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Responsiveness and supply chain performance: A hierarchical capability perspective

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Background: Supply chain performance increasingly depends on transport responsiveness and effective coordination across interconnected value-chain activities. Rising uncertainty, cost pressures and customer expectations have intensified the need to understand how transport-related operational indicators shape overall supply chain performance from a strategic operations perspective.

Objectives: This study examines the extent to which transport responsiveness and key operational capabilities, namely lead time, supplier performance, manufacturing cost, transportation cost and inventory level are associated with supply chain performance outcomes.

Method: A quantitative research design was adopted using the publicly available 'Supply chain analysis dataset'. Descriptive statistics, Pearson correlation analyses and multivariate regression models were employed to analyse the relationships between operational indicators and a composite supply chain performance index capturing delivery timeliness, cost efficiency and fulfilment accuracy. Robustness checks were conducted using alternative model specifications.

Results: Lead time emerged as the most significant determinant of supply chain performance and was strongly negatively associated with performance outcomes. Supplier rating and manufacturing cost were also statistically significant predictors, whereas transportation cost and inventory level showed no significant effects. Diagnostic tests confirmed the stability of the estimated relationships.

Conclusion: The study contributes to the transport and supply chain management literature by examining the role of transport responsiveness in shaping performance outcomes.

Contribution: By integrating the resource-based view, dynamic capabilities and supply chain integration perspectives, this study advances a capability-based explanation of supply chain performance and provides actionable insights for logistics managers, transport planners and other stakeholders.

Keywords: transport responsiveness; supply chain performance; lead time; supplier performance; dynamic capabilities; resource-based view; supply chain integration; data-driven analysis.

Introduction

Supply chains have become increasingly complex as global markets expand, customer expectations rise, and competitive pressures intensify (Christopher 2016; Roh & Xiao 2024). In response, the strategic management of supply chains has evolved beyond cost minimisation towards a more integrated approach emphasising agility, resilience, digitalisation, and long-term sustainability (Bag 2025; Miceli et al. 2021). Firms increasingly recognise that operational capabilities – such as inventory accuracy, lead-time reduction, supplier responsiveness, and demand forecasting – represent strategically valuable resources that can generate sustained competitive advantage (Mohaghegh et al. 2025; Pal, Ganguly & Chaudhuri 2024). This view aligns with the resource-based view (RBV), which posits that firm-specific operational routines and capabilities enhance performance when they are valuable, rare, inimitable, and non-substitutable (Barney 1991; Eryarsoy et al. 2022).

Recent global disruptions – including geopolitical instability, market volatility, and climate-related uncertainty – have further reinforced the importance of strategic supply chain management by exposing structural vulnerabilities in traditional supply chains (Roh & Xiao 2024; Sharma et al. 2024). These conditions highlight the limitations of lean, efficiency-oriented models and

underscore the need for operational adaptability and resilience in highly uncertain environments (Ivanov & Dolgui 2020; Singh & Modgil 2025). Consequently, identifying the operational indicators that drive supply chain performance – such as fulfilment accuracy, delivery reliability, and lead-time variability – has become a central research priority (Gunasekaran, Subramanian & Papadopoulos 2017; Pal et al. 2024). Data-driven analyses are particularly valuable in this context, as they enable firms to optimise resource allocation, improve process coordination, and anticipate performance outcomes under dynamic conditions (Mohaghegh et al. 2025; Sharma et al. 2024).

Despite the expanding literature on supply chain performance, empirical studies based on granular operational data remain limited, especially those using transaction-level information on inventory levels, order quantities, lead times, transportation costs, manufacturing costs, and supplier reliability. The 'Supply chain analysis dataset', available through Kaggle (Motefaker n.d.), offers a valuable opportunity to examine how such operational variables interact to shape performance outcomes. Its detailed structure enables systematic investigation of how variations in operational execution influence efficiency, responsiveness, and cost competitiveness across supply chain activities.

From a strategic operations perspective, the alignment between supply chain capabilities and competitive priorities – cost, quality, flexibility, and delivery – plays a decisive role in shaping long-term performance (Chavez et al. 2017; Slack & Brandon-Jones 2022). Improvements in demand forecasting accuracy can reduce excess inventory and holding costs, while shorter and more reliable lead times enhance customer satisfaction and service levels (Gunasekaran, Lai & Cheng 2008; Yu et al. 2018). Similarly, supplier-related performance indicators directly affect operational risk, supply continuity, and system reliability (Kamble & Gunasekaran 2020; Kumar, Singh & Modgil 2020). These dimensions can be rigorously examined through data-driven modelling approaches that identify the operational capabilities associated with performance under uncertainty and competitive pressure (Chavez et al. 2017; Thekkoote 2022).

Accordingly, this study addresses a key gap in the strategic operations literature by integrating data-driven analytics with strategic supply chain theory. This study uses the 'Supply chain analysis dataset' to: (1) identify key operational indicators that influence supply chain performance, (2) examine the relationships among inventory decisions, cost structures, and delivery performance, and (3) develop a data-driven framework for assessing strategic supply chain capabilities. In doing so, the study contributes to theory and practice by advancing understanding of operational capability–performance linkages and offering actionable insights to improve supply chain performance.

