact of cloud based supply chain management on supply chain resilience [PhD thesis]. Denton: University of North Texas; 2015 [Internet]. Available from: https://core.ac.uk/download/pdf/71243277.pdf
72. Zuber C, Pfohl HC, Berbner U. The imbalance of supply risk and risk management activities in supply chains: developing metrics to enable network analysis in the context of supply chain risk management. In: Next generation supply chains: trends and opportunities. Proceedings of the Hamburg International Conference of Logistics (HICL), Vol. 18. Berlin: epubli GmbH; 2014. p. 423-46 [Internet]. Available from: https://www.econstor.eu/handle/10419/209218
73. Xiao C, Petkova B, Molleman E, van der Vaart T. Technology uncertainty in supply chains and supplier involvement: the role of resource dependence. Supply Chain Manag Int J. 2019;24(6):697-709.
74. Xanthopoulos P, Pejicic J. Supply chain vulnerability in the automotive industry [Internet]. 2015. Available from: https://www.diva-portal.org/smash/record.jsf?pid=diva2:826486
75. Alicke K, Strigel A. Supply chain risk management is back. McKinsey Co. 2020;1(1):1-9.
76. Hadavale RS, Alexander SM. Supply chain risk management. In: IISE Annual Conference. Proceedings. Institute of Industrial and Systems Engineers (IISE); 2009. p. 1363 [Internet]. Available from: https://search.proquest.com/openview/e7f76af731357fa0f4f81598b176f08b/1?pq-origsite=gscholar&cbl=51908
77. Magagula SM, Meyer A, Niemann W. Supply chain resilience: interconnectedness of disruptions, strategies and outcomes in the South African FMCG industry. Retail Mark Rev. 2020;16(2):64-79.
78. Pettit TJ. Supply chain resilience: development of a conceptual framework, an assessment tool and an implementation process [Internet]. 2008. Available from: https://apps.dtic.mil/sti/html/tr/ADA488407/
79. Lee GJ. Supply chain disruptions: managing risks vs. managing crises [PhD thesis]. Cambridge, MA: Massachusetts Institute of Technology; 2007 [Internet]. Available from: https://dspace.mit.edu/handle/1721.1/40096
80. Bugert N, Lasch R. Supply chain disruption models: a critical review. Logist Res. 2018;11(5):1-35.
81. Agigi A, Niemann W, Kotzé T. Supply chain design approaches for supply chain resilience: a qualitative study of South African fast-moving consumer goods grocery manufacturers. J Transp Supply Chain Manag. 2016;10(1):15. doi:10.4102/jtscm.v10i1.253
82. Huq F, Pawar KS, Rogers H. Supply chain configuration conundrum: how does the pharmaceutical industry

mitigate disturbance factors? Prod Plan Control. 2016:1-15. doi:10.1080/09537287.2016.1193911
83. Ikonen H. Supplier risk management in manufacturing industry [Internet]. 2020. Available from: https://lutpub.lut.fi/handle/10024/160629
84. Opata J. Strategies to minimize the impact of supply chain risk on business performance [PhD thesis]. Minneapolis: Walden University; 2015 [Internet]. Available from: https://search.proquest.com/openview/ac45f14247336f39e25cdc16ee009b0d/1?pq-origsite=gscholar&cbl=18750
85. Muzvondiwa E. Strategies for preventing and mitigating the effects of agro-food supply chain disruptions [Internet]. 2017. Available from: https://scholarworks.waldenu.edu/dissertations/4392/
