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Diversification of Suppliers to Ensure Continuity of Wholesale Apparel Supply

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Abstract

This paper examines systematic supplier diversification as a key mechanism for ensuring the continuity of wholesale apparel supply under conditions of high volatility in global markets and escalating logistical and geopolitical risks. The study aims to develop and substantiate an integrative multi-sourcing strategy that combines traditional supply-chain optimization methods with advanced digital tools, enabling prompt response to disruptions. The relevance of this work is dictated by the concentration of over 70% of global apparel exports in Asia, a sharp rise in spot rates and an increase in transit times by 3–4 weeks, which have driven logistics costs up by as much as 20% and threatened disruptions during the golden quarter of sales. The novelty of the research lies in the combination of risk-pooling and postponement with formal segmentation methodologies and the digital-twin and control-tower platforms, as well as the introduction of financial models for evaluating the economic efficiency of diversification scenarios. The methodology is based on the analysis of 17 sources: UNCTAD statistics, McKinsey and Bain reports, industry case studies, and proprietary data from the Fashion Atlas Group, together with a quantitative assessment of key KPIs. The main findings demonstrate that a comprehensive approach—including geographical, structural, model-based, and logistical diversification—allows for reduction of safety stocks and smoothing of demand fluctuations, reduces Time-to-Recovery by 20%, and that the application of a digital twin plus control tower enablesoperational switching of supply flows in the digital circuit and shortens Time-to-Switch to 7 days. A practical case study of the Fashion Atlas Group, which has integrated over 600 factories and 40 brands, confirms the feasibility and significance of the proposed strategy for the fast-fashion industry. This paper will be useful to supply-chain managers, strategists, and researchers in the fields of logistics and fast fashion.

Keywords: *Supplier Diversification; Supply Continuity; Apparel Supply Chain; Risk Pooling; Postponement; Kraljic Matrix; ABC-XYZ-FSN; Digital Twin; Control Tower; OTIF; Time-to-Recovery.*

INTRODUCTION

Alongside growing demand for affordable fast-fashion collections, the global apparel supply chain remains one of the most vulnerable in the world economy. The COVID-19 pandemic merely revealed the beginning of a series of shocks: following lockdowns came restrictions in the Suez Canal, drought in Panama, and an escalation of conflict in the Red Sea. By mid-2024, the cumulative increase in spot rates on key alternative routes from Shanghai had exceeded 100%, with the South America route soaring to USD 9,026 per TEU—the highest level since 2022 [1]. For European apparel importers, the consequences manifested not only in higher logistics costs: average transit times from Southeast Asia increased by three to four weeks, and direct delivery costs rose by approximately 20% [2].

The economic impact is exacerbated by the concentration of production: Asia accounts for 70.6% of global textile and apparel exports, rendering the industry critically dependent on a limited number of transit corridors [3]. Under such conditions, any localized incident swiftly scales into a global shortage: the closure of the Port of Kaohsiung or a canal blockade immediately affects the full assortment of brand-retailers, lowering OTIF rates and, consequently, revenue during the high-margin golden quarter.

However, diversification itself remains a methodologically complex task, requiring a balance between economies of scale, resilience to disruptions, and compliance with tightening ESG standards. It is for this reason that a systematic study of supplier-diversification mechanisms has become not an academic exercise but an urgent industry necessity—without it, the wholesale channel risks repeated stoppages, with attendant market-share losses and reputational costs.

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MATERIALS AND METHODOLOGY

The study of supplier diversification for ensuring continuity of wholesale apparel supply is based on the analysis of 17 sources, including academic articles, industry reports, statistical bulletins, and case studies. For quantitative evaluation of changes in logistical parameters, data from UNCTAD on spot rates [1], Sheng Lu's report on the impact of geopolitical risks on apparel trade [2], and WTO profiles on the textile sector [3] were used. The theoretical foundation comprised works on supply-chain optimization: Yang & Yang on postponement [4], Lee et al. on the bullwhip effect [5], and Bimpikis et al. on multi-sourcing and its coordination effects [16].

Methodologically, the research combined four key approaches. First, a comparative analysis of diversification strategies: from the China + 1 model reflected in Bain's Q4 2024 survey [17] to formal segmentation via the Kraljic matrix [6] and the three-dimensional ABC-XYZ-FSN classification [7], which enabled comparison of procurement costs, disruption risks, and scaling potential. Second, a systematic review of digital tools—the concepts of digital twin and control tower [8]—and assessment of their impact on supply-chain resilience, drawing on McKinsey's models for risk management and disruption recovery [15].