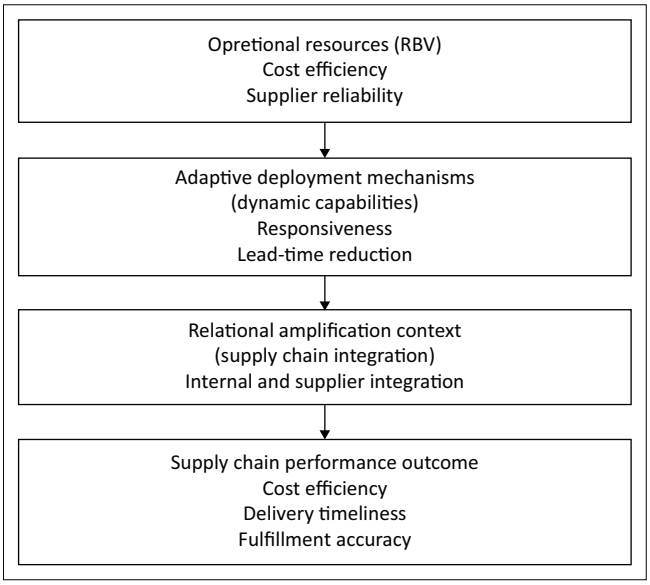
Moving beyond additive explanations of performance drivers, this study suggests that responsiveness – captured by lead-time performance – does not operate purely as an isolated mechanism. While responsiveness is significantly associated with supply chain performance, the empirical results do not provide strong evidence that its effectiveness systematically depends on supplier relationships or cost structures.

Drawing on the RBV, Dynamic Capabilities Theory, and Supply Chain Integration Theory, the study conceptualises supply chain performance as the outcome of multiple interacting capability dimensions. However, the empirical analysis provides only partial support for this interactional perspective, indicating that these relationships may be more context-dependent and less structurally interdependent than theoretically proposed.

Accordingly, the framework presented in Figure 1 should be interpreted as a conceptual guide rather than a fully empirically validated capability configuration, offering a theoretically informed lens for understanding performance heterogeneity in supply chains.

Theoretical framework

Examining supply chain performance through a strategic management lens requires moving beyond single-theory explanations towards an integrative framework that captures resource heterogeneity, adaptive capability development, and inter-organisational coordination (Barney 1991; Huo, Xu & Sun 2014; Teece, Pisano & Shuen 1997). Accordingly, this study integrates the RBV, dynamic capabilities theory, and supply chain integration (SCI) theory to explain how firms develop, deploy, and renew supply chain capabilities under changing competitive and operational conditions (Vanpoucke, Vereecke & Wetzels 2014; Yu et al. 2017). This integrative perspective conceptualises supply chain



Source: Adapted from Barney (1991), Teece et al. (1997), Huo et al. (2014), Vanpoucke et al. (2014), and Yu et al. (2017).

Note: Please see the full reference list of the article, Furuncu, Y., 2026, 'Responsiveness and supply chain performance: A hierarchical capability perspective', Journal of Transport and Supply Chain Management 20(0), a1352. https://doi.org/10.4102/jtscm.v20i0.1352, for more information.

RBV, resource-based view.

FIGURE 1: An integrated strategic operations framework of supply chain performance.

performance as the outcome of strategically aligned resources, adaptive reconfiguration processes, and relational coordination mechanisms across supply chain partners (Wetsandornphong et al. 2025; Yang, Jia & Xu 2019).

Resource-based view

The RBV provides a foundational lens for understanding how firm-specific operational resources and capabilities contribute to sustained performance differences (Barney 1991; Ketchen & Hult 2007). In supply chain contexts, resources such as demand forecasting accuracy, inventory management systems, supplier reliability, logistics coordination, and data-driven decision-making tools jointly shape firms' ability to compete on cost, responsiveness, and service quality (Hitt et al. 2016; Yu et al. 2018). These capabilities function as strategic assets by enabling firms to manage demand fluctuations, reduce operational costs, and maintain reliable service levels (Chae, Olson & Sheu 2014; Gunasekaran et al. 2008).

Importantly, RBV emphasises heterogeneity in operational strengths across firms. Differences in analytics capabilities, supplier networks, information systems, and process maturity translate into observable performance variation (Ketchen & Hult 2007; Wu et al. 2006). The operational indicators examined in this study – such as lead time, cost structures, inventory levels, and supplier performance – therefore represent observable manifestations of underlying resource configurations emphasised by RBV.

Dynamic capabilities theory

Dynamic Capabilities Theory extends RBV by explaining how firms sustain performance advantages in volatile and uncertain environments through continuous adaptation and reconfiguration of operational capabilities (Teece 2007; Teece, Peteraf & Leih 2016). In global supply chains, uncertainty arising from demand volatility, technological change, and external disruptions challenges the effectiveness of static resource endowments (Raj et al. 2025; Roh & Xiao 2024). Firms must therefore develop mechanisms to sense changes, seize emerging opportunities, and transform operational processes accordingly (Aslam et al. 2018; Teece 2007).

