Strategic Inventory Optimization and Supply Chain Resilience: A Decision-Making Framework for Sustainable Business Performance

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ABSTRACT:

Strategic inventory optimization, supply-chain resilience, supplier reliability, and operational sustainability collectively interact to support sustainable business performance. A quantitative cross-sectional analytical design was applied to 113,097 supply-chain observations representing product-supplier combinations across multiple countries. Inventory performance was assessed through warehouse inventory levels, historical demand, inventory coverage, inventory-to-demand ratio, and lead time, while resilience incorporated supplier reliability, logistics capability, route risk, disruption likelihood, delay probability, weather severity, customs-clearance efficiency, and lead-time efficiency. Operational sustainability was evaluated using shipping-cost efficiency, order fulfilment, delivery-time reliability, and supplier reliability. The analysis employed descriptive statistics, Pearson correlation analysis, one-way ANOVA, eta-squared effect sizes, risk-group comparisons, and supplier-reliability quartile analysis. The findings indicate that effective inventory management should not be considered independently of broader resilience capabilities. Higher operational performance is associated with stronger supplier reliability, improved logistics efficiency, reduced disruption exposure, and more effective risk-sensitive decision making. The integrated strategic decision score further demonstrates the value of combining resilience and operational sustainability within a unified managerial framework. Overall,

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the study shows that sustainable business performance depends on aligning inventory positioning with supplier capability, operational efficiency, and data-driven resilience strategies.

Keywords: Strategic inventory optimization; Supply-chain resilience; Supplier reliability; Operational sustainability; Sustainable business performance

1. Introduction

Today's supply chains are faced with growing uncertainty as a result of fluctuating demand, logistical disruptions, geopolitical pressures, supplier instability, and evolving customer expectations. Currently, inventory management is no longer a mere cost management function, but rather an important tool for product availability, continuity and responsiveness.

Furthermore, machine learning has enhanced the coordination of stock decisions by organizations, enabling them to make their choices more agile and in line with sustainability goals (Pasupuleti et al., 2024). Therefore, the relationship between inventory positioning and supply-chain resilience is becoming more pertinent for sustainable business performance. Supply-chain resilience is defined as the ability of a supply chain to predict, resist, respond to and recover from disruptions and continue with critical chain operations.

The COVID-19 pandemic showed that, in addition to having an extra buffer of resources, resilience is enabled by combining operational flexibility, lean practices and digitalization, to ensure continuity of business operations during a crisis (Trabucco & De Giovanni, 2021). This implies that inventory policies should be assessed in the context of other inventory issues, such as risk, supplier capacity, and operational responsiveness.

Structured decision-making processes that can combine several operational criteria are also very important for effective resilience. Considerable effort is needed to meet production continuity, resource allocation, resilience, and sustainability under uncertain operating conditions while simultaneously meeting these needs (Owida et al., 2022). This is especially relevant since there are several different considerations in making inventory decisions including lead times, disruption exposure, holding requirements, and stock availability. The era of technological development has also revolutionized the way supply-chain decisions are made.

Organizations have increasingly been provided with the opportunity to use advanced tools, such as Industry 4.0 and artificial intelligence, to process complex information from operations and to support multidimensional aspects of sustainability decisions (Streimikiene et al., 2025). Likewise, AI can boost resilience by optimizing resources, coordinating supply chains, recognizing disruptions, and predicting and managing them (Riad et al., 2024). The developments suggest that strategic inventory decisions are getting more and more dependent on integrated information instead of individual inventory measures. From a conceptual point of view, resilience and sustainability are not mutually exclusive goals for a supply chain. Integrated resilience-management framework can enable organizations to better prepare against operational shocks and mitigate long-term sustainability outcomes (Zavala-Alcivar et al., 2020).

This integration can be further facilitated through the use of predictive analytics which detects vulnerabilities and equips decision makers with predictive insights about the likelihood of disruption and operations risks (Adewusi et al., 2024). In situations where there is uncertainty regarding availability of inventory and/or operational needs, inventory management is particularly critical. It has been shown that supplier coordination, uncertainty management and supplier resilience in sustainable supply chains are valuable factors when dealing with robust inventory-based optimization (Lotfi et al., 2022). Likewise, in the context of supplier selection and order-allocation, sustainability and resilience should be considered together, as unreliable supplier relationship can undermine even a well-designed inventory system (Kayani et al., 2023). Resilience strategies should thus be assessed by quantifiable metrics beyond simply disruption recovery.

Operational, technological, sustainability and resilience-related KPIs offer a more holistic view of the preparedness of and performance of supply chains (Patidar et al., 2023). In data-driven contexts, other strategies for building resilience involve the systematic application of operational data to help anticipate, coordinate, and adaptively make decisions (Gani et al., 2023). At the management level, organizational flexibility is still crucial since the choice of the strategy must be flexible enough to meet the unpredictable and highly variable risk contexts (Settembre-Blundo et al., 2021).

