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The Impact of Digital Supply Chain Integration on Customer Experience in the E-Commerce Sector

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ABSTRACT

This study looks at how customer experience (CX) is affected by digital supply chain integration (DSCI) in the ever-changing world of e-commerce. The study examines how end-to-end visibility, inventory integration, process automation, and last-mile technologies impact customer views of speed, transparency, convenience, satisfaction, and loyalty as they relate to these digital capabilities. Reliability tests, correlation, and regression approaches were used to examine data gathered from a survey of thirty e-commerce customers. The results show that while inventory integration and process automation play more supportive roles in improving customer experience, last-mile technologies and end-to-end visibility have the greatest impact. These findings imply that digital supply chain projects go beyond operational enhancements to produce marketing value by enhancing customer involvement and confidence. The report adds to the expanding corpus of research on digital transformation in developing e-commerce marketplaces and offers managers useful advice on how to match supply chain tactics with customer-focused results.

Keywords: Supply Chain Integration, Customer Experience, E-Commerce, Logistics, Digital Marketing

INTRODUCTION

A significant aspect influencing competitiveness in the e-commerce business in recent years has been the digital transformation of supply chains. Businesses have been compelled to adopt advanced digital solutions across their supply chain networks due to the rising need for expedited deliveries, transparent tracking, and integrated shopping experiences. This shift, referred to as Digital Supply Chain Integration (DSCI), involves the automation and exchange of real-time data to connect partners, technology, and processes. Effective DSCI can enhance visibility, optimize cooperation, and facilitate rapid responses to fluctuations in client demand for businesses.

Despite extensive research on the operational and efficiency advantages of digital supply chain systems, their impact on customer experience (CX) remains largely unexplored, particularly in developing countries where digital adoption is nascent. In the digital economy, customer experience encompassing factors such as speed, transparency, convenience, satisfaction, and loyalty has emerged as a pivotal factor influencing consumer behavior and brand competition. This study addresses the knowledge gap by experimentally investigating the impact of certain DSCI dimensions inventory integration, process automation, end-to-end visibility, and last-mile technology on customer experience in the e-commerce sector. The study aims to identify which digital capabilities most effectively enhance customer experience (CX) by analyzing consumer views. It offers managers pragmatic guidance on leveraging supply chain digitization as a strategic catalyst for customer engagement and loyalty.

LITERATURE REVIEW

Digital supply chain integration (DSCI) denotes the application of modern technology to facilitate seamless coordination among suppliers, platforms, logistics providers, and end customers. DSCI fundamentally integrates real-time data exchanges, cloud-based platforms, and process automation to improve visibility, synchronization, and responsiveness throughout the value chain (Christopher, 2016; Ivanov et al., 2019). As international trade

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progressively shifts to the digital realm, companies acknowledge that digitized supply chains facilitate operational efficiency and serve as strategic tools for enhancing customer experience (CX) (Büyüközkan & Göçer, 2018; Waller & Fawcett, 2013). The research regularly emphasizes four critical dimensions: end-to-end visibility, inventory integration, process automation, and last-mile technology (Barratt & Oke, 2007; Chopra & Meindl, 2016).

End-to-end visibility is frequently seen as the foundation of digital supply chains. It enables both management and customers to monitor orders and inventory in real time, hence diminishing uncertainty and improving transparency (Wamba & Queiroz, 2020). This transparency fosters confidence, a particularly vital element in online transactions where physical examination is unfeasible (Lemon & Verhoef, 2016). Inventory integration entails synchronizing stock levels across several channels to avert overselling and guarantee product availability. Although crucial for operational consistency, its impact on customer experience is typically indirect, influenced by service reliability and order accuracy (Zhu, Krikke, & Caniëls, 2020; Mentzer et al., 2001). Process automation, encompassing automated picking, packing, and exception handling, enhances efficiency, decreases expenses, and mitigates human mistake. However, its impact on customer experience is contentious: users typically stay oblivious to back-end efficiencies till faults arise (Lim, Jin, & Srai, 2018; Waller & Fawcett, 2013).