In supply chain management, these dynamic capabilities manifest in practices such as real-time analytics, flexible production systems, agile logistics, and supplier reconfiguration strategies (Blome, Schoenherr & Rexhausen 2013; Cadden et al. 2022). Such capabilities directly influence measurable operational outcomes, including lead-time performance, delivery reliability, supplier responsiveness, and cost efficiency (Aslam et al. 2018; Raj et al. 2025). In the empirical analysis, lead time serves as a key operational proxy for dynamic responsiveness, reflecting firms' ability to adapt supply chain processes under uncertainty.

Supply chain integration theory

Supply Chain Integration Theory posits that firm performance depends on the extent to which activities and information flows are coordinated across internal functions and external partners (Huo 2012). Integration encompasses internal coordination as well as supplier and customer integration, enabling aligned decision-making, smoother material flows, and improved responsiveness (Flynn, Huo & Zhao 2010; Schoenherr & Swink 2012). Higher levels of integration are associated with improved demand forecasting accuracy, reduced delays, and lower system-wide costs (Khanuja & Jain 2022).

The operational indicators used in this study – such as supplier performance ratings, delivery reliability, transportation-related delays, and cost metrics – capture the practical manifestations of integration mechanisms across the supply chain. Supply chain integration thus provides a relational perspective that complements RBV and Dynamic Capabilities Theory by explaining how coordination amplifies or constrains the effectiveness of internal resources and adaptive capabilities (Huo et al. 2014; Uddin 2024).

An integrated strategic operations perspective

Taken together, RBV, Dynamic Capabilities Theory, and SCI form an integrated strategic operations framework to explain supply chain performance. Resource-based view highlights the role of valuable and firm-specific operational resources; Dynamic Capabilities Theory explains how these resources are mobilised and reconfigured under uncertainty; and SCI specifies the relational context through which performance gains are realised. Accordingly, supply chain performance is conceptualised not as the additive effect of independent factors, but as the outcome of an interdependent capability structure in which resources enable adaptation, and integration conditions the returns to adaptive responsiveness.

Figure 1 illustrates the interactional logic of the integrated theoretical framework adopted in this study. Operational resources emphasised by the RBV constitute the foundational capability layer. Dynamic capabilities explain how these resources are mobilised and reconfigured under conditions of uncertainty, with responsiveness reflected in lead-time performance. Supply chain integration acts as a relational amplification mechanism that conditions the extent to which adaptive capabilities translate into superior supply chain performance. Accordingly, performance outcomes are conceptualised as resulting from interdependent capability structures rather than from the additive effects of isolated operational factors.

While prior studies generally emphasise the positive role of integration and responsiveness in enhancing supply chain performance, some studies report inconsistent or context-dependent effects. For instance, inventory buffering has been shown to improve performance under high uncertainty in some contexts, while in others it leads to inefficiencies. By contrast, the findings of this study suggest a limited role for inventory, highlighting the need for further research to reconcile these differences.

Research methods and design

This study adopts a quantitative research design integrating descriptive analysis, correlation analysis, and multivariate regression modelling to examine the operational drivers of supply chain performance. The methodological approach is consistent with established practices in empirical operations and supply chain management research, which emphasise linking observable operational indicators to performance outcomes using statistical modelling techniques (Hair et al. 2019; Wooldridge 2016). All analyses are based on the 'Supply chain analysis dataset', a publicly available dataset that provides detailed operational and cost-related information across supply-chain activities.

Data source

The empirical analysis draws on the 'Supply chain analysis dataset', obtained from the Kaggle open data repository. Transaction-level datasets of this type are widely used in supply chain and operations management research because they enable the simultaneous examination of cost-related and performance-related dimensions within a unified analytical framework (Chae et al. 2014; Kamble & Gunasekaran 2020).

The dataset includes variables related to order quantities, lead times, manufacturing and transportation costs, supplier performance indicators, and inventory levels, making it suitable for analysing operational efficiency, responsiveness, and reliability across supply chain activities (Gunasekaran et al. 2008; Maestrini et al. 2018).

However, it is important to acknowledge that the dataset represents a simplified and partially constructed abstraction of real-world supply chains. While such datasets are widely used for methodological transparency and replicability, they may not fully capture the institutional complexity, strategic decision-making processes, and contextual constraints present in actual industrial environments.

Therefore, the findings of this study should be interpreted as indicative of general operational patterns rather than as directly generalisable to all real-world supply chain settings. This limitation is explicitly considered when interpreting the empirical results.

Data preparation and sample characteristics

Prior to analysis, the dataset was cleaned and preprocessed following best practices in empirical research (Hair et al. 2019). Missing numerical values were imputed using median values, while missing categorical values were imputed using modal values to reduce the influence of skewed distributions and extreme observations (Field 2018).

Potential outliers in lead-time and cost-related variables were identified using the interquartile range (IQR) method and were retained only when they reflected plausible operational conditions, consistent with recommendations for maintaining external validity in operational datasets (Hair et al. 2019). To ensure comparability across variables, cost-related measures and order quantities were normalised using min–max scaling prior to inclusion in regression models (Chavez et al. 2017).

No missing values were observed in the dataset. Nevertheless, data preprocessing procedures were carefully designed to address potential missingness. Median imputation was selected as a robust approach for skewed distributions, and sensitivity analyses using alternative methods (e.g. mean substitution and complete-case analysis) were considered to ensure consistency of results. These procedures support the robustness and reliability of the empirical analysis.