The objective of the present study is to build an integrated view of strategic inventory optimization and supply-chain resilience and sustainable business performance. In particular, the study aims to consider inventory and risk characteristics, analyze the relationships between resilience-related indicators, analyze operational outcomes as they relate to low, moderate, and high-risk scenarios, compare the differences between supplier reliability and resilience and operational sustainability, and incorporate resilience and operational sustainability into a strategic decision-making process for supply-chain management.

2. Methodology

2.1 Research Design and Data Preparation

This study used a quantitative cross sectional analytical design to analyze strategic inventory management, supply chain risk, supplier reliability, resilience, operational sustainability

and strategic decision performance. The unit of

analysis in the study was an individual product-supplier supply-chain observation. The final analysis sample included 113,097 observations over multiple supplier and geographic contexts for supply-chain activities. The data were completed, checked for duplications, uniformity of variable format and appropriate numerical ranges prior to analysis (Natasha, 2025).

There was no duplication of observations found. There were no missing values for any of the variables used in the analyses, thus the entire sample (N113,097) was retained. There were no missing data points that were removed from the analysis, nor were any mean substitutions, interpolations, multiple imputations, etc. conducted on missing data. Product ID, supplier ID and supplier country were kept as identification and contextual variables and not entered as continuous analytical predictors. Risk classification was a categorical variable (low risk, moderate risk, and high risk).

2.2 Variable Definition and Construction

Warehouse inventory level, historical demand, inventory to demand ratio, inventory coverage percentage, and lead time were the strategic inventory conditions. The inventory-to-demand ratio was a measure of the amount of inventory as a percentage of the historical demand; inventory coverage was the ratio of inventory to the historical demand. Route risk level, disruption likelihood, delay probability, weather-condition severity, customs-clearance time and lead time were used to represent supply-chain risk. Supplier and logistics capability was mainly manifested as supplier reliability, availability of handling equipment, and cargo-condition status.

The disruption likelihood used to calculate risk classification. Disruption-likelihood values were grouped into low risk (<0.30), moderate risk (0.30 to <0.70) and high risk (≥0.70) categories. This yielded the three groups of the frequency distributions and risk-group comparisons presented. The supply-chain resilience score was built around nine equally weighted components: supplier reliability, handling

equipment availability, cargo-condition status,

severity of weather conditions, route risk, customs-clearance efficiency, likelihood of disruptions, delay probability, and lead-time efficiency. Adverse indicators were inverted or scaled to produce consistently better resilience conditions as the indicators increased. The final resilience measure was the mean of these nine components that directly correlated with the resilience score reported in the Results.

While measures like carbon emissions, energy consumption and waste generation were not available, operational sustainability was operationalized as an operational and economic sustainability indicator, rather than as a direct environmental sustainability measure. The operational sustainability score was made up of four equally weighted components: shipping-cost efficiency, order fulfilment status, delivery-time efficiency and supplier reliability. The shipping-cost and delivery-time measures were transformed to have higher values indicating better operational performance. These four components were thus represented in the denominator of the operational sustainability measure.

A strategic decision score was then developed by equalizing the importance of the supply-chain resilience score and the operational sustainability score. These two strategic dimensions were averaged to come up with the final score, and higher scores signified that the company's resilience and operational sustainability performance was stronger.

2.3 Descriptive and Correlation Analysis

Principal continuous variables reported in the Results were subjected to descriptive statistics. These comprised aspects such as warehouse inventory level, historical demand, inventory-to-demand ratio, inventory coverage percentage, lead time, supplier reliability, route risk level, disruption likelihood, delay probability, supply-chain resilience, shipping costs, order fulfilment status, delivery-time deviation, operational sustainability and strategic decision score.

The mean, standard deviation, minimum, median and maximum were computed for each continuous indicator. Data on risk classification

was summarized as frequencies and percentages.

100% of the 113,097 observations were the denominator for all reported percentages. Therefore, the low, moderate and high-risk observations were calculated as a percentage of the full sample, not as a percentage of a reduced sample or a specific subgroup. The two main performance outcomes were examined for their relationship with selected indicators of the supply chain using Pearson product-moment correlation analysis. Supplier Reliability, Inventory Coverage Percentage, Lead Time, Route Risk Level, Disruption Likelihood and Delay Probability were the predictors. Correlations were analyzed separately with the supply-chain resilience score and operational sustainability score.

The direction and strength of relationships were emphasized in the interpretation of the correlations. Due to the large sample size, practical significance was also given a high priority and not just statistical significance. There were no partial correlations, rank correlations or regression association measures applied.

2.4 Risk-Group Comparisons and Effect-Size Analysis

A comparison of observations across the pre-defined low, moderate and high-risk groups was used to determine if there was a difference in operational outcomes for groups of varying exposure to disruption. Group-specific means for the main outcomes from the Results were explored. One-way analysis of variance (ANOVA) was used for formal inferential testing whereby the grouping variable was the risk classification. One-way ANOVA models were used for supply-chain resilience score, operational sustainability score, order fulfilment status, shipping costs, and deviation in delivery time.

