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Factors Impacting Supply Chain Efficiency in Indian E-Commerce

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Abstract
In the fast-growing e-commerce industry in India, supply chain efficiency plays a crucial role in enhancing operational effectiveness, delivery reliability, and customer satisfaction. This study aims to explore the relationships between six explanatory factors and supply chain efficiency from a quantitative perspective within an integrated framework. IBM SPSS Statistics 21 was used to analyze 240 observations. Construct reliability and statistical relationships were assessed using descriptive statistics, Cronbach's Alpha, Pearson correlation, multiple linear regression, and regression diagnostics. The internal consistencies were good for all seven constructs, ranging from 0.755 to 0.794 Cronbach's alpha. The regression model was statistically significant ($p < 0.001$, $F = 10.381$) and accounted for 21.1% of the variance in supply chain efficiency. Consumer and Market Demand emerged as the strongest significant predictor ($\beta = 0.290$, $p < 0.001$), followed by Technological Integration ($\beta = 0.166$, $p = 0.008$) and Operational Strategies ($\beta = 0.139$, $p = 0.019$). There was no significant independent association with Sustainability Initiatives, Geographical and Institutional Factors, and Policy and Regulatory Environment. Regression diagnostics showed generally satisfactory model assumptions. The results show the feasibility of using an integrated analytical tool to analyze several supply chain factors at a time.

Keywords: Supply Chain Efficiency; Indian E-Commerce; Technological Integration; Consumer and Market Demand; Multiple Linear Regression

. Introduction

In today's retail landscape, the growing impact of e-commerce has accentuated the need for efficient supply chain management systems. E-commerce supply chains include a variety of activities that are interrelated, such as procurement, inventory management, warehousing, order processing, transportation, and last-mile delivery. Coordinating these activities is critical to ensure delivery reliability, meet evolving customer needs, and reduce operational costs. Advanced information systems, automation, and information-based decision-making are associated with the opportunities for integration of the processes in the supply chain that have occurred under digital transformation (Al Mashalah et al., 2022). The growth of online retail in India has led to significant logistical hurdles, such as geographical dispersion, infrastructure constraints, delivery systems, and the changing nature of consumer demand. Efficient last-mile delivery service is more relevant than ever, as the operational performance of delivery service is directly linked to transportation costs, delivery speed, and service reliability. Last-mile delivery systems need to be tailored to the needs and circumstances of the customer, according to Lim and Winkenbach (2019). The growth of Indian e-commerce logistics companies also highlights the need for scalable fulfilment capabilities and synergistic transportation networks (Parameswar & Dhir, 2022).

Factors such as technological integration, operational strategies, sustainability efforts, geographical factors, consumer demand, and regulatory frameworks are crucial aspects of supply chain efficiency. If we understand the dynamics between them, we can put a structure in place for integrated supply chain management. If we can understand their relationships, we can build a structure of integrated supply chain management. Environmental and customer-oriented aspects. Masorgo et al. (2024) provided a concept of last-mile delivery as an integrated process, which includes coordination of operational activities and service results. Additionally, as customers increasingly demand more from logistics providers, they have also begun to look for responsive delivery systems and enhanced service performance (Daugherty et al., 2019).

Customer expectations and the ability to deliver these expectations affect online retail operations because there is a need to balance capacity, cost, and time of fulfillment (Cui et al., 2024). Other opportunities for the improvement of resource utilization and delivery performance lie in operational innovations. Dayarian and Savelsbergh (2020) examined crowdshipping methods with in-

store customers, discussing alternative delivery methods. Likewise, Castillo et al. (2022) examined the topic of hybrid delivery vehicles and crowdsourcing scenarios within the context of cost-service trade-offs. Another significant body of research is on technological integration. Gunasekaran et al. (2017) analysed the contribution of big data and predictive analytics to supply chain and organizational performance. To provide a coherent perspective on digital transformation, the study reviewed and summarized the knowledge and findings of the existing literature on digital supply chains (Farajpour et al., 2022). Other areas of exploration in the context of digital innovation and analytics have included supply chain resilience and operational adaptability (Iftikhar et al., 2024).

Furthermore, blockchain applications can be used to improve information sharing, coordination, and operational transparency (Lohmer et al., 2022). Apart from technology, there is also logistics integration in the coordination of operations in omnichannel retail (Liu & Song, 2023). Sustainability and resilience have also been addressed as additional factors in the sustainability of the supply chain, particularly in the face of uncertainty in operations (Ivanov, 2022). Resource efficiency and supporting circular economic practices are other opportunities provided by logistics digitalization (Xu et al., 2023). These studies were taken together to show the relevance of the various factors in the supply chain. Their theoretical and operational focuses are, however, varied, so that the need remains for integrated analytical frameworks that can also take a comprehensive look at all these dimensions. A number of inter-related technological, operational, environmental, institutional and market-related conditions affect the efficiency of the e-commerce supply chain. There is much literature on individual dimensions, but an integrated assessment is needed to differentiate the various relationships between the dimensions and supply chain efficiency.