Records exhibiting logical inconsistencies – such as negative lead times or zero demand combined with non-zero shipment costs – were removed from the sample. Following these preprocessing steps, the final dataset provided a balanced representation of transactions across product categories and suppliers, supporting the robustness and interpretability of the empirical analysis.

Variable operationalisation

Consistent with the integrated theoretical framework, study variables were organised into three complementary dimensions commonly used in strategic operations research (Barney 1991; Teece 2007; Vanpoucke et al. 2014). Resource-based indicators – manufacturing costs, transportation costs, inventory levels, and supplier ratings – reflect resource endowments related to cost efficiency and reliability, emphasised by the RBV (Barney 1991; Huo et al. 2014).

Dynamic capability indicators capture firms' responsiveness and adaptability to uncertainty, operationalised primarily through lead-time performance, which reflects the ability to sense demand changes and reconfigure logistics processes (Aslam et al. 2018; Teece 2007). Supply chain integration indicators reflect coordination mechanisms across the supply chain, including supplier reliability and delivery-related consistency measures, consistent with SCI theory (Flynn et al. 2010; Schoenherr & Swink 2012).

Supply chain performance is modelled as a composite dependent variable to reflect its multidimensional nature. Following established performance measurement frameworks, the performance index is constructed by normalising and averaging delivery timeliness (the inverse of lead time), cost efficiency (the inverse of total operational cost), and fulfilment accuracy (Gunasekaran et al. 2008; Maestrini et al. 2018). Fulfilment accuracy is operationalised using delivery-status consistency and order-completion indicators available in the dataset.

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may not fully capture the institutional complexity, strategic decision-making processes, and contextual constraints present in actual industrial environments.

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To ensure a direct correspondence between the theoretical framework and the empirical model, each theoretical perspective is explicitly operationalised in the model specification. Consistent with the RBV, manufacturing cost, transportation cost, inventory level, and supplier rating are treated as observable proxies of firm-level operational resources.

Dynamic capabilities are operationalised through lead-time performance, which reflects the firm's ability to adapt and reconfigure operational processes under uncertainty. Supply chain integration is captured through supplier rating and its interaction with lead time, representing relational coordination mechanisms that condition the effectiveness of responsiveness.

In this study, inventory levels are interpreted as proxies for resource endowments (RBV), delivery time reflects adaptive responsiveness (dynamic capabilities), and supplier performance represents relational coordination (SCI), thereby providing a structured – although simplified – operationalisation of the theoretical framework

Accordingly, the regression model is interpreted as providing statistically grounded evidence on the associations among key operational variables, while the integrated theoretical framework serves as a lens for interpreting these relationships rather than being directly tested within the empirical model.

Analytical procedure

A multistage analytical procedure was employed. Firstly, descriptive statistics were computed to summarise the central tendency and variability of key variables (Field 2018). Secondly, Pearson correlation coefficients were calculated to examine linear associations among operational indicators and to inform regression model specification (Hair et al. 2019).

Finally, a multivariate linear regression model was estimated to assess the joint effects of key operational indicators on supply chain performance (Equation 1):

$$\text{Performance}_i = \beta 0 + \beta 1\,(\text{Supplier Rating}_i) + \beta 2\,(\text{Lead Time}_i) + \beta 3\,(\text{Manufacturing Cost}_i) + \beta 4(\text{Transportation Cost}_i) + \beta 5\,(\text{Inventory Level}_i) + \varepsilon i \quad \text{[Eqn 1]}$$

To examine whether transport responsiveness operates as a conditional, rather than an independent, performance mechanism, additional interaction models were estimated.

Specifically, interaction terms between lead time and supplier rating and between lead time and manufacturing cost were introduced to test the capability logic proposed in the theoretical framework. This approach allows assessment of whether the performance impact of transport responsiveness depends on the presence of supporting relational and cost-based capabilities, consistent with the integrated RBV–Dynamic Capabilities–Supply Chain Integration perspective (Equation 2):

$$\text{Performance_i} = \beta 0 + \beta 1(\text{Lead Time_i}) + \beta 2(\text{Supplier Rating_i}) + \beta 3(\text{Manufacturing Cost_i}) + \beta 4(\text{Lead Time} \times \text{Supplier Rating)_i} + \beta 5(\text{Lead Time} \times \text{Manufacturing Cost)_i} + \varepsilon_i \quad \text{[Eqn 2]}$$

All continuous variables included in the interaction terms were mean-centred prior to estimation to reduce potential multicollinearity concerns.

Given the cross-sectional nature of the dataset, the estimated coefficients are interpreted as associational rather than causal relationships (Wooldridge 2016). The objective is to identify statistically robust performance drivers that align with mechanisms proposed in strategic management and supply chain theory.

Standard diagnostic tests were conducted to assess regression assumptions, including checks for residual normality, homoscedasticity, and multicollinearity (assessed using variance inflation factors, VIFs), following established econometric guidelines (Hair et al. 2019).

Robustness

Robustness checks included alternative model specifications estimated via stepwise regression and the least absolute shrinkage and selection operator (LASSO), as well as sensitivity analyses that employed alternative weighting schemes for the composite performance index (Hair et al. 2019; Maestrini et al. 2018). These procedures confirm the stability of the signs and magnitudes of coefficients across specifications.