A p value $< .05$ was statistically significant. Due to the large sample size, statistically significant results were possible even if there was only a very small difference between groups, etasquared (eta2) was computed for each ANOVA to determine the percentage of total outcome variance accounted for by risk

classification. Interpretation thus considered not only the ANOVA probability value, but also the magnitude of the effect.

These procedures directly correspond to the reported comparisons demonstrating differences between resilience, operational sustainability, order fulfilment, shipping costs, and delivery-time deviation from the three risk categories.

2.5 Supplier-Reliability and Strategic Decision Analysis

The empirical distribution of supplier reliability was used to divide the observations into four quartile groups, further examining the reliability of suppliers. Groups represented were increasingly reliable suppliers from Q1 (the lowest quartile) to Q4 (the highest quartile). The number of observations per supplier-reliability quartile was calculated along with the mean supplier reliability, the mean operational sustainability score, the mean supply-chain resilience score and the mean strategic decision score.

A procedure was employed to test if there were an increase in supplier reliability being matched by a commensurate increase in operational and strategic supply-chain performance. All 113,097 observations used in the whole analytical sample for all statistical procedures. The final analytical strategy was thus only descriptive statistics, frequencies and percentages, Pearson correlations, risk-stratified descriptive comparisons, one-way ANOVA, effect-size estimation (eta-squared) and supplier-reliability quartile comparisons.

Linear regression, multiple regression, logistic regression, mediation, moderation, structural equation model or another regression-based model was not fitted nor reported. For this reason, regression coefficients, standardized beta coefficients, odds ratios, regression confidence intervals, R2, adjusted R2, fit indices, and hypothesis tests based on the regression model were not computed.

2.6 Ethical Considerations

The study used a publicly available secondary dataset with no direct human participation or personally identifiable information. Therefore, informed consent and ethical approval were not required. Data were analysed solely for academic purposes while maintaining transparency, confidentiality, and research integrity.

3. Results

3.1 Descriptive Profile and Supply-Chain Risk Distribution

A total of 113,097 observations were included in the final analysis, representing the entire supply chain. On average, the inventory in the warehouse was 300.38 units while the average demand was 6,019.93 units over the last 20 years (Table 1). This resulted in a mean inventory-to-demand ratio of 0.190 or an average inventory coverage of 19.04%. The average lead time was 5.22 days.

The supplier reliability for the observations averaged 0.501, which means it was around the midpoint of reliability. The average disruption likelihood was relatively high (0.803), and the average delay probability was 0.700. In turn, the average for overall supply-chain resilience was 0.411. The mean operational sustainability and strategic decision scores were 0.535 and 0.473, respectively. The size of the standard deviations in inventory and demand variables suggests significant variation in inventory positioning and requirements for operating across the observations of product-suppliers

Table 1. Descriptive Statistics of Principal Supply-Chain Variables

Variable	Mean	SD	Minimum	Median	Maximum
Warehouse inventory level	300.378	323.861	0.000	159.126	999.999
Historical demand	6,019.929	3,429.395	100.003	6,786.804	10,000.000
Inventory-to-demand ratio	0.190	0.682	0.000	0.032	9.889
Inventory coverage (%)	19.044	68.182	0.000	3.232	988.932
Lead time (days)	5.216	4.517	1.000	3.283	15.000
Supplier reliability score	0.501	0.354	0.000	0.503	1.000
Route risk level	6.997	3.237	0.000	8.376	10.000
Disruption likelihood	0.803	0.279	0.000	0.958	1.000
Delay probability	0.700	0.324	0.000	0.841	1.000
Supply-chain resilience score	0.411	0.109	0.041	0.409	0.859
Shipping costs	459.696	312.319	100.000	389.202	1,000.000
Order fulfilment status	0.601	0.346	0.000	0.682	1.000
Delivery-time deviation	5.171	4.159	-2.000	6.089	10.000
Operational sustainability score	0.535	0.175	0.004	0.535	0.993
Strategic decision score	0.473	0.111	0.100	0.474	0.857

As shown in Figure 1, the observations in this data set were predominantly high-risk. Specifically, 84,368 observations (74.60%) were classified as high risk, compared with 17,783 (15.72%) moderate-risk and 10,946 (9.68%) low-risk observations. Most high-risk cases suggest a high disruption exposure for the analyzed supply-chain context.