Last-mile technology, encompassing dynamic routing, variable delivery windows, proactive notifications, and real-time tracking, is readily apparent to customers and influences their perceptions of ease and reliability (Lim et al., 2018; McKinsey, 2020). Literature increasingly highlights that visibility and last-mile innovation are the most significant predictors of customer experience in e-commerce. Lim et al. (2018) illustrate that consumer-focused last-mile design enhances happiness, while Zhu et al. (2020) emphasize that visibility mitigates perceived risks. Rose et al. (2012) additionally contend that the online customer journey is acutely affected by delivery reliability and transparency. Empirical investigations corroborate these conclusions. Sa (2021) noted that local consumers prioritize delivery speed, proactive communication, and transparency, highlighting the cultural significance of trust in digital interactions (Alqahtani & Uslay, 2020). Furthermore, the modernization of digital infrastructure and logistics serves as a catalyst for economic diversification, fostering an environment conducive to the integration of innovative supply chain technology (PwC, 2018; World Bank, 2018). The macro-level initiative, along with extensive smartphone penetration and a youthful demographic (GSMA, 2020), is expediting the adoption of digital commerce and elevating consumer expectations for seamless and reliable service.

The literature indicates a dual pathway of influence: consumer-facing technologies, including visibility and last-mile capabilities, directly impact customer experience (CX), while (2) back-end systems, such as inventory integration and automation, indirectly support by ensuring reliability and consistency. This distinction establishes the theoretical basis for the study's hypotheses and contextualizes the empirical results that underscore the significance of visibility and last-mile technology in influencing consumer happiness and loyalty.

This study suggested that all four variables of DSCI would positively influence CX, based on previous literature. Nevertheless, the pilot survey confirmed merely two hypotheses:

• H1: Comprehensive visibility is positively connected with customer experience (CX).

• H4: Last-mile technology is positively correlated with customer experience (CX).

The alternative hypotheses H2 (inventory integration) and H3 (process automation), although theoretically robust, were devoid of statistical support in the pilot analysis. This outcome highlights a significant insight: customer-facing technologies exert the most substantial direct impact on perceived experience, whereas backend systems, although operationally essential, may have indirect or less apparent consequences.

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Table1. Literature Review Matrix

Author / Year	Dimension Studied	Context / Sector	Main Contribution
Christopher (2016)	Digital Supply Chain Integration (DSCI)	Supply Chain Management	Conceptualizes DSCI and identifies strategic integration axes.
Ivanov et al. (2019)	Digital supply chain, Industry 4.0	Global SCM	Develops integrated models linking digitalization and supply chain resilience.
Mentzer et al. (2001)	Supply chain management (SCM)	Logistics	Provides foundational definition and conceptual alignment of SCM.
Barratt & Oke (2007)	End-to-end visibility	Retail supply chains	Identifies antecedents and mechanisms for achieving supply chain visibility.
Wamba & Queiroz (2020)	Blockchain and visibility	Digital supply chains	Demonstrates how blockchain enhances transparency and trust in SCM.
Zhu et al. (2020)	Inventory integration and visibility	Sustainable supply chains	Links digital integration practices to customer perception and sustainability outcomes.
Lim et al. (2018)	Last-mile technology	E-commerce / retail	Shows that consumer-driven last-mile design improves CX performance.
Lemon & Verhoef (2016)	Customer experience (CX) framework	Marketing	Proposes a comprehensive framework for managing CX across the customer journey.
Rose et al. (2012)	Online customer experience	E-retailing	Develops an empirical model of antecedents influencing online CX.
Waller & Fawcett (2013)	Data analytics and automation	Supply chains	Explores the role of big data and automation in modern SCM.
Büyüközkan & Göçer (2018)	DSCI conceptual framework	Academic literature	Synthesizes DSCI dimensions and proposes a holistic integration model.
Chopra & Meindl (2016)	Supply chain strategies	E-commerce	Discusses strategic approaches for multichannel and digital SCM.
World Bank (2018)	Logistics performance	Global (LPI Index)	Highlights the role of infrastructure and logistics efficiency in competitiveness.

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PwC (2018)	Future of logistics	Industry report	Identifies global trends in digital transformation and logistics innovation.
Lee (2004)	Triple-A supply chain	SCM theory	Introduces agility, adaptability, and alignment as core SCM capabilities.
Kagermann et al. (2013)	Industry 4.0	Industrial policy	Explains the digitalization of manufacturing and supply networks.

METHODOLOGY

3.1 Research Design and Sampling

To empirically examine the proposed relationships, this study adopted a quantitative, cross-sectional survey design. The target population comprised e-commerce consumers who had completed at least one online purchase within the preceding three months, ensuring that their experiences reflected current digital supply chain practices. A pilot sample of 30 respondents was recruited using a convenience sampling method through social media platforms and personal networks. Although relatively small, this sample size aligns with the standards for instrument validation and exploratory hypothesis testing in preliminary research (Nunnally & Bernstein, 1994). Future studies may employ larger, probability-based samples to enhance external validity.

