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Calibration of Managerial Resilience Strategies in Anticipating Global Supply Chain Disruptions within Export-Oriented Manufacturing Firms

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ABSTRACT

The global export manufacturing landscape is currently navigating a state of "polycrisis," where systemic supply chain disruptions pose an existential threat to organizational endurance. This research addresses the critical need for "Managerial Resilience Calibration" a process of precision-tuning organizational strategies based on real-time data to safeguard export continuity. Utilizing a longitudinal quantitative approach, this study analyzes secondary data from 78 export-oriented manufacturing firms listed on the Indonesia Stock Exchange (IDX), integrated with macro-logistical reports from the Central Bureau of Statistics (BPS) and the Ministry of Industry (2021–2024). The results indicate that firms implementing "Active Calibration" characterized by a Resilience Investment Ratio (RIR) exceeding 20% and a Supplier Concentration Index (HHI) below 0.40 maintained 30% higher export stability compared to those following static, cost-centric paradigms. Statistical testing further validates that technological investment and geographical supplier diversification are significant predictors of export resilience ($R^2 = 0.624$). This study concludes that a shift from pure cost-efficiency toward resilience-based effectiveness is mandatory for international competitiveness. These findings advance the dynamic capabilities framework by quantifying the calibration mechanism through empirical corporate performance.

Keywords: Managerial Resilience; Supply Chain Disruption; Export Manufacturing; Strategic Calibration; Dynamic Capabilities; Global Logistics.

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1. Introduction

The contemporary global manufacturing landscape is currently navigating a state of "polycrisis," characterized by overlapping disruptions ranging from geopolitical tensions to systemic logistical failures. For manufacturing firms within the export sector, these challenges represent far more than routine market fluctuations; they constitute an existential threat to the integrity of global supply chains. In this context, managerial resilience has evolved into a critical strategic capability that necessitates continuous "calibration" a process of precision-tuning organizational strategies based on real-time data parameters. This ensures that an organization possesses not only the absorptive capacity to withstand shocks but also the adaptive agility to outpace market volatility. The significance of this study is rooted in the urgent requirement to redefine how managerial decision-making is calibrated amidst unprecedented uncertainty to preserve international market share [1].

Recent disruptive events have exposed the fundamental fragility of the lean manufacturing paradigm and the "just-in-time" strategy once considered gold standards. According to official data from the Central Bureau of Statistics (BPS) in the report "Indonesian Export and Import Developments," the manufacturing sector has faced severe pressure due to escalating global logistics costs and volatile producer price indices. Fluctuations in manufacturing export values, which have reached uncertainty thresholds of 15% in specific quarters, indicate that static resilience strategies are no longer sufficient. Managers are now compelled to calibrate their dependency ratios on single-source suppliers [2]. Recent literature in the text *Supply Chain Resilience* emphasizes that resilience must be viewed as a dynamic function of visibility, flexibility, and collaboration [3]. Without precise calibration of these elements, export-oriented manufacturing firms risk becoming ensnared in massive cost inefficiencies whenever global shipping lanes encounter bottlenecks [4].

In a more profound context, the operational behavior of manufacturing firms listed on the Indonesia Stock Exchange (IDX) reveals compelling adaptation patterns within their *Management Discussion & Analysis* (MD&A) reports [5]. Secondary data from the annual reports of consumer goods and basic industry issuers indicate a significant shift in

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capital allocation; approximately 20% to 30% of operational budgets are now being redirected toward strengthening strategic inventories and diversifying cross-border vendors. This strategic calibration is executed to mitigate the "bullwhip effect," which has been exacerbated by logistical disruptions [6]. Future supply chains must pivot from a pure cost-efficiency focus toward "resilience-based effectiveness." This shift triggers a critical managerial debate: to what extent should firms sacrifice short-term profit margins to construct a robust resilience fortress capable of maintaining competitiveness in the export market [7].

This disruptive phenomenon is further reflected in data from the Ministry of Industry via the Industrial Confidence Index (IKI). IKI metrics consistently demonstrate that manufacturing sub-sectors with high export intensity exhibit greater vulnerability to imported raw material availability compared to domestically-oriented industries. Consequently, managerial calibration must integrate digital technologies such as the *Internet of Things* (IoT) and AI to enhance supply chain transparency [8]. "Dynamic capabilities" within top management are essential for rapidly reconfiguring corporate assets during tectonic shifts in the global economy. A failure in calibration to detect market signals can result in the loss of long-term export contracts, which subsequently impacts national GDP growth [9].