Research that highlights technological change can offer only a partial comparative perspective on consumer demand or geographical conditions; operational research tends to be more specific, relating to a specific delivery configuration. The challenge is particularly relevant in the context of Indian e-commerce as companies need to address all these simultaneously across various markets, infrastructure, and delivery systems. Determining the relative contributions of several explanatory constructs to the overall data pattern can aid in guiding further empirical research. This is a methodological need that was addressed as part of the proposed work, which uses a quantitative approach and includes six explanatory constructs and the variable of supply chain efficiency as the dependent variable.

The study is guided by three research objectives:

- To examine the relationships between technological integration, operational strategies, sustainability initiatives, geographical and institutional factors, consumer and market demand, policy and regulatory environment, and supply chain efficiency
- To evaluate the independent predictive contributions of the six explanatory constructs to supply chain efficiency through Pearson correlation and multiple linear regression analyses
- To determine the relative statistical importance of the explanatory constructs and assess the reliability and diagnostic adequacy of the proposed quantitative framework for subsequent empirical research

2. Methodology

2.1 Research Design

A quantitative, cross-sectional analytical framework was used to explore the relationship between supply chain efficiency and six explanatory variables that are pertinent to the Indian context of eCommerce. The analytical framework included technological integration, operational strategies, sustainability measures, geographical and institutional considerations, consumer/market demand, and policy and regulatory framework. The dependent variable was supplying chain efficiency, and the other six constructs were independent variables. A dataset with 240 observations was used for analysis. To illustrate the measurement by questionnaires, reliability assessment, correlation analysis, and multiple linear regression were used.

2.2 Data Source and Study Variables

The analytical data consisted of 240 observations that were grouped around organizational and professional attributes of an e-commerce supply chain. Categorical information about roles, organizational types, turnover of the organization during the year, and geographical scale of activity were included in the data set. The professional roles included logistics, inventory, procurement, warehouse, supply chain, delivery, and operational management. The categories of organizations covered: direct to consumer brands, logistics service providers, marketplaces, omnichannel retailers and online-first retailers. The 7 constructs of the research were represented by 28 items in the questionnaire; each construct was represented by 4 items. The outcome variable was Supply Chain Efficiency (SCE), and the explanatory variables were Technological Integration (TI), Operational Strategies (OS), Sustainability Initiatives (SI), Geographical and Institutional Factors (GI),

Consumer and Market Demand (CMD), and Policy and Regulatory Environment (PRE). Thé questionnaires comprised 20 items that were numbered and given a 5-point response scale. Organizational profile variables were added for descriptive characterization, and the 28 measurement items were added to the reliability and composite score analysis.

2.3 Measurement and Construct Development

The measurement framework was built around seven e-commerce supply chain dimensions that are significant to the performance of the industry. Supply Chain Efficiency focused on improving operational costs, delivery reliability, and delivery results for these. Technological Integration discussed digital applications like data analytics, shipment visibility, artificial intelligence (AI) based forecasting, and blockchain. The Operational Strategies were Inventory Management, Route Optimization, last-mile operations, and Service Continuity. Sustainability Initiatives was asked about the work of the supply chain to be mindful of environmentally and resource aware materials. Geographical and institutional factors included geographical conditions, infrastructure, coordination across the boundary, and institutional support. Consumer and Market Demand highlighted customers' expectations and the pressures on market demand. The Policy and Regulatory Environment construct included policy support, digital transformation, trade regulations, and disruption recovery. To determine the internal consistency of the four items on each construct, Cronbach's Alpha was computed separately for each construct. Corrected item-total correlations and Cronbach's Alpha if an item was deleted were examined to evaluate item consistency. Coefficients for all seven constructs were above 0.70 (range: 0.755 – 0.794). As a result, all 28 items were retained. The four items of each construct were averaged to create composite scores.