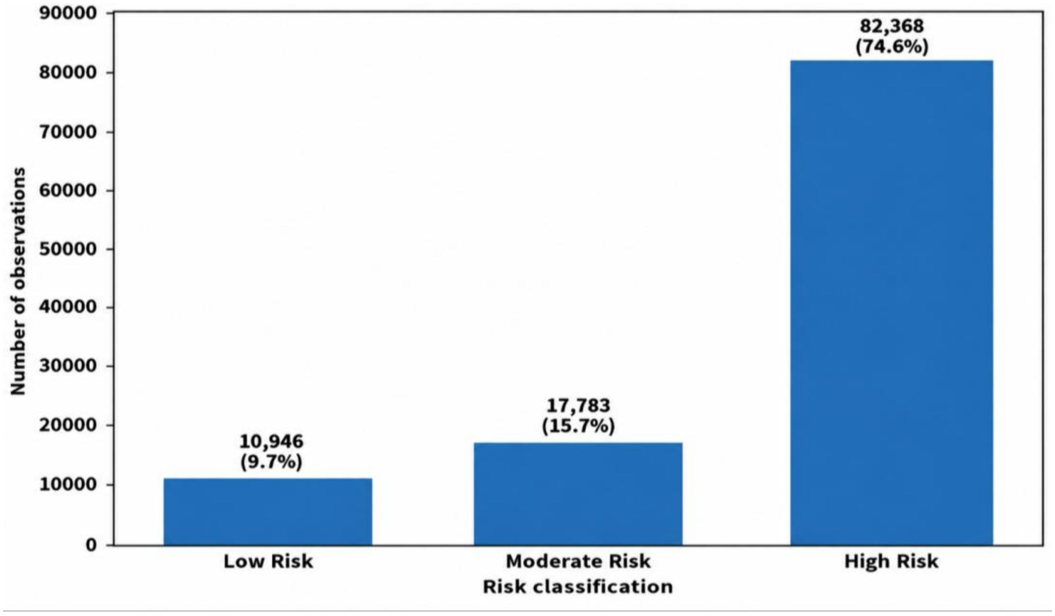

Figure 1. Distribution of Supply-Chain Risk Classification

3.2 Correlates of Supply-Chain Resilience and Operational Sustainability

Pearson correlation analysis was used to explore the links between principal inventory, supplier and risk indicators and the two primary performance outcomes. Supplier reliability had a moderate positive correlation with supply-chain resilience (r = 0.361) and a moderate strong positive correlation with operational sustainability (r = 0.507), as reported in Table 2.

This was the biggest association with operational sustainability of the indicators studied. There was a negative correlation between lead time and resilience (r = -0.331), so the longer the lead time was, the lower the resilience was. Similarly, route risk (r = -0.320), delay probability (r = -0.327) and disruption likelihood (r = -0.279) were negative. By contrast, there was very little linear relationship between inventory coverage and resilience (r = -0.003) or very little linear relationship between inventory coverage and operational sustainability (r = 0.012).

Table 2. Pearson Correlations with Supply-Chain Resilience and Operational Sustainability

Predictor	**Resilience score, r**	**Operational sustainability, r**
Supplier reliability score	0.361	0.507
Inventory coverage (%)	-0.003	0.012
Lead time (days)	-0.331	0.000
Route risk level	-0.320	0.005
Disruption likelihood	-0.279	-0.006
Delay probability	-0.327	-0.001

The relative magnitude and direction of the resilience correlations are shown in Figure 4. As illustrated in the figure, supplier reliability was the main positive correlate while lead time, delay probability, route risk and disruption likelihood were the key negative correlates. The results suggest that the service provider's ability and risk management abilities are closely related to resilience rather than to the amount of inventory coverage.