The third methodological element was content analysis of industry surveys and case studies: Supply Chain Dive data on key threats and trends for 2025 [10], research by Fibre2Fashion and USFIA on political and tariff risks [12], and Bain reports on the redistribution of China's share in supply [17]. For financial comparison of strategies, total cost of ownership calculations and NPV models from McKinsey were employed, illustrating the trade-off between downtime losses and benefits from backup capacities [15].

Finally, to test the practical applicability of the developed recommendations, an analysis of key continuity KPIs—OTIF, LT Variance, Fill Rate, and Time-to-Recovery—was conducted using internal data from the Fashion Atlas Group platform and external estimates of TTR-reduction impact on revenue losses [9].

Beyond this, the paper makes a distinct theoretical and methodological contribution by weaving together three strands of supply-chain scholarship that have hitherto developed in parallel. It unifies postponement theory, statistical risk-pooling principles, and the emergent digital twin/control tower paradigm into a single, operationally coherent diversification framework that can be executed end-to-end. To validate the framework's practical relevance, a performance evaluation model is constructed that links classical resilience metrics — On-Time-In-Full (OTIF), Time-to-Recovery (TTR), and Fill Rate — to an integrated KPI dashboard. This dashboard not only quantifies the trade-off between robustness and cost, but also enables decision-makers to rank alternative sourcing scenarios and simulate the impacts of disruptions in real time. By bridging conceptual silos and embedding the KPI model within a digital twin environment, the study provides a replicable blueprint for firms seeking data-driven governance of multi-sourced apparel supply chains in the face of heightened geopolitical and logistical volatility.

RESULTS AND DISCUSSION

Supply chain continuity is defined as the network's ability to uninterruptedly maintain the flow of resources, even if individual nodes experience internal or external disruptions; in international practice, this definition is codified in ISO 22318, which emphasizes the connection between guaranteed access to material flows and overall business resilience. In the fashion industry—where the life cycle of collections is measured in weeks—this continuity becomes critical, since even a brief disruption in the supply of raw materials or finished goods leads to trend obsolescence and direct margin losses.

The probability of such disruptions is classically reduced by two concepts: risk pooling, based on the statistical smoothing effect of demand fluctuations when inventories are centralized, and postponement, which involves shifting points of product differentiation to later, less risky stages of the process. Theoretically, risk pooling allows safety stock to be reduced in proportion to the square root of the number of aggregated locations, whereas postponement is regarded as an effective method for mitigating the consequences of rare but severe disruptions by enabling final configuration of the product closer to the point of consumption [4].

However, even optimally placed inventories cannot shield the network from the effects of information distortion. The classic bullwhip model explains how a small deviation in retail demand is exponentially amplified up the supply hierarchy to raw-material suppliers, causing shortages and then excess inventory; the fundamental mechanisms of this phenomenon, described by MIT researchers in the 1990s, remain relevant today as additional volatility is introduced by marketplace algorithmic ordering [5].

These systemic risks are commonly described by the terms robustness and resilience. A robust chain maintains target throughput during a disruption, whereas a resilient chain rapidly restores it after disturbances, sometimes in a modified topology. The COVID-19 period demonstrated that geographically diversified networks possess higher resilience, since they can replace a disrupted node with an alternative partner, while highly integrated but single-focused networks exhibit better short-term robustness but require longer to return to baseline efficiency.

The choice of an optimal strategy is impossible without formal supplier segmentation. At the strategic level, the Kraljic matrix is employed (see Fig. 1), classifying items by importance and market risk and defining four basic management scenarios—from simple aggregated tendering to strategic partnerships [6].