2.4 Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics 21. The analytical procedure consisted of descriptive statistics, internal consistency analysis, Pearson correlation, multiple linear regression, and regression diagnostic assessment. First, frequencies and percentages were calculated to summarize organizational and professional characteristics. Means, standard deviations, minimum values, and maximum values were obtained for individual questionnaire items and composite variables. Second, Cronbach's Alpha was applied to assess internal consistency for the seven constructs. Third, Pearson's product-moment correlation coefficients were calculated to examine linear associations between Supply Chain Efficiency and the six explanatory variables. Two-tailed significance tests were used, with statistical significance evaluated at the 0.05 level. Fourth, standard multiple linear regression was performed using the Enter method, with all six explanatory variables entered simultaneously. The regression model was specified as:

$$SCE = \beta_0 + \beta_1(TI) + \beta_2(OS) + \beta_3(SI) + \beta_4(GI) + \beta_5(CMD) + \beta_6(PRE) + \varepsilon$$

where β_0 represents the intercept, β_1–β_6 represent the regression coefficients, and ε represents the residual error term. Model performance was evaluated using the coefficient of determination (R^2), adjusted R^2, F-statistic, and regression coefficient significance tests. Standardized regression coefficients were examined to compare conditional associations across predictors. Squared semi-partial correlations were additionally used to estimate each predictor's unique contribution to explained variance.

2.5 Regression Diagnostics and Analytical Limitations

Standardized residual plots, residual histogram, normal probability P–P plot, and multicollinearity diagnostics were used to evaluate regression assumptions. Linearity and homoscedasticity were assessed by visual inspection of standardized residuals against predicted values and the inspection of a histogram and a P- P plot for approximate residual normality. To check for possible multicollinearity, the values of Tolerance and Variance Inflation Factor (VIF) were computed. The Durbin-Watson statistic was reported for the purpose of checking for possible first-order residual autocorrelation. Cook's Distance was used to identify any potentially influential observations. These procedures gave diagnostic information about the suitability of the fitted linear regression model.

3. Results

3.1 Demographic and Organizational Characteristics

Table 1 shows the demographic and organizational features of the 240 observations. The data consisted of eight occupations related to e-commerce supply chain operations. The largest group included Logistics Managers (17.1%), Last-Mile Delivery Managers (13.8%), and Operations Managers (13.3%). The smallest proportion (8.3%) was the Warehouse Managers. This distribution covered procurement, inventory management, logistics coordination, warehousing, and operational decision-making. In terms of organizational type, Direct-to-Consumer (D2C) Brands and Omnichannel Retailers shared the lead with 23.3% each. Online-First Retailers came in at 17.9%, Marketplaces came in at 17.1%, and Logistics

Service Providers came in at 14.2%. The remainder, 4.2%, was from other organizational categories. The turnover of ₹10 crore to ₹100 crore was the highest (42.1%), followed by those with turnover less than ₹10 crore (26.3%). Organizations with turnover in the range of ₹100 to ₹1,000 crore accounted for 21.3%, while those with turnover over ₹1,000 crore accounted for 10.4%. In terms of geographical operations, the largest share (45.0%) was represented by geographically operating organizations, followed by regional (24.2%), international (18.3%), and hyperlocal (12.5%). The data set thus included a variety of organizational profiles from diverse operating contexts.

Table 1. Demographic and Organizational Profile of Records (N = 240)

Characteristic	Category	Frequency	Percentage (%)
Professional Role	E-Commerce Operations Lead	30	12.5
	Inventory Analyst	27	11.3
	Last-Mile Delivery Manager	33	13.8
	Logistics Manager	41	17.1
	Operations Manager	32	13.3
	Procurement Specialist	29	12.1
	Supply Chain Manager	28	11.7
	Warehouse Manager	20	8.3
Organization Type	D2C Brand	56	23.3
	Logistics Service Provider (3PL/4PL)	34	14.2
	Marketplace	41	17.1
	Omnichannel Retailer	56	23.3
	Online-First Retailer	43	17.9
	Other	10	4.2
Annual Turnover	Below ₹10 crore	63	26.3
	₹10–100 crore	101	42.1
	₹100–1,000 crore	51	21.3
	Above ₹1,000 crore	25	10.4
Geographical Scale	Hyperlocal/City-specific	30	12.5
	Regional	58	24.2
	National	108	45.0
	International	44	18.3

3.2 Descriptive Statistics and Internal Consistency Reliability

The seven research constructs were reviewed for descriptive statistics and internal consistency reliability, and are shown in Table 2. Four items on the respective questionnaires were used to compute all composite variables. No data were missing in either of the constructs, and there were 240 valid observations in each construct. The composite scores ranged from 3.099 to 3.207 (on a five-point response scale) with relatively moderate ratings across the records. The mean values for Sustainability Initiatives (M = 3.207, SD = 0.721) and Supply Chain Efficiency (M = 3.199, SD = 0.786) were the highest. The mean (M = 3.099, SD = 0.737) of Consumer and Market Demand was the lowest. The standard deviations for the constructs varied from 0.721 to 0.793, which is also a similar range. The test of internal consistency was conducted using Cronbach's Alpha. Reliability coefficients ranged from 0.755 to 0.794, which is above the accepted minimum of 0.70. The reliability of the instruments was highest for Supply Chain Efficiency ($\alpha = 0.794$) and lowest for Operational Strategies ($\alpha = 0.755$). All the measurement items had corrected item-total correlations above 0.30. Further, the reliabilities of the scores for such subscale items did not increase when they were deleted. Therefore, all 28 items on the questionnaire were kept for further correlation and regression analyses.