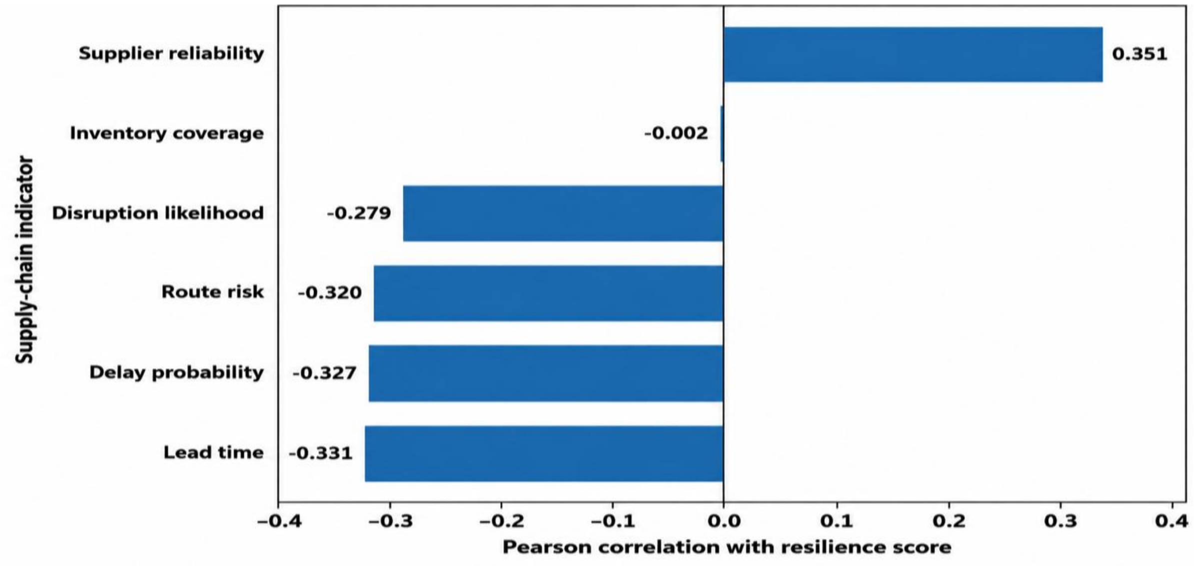

Figure 4. Key Correlates of Supply-Chain Resilience

3.3 Differences in Outcomes Across Supply-Chain Risk Groups

The risk stratified analysis showed distinct differences in resistance among the low risk, moderate risk and high-risk observations. Table 3 shows that the mean score for resilience decreased gradually across the low-risk, moderate-risk and high-risk groups: (0.481, 0.445 and 0.395 respectively). One-way (ANOVA) analysis indicated that there was a significant difference between the groups: F = 4,295.05, p < .001, eta2 = 0.071.

The variation in resilience due to risk classification was thus about 7.1% of the overall variation. However, operational sustainability did not change significantly among the risk categories, with means of 0.537, 0.536, and 0.535 for low-, moderate-, and high-risk observations, respectively. The difference was not found to be statistically significant (F = 1.43, p = .239) and was too small to be considered an effect size. No significant difference was found between the two risk groups regarding shipping costs or deviation in delivery time. Order fulfilment was found to differ statistically across risk groups (F = 8.12, p < .001), but the effect size (eta2 < 0.001) is extremely minimal. The results shown here illustrate why it is significant to separate statistical significance from practical size within the context of this rather small data set.

Table 3. Risk-Group Means and One-Way ANOVA Results

Outcome	Low Risk Mean	Moderate Risk Mean	High Risk Mean	F	p	eta2
Supply-chain resilience	0.481	0.445	0.395	4,295.05	<.001	0.071
Operational sustainability	0.537	0.536	0.535	1.43	.239	<0.001
Order fulfilment	0.601	0.611	0.599	8.12	<.001	<0.001
Shipping costs	461.561	461.016	459.176	0.47	.625	<0.001

Outcome	Low Risk Mean	Moderate Risk Mean	High Risk Mean	F	p	eta2
Delivery-time deviation	5.099	5.183	5.177	1.81	.164	<0.001

The differences between the resilience and operational sustainability of each risk category are graphically illustrated in Figure 2. Operational sustainability varies little with increased risk, while the resilience decreases in steps. This indicates that the exposure of disruptions is a significant factor in the built resilience measure, and other factors beyond the risk classification are also important for the operational sustainability measure.

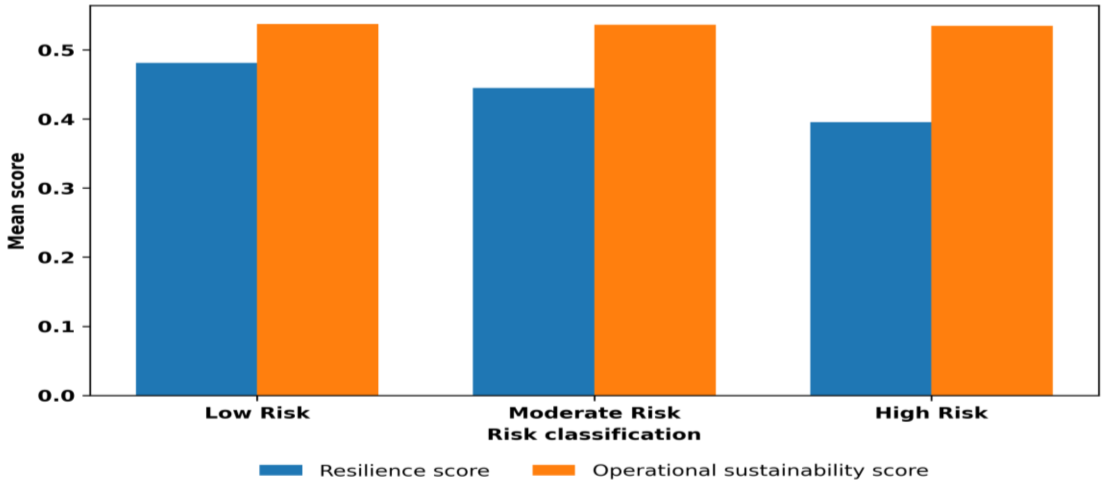

Figure 2. Mean Resilience and Operational Sustainability by Risk Group

3.4 Supplier Reliability and Strategic Performance

Supplier reliability was split into four empirical quartiles to further assess the ability of suppliers. Table 4 shows that the greater the level of supplier reliability, the more sustainable the operation. The operational sustainability rose from 0.420 in the lowest quartile of reliability up to 0.647 in the highest quartile of reliability, 0.489 in Q2, 0.584 in Q3. Similar pattern was seen for supply-chain resilience, which increased from 0.361 in Q1 to 0.461 in Q4.