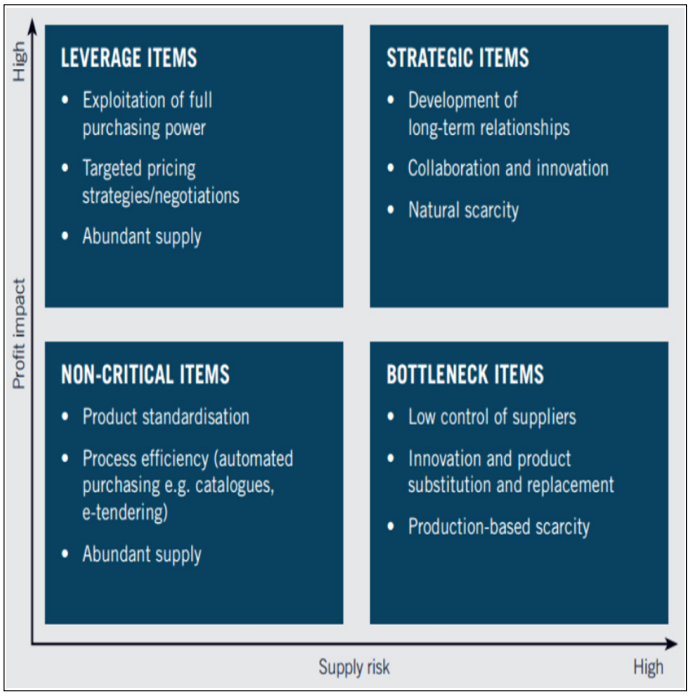

Fig. 1. Kraljic Matrix [6]

For tactical planning, combined ABC-XYZ-FSN methods are convenient, as they allow simultaneous consideration of cost, demand variability, and turnover speed; the effectiveness of this three-dimensional classification has been confirmed in empirical studies of the pharmaceutical and textile sectors [7].

The digital shift of recent years provides the instrumental basis for these methodologies to operate in real time. The concept of digital twin + control tower, according to [8], treats factories, warehouses, and routes as dynamically updated objects within a unified virtual space, where machine-learning algorithms forecast events and suggest optimal re-routing scenarios before an actual disruption occurs. For wholesale apparel operators, this means the ability to pre-reserve production slots at alternative sites and instantly recalculate batch economics, accounting for new logistics and brand requirements.

The effectiveness of any solution is evaluated through a system of metrics. At its core is OTIF, indicating the proportion of orders delivered on time in full. Lead-time variance serves as an indicator of operational predictability. Fill rate reflects the network's ability to satisfy instantaneous demand, and Time-to-Recovery measures the number of days required for a node to return to design capacity after a disruption; industry reviews show that reducing TTR leads to a disproportionate reduction in total revenue losses during large-scale disruptions [9]. Together, these indicators form the quantitative foundation on which a managed diversification strategy can be built and its impact compared against costs.

Operational risk in fashion has long ceased to be limited to seasonal demand fluctuations: in 2025, 39% of surveyed CPOs reported that a combination of port congestion, labor shortages and potential tariff shocks made the year worse than the last for their supply chains, and another 41% did not anticipate improvements, according to Supply Chain Dive's industry-trends analysis [10]. This context gives rise to five interrelated threats. First, purely operational disruptions—container delays, freight shortages, temporary channel closures—immediately extend lead-time and invalidate sales forecasts. Second, price risk: Apparel duties average 14.6% compared to 5% for steel, so a sudden change in the tariff regime instantly shifts contract breakeven points [11]. The third group comprises regulatory barriers; a USFIA study showed that for 45% of American importers in 2024, political instability and new forced-labor legislation were the primary sources of uncertainty [12]. The fourth group entails reputational losses: analysts at Cornell GLI and Schroders forecast up to USD 65 billion in under-deliveries by 2030 due to extreme weather in key garment clusters, directly impacting brand image and investors [13]. Finally, innovation risk relates to the fact that 80% of companies have already implemented 3D modeling and digital samples; those that have not synchronized their IT systems with multi-sourcing objectively lose speed and flexibility [14]. At the same time, brands are raising their targets for sustainable materials: for example, in 2023, 86% of respondents said they would use recycled polyester in the next five years, an increase of 19% since 2019, as shown in Figure 2.