Table 2. Descriptive Statistics and Reliability of Research Constructs (N = 240)

Construct	Items	Mean	SD	Cronbach's α
Supply Chain Efficiency (SCE)	4	3.199	0.786	0.794
Technological Integration (TI)	4	3.121	0.782	0.792
Operational Strategies (OS)	4	3.174	0.737	0.755
Sustainability Initiatives (SI)	4	3.207	0.721	0.759
Geographical and Institutional Factors (GI)	4	3.146	0.793	0.782

Consumer and Market Demand (CMD)	4	3.099	0.737	0.757
Policy and Regulatory Environment (PRE)	4	3.171	0.769	0.780

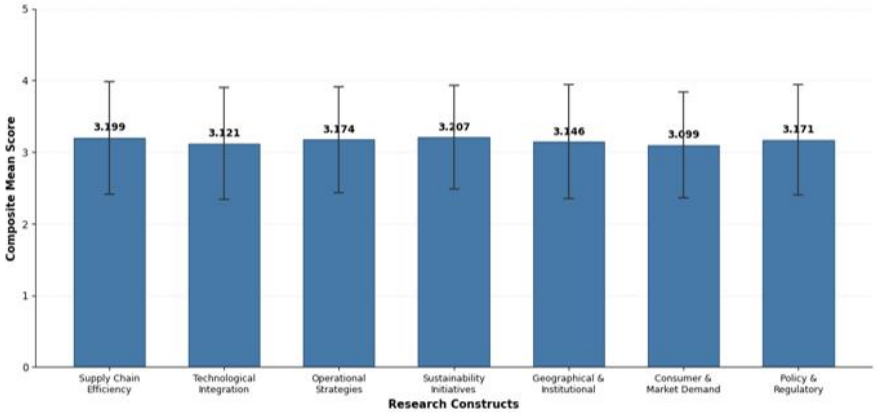


Figure 1. Mean Scores of Supply Chain Efficiency and Its Explanatory Constructs

The composite mean scores of the seven research constructs for 240 observations are shown in Figure 1, with the error bars representing standard deviations. The mean score for Sustainability Initiatives was the highest (M = 3.207), followed by Supply Chain Efficiency (M = 3.199) and Operational Strategies (M = 3.174). The lowest mean score (M = 3.099) was for Consumer and Market Demand. Construct standard deviations ranged from 0.721 to 0.793, with moderate variability observed among constructs. The relatively small difference between the mean scores shows that the ratings are broadly similar across the seven dimensions, and the error bars overlap, signifying that there is significant variation within the observations.

3.3 Pearson Correlation Analysis

To test for the linear relationships between Supply Chain Efficiency and the six independent constructs, Pearson correlation analysis was used. Table 3 shows the correlation matrix. The analysis was based on the seven composite variables, and there were 240 observations per variable. The highest positive correlation was observed between the factors of Consumer and Market Demand and Supply Chain Efficiency ($r = 0.363$, $p < 0.001$). The other items with significant positive correlations were Technological Integration ($r = 0.254$, $p < 0.001$) and Sustainability Initiatives ($r = 0.234$, $p < 0.001$). Policy and Regulatory Environment had a negative but significant correlation with Supply Chain Efficiency ($r = -0.194$, $p = 0.003$). There was also a significant positive correlation ($r = 0.181$, $p = 0.005$) with Operational Strategies. In contrast, there was no significant association ($r = 0.085$, $p = 0.187$) between Geographical and Institutional Factors. The interrelationships between the six independent constructs ranged from −0.017 to 0.245. The highest correlation between independent variables was observed for Sustainability Initiatives and Policy and Regulatory Environment ($r = 0.245$, $p < 0.001$). Overall, five explanatory constructs demonstrated significant positive bivariate associations with Supply Chain Efficiency. But there were no apparent pairwise multicollinearity concerns because of the relatively low intercorrelation of the predictors.