Ultimately, this article aims to investigate the internal mechanisms through which managers calibrate their resilience strategies by leveraging validated secondary data from authoritative institutions. Through a comprehensive analysis of macro and micro trends, this research will delineate how supplier diversification, logistical cost adjustments, and the utilization of real-time data serve as the primary pillars in anticipating global supply chain disruptions. The conclusions drawn from this study are intended to provide a theoretical and practical framework for decision-makers in the export manufacturing sector to balance organizational resilience with economic sustainability in an increasingly unpredictable world.

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2. Materials and Method

The study employs an explanatory quantitative approach using a longitudinal secondary data design. This approach enables systematic observation of managerial calibration behaviors across multiple reporting periods, ensuring analytical robustness and temporal validity. Data were extracted from audited corporate disclosures and authoritative national databases to ensure reliability and replicability.

Population, Sampling, and Data Sources

The research population comprises all manufacturing firms listed on the Indonesia Stock Exchange (IDX) across the Industrials, Consumer Non-Cyclicals, and Basic Materials sectors, totaling 218 firms. Purposive sampling was applied to identify firms with significant export orientation, based on the following criteria: (i) export revenue constituting at least 30% of total operating income; (ii) availability of complete annual and sustainability reports with MD&A disclosures; and (iii) audited financial statements with unmodified opinions. This process yielded a final sample of 78 firms, representing a substantial proportion of Indonesia's manufacturing export volume [10,11].

Secondary Data Collection Procedures and Source Inventory

Data acquisition was performed through electronic documentation methods and systematic searches of official databases. The data were categorized into three distinct levels of analysis:

- Macro Level (Global & National): Utilizing the Central Bureau of Statistics (BPS) database, specifically the "Foreign Trade Statistics" and "Wholesale Price Index" reports. Extracted data points include the volatility of global manufacturing input prices and average port dwelling times as proxies for logistical disruption.
- Meso Level (Sectoral): Leveraging datasets from the Ministry of Industry regarding the Industrial Confidence Index (IKI) to quantify aggregate managerial sentiment toward raw material supply stability.
- Micro Level (Corporate): Accessing the IDXNet system to retrieve raw data from corporate annual filings. Variables extracted include *Cost of*

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Goods Sold (COGS), inventory turnover ratios, CAPEX allocations for digitalization, and the count of cross-border supplier partnerships.

Operationalization of "Managerial Resilience Strategy Calibration"

Calibration is measured through the development of a composite index consisting of four primary variables adapted from the theory of *Supply Chain Dynamic Capabilities* (Teece, 2020):

1. Resilience Investment Ratio (RIR): The percentage of investment in supply chain technologies (AI, IoT) relative to the firm's total capital expenditure.
2. Supplier Geographic Diversification (SGD): A supplier concentration index calculated using the *Herfindahl-Hirschman Index* (HHI) to determine the degree of dependence on specific geographic regions.
3. Logistics Buffer Calibration (LBC): Adjustments in safety stock levels compared to the fluctuation trends of global maritime logistics costs.
4. Agility Lead Time (ALT): The speed of managerial response in rerouting supply chains, identified through content analysis of narrative disclosures in sustainability reports.

Data Analysis Techniques and Statistical Testing

The data were analyzed using multiple linear regression and path analysis to examine the impact of strategy calibration on export performance. The testing procedures included:

- Classical Assumption Tests: Including normality, multicollinearity, heteroscedasticity, and autocorrelation tests to ensure the regression model satisfies the *Best Linear Unbiased Estimator* (BLUE) criteria.
- Hypothesis Testing: Utilizing T-tests (partial) and F-tests (simultaneous) with a significance level α of 5%.
- Digital Content Analysis: Employing text analysis software to quantify the urgency of resilience themes within corporate MD&A reports.

All procedures were conducted transparently and in accordance with international research protocols to ensure that findings can be replicated by subsequent researchers using identical datasets from public domain databases.

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3. Result

Strategic Discoveries: The Paradigm Shift in Resilience Investment

An exhaustive analysis of the Management Discussion & Analysis (MD&A) sections within the Indonesia Stock Exchange (IDX) filings reveals a pivotal shift: manufacturing entities have largely moved away from pure cost-efficiency models. The average Resilience Investment Ratio (RIR) among the sampled firms reached 18.45%, with the Industrials sector recording the highest allocation at 22.15%. This indicates that managers are actively calibrating by redirecting capital expenditures from physical production expansion toward reinforcing digital infrastructures to achieve end-to-end supply chain visibility.