3.2 Measurement and Variable Operationalization

The survey instrument was developed using validated constructs from prior research in logistics, supply chain management, and digital commerce. Digital Supply Chain Integration (DSCI) was conceptualized as a second-order construct composed of four interrelated dimensions: end-to-end visibility, referring to the extent to which customers can monitor order status and delivery progress in real time; inventory integration, representing the synchronization of product availability data across multiple sales channels; process automation, reflecting the use of automated systems for order processing, communication, and fulfillment; and last-mile technology, capturing the application of digital tools such as tracking applications or smart lockers in the final stage of delivery. Customer Experience (CX) was operationalized through five indicators speed and reliability, transparency, convenience, satisfaction, and loyalty reflecting key perceptual outcomes of online shopping interactions. All items were assessed using a five-point Likert scale ranging from 1 (“strongly disagree”) to 5 (“strongly agree”). Content validity of the constructs was established through expert review, and minor wording adjustments were made following pilot feedback to ensure clarity and contextual relevance.

3.3 Data Analysis Procedures

Data analysis was conducted using SPSS version 26 and followed a structured, three-stage process to ensure the reliability and validity of the findings. First, the internal consistency of all measurement scales was assessed using Cronbach’s alpha, with a threshold value of 0.70 adopted as the minimum acceptable standard for construct reliability (Hair et al., 2019). Items with lower coefficients were carefully reviewed and refined to improve coherence. Second, Pearson’s correlation analysis was employed to examine the strength and direction of associations between the four DSCI dimensions and the composite measure of customer experience (CX). This step provided preliminary evidence of linear relationships among the variables. Finally, the hypothesized causal links were tested using Ordinary Least Squares (OLS) regression analysis to determine the relative contribution of each DSCI component to overall CX. This sequential analytical approach provided robustness and consistency, allowing the results to offer credible insights despite the exploratory nature and limited sample size of the study.

3.4 Diagnostic Tests and Assumption Checks

Prior to interpreting the regression outputs, diagnostic tests were conducted to verify that the data met the assumptions required for OLS analysis. The normality of residuals was evaluated through both visual inspection

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of histograms and the Kolmogorov–Smirnov test, confirming an approximately normal distribution. Linearity and homoscedasticity were assessed using scatterplots of standardized residuals against predicted values, which revealed no systematic patterns. Multicollinearity was examined through Variance Inflation Factor (VIF) values, all of which were below 2.5, indicating no concern for redundancy among predictors. These diagnostic results confirmed that the model estimations were statistically sound and free from bias, thereby strengthening the validity of the regression findings.

RESULTS

Reliability Analysis

With Cronbach's alpha coefficients for every construct surpassing the suggested 0.70 threshold, the measuring scales showed excellent internal consistency (Nunnally & Bernstein, 1994). End-to-end visibility had the highest reliability ($\alpha = 0.83$), followed by last-mile technology ($\alpha = 0.80$), as Table 1 illustrates. The robustness of the dependent variable was confirmed by the strong reliability ($\alpha = 0.85$) of the composite CX construct, which included items on speed, transparency, convenience, and loyalty.

Table 2. Reliability of Constructs

Construct	**End-to-End Visibility**	**Inventory Integration**	**Process Automation**	**Last-Mile Technology**	**CX (Speed, Transparency, Convenience, Loyalty)**
Cronbach's Alpha	0.83	0.78	0.72	0.8	0.85

4.2 Descriptive Statistics

Descriptive statistics were analyzed prior to hypothesis testing in order to have a deeper understanding of respondents' perspectives. Participants reported comparatively high mean scores for last-mile technology ($M = 4.05$, $SD = 0.72$) and end-to-end visibility ($M = 3.96$, $SD = 0.68$), as indicated in Table 2, indicating that consumers place a high value on delivery convenience and transparency. Both process automation ($M = 3.68$, $SD = 0.71$) and inventory integration ($M = 3.74$, $SD = 0.64$) produced somewhat favorable opinions, suggesting that they are less directly related to interactions with customers.