Strategic decision performance also jumped significantly, from 0.391 for the least reliable suppliers to 0.554 for the most reliable suppliers. These results also support the correlation results and suggest that supplier reliability is an important operational feature which is related to resilience and sustainable performance.

Table 4. Supply-Chain Performance Across Supplier-Reliability Quartiles

Supplier reliability quartile	n	Mean supplier reliability	Mean operational sustainability	Mean resilience	Mean strategic decision score
Q1 - Lowest	28,276	0.049	0.420	0.361	0.391
Q2	28,277	0.314	0.489	0.391	0.440
Q3	28,274	0.690	0.584	0.432	0.508
Q4 - Highest	28,270	0.949	0.647	0.461	0.554

Figure 3 clearly shows the progressive step-up in operational sustainability by the reliability quartiles. The almost monotonic increase shows that supplier reliability is much more informative for operational sustainability than inventory coverage alone. Overall, the findings indicate that optimum performance of strategic supply chains relies on linking inventory and supplier performance in terms of supplier quality, lead-time performance, disruption management and overall resilience rather than on holding more inventory to the detriment of the other attributes.

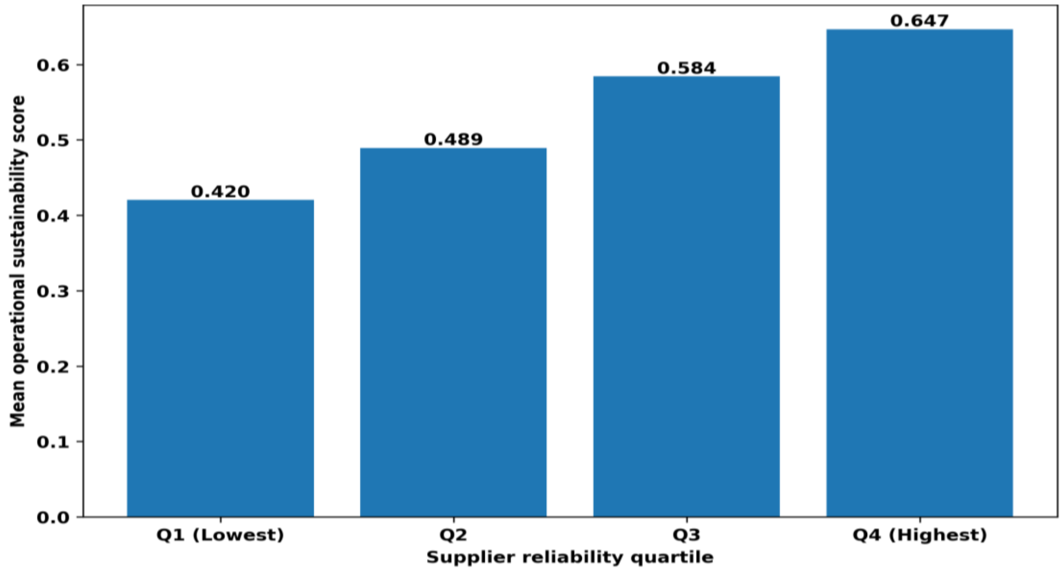

Figure 3. Operational Sustainability Across Supplier-Reliability Quartiles

4. Discussion

The results from the present study support the hypothesis that strategic inventory management should be viewed as a component of a broader resilience architecture as opposed to a single-step approach for either maximizing or minimizing inventory. While inventory levels

and inventory coverage offer a key operational certainty, they also enable a strategic cushion that is reliant on the interdependency of supplier reliability, lead time efficiency, disruption exposure, and logistics performance.

This interpretation aligns with the argument

that strategic inventory can enhance the resilience when there is an explicit link between inventory policy and disruption preparedness and continuity requirements (Rachid et al., 2025). The observed relevance of supplier-related capability is of special relevance. By minimizing the uncertainty of material availability, fulfilment and ability to recover in the event of a disruption, reliable suppliers help ensure continuity. But there needs to be managerial coordination and organizational leadership that enhances supplier reliability as well because resilience requires people and supply-chain partners to respond cohesively in uncertain times (Clottey, 2025).

The supplier-reliability quartile comparison used for this study is therefore an important managerial view as it directly links supplier performance to operational sustainability. The resilience framework also illustrates the benefits of combining various risk and capability measurements. Digital intelligence can complement this process and support its improvement by providing better visibility, information processing, forecasting and adaptive responses across the supply chain (Wu et al., 2025). The current supplier reliability settings for your route, the risk of disruptions, the probability of delay, the efficiency of customs clearance, weather conditions and the efficiency of your lead-time are also all contributing factors to supplier resilience, rather than a single operational outcome.

The multi-dimensional perspective is aligned with the new Supply Chain 5.0 visions that include decision models that can achieve a balance between resilience, sustainability, technological capability, and performance of the enterprise (Ismail et al., 2024). Additionally, it offers evidence that smart supply-chain capabilities have a positive impact on sustainable business performance when they offer greater agility and resilience than just focusing on short-term efficiencies (Sharma et al., 2025). The connection between an inventory decision and resilience needs to be taken with a grain of salt, however. Reliable suppliers, short lead times, low route exposure, and low probabilities of disruptions cannot be made up for with a high inventory availability that is kept indefinitely. Thus, the process of making decisions becomes the key mechanism in the process of transferring forecasting, information technology, inventory optimization, and resilience capabilities into operational results (Ghaleb & Shamansurova, 2025).