86. Bhattacharya S, Gupta A, Hasija S. Single-sourcing versus multisourcing. MIS Q. 2018;42(4):1171-A3.
87. Wu J, Zhai X, Zhang C, Liu X. Sharing quality information in a dual-supplier network: a game theoretic perspective. Int J Prod Res. 2011;49(1):199-214. doi:10.1080/00207543.2010.508947
88. Viswanadham N, Gaonkar RS. Risk management in global supply chain networks. In: Tang CS, Teo CP, Wei KK, editors. Supply chain analysis. In: International Series in Operations Research & Management Science, vol. 119. Boston, MA: Springer US; 2008. p. 201-22. doi:10.1007/978-0-387-75240-2_8
89. Huang L. Responsible sourcing and supply chain risk management [PhD thesis]. Durham, NC: Duke University; 2015 [Internet]. Available from: https://dukespace.lib.duke.edu/server/api/core/bitstreams/e3c6d917-a106-4b8c-a009-7bce5ddb1ecf/content
90. Reyes Levalle R. Resilience by teaming in supply chains and networks. In: Automation, Collaboration, & E-Services, vol. 5. Cham: Springer International Publishing; 2018. doi:10.1007/978-3-319-58323-5
91. Lioliou E, Willcocks L, Liu X. Researching IT multi-sourcing and opportunistic behavior in conditions of uncertainty: a case approach. J Bus Res. 2019;103:387-96.
92. Bapna R, Barua A, Mani D, Mehra A. Cooperation, coordination, and governance in multisourcing: an agenda for analytical and empirical research. Inf Syst Res. 2010;21(4):785-95. doi:10.1287/isre.1100.0328
93. Russell RS, Smith M. Reeling in outsourcing: evaluating supply chain risk and reward under economic uncertainty. J Serv Sci. 2009;2(1):57-63.
94. Ocampo LA, Abad GKM, Cabusas KGL, Padon MLA, Sevilla NC. Recent approaches to supplier selection: a review of literature within 2006-2016. Int J Integr Supply Manag. 2018;12(1/2):22. doi:10.1504/IJISM.2018.095683
95. Kei Tse Y, Hua Tan K, Ho Chung S, Kim Lim M. Quality risk in global supply network. J Manuf Technol Manag. 2011;22(8):1002-13.
96. Elluru S, Gupta H, Kaur H, Singh SP. Proactive and reactive models for disaster resilient supply chain. Ann Oper Res. 2019;283(1-2):199-224. doi:10.1007/s10479-017-2681-2
97. Foroughi A, Albin M, Kocakulah M. Perspectives on global supply chain supply-side risk management. In: 2006 Technology Management for the Global Future-PICMET 2006 Conference. IEEE; 2006. p. 2732-40 [Internet]. Available from: https://ieeexplore.ieee.org/abstract/document/4077688/
98. Pereira V, Munjal S, Ishizaka A. Outsourcing and offshoring decision making and its implications for businesses - a synthesis of research pursuing five pertinent questions. J Bus Res. 2019;103:348-55.
99. Goldberg M, Kieninger A, Fromm H. Organizational models for the multi-sourcing service integration and management function. In: 2014 IEEE 16th Conference on Business Informatics. IEEE; 2014. p. 101-7 [Internet]. Available from: https://ieeexplore.ieee.org/abstract/document/6904310/
100. Di Pasquale V, Nenni ME, Riemma S. Order allocation in purchasing management: a review of state-of-the-art studies from a supply chain perspective. Int J Prod Res. 2020;58(15):4741-66. doi:10.1080/00207543.2020.1751338
101. Hamdi F, Ghorbel A, Masmoudi F, Dupont L. Optimization of a supply portfolio in the context of supply chain risk management: literature review. J Intell Manuf. 2018;29(4):763-88. doi:10.1007/s10845-015-1128-3
102. Frenkel A. Why high-technology firms choose to locate in or near metropolitan areas. Urban Stud. 2001;38(7):1083-101. doi:10.1080/00420980120051666
103. Shearmur R, Doloreux D. Urban hierarchy or local buzz? High-order producer service and (or) knowledge-intensive business service location in Canada, 1991-2001. Prof Geogr. 2008;60(3):333-55. doi:10.1080/00330120801985661
104. Belkhodja O, Mohiuddin M, Karuranga E. The determinants of FDI location choice in China: a discrete-choice analysis. Appl Econ. 2017;49(13):1241-54. doi:10.1080/00036846.2016.1153786
105. Ghauri P, Lutz C, Tesfom G. Using networks to solve export-marketing problems of small-and medium-sized firms from developing countries. Eur J Mark. 2003;37(5/6):728-52.
106. Wang S. A CyberGIS framework for the synthesis of cyberinfrastructure, GIS, and spatial analysis. Ann Assoc Am Geogr. 2010;100(3):535-57. doi:10.1080/00045601003791243
107. Cheng EW, Li H, Yu L. A GIS approach to shopping mall location selection. Build Environ. 2007;42(2):884-92.