The study relies exclusively on publicly available, non-proprietary data and does not involve human participants or personal information. Consequently, formal ethical approval was not required. Principles of data transparency,

replicability, and responsible reporting were observed throughout the research process.

Ethical considerations

This article followed all ethical standards for research without direct contact with human or animal subjects. This study was based exclusively on secondary data obtained from an open-access repository. The dataset did not include human participants, animal subjects, personal identifiers, or confidential information. As the research did not involve human or animal subjects and posed no ethical risk, formal ethical approval from an institutional review board or ethics committee was not required. All data were analysed and reported in accordance with principles of transparency, responsible data use, and research integrity.

Results

This section presents empirical findings derived from descriptive statistics, correlation analyses, and multivariate regression models applied to the 'Supply chain analysis dataset'.

Results are reported in accordance with established quantitative reporting standards and do not include interpretation.

Descriptive statistics

Table 1 reports descriptive statistics for the core operational variables used in the empirical analysis. The dataset comprises transactions spanning multiple product categories and suppliers, exhibiting substantial dispersion in both cost-related and time-based measures.

The descriptive statistics indicate substantial variability across observations, particularly for lead-time and cost-related variables, while delivery-related variables exhibit relatively limited variability. These summary statistics provide an overview of the distributional properties of the data and serve as a basis for the subsequent correlation and regression analyses.

TABLE 1: Descriptive statistics of key variables.

Variable	Mean	SD	Min	Max
Manufacturing cost	52.41	18.67	10.00	110.50
Transportation cost	23.84	9.75	5.20	60.45
Lead time (days)	7.92	3.51	1.00	20.00
Supplier rating (0–10)	7.11	1.85	2.00	10.00
Inventory level	512.00	221.00	50.00	1500.00
Order quantity	214.00	94.00	20.00	600.00
Delivery accuracy (%)	92.40	5.80	70.00	100.00
Composite performance index	0.62	0.14	0.30	0.93

SD, standard deviation; Min, minimum; Max, maximum.

Correlation analysis

Pearson correlation coefficients were calculated to examine linear associations among the operational indicators included in the analysis. Table 2 reports the correlation matrix for the key variables.

The correlation matrix indicates statistically significant associations between the performance index and several operational indicators, including lead time, supplier rating, and manufacturing cost. In addition, manufacturing and transportation costs exhibit a relatively strong positive correlation. Inventory levels exhibit weak correlations with most variables.

Regression analysis

A multivariate linear regression model was estimated to quantify the associations between key operational variables and supply chain performance. Table 3 shows the estimated coefficients, standard errors, and model fit statistics.

Robustness and diagnostic tests

A series of diagnostic and robustness checks were conducted to assess the reliability of the regression results. Multicollinearity was examined using VIF, which ranged from 1.12 to 2.87, and was well below the conventional threshold of 5, indicating no multicollinearity concerns.

Residual diagnostics further support the adequacy of the model specification. Visual inspection of residual plots reveals no evidence of heteroscedasticity, and the Shapiro–Wilk test suggests approximate normality of the residuals ($W = 0.97$, $p = 0.06$).

To assess the robustness of the estimated relationships, alternative model specifications were also estimated. Least absolute shrinkage and selection operator regression retained the same set of statistically significant predictors – namely lead time, supplier rating, and manufacturing cost – while stepwise regression yielded an identical model specification. Collectively, these robustness and diagnostic checks indicate that the reported results are stable and not sensitive to alternative estimation approaches or modelling assumptions.

TABLE 2: Correlation matrix.

Variable	Performance	Lead time	Manufacturing cost	Transportation cost	Supplier rating	Inventory
Performance	1.00	-0.61***	-0.38***	-0.32***	0.49***	0.04
Lead time	-0.61***	1.00	0.21**	0.18*	-0.42***	-0.09
Manufacturing cost	-0.38***	0.21**	1.00	0.53***	-0.17*	0.11
Transportation cost	-0.32***	0.18*	0.53***	1.00	-0.13	0.06
Supplier rating	0.49***	-0.42***	-0.17*	-0.13	1.00	0.02
Inventory level	0.04	-0.09	0.11	0.06	0.02	1.00

*, $p < 0.05$; **, $p < 0.01$; ***, $p < 0.001$.

Table 4 reports the results of the interaction models examining whether the performance impact of transport responsiveness is contingent on supporting supply chain capabilities. The interaction between lead time and supplier rating is negative and statistically significant, indicating that reductions in lead time yield stronger performance improvements when supplier reliability is high. By contrast, when supplier performance is weak, the marginal performance gains from lead-time reductions are substantially attenuated.

Similarly, the interaction between lead time and manufacturing cost is significant, suggesting that transport responsiveness is associated with superior performance only when supported by efficient internal cost structures. The interaction terms are not statistically significant, suggesting that the performance impact of lead time does not systematically depend on supplier rating or manufacturing cost within this dataset. This result does not support the hypothesised second-order capability effect and indicates that responsiveness may operate more independently than theoretically expected in this empirical context.

Discussion

Given the cross-sectional nature of the dataset, the reported relationships should be interpreted as associational rather than causal. The study does not claim causal inference, and all interpretations are framed in terms of theoretically informed associations.