Table 3. Pearson Correlation Matrix of Research Constructs (N = 240)

Variable	SCE	TI	OS	SI	GI	CMD	PRE
SCE	1.000						
TI	0.254**	1.000					
OS	0.181**	−0.017	1.000				
SI	0.234**	0.235**	0.114	1.000			
GI	0.085	0.159*	0.047	0.075	1.000		
CMD	0.363**	0.170**	0.093	0.178**	0.110	1.000	
PRE	0.194**	0.237**	0.074	0.245**	0.187**	0.191**	1.000

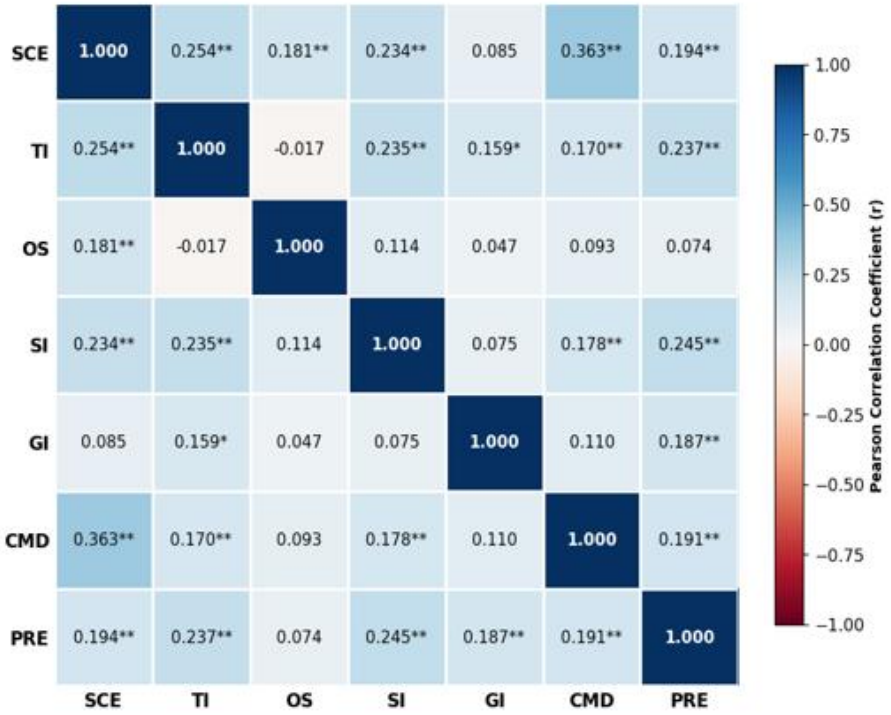


Figure 2. Pearson Correlations Between Supply Chain Efficiency and Explanatory Factors

The Pearson correlation of each pair of the seven supply chain constructs is displayed in Figure 2. Consumer and Market Demand had the highest positive correlation with Supply Chain Efficiency ($r = 0.363$, $p < 0.001$), followed by Technological Integration ($r = 0.254$, $p < 0.001$) and Sustainability Initiatives ($r = 0.234$, $p < 0.001$). There were also significant positive associations between Operational Strategies ($r = 0.181$, $p = 0.005$) and Policy and Regulatory Environment ($r = 0.194$, $p = 0.003$). Geographical and Institutional Factors, however, were not statistically significant ($r = 0.085$, $p = 0.187$). There were relatively few correlations among the explanatory constructs, indicating little or no multicollinearity between the constructs.

3.4 Multiple Linear Regression and Predictor Significance

Multiple linear regression was used to check the independent relationships between the six explanatory constructs and Supply Chain Efficiency. The Enter method was used to enter all the predictors at once. The regression model was statistically significant, $F(6, 233) = 10.381$, $p < 0.001$, with $R = 0.459$ and $R^2 = 0.211$. The adjusted R^2 was 0.191, which suggested that the six predictors accounted for about 21.1% of the variation in Supply Chain Efficiency. The explanatory variables that showed the highest statistically significant positive coefficient (β) were Consumer and Market Demand ($\beta = 0.290$, $p < 0.001$). Technological Integration was the second-best significant predictor ($\beta = 0.166$, $p = 0.008$), followed by Operational Strategies ($\beta = 0.139$, $p = 0.019$). Sustainability Initiatives had a positive but statistically non-significant coefficient ($\beta = +0.112$, $p = 0.072$), as shown in Table 4. Likewise, Policy and Regulatory Environment ($\beta = 0.061$, $p = 0.326$) and Geographical and Institutional Factors ($\beta = 0.001$, $p = 0.989$) were not statistically significant. Thus, three of the six constructs of explanation showed significant independent relationships with Supply Chain Efficiency after controlling for the other constructs. The predictive ability of the regression model was not high.