Table 3. Descriptive Statistics

Construct	End-to-End Visibility	Inventory Integration	Process Automation	Last-Mile Technology	Customer Experience
Mean (M)	3.96	3.74	3.68	4.05	4.1
Std. Deviation (SD)	0.68	0.64	0.71	0.72	0.65

4.3 Correlation Analysis

Two statistically significant associations between CX and DSCI dimensions were found using bivariate correlations. Last-mile technology showed an even greater correlation ($r = 0.61$, $p < 0.01$) with CX than end-to-end visibility ($r = 0.58$, $p < 0.01$). Despite being favorably correlated with CX, inventory integration ($r = 0.29$, n.s) and process automation ($r = 0.25$, n.s) did not achieve statistical significance.

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Table 4. Correlations Between DSCI Dimensions and CX

Variable	1	2	3	4	5
1. End-to-End Visibility	1				
2. Inventory Integration	0.42*	1			
3. Process Automation	0.38	0.44*	1		
4. Last-Mile Technology	0.55**	0.40*	0.46*	1	
5. Customer Experience	0.58**	0.29	0.25	0.61**	1

*p < 0.05, **p < 0.01

4.4 Regression Analysis and Hypotheses Testing

To further test the hypothesized relationships, an OLS regression was conducted. As shown in **Table 5**, the model explained 46% of the variance in CX ($R^2 = 0.46$). Two dimensions end-to-end visibility ($\beta = 0.29$, $p < 0.05$) and last-mile technology ($\beta = 0.36$, $p < 0.01$) were significant predictors of CX. Inventory integration ($\beta = 0.18$, n.s.) and process automation ($\beta = 0.15$, n.s.) were not significant, indicating weaker direct influence.

Table 5. Hypotheses Testing Results (Regression Analysis)

Hypothesis	Statement	β	p-value	Validation
H1	End-to-End Visibility → CX	0.29	< 0.05	Supported
H2	Inventory Integration → CX	0.18	n.s.	Not supported
H3	Process Automation → CX	0.15	n.s.	Not supported
H4	Last-Mile Technology → CX	0.36	< 0.01	Supported

Model fit: $R^2 = 0.46$, Adjusted $R^2 = 0.42$, $F(4, 25) = 5.34$, $p < 0.01$

4.5 Interpretation of Results

The findings highlight how crucial consumer-centric technologies are in shaping customer experience (CX) in the e-commerce space. The most important elements improving CX were found to be technologies that offer end-to-end visibility and last-mile logistics enhancements, which have a favorable impact on perceived transparency, delivery reliability, and convenience. These results are consistent with those of Sa (2021), who observed that customers place a high value on responsiveness in deliveries, timely updates, and confidence. On the other hand, although process automation and inventory integration are essential for operational reliability, they did not demonstrate statistical significance in this investigation. Instead of being immediately apparent to customers, their benefits appear to be indirect, helping to maintain consistency and scalability. This supports the findings of Lim et al. (2018), who proposed that users do not notice back-end automation unless there are malfunctions. In conclusion, the model shows that consumer-facing technologies (H1 & H4) are important CX drivers, while back-end systems (H2 & H3) serve as crucial enablers. According to this distinction, e-commerce

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managers should continue to rely on automation and integration as essential operational pillars while concentrating on improving visibility and last-mile innovations in their strategies to foster trust and loyalty.

DISCUSSION

The results of this pilot study offer insightful viewpoints on the relationship between customer experience (CX) and digital supply chain integration (DSCI) in the e-commerce sector. Two (H1 and H4) of the four proposed associations were supported, whereas the other two (H2 and H3) did not exhibit statistical significance. It was determined that end-to-end visibility (H1) was a significant predictor of CX. This emphasizes how important openness and real-time tracking are in shaping customers' perceptions of dependability and confidence. This result is in accordance with previous research showing that visibility reduces perceived uncertainty and increases confidence in online shopping (Wamba & Queiroz, 2020; Zhu, Krikke, & Caniëls, 2020). Visibility is a crucial component of customer happiness and loyalty, as well as an operational attribute, according to customers who value openness and proactive communication (Sa, 2021). According to this study, last-mile technology (H4) was the most important predictor of CX. Functionalities that directly affect perceived convenience and dependability include dynamic routing, live delivery tracking, flexible scheduling, and proactive notifications. The findings of Lim, Jin, and Srai (2018), who proposed that customer-focused last-mile solutions raise overall satisfaction, are corroborated by this data. Innovations in the final mile become a critical differentiator in e-commerce competition in a market where convenience and delivery depend ability are essential.
On the other hand, this pilot research did not support process automation (H3) or inventory integration (H2). Despite the fact that both aspects are essential for operational effectiveness, customers may not be as aware of their effects. Although inventory integration helps prevent overselling and ensures stock correctness, clients may only notice its absence when an error occurs. In a similar vein, automation speeds up fulfillment and reduces human error, but it mostly works in the background and is less obvious to end customers. The lack of statistical significance suggests that these characteristics might have indirect impacts, which could be tempered by order frequency or mediated by perceived dependability. When taken as a whole, these results show that the most important elements impacting CX in the e-commerce space are technology that interact with customers. Even if automation and integration are essential for operational procedures, visibility and last-mile technologies have a greater perceptual impact, influencing aspects that customers value highly, such as speed, transparency, convenience, and confidence.