Table 1. Managerial Resilience Strategy Calibration Matrix Based on Secondary Data

Managerial Calibration Indicators	Basic Materials	Industrials	Consumer Non-Cyclicals	Sample Average
Resilience Investment Ratio (RIR) (%)	14.20	22.15	19.00	18.45
Supplier Diversification (HHI Index)	0.52	0.38	0.36	0.42
Safety Stock Buffer (Days)	45.00	60.00	30.00	45.00
Disruption Response Speed (Days)	12.50	08.20	05.40	08.70
Logistics Cost Volatility (%)	15.30	18.40	11.20	14.97
Export Performance Growth (%)	05.20	12.40	08.15	08.58

Source: Processed Secondary Data from IDX Annual Reports and Sectoral Statistics (2024)

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Operational Impact Findings: Correlation of BPS and IKI Data

This research identifies a linear relationship between port dwelling time data from the Central Bureau of Statistics (BPS) and managerial confidence levels. When dwelling times exceeded the threshold of 5.2 days, firms categorized under "Precision Calibration" automatically activated dual-sourcing schemes. This finding is corroborated by the Ministry of Industry through the Industrial Confidence Index (IKI), where manufacturing sub-sectors that diversified suppliers geographically (HHI < 0.40) consistently remained in the expansive zone with an average score of 52.40, while firms with static strategies regressed into the contraction zone (47.15). Furthermore, BPS data indicates that firms performing logistics route calibration managed to mitigate maritime shipping cost spikes up to 25% more effectively than their inflexible counterparts. These results confirm that strategy calibration is not merely a survival tactic but a method for cost optimization amidst crisis.

Inferential Analysis: Validity of Managerial Calibration

Multiple linear regression analysis was performed on the calibration variables to validate the significance of these findings. The statistical test produced a value of $F(3,74) = 14.582$; $p < 0.001$, signifying a high level of simultaneous model validity.

Table 2. Partial Significance Test Results for Calibration Strategies

Independent Variable	Coefficient (β)	t-Statistic	Significance (p)	Interpretation
Technology Investment (RIR)	0.385	4.120	0.000	Highly Significant
Vendor Diversification (SGD)	-0.412	-4.567	0.000	Highly Significant
Logistics Buffer (LBC)	0.295	3.450	0.001	Significant
Organizational Resilience	0.150	2.115	0.037	Significant

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Coefficient of Determination (R^2)	0.624

Source: Statistical Analysis Results Based on Audited Reports (2024)

An $R^2 = 0.624$ suggests that 62.40% of the stability in corporate export performance is influenced by the precision with which managers calibrate three primary aspects: technological investment, supplier diversification, and logistics buffer management. This serves as empirical evidence that resilience is the product of measurable managerial actions rather than market fortuity.

In-Depth Managerial Behavior Insights (MD&A)

Narrative analysis of the 78 MD&A reports demonstrates that 92% of export-oriented manufacturing firms have integrated "Supply Chain Risk" as a top-tier priority within their corporate risk management frameworks. A crucial emerging trend is "Regionalization," where managers calibrate by shifting supplier bases from distant global partners to closer regional counterparts to reduce lead times by up to 30%. While these calibration decisions occasionally increase unit costs by 2.5% to 4.0%, they have proven effective in guaranteeing the continuity of export deliveries without significant impediments during global logistical crises.

4. Discussion

The empirical evidence presented in this study strongly suggests that the calibration of resilience strategies is not merely a reactive defense mechanism but a fundamental reconfiguration of dynamic capabilities that dictates export competitiveness. The finding that technology investment (RIR) and supplier diversification (SGD) significantly influence export stability reinforces the argument that supply chain management has transitioned from linear paradigms toward adaptive, network-based frameworks. Overall, the findings demonstrate that managerial resilience calibration operationalized through technological investment, supplier diversification, and logistics buffer adjustments—significantly enhances export stability by strengthening firms' dynamic

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capabilities in responding to global supply chain disruptions. Specifically, firms that actively recalibrate their strategies achieve superior adaptability, operational continuity, and competitive endurance in volatile international markets.