Table 4. Multiple Linear Regression Results for Supply Chain Efficiency

Predictor	B	SE	Standardized β	t	p-value
Constant	0.656	0.367	—	1.788	0.075
Technological Integration	0.167	0.062	0.166	2.688	0.008
Operational Strategies	0.149	0.063	0.139	2.363	0.019
Sustainability Initiatives	0.122	0.067	0.112	1.809	0.072

Geographical and Institutional Factors	0.001	0.059	0.001	0.013	0.989
Consumer and Market Demand	0.309	0.064	0.290	4.796	<0.001
Policy and Regulatory Environment	0.063	0.064	0.061	0.985	0.326

Model summary: R = 0.459; R^2 = 0.211; Adjusted R^2 = 0.191; F(6, 233) = 10.381; p < 0.001.

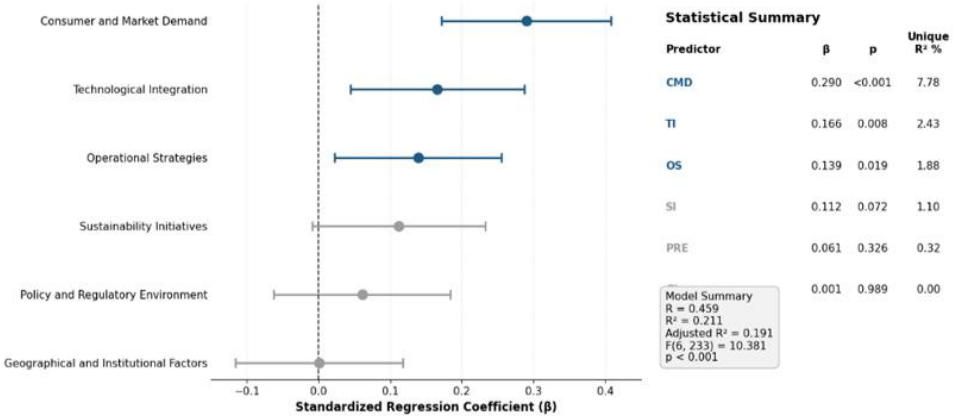


Figure 3. Standardized Regression Coefficients of Factors Associated with Supply Chain Efficiency

To illustrate the standardized regression coefficients, approximate 95% confidence intervals, statistical significance, and unique explained-variance contribution of six explanatory factors, the standardized regression coefficient estimates are displayed in Figure 3. Consumer and Market Demand exhibited the highest significant positive correlation with Supply Chain Efficiency (β = 0.290, p < 0.001) with 7.78% of unique explained variance. There were also significant positive associations between Technological Integration and Operational Strategies (β = 0.139, p = 0.019) and between Technological Integration and TOT (β = 0.166, p = 0.008). Sustainability Initiatives, Policy and Regulatory Environment, and Geographical and Institutional Factors were not statistically significant. The overall regression model was significant, F(6, 233) = 10.381, p < 0.001, explaining 21.1% of the variance in Supply Chain Efficiency (R^2 = 0.211).

3.5 Predictor Importance and Regression Diagnostic Assessment

Standardized regression coefficients and squared semi-partial correlation were employed to measure the relative importance of the predictors. Table 5 gives a summary of the results. The highest unique contribution to explained variance was Consumer and Market Demand (7.78 percentage points), followed by Technological Integration (2.43 percentage points) and Operational Strategies (1.88 percentage points). All three of these predictors showed statistical significance for regression coefficients. About 1.10 percentage points of unique explained variance was attributable to Sustainability Initiatives, while 0.32 percentage points were attributable to Policy and Regulatory Environment. Geographical and Institutional Factors did not make a significant contribution. Numerous regression diagnostics were then investigated. The range of Variance Inflation Factors was from 1.025 to 1.149, which suggested that there was no significant multicollinearity in the data. There was no noticeable first-order residual autocorrelation, with a Durbin-Watson statistic of 1.911. Normality of the residuals was suggested by the standardized residual histogram and the normal probability P–P plot. A funnel or nonlinear pattern was not prominent in the residual scatterplot. The standardized residual's minimum value was −3.023, suggesting a possible outlier. Cook's Distance ranged from 0.00000 to 0.03766, with a mean of 0.00388. However, none of the observations came near the conventional influence limit of 1.0, the highest of which passed the more sensitive 4/N screening limit. Overall, the results of the diagnostics were satisfactory.