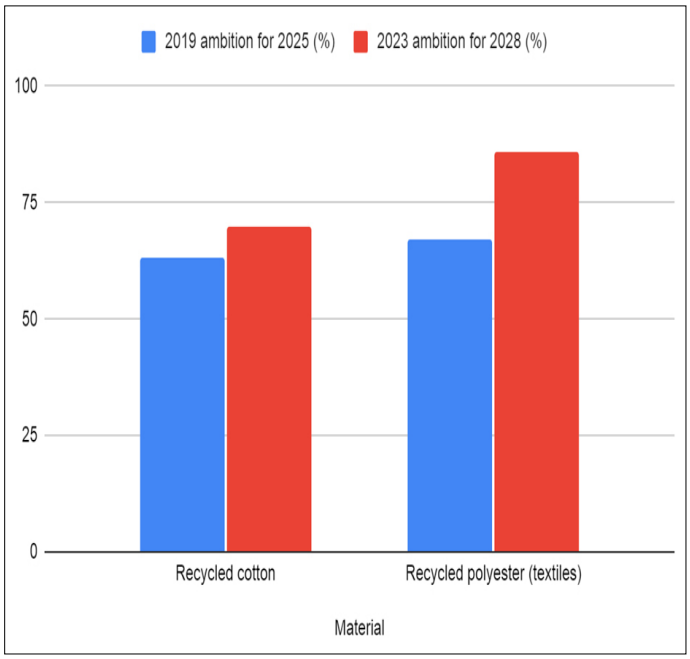

Fig. 2. Temporal Trends in Corporate Ambitions for Sustainable Textile Content: Surveyed Targets for Recycled Cotton and Polyester by 2025 and 2028 [14]

The financial dimension of choosing between a single supplier and a portfolio of counterparties is calculated via total cost of ownership (TCO). A McKinsey Global Institute study across 23 industries shows that the cumulative loss from severe disruptions is equivalent to 45% of annual EBITDA if a company has not provisioned backup capacity [15], as illustrated in Fig. 3.

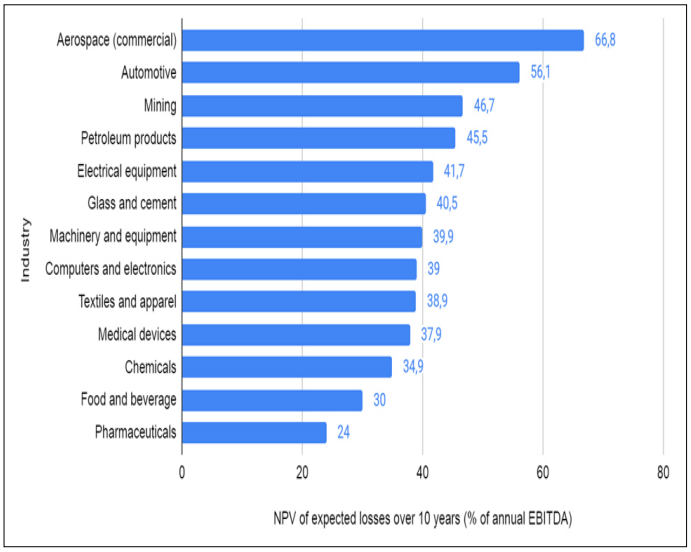

Fig. 3. Comparative Net Present Value of Anticipated Ten-Year Losses Relative to Annual EBITDA Across Industry Sectors [15]

By adding a second or third supplier, a brand typically incurs higher unit costs and duplicated audit expenses, but at the same time drastically reduces the expected cost of downtime; academic modeling of multi-sourcing in Operations Research confirms that, for equal margins, the risk-adjusted cost minimum is achieved precisely by allocating volumes among several factories rather than by rigid sole-sourcing—especially when production functions are nonlinear and load-dependent [16]. Thus, in the TCO formula, the increased procurement cost is offset by reductions in safety stocks, late-delivery penalties, and lost turnover.

Meanwhile, economies of scale remain real: a large order yields discounts, simplifies quality control, and lowers transaction expenses. But there exists a switching threshold—the aggregate cost of identification, audit, re-engineering of processes, and legal formalization for a new contract. USFIA data indicate that 70% of large U.S. companies already distribute orders across at least ten countries, demonstrating that actual switching costs proved lower than the benefit from flexibility and regulatory hedging [12]. Ultimately, this balance underpins rational diversification: it permits partial sacrifice of discounts but transforms a one-off shock—be it a tariff, storm, or labor-rights scandal—from a collection-wide catastrophe into a manageable, localized risk.

Supply-chain diversification is implemented on multiple levels, each addressing a specific vulnerability group identified earlier. Geographically, the principal trend remains the shift from mono-focused all-from-China dependency to a China + 1 model: a Bain Q4 2024 survey found that 70% of international retailers have already made reducing China's share a strategic priority due to rising tariffs and political risks [17].