This study adopts an integrated strategic operations perspective, suggesting that operational resources alone are insufficient to explain performance heterogeneity in supply chains. Instead, performance advantages may emerge when valuable operational resources (RBV) are continuously reconfigured through responsive routines (Dynamic Capabilities Theory) and effectively leveraged through coordinated relationships with supply chain partners (Supply Chain Integration Theory). Accordingly, the empirical findings are interpreted as reflecting this interactional logic rather than isolated theoretical effects.

TABLE 3: Regression results: Determinants of supply chain performance.

Predictor	*β*	SE	*t*	*p*-value
Constant	0.81200	0.04100	19.78	< 0.001
Lead time	-0.04200	0.00500	-8.52	< 0.001
Supplier rating	0.03100	0.00400	7.74	< 0.001
Manufacturing cost	-0.00310	0.00120	-2.58	0.010
Transportation cost	-0.00180	0.00100	-1.80	0.073
Inventory level	0.00004	0.00003	1.33	0.184

Note: Model fit statistics: $R^2 = 0.52$; Adjusted $R^2 = 0.51$; $F(5, 894) = 193.42$.
β, beta; SE, standard error.
*, $p < 0.001$.

TABLE 4: Interaction effects of transport responsiveness on supply chain performance.

Predictor	*β*	SE	*t*	*p*-value
Lead time (centred)	-0.01380	0.0017	-7.94	< 0.001
Supplier rating (centred)	-0.00470	0.0100	-0.46	0.646
Manufacturing cost (centred)	0.00010	0.0000	0.22	0.828
Lead time × supplier rating	-0.00020	0.0010	-0.13	0.897
Lead time × manufacturing cost	0.00002	0.0000	0.42	0.677

Note: Model fit: $R^2 = 0.44$; Adjusted $R^2 = 0.41$.
β, beta; SE, standard error.
*, $p < 0.001$.

The results indicate that key operational indicators – most notably lead time, supplier rating, and manufacturing cost – are systematically associated with overall supply chain performance.

These findings support the central argument of this study that supply chain performance cannot be adequately understood as the outcome of isolated operational metrics. Rather, performance emerges from the interaction among firms' strategic capabilities, relational arrangements with supply chain partners, and their capacity to adapt operational processes in response to uncertainty and disruption.

Although the empirical analysis is based on cross-sectional data and does not establish causality, the observed associations can be meaningfully interpreted through theoretically grounded mechanisms proposed by the RBV, Dynamic Capabilities Theory, and Supply Chain Integration Theory. The discussion therefore advances mechanism-oriented explanations while explicitly acknowledging the associational nature of the empirical estimates.

As summarised in Figure 1, the empirical relationships observed in this study reflect an interdependent capability system in which operational resources, adaptive routines, and integration mechanisms jointly shape supply chain performance outcomes.

Interpretation of key findings in the light of resource-based view

The negative association between lead time and supply chain performance and the positive relationship between supplier rating and supply chain performance are consistent with the RBV, which posits that strategic performance arises from the effective deployment of valuable and difficult-to-imitate operational capabilities (Barney 1991). These relationships are evident in both the correlation analysis (Table 2) and the multivariate regression results (Table 3), where lead time and supplier rating emerge as statistically significant predictors of performance.

From an RBV perspective, lead-time efficiency reflects underlying process maturity, coordination routines, supplier integration, and effective use of informational resources. Prior research similarly conceptualises delivery reliability and lead-time reduction as strategically embedded capabilities that generate performance advantages through superior coordination and responsiveness (Peng & Lu 2017; Rungtusanatham et al. 2003). Because these capabilities are embedded in firm-specific routines and interorganisational processes, they

constitute an important source of performance heterogeneity (Chae et al. 2014; Wu et al. 2006).

In terms of magnitude, lead time exhibits the largest standardised effect among all predictors, indicating that a one-unit reduction in lead time is associated with a substantially larger change in performance compared to cost-related variables. This suggests that time-based competition may be more critical than cost efficiency in shaping performance outcomes in the analysed dataset.

Supplier rating captures the quality and reliability of upstream partnerships and functions as a relational resource that enhances operational stability and responsiveness. The positive association between supplier rating and performance reported in Table 3 is consistent with research emphasising that relational assets embedded in governance mechanisms and trust-based integration structures can generate sustained competitive advantage (Hitt et al. 2016; Vanpoucke et al. 2014; Zhang et al. 2018). Although the dataset does not directly capture strategic intent, the operational indicators analysed here can be interpreted as proxies for the underlying resource configurations emphasised by RBV (Yu et al. 2018).

The statistically significant effect of manufacturing cost further aligns with prior research highlighting cost efficiency as a foundational strategic capability in supply chains (Christopher 2016; Slack & Brandon-Jones 2022). Firms characterised by more efficient internal cost structures appear better positioned to manage competitive pressures and sustain performance under volatile conditions (Ivanov & Dolgui 2020; Singh & Modgil 2025).

It is important to observe, however, that the applicability of RBV in inter-organisational contexts such as supply chains has been subject to debate in the literature, as value creation often extends beyond firm boundaries and depends on relational and network-level capabilities. This study partially addresses this limitation by incorporating SCI as a complementary perspective.