This complements the current study's combined approach of resilience and operational sustainability for one strategic decision score. In addition, risk-stratified comparisons are of practical value when assessing operational results as they enable managers to determine if there is a systematic decline in result as the level of disruption rises. Artificial-intelligence based resilience frameworks also focus on identifying vulnerabilities proactively, and supporting decision-making as opposed to recovery post-disaster (Belhadi et al., 2022). In highly uncertain contexts, fuzzy and multi-criteria approaches have also demonstrated that decisions on resilience should be made based on the consideration of several uncertain factors of the supply chain (Rehman & Ali, 2022).

The implications are not just for the very extraordinary situations. Research during the pandemic showed that resilient strategies can help to maintain the performance of the supply chain even in the face of a major and lasting disruption, highlighting the need to prepare in advance for disruption (Sharma et al., 2021). Designing a sustainable network also needs to take account of resilience aspects from the beginning in sourcing, distribution, and inventory planning (Zarei-Kordshouli et al., 2023). Another significance to the role of performance measurement is also relevant.

Use of resilience and operational sustainability scores recognizes that inventory quantities are not enough to represent performance in the supply-chain. The need to establish clear resilience indicators linking preparedness at the operational level to preparedness at the strategic level has been growing over time. Resilience management can also be integrated with business responses and with longer-term organisational goals, to support resilience management strategies (Shashi et al., 2020). In the end, the results lead to a data-based supply-chain decision-making approach. Combining inventory, risk, supplier, logistics and operational measures quantitatively, can give a more solid basis for prioritizing interventions than individual measures will. Other data-driven decision-making models have proven the value of using operational information and sustainability metrics to assess complex supply-chain decisions (Beinabadi et al., 2024).

The study shows that, on an overall level, sustainable business performance is more likely to develop when inventory optimization is aligned with supplier reliability, risk management, resilience capability and operational efficiency, and thus moves beyond the simple stock-control function to take on an integrated strategic decision-making process.

5. Conclusion

With the view of inventory optimization as a distinct stock control function, this study shows that strategic inventory optimization is the best achieved when combined with supply-chain resilience, supplier reliability, risk management and operational sustainability. The analysis of 113,097 observations in the supply chain offered a wide empirical foundation to explore how each of the inventory coverage, lead time, disruption likelihood, route risk, delay probability, supplier reliability, and logistics efficiency affects the resilient and sustainable operational performance. The results indicate that it's not enough to have an inventory if the situation is uncertain. Coordinated decision making, supported by the right stock positioning, credible suppliers, decreased disruption exposure, rapid lead times and enhanced operational responsiveness are key to better performance. The adoption of risk-group comparisons and supplier-reliability quartiles is another example that demonstrates the need to differentiate between different degrees of vulnerability in the supply-chain when planning strategic interventions. The study's ability to merge the concepts of resilience and operational sustainability, and create a single strategic decision score, provides a practical framework for providing support for evidence-based supply-chain management. The framework can help managers to determine vulnerabilities, prioritize actions to increase resilience, and weigh the availability of inventory against operational efficiency. In general, when inventory management decisions are integrated with a more holistic approach to resilience and risk management throughout the value chain, sustainable business performance is improved.

References

Adewusi, A. O., Komolafe, A. M., Ejairu, E., Aderotoye, I. A., Abiona, O. O., & Oyeniran, O. C. (2024). The role of predictive analytics in optimizing supply chain resilience: A review of techniques and case studies. International Journal of Management & Entrepreneurship Research, 6(3), 1686-1697.

Beinabadi, H. Z., Baradaran, V., & Komijan, A. R. (2024). Sustainable supply chain decision-making in the automotive industry: A data-driven approach. Socio-Economic Planning Sciences, 95, 101908.

Belhadi, A., Kamble, S., Fosso Wamba, S., & Queiroz, M. M. (2022). Building supply-chain resilience: An artificial intelligence-based technique and decision-making framework. International Journal of Production Research, 60(14), 1686-1697.

Clottey, F. A. (2025). The role of strategic leadership in strengthening team performance and supply chain resilience for business growth. IPHO-Journal of Advance Research in Business Management and Accounting, 3(07), 1686-1697.

Gani, M. O., Yoshi, T., & Rahman, M. S. (2023). Optimizing firm's supply chain resilience in data-driven business environment. Journal of Global Operations and Strategic Sourcing, 16(2), 1686-1697.

Ghaleb, M. M. S., & Shamansurova, Z. (2025). Inventory management optimization via forecasting, IT infrastructure, technology integration, and supply chain resilience: Exploring the mediating role of decision-making effectiveness. Decision Making: Applications in Management and Engineering, 8(1), 1686-1697.