The next layer is structural. The classic division of suppliers into Tier 1 and Tier 2 means that a company does not limit itself to direct counterparties but forms a multi-layered network that allows it, if necessary, to transfer orders not only from one sewing factory to another but also to promptly replace fabric, dyeing or accessories components if a disruption originates deeper in the cascade. Under a collaborative model, the industry employs a combination of OEM, ODM, private-label contracts, and in-house capacity. OEM remains economical for high-volume basic items, as it delivers minimal unit cost through scale; ODM is preferred by fast-fashion brands, which require the ability to adapt a design to a local trend within four to six weeks. In-house factories remain justifiable only for strategically critical SKUs, since they demand capital investment and do not provide geographic hedging.

Logistical diversification completes this triad of instruments. Here, alternative corridors and multimodal schemes play the central role. For rapid supplementing of collections, brands increasingly use split-routing: core assortments travel by sea, while limited-edition batches fly by air or move via the Xi'an–Mannheim rail service through Central Asia.

At all of these levels, digital infrastructure becomes critical. Gartner reports that over 50% of sector companies will invest in supply-chain digital-twin technologies and advanced analytics by the end of 2024, because only a virtual network model enables real-time assessment of the consequences of rerouting suppliers and corridors [8]. Finally, by diversifying their supplier portfolios, wholesalers simultaneously address regulatory and reputational compliance. Since nearly all fashion brands' carbon footprint resides in Scope 3—chiefly in procurement and logistics—the decarbonization roadmaps recommended by the Apparel Impact Alliance focus on shifting volumes to sites with lower carbon factors and on moving from air to sea or rail transport [5].

Thus, geographic, structural, model-based, and logistical solutions—underpinned by end-to-end IT platforms and a calibrated ESG framework—form a unified diversification architecture. It does not negate economies of scale nor preclude strategic partnerships, but transforms the chain from a fragile, hierarchically linear structure into an adaptive network capable of absorbing localized shocks without interrupting supply continuity, which constitutes the subject of further analysis.

Fashion Atlas Group relies on a database of more than six hundred vetted factories and a portfolio of forty turnkey brands; these two parameters simultaneously create both breadth of alternatives and a stable internal demand. Each factory is pre-integrated into a unified IT platform, on which standard tech packs, agreed consumption norms, and digital quality-control templates are hosted. When a brand submits a new model, the system automatically transforms its specification into a standardized list of operations and materials, after which an algorithm selects suitable sites from the entire pool: first, technological capabilities and current load are compared; then, collection-launch timing requirements and any regulatory constraints are taken into

account; production slots along with calculated unit costs are immediately dispatched to the selected factories. This end-to-end data exchange reduces repetitive engineering operations, reduces the probability of drawing errors, and enables order switching among network participants with virtually no transactional delay.

Complete life-cycle coverage further enhances resilience: information embedded at the design stage accompanies the product through manufacturing, logistics, and branding until it enters international markets. If it is necessary to adapt a collection for a specific region, the built-in ODM/OEM model permits modifications to pattern, labeling, and packaging within the same digital environment, after which the flow can be rapidly redirected to a factory with the required specialization. The elimination of intermediary links shortens communication loops and removes the typical industry disconnect between engineers, procurement, and export departments.

Thanks to this combination of a large supplier base, unified procedures, and flexible customization, Fashion Atlas Group has built a multi-tiered failure-insurance system. If a disruption of raw-material supply or logistics arises in one country, the load is redistributed to available capacity without loss of original specifications, and the documentation chain automatically adjusts to the new route. As a result, the company obtains not merely backup capacity but a managed network in which each node is designed from the outset to be interchangeable. This transforms diversification from a disparate set of contracts into an integrated operational model capable of ensuring continuity of wholesale apparel supply regardless of local force-majeure events.

Unlike companies that concentrated all their supply in one region and faced a sharp collapse of supply chains in 2020-2022 - when localized blockages of factories in Zhejiang and delays at ports in southern China led to months-long delays of collections - Fashion Atlas initially built a backup multi-node model that allowed it to painlessly redistribute orders to alternative sites and keep OTIF at a high level.