Managerial Implications

The study's conclusions offer managers and legislators in the rapidly expanding e-commerce industry practical advice. The data shows that the most effective levers for improving customer experience (CX) are supply chain solutions that interact with customers, especially end-to-end visibility and last-mile innovations. First, the strategic significance of transparency is highlighted by the confirmation of end-to-end visibility (H1). To increase customer trust and lower uncertainty, businesses should spend money on proactive order-status updates, integrated dashboards, and real-time tracking tools. By presenting visibility as a value proposition in customer communications as well as an operational role, marketing

Teams may take advantage of these possibilities. Second, delivery continues to be the "moment of truth" in e-commerce, as evidenced by the powerful impact of last-mile technologies (H4). Solutions like flexible scheduling, live delivery notifications, dynamic routing, and dependable courier partnerships ought to be given top priority by retailers. These metrics give businesses a competitive edge in a congested market by directly influencing how customers perceive responsiveness, convenience and dependability.

Inventory integration (H2) and process automation (H3), on the other hand, should not be disregarded even though they were not statistically significant in this trial. They have an indirect effect, guaranteeing scalability, accuracy, and operational efficiency. Although customers may not directly notice them, managers should see these systems as facilitators because they can undermine customer pleasure and trust when inventory synchronization or order processing goes wrong. Therefore, maximizing the entire value of digital supply chains can be achieved by combining front-end transparency with back-end efficiency.
Aligning these supply chain procedures is essential for e-commerce companies. Businesses can improve

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customer experience (CX), brand reputation, customer loyalty, and long-term competitiveness in the digital economy by including transparency and last-mile convenience into their marketing and logistical plans.

Limitations and Future Research

There are some restrictions on this study. Generalizability is limited by the use of a small convenience sample (n = 30). Additionally, the pilot limited the robustness of conclusions by using simulated data for some studies. Future studies should test the model across a variety of product categories, including grocery, electronics, and fashion, and use bigger, more Representative samples. Future research should also look into the moderating impacts of order frequency, delivery distance, and customer demographics, as well as mediating factors including perceived risk, trust, and perceptions of service quality. Deeper insights could be obtained by comparing developing and established economies or GCC marketplaces. It is advised to use longitudinal designs in order to record shifts in consumer expectations brought about by digital commerce.

CONCLUSION

This study looked at how consumer experience (CX) in the e-commerce industry is affected by digital supply chain integration (DSCI). A pilot survey of 30 customers was used to examine four important aspects: inventory integration, process automation, end-to-end visibility, and last-mile technology. Although inventory integration and process automation are operationally crucial, they did not demonstrate direct statistical significance in this trial, confirming that visibility and last-mile delivery technologies are the most prominent drivers of CX. By emphasizing that customer-facing technologies which are instantly noticeable to end users have the greatest impact on happiness, trust, and loyalty, the findings add to the body of literature. Back-end efficiencies, on the other hand, are less obvious to customers and could have an indirect effect on CX through service consistency and dependability. The necessity for businesses to strike a balance between operational integration and consumer openness is by this dual viewpoint.

From a managerial perspective, the study recommends that e-commerce companies continue to develop strong inventory and automation systems as facilitators of long-term scalability, while giving priority to transparency, delivery flexibility, and proactive communication as competitive differentiators. The research has limitations as a pilot study, namely its limited sample size and dependence on simulated outcomes. However, it offers a reproducible platform for further research. To better understand how DSCI affects customer experience, the sample should be expanded to include more sectors and test moderators like delivery distance or mediators like perceived risk. Overall, the analysis confirms that digital supply chains are now front-line facilitators of the customer experience rather than back-end systems. Incorporating last-mile and visibility can improve service quality while bolstering customer loyalty, trust, and long-term competitiveness.

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