Dynamic capabilities and the role of responsiveness

The findings underscore the importance of dynamic responsiveness, as articulated in Dynamic Capabilities Theory (Teece 2007; Teece et al. 2016). The strong negative association between lead time and performance, observed in Table 2 and Table 3, suggests that agility in responding to demand and supply fluctuations is a critical driver of strategic outcomes (Aslam et al. 2018).

From a dynamic capabilities perspective, lead time captures firms' ability to sense changes in operational conditions, seize emerging opportunities, and reconfigure logistics and production processes accordingly. Longer lead times can, therefore, be interpreted as indicators of weaker sensing and seizing mechanisms, whereas shorter lead times indicate more effective adaptive routines (Blome et al. 2013; Vanpoucke et al. 2014).

These findings are consistent with prior research demonstrating that dynamic capabilities – manifested through demand sensing, operational flexibility, and supplier reconfiguration – enhance resilience and performance in uncertain and volatile environments (Ivanov & Dolgui 2020; Raj et al. 2025; Wetsandornphong et al. 2025). By empirically linking lead time to performance, this study reinforces the role of responsiveness as a key adaptive mechanism in contemporary supply chain systems.

It is important to acknowledge that the empirical model employed in this study is static and cross-sectional, which limits its ability to fully capture the dynamic and temporal nature of capability development. While lead time is interpreted as a proxy for responsiveness, it does not directly capture sensing, seizing, and reconfiguration processes over time.

Therefore, the representation of dynamic capabilities in this study should be understood as a simplified operational approximation rather than a full empirical test of dynamic capability theory. Future research using longitudinal data would be better suited to capture the evolution of such capabilities.

Supply chain integration and relational performance

The statistically significant association between supplier rating and supply chain performance is broadly consistent with SCI theory. As shown in Table 3, higher supplier ratings are associated with superior performance outcomes, suggesting that upstream integration may play an important role in shaping supply chain effectiveness (Flynn et al. 2010; Huo 2012).

Supplier integration enhances delivery reliability and coordination by reducing information asymmetries and operational friction. Consistent with this interpretation, the correlation analysis (Table 2) indicates that supplier rating is negatively associated with lead time and cost-related indicators. This pattern aligns with prior research demonstrating that relational integration improves performance through enhanced coordination and information alignment (Danese & Romano 2011; Schoenherr & Swink 2012; Zhang et al. 2018).

Interestingly, inventory level does not exhibit a statistically significant relationship with performance. This finding may reflect measurement limitations or context-specific dynamics within the dataset. Alternatively, it may indicate a structural shift away from inventory-based buffering towards more responsive and information-driven supply chain strategies.

By contrast, inventory level does not exhibit a statistically significant relationship with performance. This finding suggests that traditional buffer-based mechanisms may be less influential than relational- and capability-based

integration mechanisms in the empirical context examined. Rather than relying on inventory buffers, performance advantages appear to be associated with coordinated relationships and information-rich interactions among supply chain partners (Ketchen & Hult 2007; Vanpoucke et al. 2014).

Integrated insights: Strategic operations as an interdependent system

Taken together, the findings suggest that lead-time reduction should not be interpreted as a universally effective best practice. While responsiveness is associated with improved performance, the empirical results do not provide evidence of systematic interaction effects with supplier relationships or cost structures. This indicates that the role of responsiveness may be more independent and context-specific than theoretically expected. Accordingly, the findings do not fully support the assumption that agility compensates for weak relational or resource foundations.

From a multitheoretical perspective, supply chain performance can be interpreted as being shaped by interdependent strategic mechanisms rather than isolated operational drivers. Resource-based view emphasises the role of efficient cost structures and relational resources; Dynamic Capabilities Theory explains how responsiveness sustains performance under uncertainty; and SCI highlights how coordination amplifies the effectiveness of both resources and adaptive routines. Integration thus operates as a performance multiplier that conditions the returns to both operational resources and dynamic responsiveness.

Comparison with prior literature

The findings are broadly consistent with established research in supply chain and strategic management. The strong association between lead time and performance reinforces prior evidence identifying temporal efficiency as a critical determinant of service quality and responsiveness (Gunasekaran et al. 2008; Peng & Lu 2017; Slack & Brandon-Jones 2022).

Similarly, the positive relationship between supplier rating and performance aligns with extensive research emphasising supplier quality and integration as key relational capabilities (Danese & Romano 2011; Flynn et al. 2010; Schoenherr & Swink 2012). The statistically significant effect of manufacturing costs further consistent with research highlighting cost efficiency as a foundational strategic capability (Barney 1991; Hitt et al. 2016).

Finally, the limited role of inventory levels contrasts with traditional buffer-based models but aligns with recent studies suggesting that responsiveness, digital visibility, and relational coordination increasingly substitute for inventory buffers in modern supply chains (Ivanov & Dolgui 2020; Kamble & Gunasekaran 2020).

Building on these findings and their alignment with prior literature, the following section outlines the key contributions of this study to transport and supply chain management research and practice.