Ismail, M. M., Ahmed, Z., Abdel-Gawad, A. F., & Mohamed, M. (2024). Toward supply chain 5.0: An integrated multi-criteria decision-making models for sustainable and resilience enterprise. Decision Making: Applications in Management and Engineering, 7(1), 1686-1697.

Kayani, S. A., Warsi, S. S., & Liaqait, R. A. (2023). A smart decision support framework for sustainable and resilient supplier selection and order allocation in the pharmaceutical industry. Sustainability, 15(7), 5962.

Lotfi, R., Kargar, B., Rajabzadeh, M., Hesabi, F., & Ozceylan, E. (2022). Hybrid fuzzy and data-driven robust optimization for resilience and sustainable health care supply chain with vendor-managed inventory approach. International Journal of Fuzzy Systems, 24(2), 1686-1697.

Majalekar, S., Dhamodaran, S., Thenmozhi, R., Agrawal, M. K., Sharma, A. K., & Hirlekar, V. (2026). An AI-driven blockchain framework for enhancing cybersecurity and fraud detection in FinTech platforms. Journal of Intelligent Decision Making and Information Science, 3(5s), 1634–1646.

Natasha0786. (2025). Supply chain dataset [Data set]. Kaggle. Kaggle dataset

Owida, A., Galal, N. M., & Elrafie, A. (2022). Decision-making framework for a resilient sustainable production system during COVID-19: Evidence-based research. Computers & Industrial Engineering, 164, 107905.

Pasupuleti, V., Thuraka, B., Kodete, C. S., & Malisetty, S. (2024). Enhancing supply chain agility and sustainability through machine learning: Optimization techniques for logistics and inventory management. Logistics, 8(3), 73.

Patidar, A., Sharma, M., Agrawal, R., & Sangwan, K. S. (2023). Supply chain resilience and its key performance indicators: An evaluation under Industry 4.0 and sustainability perspective. Management of Environmental Quality: An International Journal, 34(4), 1686-1697.

Rachid, M., Abderrahmane, B. K., Hassan, M., & Abdelmajid, E. (2025). Enhancing supply chain resilience through strategic inventory. Supply Chain Management in Modern Manufacturing, 71.

Rawat, G., Agrawal, M., Singh, C. S., Singh, S. K., Soni, K., Assumi, K. H., & Singh, N. K. (2025). Cultural identity in a globalized world: A sociological study of youth and media consumption. Scientific Culture, 11(4), 205.

Rehman, O. U., & Ali, Y. (2022). Enhancing healthcare supply chain resilience: Decision-making in a fuzzy environment. The International Journal of Logistics Management, 33(2), 1686-1697.

Riad, M., Naimi, M., & Okar, C. (2024). Enhancing supply chain resilience through artificial intelligence: Developing a comprehensive conceptual framework for AI implementation and supply chain optimization. Logistics, 8(4), 111.

Settembre-Blundo, D., Gonzalez-Sanchez, R., Medina-Salgado, S., & Garcia-Muina, F. E. (2021). Flexibility and resilience in corporate decision making: A new sustainability-based risk management system in uncertain times. Global Journal of Flexible Systems Management, 22(Suppl 2), 1686-1697.

Sharma, M., Antony, R., Sharma, A., & Daim, T. (2025). Can smart supply chain bring agility and resilience for enhanced sustainable business performance? The International Journal of Logistics Management, 36(2), 1686-1697.

Sharma, M., Luthra, S., Joshi, S., & Kumar, A. (2021). Accelerating retail supply chain performance against pandemic disruption: Adopting resilient strategies to mitigate the long-term effects. Journal of Enterprise Information Management, 34(6), 1686-1697.

Shashi, Centobelli, P., Cerchione, R., & Ertz, M. (2020). Managing supply chain resilience to pursue business and environmental strategies. Business Strategy and the Environment, 29(3), 1686-1697.

Streimikiene, D., Bathaei, A., & Streimikis, J. (2025). Enhancing sustainable global supply chain performance: A multi-criteria decision-making-based approach to Industry 4.0 and AI integration. Sustainability, 17(10), 4453.

Trabucco, M., & De Giovanni, P. (2021). Achieving resilience and business sustainability during COVID-19: The role of lean supply chain practices and digitalization. Sustainability, 13(22), 12369.

Wu, H., Li, G., & Zheng, H. (2025). How does digital intelligence technology enhance supply chain resilience? Sustainable framework and agenda. Annals of Operations Research, 355(1), 1686-1697.

Zarei-Kordshouli, F., Paydar, M. M., & Nayeri, S. (2023). Designing a dairy supply chain network considering sustainability and resilience: A multistage decision-making framework. Clean Technologies and Environmental Policy, 25(9), 1686-1697.

Zavala-Alcivar, A., Verdecho, M. J., & Alfaro-Saiz, J. J. (2020). A conceptual framework to manage resilience and increase sustainability in the supply chain. Sustainability, 12(16), 6300.