Whereas most apparel supply chain frameworks apply risk pooling, postponement, or supplier segmentation as separate silos of activity, often underpinned by static China + 1 mandates or one-off Kraljic assessments, Fashion Atlas Group's approach fuses these classical methods into a single, digitally orchestrated control tower ecosystem. Typical industry models rely on periodic reviews and manual rerouting of orders when disruptions occur; by contrast, the company's digital-twin platform continuously simulates alternative sourcing scenarios, auto-selects backup capacities based on real-time KPIs (OTIF, LT Variance, TTR), and immediately recalculates total-cost impacts. This end-to-end integration not only slashes decision latency from weeks to days but also drives a further reduction in safety stocks without eroding service levels, compared to standalone diversification practices.

In summary, the analysis shows that a comprehensive approach to supplier diversification—from theoretical models of risk-pooling and the Kraljic matrix to geographic, structural and logistical rotation layers—supported by digital twin and control tower digital tools, together with the metrics OTIF, LT Variance and Time-to-Recovery, creates a resilient and adaptive supply network. In practice, this is confirmed by the success of the Fashion Atlas Group platform, which has unified over 600 factories and 40 brands within a single IT ecosystem capable of operational switching of supply flows in the digital circuit and reducing Time-to-Switch to 7 days. Such a synergistic synthesis of economies of scale, the flexibility of the OEM/ODM model, and rigorous ESG control not only reduces the risks of localized force-majeure events but also provides a robust foundation for the further design of continuity strategies in supply chains.

CONCLUSION

This study demonstrates that systematic supplier diversification in all its dimensions—geographic, structural, model-based, and logistical—combined with the digital tools digital twin and control tower, constitutes a resilient, adaptive network capable of ensuring continuity of wholesale apparel supply. The application of classic concepts of risk-pooling and postponement, in conjunction with formal segmentation via the Kraljic matrix and ABC-XYZ-FSN methods, not only reduces safety stocks and smooths demand fluctuations but also enables rapid response to severe, rare disruptions through late-stage node differentiation and production-slot reservation.

Evaluation of diversification measures via OTIF, cycle-time variance, and Time-to-Recovery metrics shows that a 20 % reduction in TTR yields a significant decrease in revenue losses during large-scale disruptions. Digital integration of data across all stages of the collection life cycle allows real-time disruption forecasting and rerouting of supply flows without redundant engineering input, substantially reducing transactional delays and minimizing the risk of bullwhip-effect pulsations.

The Fashion Atlas Group case confirms that a unified IT platform and a single database of over 600 factories create extensive alternative corridors for quick order transfers, enabling a reduction in Time-to-Switch to seven days. This demonstrates the practical feasibility of the proposed approach and its significance for the fast-fashion industry, where the speed of trend adaptation is a decisive competitive factor.

Moreover, the proposed architecture can be scaled to other FMCG segments exposed to logistical risks, for example:

- Perishable food transport (such as dairy, fruits, and vegetables), where even minimal delays can critically affect quality and shelf life.
- Pharmaceutical distribution requires strict temperature control and precise delivery windows to ensure efficacy and compliance.

- Household chemicals and cosmetics, which combine broad assortments with seasonal promotions, demand a careful balance of speed, cost, and regulatory adherence.
- Packaged food logistics, such as snacks and frozen goods, where multimodal routing enhances resilience against transit disruptions.
- Consumer electronics distribution, where rapid product launches and short lifecycle models necessitate flexible management of production and transportation nodes.

These findings underscore the scalability of the proposed framework in two key dimensions. First, the unified postponement–risk-pooling–digital-twin logic can be transferred, with minimal re-parametrization, to adjacent fast-clock-speed sectors such as consumer electronics, personal-care FMCG, and even high-mix, low-volume industrial components, where geopolitical shocks and rapid product obsolescence create similar exposure profiles. Second, the architecture is inherently modular, allowing organizations of different sizes to adopt it selectively: global retailers can roll out the full digital-twin/control-tower stack across hundreds of nodes, while regional wholesalers or medium-sized distributors can start with lightweight KPI dashboards and scenario engines yet still achieve measurable reductions in Time-to-Recovery and OTIF variance. Thus, the strategy functions not as a one-off blueprint for large enterprises but as a portable playbook that scales down—and out—without losing its resilience dividend.

Thus, comprehensive supplier diversification—through the synergy of economies of scale, OEM/ODM-model flexibility, and integrated ESG control—not only reduces supply-chain vulnerability but also provides a solid basis for the further development of business-continuity and resilience strategies in the face of increasing global-market volatility.

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