Table 5. Predictor Importance and Regression Diagnostics

Indicator	Value	Assessment
CMD unique R^2 contribution	7.78 percentage points	Highest
TI unique R^2 contribution	2.43 percentage points	Second

OS unique R^2 contribution	1.88 percentage points	Third
SI unique R^2 contribution	1.10 percentage points	Nonsignificant predictor
PRE unique R^2 contribution	0.32 percentage points	Nonsignificant predictor
GI unique R^2 contribution	<0.01 percentage points	Negligible
Minimum VIF	1.025	Acceptable
Maximum VIF	1.149	Acceptable
Durbin-Watson statistic	1.911	No obvious first-order autocorrelation
Minimum standardized residual	−3.023	Potentially unusual case
Maximum Cook's Distance	0.03766	No, exceptionally influential case

4. Discussion

Based on the results of the statistical analysis, there are three positive correlation values, with the highest positive correlation being between Consumer and Market Demand versus Supply Chain Efficiency, Technological Integration and Supply Chain Efficiency, and Operational Strategies and Supply Chain Efficiency. There were no statistically significant independent associations found for Sustainability Initiatives, Geographical and Institutional Factors, and Policy and Regulatory Environment. The regression model produced an explanatory power of 21.1%, which suggests moderate explanatory power. The relative importance of the three factors in the analytical framework comes from the results of this analysis. The results have methodological and managerial implications for identifying how efficient the supply chain is in e-commerce. From the findings, further empirical research is suggested to be directed towards consumer responsiveness to demand, technological implementation, and operational approaches when studying the performance of the supply chain.

Demand forecasting, delivery reliability, inventory coordination, and logistics processes based on technology could be potential areas of improvement. The nonsignificant coefficients of the sustainability, geographical conditions, and regulatory factors suggest that the relationship of these three factors with each other is not independent and should not be abandoned. The study offers a model for future studies using real organizational data to test for practical applicability and generalizability. Consumer and Market Demand and Supply Chain Efficiency were related in a positive manner, and the relationship was the strongest. This is consistent with the findings of Lu et al. (2026), which investigated the role of last-mile delivery in online retail, highlighting the vital role of delivery in e-commerce. The other variables that were significant predictors were also technological integration. This was achieved by analysing the technology-related gains in a meaningful perspective, as investigated by Rana et al. (2025) under the theme of digital transformation and performance of supply chain.

Likewise, Sudrajat et al. (2026) studied the Artificial Intelligence (AI) and Big Data capabilities with agility and resilience as mediators. The study by Gopal et al. (2024) substantiates the theory of using analytics in operations by examining the factors impacting the linkage between big data analytics and supply chain performance. In contrast, the adjusted association was not statistically significant for Sustainability Initiatives. Mugoni et al. (2024) indicated the practices of sustainable supply chain in the context of environmental performance. This separation implies that environmental performance and operational efficiency cannot be seen as synonymous goals. There are, however, some restrictions to be taken into account in discussing the statistical results. The study does not make conclusions on the causal relationships among the explanatory variables and the efficiency of the supply chain in the cross-sectional analytical framework. The regression model explained 21.1% of the variance of Supply Chain Efficiency, indicating that there may be other factors that may be relevant but not included in this model. Lastly, due to infrastructure, organizational, regional logistics, and operational differences, it was not possible to validate each separately. The findings of the research are limited to the context and cannot be easily extrapolated to other contexts.

Future research suggested that the analytical framework be tested with a larger sample from the e-commerce companies, logistics service providers, and supply chain professionals from different parts of India. Later results would be more generalizable with more representative and larger samples. Time-series or longitudinal studies might explore the relationship between technological integration, consumer demand and operational approaches over the course of time and to study how this affects efficiency in the supply chain over time. In addition, other parameters such as the quality of logistic network, level of warehouse automation, transportation cost, density of the delivery network and collaboration within the supply chain should be considered in the next study. More complex relationships and construct validity could be assessed using confirmatory factor analysis (CFA) or structural equation modeling (SEM).

5. Conclusion

The study examined the extent of the relationship between technological integration, operational strategies, sustainability initiatives, geographical and institutional factors, consumer and market demand, policy and regulatory environment, and supply chain efficiency in the context of Indian e-commerce. Descriptive statistics, reliability analysis, Pearson correlation, and multiple linear regression were used to analyse 240 observations by means of a quantitative analytical approach. The results showed good internal consistency of the items in all seven constructs, as Cronbach's Alpha ranged between 0.755 and 0.794. Consumer and Market Demand ($\beta = 0.290$, $p < 0.001$), Technological Integration ($\beta = 0.166$, $p = 0.008$), and Operational Strategies ($\beta = 0.139$, $p = 0.019$) emerged as the most statistically significant predictors of Supply Chain Efficiency. There were no statistically significant independent associations for Sustainability Initiatives, Geographical and Institutional Factors, and Policy and Regulatory Environment. The model had a modest value of R2 of 21.1% for the explained variance in Supply Chain Efficiency. The diagnostic assessments indicated that the overall regression assumptions were acceptable, with no high leverage or high influence observations, and little multicollinearity. The results indicate that the theoretical importance of market responsiveness, digital capabilities, and operational coordination is highlighted when assessing the efficiency of e-commerce supply chains. Future research should use longitudinal analytical techniques to provide further empirical evidence and provide input to make informed practical supply chain decisions.