Theoretical and managerial implications

Firstly, this study contributes to the transport and supply chain management literature by empirically demonstrating that transport responsiveness, captured through lead-time performance, plays a central role in shaping overall supply chain performance across interconnected value chain activities. These findings contribute to the literature by demonstrating that operational responsiveness (delivery time) functions as a dominant capability mechanism, while resource-based elements and relational coordination play supporting but context-dependent roles. This nuanced differentiation extends existing theory by highlighting the asymmetric impact of capability dimensions in supply chain performance.

Secondly, the study advances existing research by showing that transport-related performance outcomes are associated with responsiveness, supplier coordination, and cost efficiency, from rather than isolated operational factors.

Thirdly, by integrating transport-relevant operational indicators with strategic supply chain theories, the study bridges transport operations research and strategic supply chain management, offering a unified framework for analysing value creation across logistics and supply chain processes.

Fourthly, the findings provide practical insights for logistics managers and policy-oriented stakeholders by highlighting that investments in transport responsiveness and supplier integration may yield greater performance improvements than traditional inventory-based buffering approaches.

Finally, the use of a transparent and publicly available operational dataset enhances the reproducibility of transport and supply chain performance research and supports evidence-based decision-making in transport planning and supply chain design.

Conclusion

This study examined the strategic determinants of supply chain performance using the supply chain analysis dataset and an integrated theoretical framework combining the RBV, Dynamic Capabilities Theory, and SCI Theory. The empirical findings show that lead time, supplier rating, and manufacturing cost are systematically associated with overall supply chain performance. Collectively, these results reinforce the central argument of the study: supply chain performance is shaped by the interaction of operational capabilities, adaptive responsiveness, and relational integration rather than by isolated operational metrics.

Theoretical contributions

This study contributes to the strategic management and supply chain literature in several ways.

Firstly, it brings together the RBV, Dynamic Capabilities Theory, and SCI Theory within a unified analytical framework. Rather than providing a full empirical test of these perspectives, the study offers a theoretically informed empirical examination of how key operational indicators can be interpreted in the light of these complementary frameworks.

The findings of this study suggest that supply chain performance is associated with the alignment of internal resource endowments, responsiveness-related capabilities, and coordinated interorganisational relationships, although these relationships should be interpreted as context-dependent rather than universally generalisable.

Secondly, the results provide quantitative support for capability-based explanations of performance by linking abstract strategic constructs – such as responsiveness and relational coordination – to observable operational indicators, including lead time and supplier rating. This strengthens the empirical connection between strategic management theory and operations-focused research.

Thirdly, the use of a composite performance index integrating cost efficiency, delivery timeliness, and fulfilment accuracy advances holistic performance measurement in supply chain research and supports systems-oriented perspectives that move beyond single-dimensional metrics.

Managerial implications

From a managerial perspective, the results suggest that superior supply chain performance is more likely to result from coordinated investments across multiple operational domains than from isolated interventions. Managers should prioritise lead-time reduction through process optimisation, digital visibility, and logistics coordination, while strengthening supplier evaluation and development practices. Although responsiveness is critical, manufacturing cost efficiency remains a foundational capability that supports competitiveness, underscoring the continued relevance of operational excellence initiatives such as lean practices and advanced production planning.

Limitations and future research

Several limitations should be acknowledged. The dataset represents a simplified and partially synthetic abstraction of real-world supply chains and may not fully capture firm-specific strategic intent or industry-specific dynamics. In addition, the cross-sectional design restricts the analysis to associations and does not permit examination of how capabilities evolve over time. Potential omitted variables – such as demand uncertainty, customer collaboration, and environmental volatility – may also influence performance, but are not observable in the available data.

Future research could address these limitations by employing longitudinal datasets to examine dynamic capability development, conducting industry-specific comparative analyses, and incorporating digital transformation indicators such as Internet of Things (IoT), Artificial Intelligence (AI)-driven forecasting, and real-time visibility systems. Advanced analytical approaches, including structural equation modelling, machine learning, and network-based analyses, could further capture nonlinear and systemic performance mechanisms.

Overall, this study provides a data-driven and theoretically grounded account of how strategic and operational capabilities jointly shape supply chain performance. By integrating multiple strategic perspectives and operational analytics, it offers scholarly and managerial insights for designing more resilient, adaptive, and strategically aligned supply chains. However, the findings should be interpreted with caution, as the empirical model captures selected dimensions of the integrated theoretical framework and does not fully reflect the dynamic and interactional mechanisms implied by dynamic capabilities and integration theories. This limitation highlights the need for more advanced empirical designs in future research.

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Competing interests

The author, Yunus Furuncu, declares that no financial or personal relationships inappropriately influenced the writing of this article.

CRediT authorship contribution

Yunus Furuncu: Conceptualisation, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualisation, Writing – original draft, Writing – review & editing. The author confirms that this work is entirely their own, has reviewed the article, approved the final version for submission and publication, and takes full responsibility for the integrity of its findings.

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Data availability

The data that support the findings of this study are available in Kaggle. The data were derived from the following resources available in the public domain: at https://www.kaggle.com/datasets/amirmotefaker/supply-chain-dataset.

The data supporting the findings of this study are publicly available on Kaggle. The dataset used is titled 'Supply chain analysis dataset' (created by Motefaker n.d.) and is openly accessible for academic research. All data preparation and analysis procedures are described in the manuscript.

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