Technological Calibration and Supply Chain Transparency

The significant impact of the Resilience Investment Ratio (RIR), evidenced by $t = 4.120$; $p < 0.001$, aligns with the theoretical propositions of Ivanov (2021), who identifies digitalization as a non-negotiable prerequisite for modern resilience. Investing in Artificial Intelligence (AI) and the Internet of Things (IoT) empowers managers to perform "real-time calibration" against logistical bottlenecks. Secondary data from the IDX indicates that firms adopting integrated digital systems exhibit a 30% faster response rate when rerouting shipments following disruptions at major ports. This confirms that technology is no longer an operating expense but a strategic asset that mitigates information asymmetry within global supply networks [12].

The Efficiency vs. Resilience Paradox: A Diversification Analysis

A pivotal finding of this research is the inverse relationship between the HHI index and resilience; specifically, higher supplier diversification (lower HHI scores) correlates with enhanced export stability. This directly challenges traditional single-sourcing models often favored for their cost-efficiency. Christopher (2022) argues that in an era of volatility, efficiency devoid of resilience constitutes a hidden vulnerability. Data from the Ministry of Industry corroborates this: sub-sectors heavily reliant on a single geographic region for raw materials suffered the most profound contractions during regional geopolitical crises or lockdowns. While calibration through vendor diversification introduces management complexity, it provides an "operational insurance" that ensures export continuity [13].

Dynamic Capabilities and Managerial Responsiveness

The integration of BPS macro-data regarding port dwelling times with corporate micro-data on safety stocks reveals the functioning of dynamic

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capability mechanisms. Consistent with the framework by Teece (2020), successful managers are those capable of "sensing" shifts in official logistics data and immediately "reconfiguring" inventory levels. The observation that firms with active calibration cycles experience significantly lower performance volatility proves that the ability to adjust strategies with precision is a tangible form of managerial agility. The broader implication is that national export policies must be underpinned by logistical data transparency accessible to manufacturing stakeholders.

Regionalization and the Future of Export Supply Chains

The emerging trend toward "Regionalization" or "Near-shoring" documented in corporate MD&A reports indicates that strategic calibration also involves a geographical shift in trade orientation. Choi (2021) notes that reducing the physical distance of the supply chain is one of the most effective methods for dampening maritime logistics risks. Indonesian manufacturing exporters that have begun sourcing raw materials from within the ASEAN bloc demonstrate more stable endurance. Although per-unit costs may rise, the stability of the supply ensures that international contracts remain intact, which is more profitable in the long term than chasing thin margins at the risk of delivery failures.

Limitations and Directions for Future Research

This study is limited by its reliance on publicly available secondary data, which may not fully capture internal nuances such as organizational culture during crises. Future research should consider a mixed-methods approach, combining secondary datasets with primary surveys to evaluate the psychological dimensions of managerial decision-making. Furthermore, investigating the role of "Green Supply Chains" in bolstering long-term resilience is highly relevant, given the tightening of global environmental regulations for manufactured export products.

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5. Conclusions

Conclusion

This study concludes that the sustainability of manufactured export performance under global volatility is fundamentally driven by the precision of managerial strategy calibration. Firms that actively recalibrate their operational strategies through technological investment and supplier network diversification exhibit superior export stability, highlighting a strategic shift from traditional cost-efficiency toward resilience-based effectiveness. This transformation underscores the central role of adaptive managerial decision-making in sustaining international competitiveness.

By empirically operationalizing the concept of managerial calibration, this research advances the dynamic capabilities framework and provides robust evidence linking strategic responsiveness to tangible export outcomes. The findings further demonstrate that resilience represents a continuous process of organizational realignment in response to evolving market signals and macro-logistical dynamics, rather than a static defensive posture. Nevertheless, the generalizability of these results remains limited due to the focus on large publicly listed manufacturing firms, which may possess greater financial and technological resources than small and medium-sized enterprises. Moreover, reliance on publicly available secondary data introduces potential time-lag effects and constrains the capture of deeper organizational and behavioral dynamics.

Suggestions and Recommendations

Based on the findings, export-oriented manufacturing firms should integrate real-time logistical data into strategic planning and shift toward diversified regional sourcing to mitigate global supply chain risks. Policymakers are encouraged to establish a unified inter-agency data platform to support rapid, evidence-based decision-making, while future research should explore the predictive role of Artificial Intelligence (AI) and conduct comparative sectoral analyses to further advance supply chain resilience strategies.

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