References

1. Al Mashalah, H., Hassini, E., Gunasekaran, A., & Bhatt, D. (2022). The impact of digital transformation on supply chains through e-commerce: Literature review and a conceptual framework. Transportation Research Part E: Logistics and Transportation Review, 165, 102837.
2. Castillo, V. E., Bell, J. E., Mollenkopf, D. A., & Stank, T. P. (2022). Hybrid last mile delivery fleets with crowdsourcing: A systems view of managing the cost-service trade-off. Journal of Business Logistics, 43(1), 36–61.
3. Cui, R., Lu, Z., Sun, T., & Golden, J. M. (2024). Sooner or later? Promising delivery speed in online retail. Manufacturing & Service Operations Management, 26(1), 233–251.
4. Daugherty, P. J., Bolumole, Y., & Grawe, S. J. (2019). The new age of customer impatience: An agenda for reawakening logistics customer service research. International Journal of Physical Distribution & Logistics Management, 49(1), 4–32.
5. Dayarian, I., & Savelsbergh, M. (2020). Crowdshipping and same-day delivery: Employing in-store customers to deliver online orders. Production and Operations Management, 29(9), 2153–2174.
6. Farajpour, F., Hassanzadeh, A., Elahi, S., & Ghazanfari, M. (2022). Digital supply chain blueprint via a systematic literature review. Technological Forecasting and Social Change, 184, 121976.
7. Gopal, P. R. C., Rana, N. P., Krishna, T. V., & Ramkumar, M. (2024). Impact of big data analytics on supply chain performance: An analysis of influencing factors. Annals of Operations Research, 333(2), 769–797.
8. Gunasekaran, A., Papadopoulos, T., Dubey, R., Wamba, S. F., Childe, S. J., Hazen, B., & Akter, S. (2017). Big data and predictive analytics for supply chain and organizational performance. Journal of Business Research, 70, 308–317.
9. Iftikhar, A., Ali, I., Arslan, A., & Tarba, S. (2024). Digital innovation, data analytics, and supply chain resiliency: A bibliometric-based systematic literature review. Annals of Operations Research, 333(2), 825–848.
10. Ivanov, D. (2022). Viable supply chain model: Integrating agility, resilience and sustainability perspectives—Lessons from and thinking beyond the COVID-19 pandemic. Annals of Operations Research, 319(1), 1411–1431.
11. Lim, S. F. W., & Winkenbach, M. (2019). Configuring the last-mile in business-to-consumer e-retailing. California Management Review, 61(2), 132–154.
12. Liu, Y., & Song, G. (2023). Role of logistics integration capability in enhancing performance in omni-channel retailing: Supply chain integration as mediator. Sustainability, 15(11), 9053.
13. Lohmer, J., Ribeiro da Silva, E., & Lasch, R. (2022). Blockchain technology in operations & supply chain management: A content analysis. Sustainability, 14(10), 6192.
14. Lu, Z., Cui, R., Sun, T., & Wu, L. (2026). The value of last-mile delivery in online retail. Management Science.
15. Masorgo, N., Dobrzykowski, D. D., & Fugate, B. S. (2024). Last-mile delivery: A process view, framework, and research agenda. Journal of Business Logistics, 45(4), e12397.
16. Mugoni, E., Kanyepe, J., & Tukuta, M. (2024). Sustainable supply chain management

practices (SSCMPS) and environmental performance: A systematic review. Sustainable Technology and Entrepreneurship, 3(1), 100050.
17. Parameswar, N., & Dhir, S. (2022). Delhivery: Fulfilling e-commerce delivery. Asian Journal of Management Cases, 19(2), 93–105.
18. Rana, J., Daultani, Y., Goswami, M., & Kumar, S. (2025). Exploring the impact of supply chain digital transformation on supply chain performance: An empirical investigation. Business Strategy and the Environment, 34(3), 3497–3521.
19. Sudrajat, D., Nagari, A. L., & Apriyanto, D. (2026). Investigating the impact of AI and big data capabilities on supply chain performance: The mediating role of agility and resilience. International Journal of Business Performance and Supply Chain Modelling, 16(5), 1–26.
20. Xu, A., Qian, F., Ding, H., & Zhang, X. (2023). Digitalization of logistics for transition to a resource-efficient and circular economy. Resources Policy, 83, 103616.