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RESEARCH PAPER

A DEMATEL-based analysis of logistics determinants in online retail

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ABSTRACT

Goal: The objective of this study is to perform the analysis of the logistical determinants for the purchase of a product online through the DEMATEL methodology.

Design/methodology/approach: The factors that drive a customer to make a purchase online have become competitive and make it so that the customer can quickly compare online sales platforms and then select the one that is most attractive to them. This study sought through the DEMATEL methodology to identify with experts in the area, factors that lead a customer to make a purchase decision in an online retail in the logistics context.

Results: The results show that the experience that the retailer delivers to the customer in the delivery logistics process is totally directed with the purchase decision and that this is a focus factor of the specialists in the decision-making process.

Research limitations: Some data on logistics factors, customer preferences, or purchasing behavior may compromise the accuracy and reliability of the analysis results.

Practical implications: Understanding the factors, businesses can optimize their supply chain processes to meet customer demands efficiently, reducing lead times, stockouts, and delivery delays. This may involve renegotiating contracts with shipping providers, investing in warehouse automation technology, or optimizing transportation routes to reduce costs and improve overall operational efficiency.

Originality/value: Few studies have applied DEMATEL to logistics issues, especially in the context of online retail. This article seeks to point out indicators for decision-making that are rarely studied in the literature and that serve as a new way of helping managers make decisions.

Keywords: E-commerce; Logistics; Dematel; Online; Retail; Logistic.

1 INTRODUCTION

The COVID-19 while pandemic has been one of the most impactful events in the world in the 21st century, affecting consumer behavior. One of the main movements ended up being the adoption of e-commerce (Souza *et al.*, 2020; Stradioto *et al.*, 2020). Therefore, the consumer started to buy more products online, and once this increase occurs, the competitiveness among retailers increases (Jin *et al.*, 2020; Souza *et al.*, 2023a). Thus, those who provide a logistical differential in the delivery of products increase the attractiveness to customers (Pereira *et al.*, 2018).

The role of logistics in e-commerce goes beyond mere product transportation; it directly impacts customer satisfaction and influences purchasing decisions. The logistics differential is directly related to the level of logistics service and its factors (Zoubek and Simon, 2021).

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The logistical service level refers to the degree of customer satisfaction in relation to the services provided by a company's logistics (Uzir *et al.*, 2021). In other words, it is the company's ability to provide customers with exactly the correct products, in precisely amount, at exactly the required location, and at exactly the right time (Kawa and Światowiec-Szczepańska, 2021). The higher the level of logistics service, the more likely the customer is to be satisfied and the company is to retain and build customer loyalty (Wang *et al.*, 2021). A high logistical service level can help a company stand out in a highly competitive market, increase customer loyalty and enhance its reputation (Souza *et al.*, 2019; Michalski and Montes-Botella, 2022).

The customer's perception of logistics value may vary according to the type of product, the urgency of delivery, the customer profile, and other specific characteristics (Mrutzek-Hartmann *et al.*, 2022). However, there are some common preferences that can influence customer satisfaction with logistics, such as speed of delivery, order tracking, delivery flexibility, suitable packaging, and delivery options (Huang *et al.*, 2021; Jensen *et al.*, 2021). Customer preference for logistics is strongly related to the quality of service provided, efficiency of delivery, and the capability of the enterprise to respond to the customer's needs and expectations (Souza *et al.*, 2022a, 2023b). Companies that are able to offer a high level of logistical service, with speed, transparency, and flexibility, have a greater chance of retaining and satisfying their customers (Chu *et al.*, 2021).

Given the complexity of online retail logistics, a key challenge for retailers is understanding the interdependencies among logistics factors that drive purchasing decisions (Mrutzek-Hartmann *et al.*, 2022). These factors do not operate in isolation; rather, they form a dynamic system where one factor may influence others, either directly or indirectly. Traditional statistical methods often fail to capture these intricate cause-effect relationships. To address this gap, this study employs the Decision-Making Trial and Evaluation Laboratory (DEMATEL) methodology (Tzeng and Huang, 2012), which is specifically designed to analyze complex systems by mapping causal relationships among factors.

DEMATEL allows for a structured evaluation of logistics determinants in online purchasing decisions by identifying which factors act as primary drivers and which are influenced by others (Torbacki and Kijewska, 2019). This distinction is critical for e-commerce managers seeking to optimize their logistics strategies. Unlike conventional correlation-based approaches, DEMATEL provides a causal network analysis, revealing the most influential logistics determinants in the customer's decision-making process. By applying DEMATEL, this study offers a unique contribution to the field, shedding light on how logistics service factors impact e-commerce competitiveness and customer satisfaction.

Therefore, understanding the logistics factors that impact the customer from a perspective of specialists who work in the operation is important in the decision-making process (Ling *et al.*, 2021). Research has emerged to help retailers in this understanding and as methodology the DEMATEL (Decision Making Trial and Evaluation Laboratory) (Tzeng and Huang, 2012). In logistics, DEMATEL may be applied to analyze and evaluate several aspects related to the logistics management of a company, such as: identify which are the main bottlenecks in the information flow and which measures can be taken in order to improve this process and identify which are the main problems in transportation and distribution management and how they can be solved, among others in the ecommerce context (Govindan *et al.*, 2016; Govindan and Chaudhuri, 2016; Khan *et al.*, 2022; Mishra, 2021).

One of the key advantages of DEMATEL is its ability to classify logistics factors into two groups: "cause factors" (which drive other factors) and "effect factors" (which are influenced by others) (Bouzon *et al.*, 2018; Govindan and Bouzon, 2018, Campos *et al.*, 2021). Causal factors are those that influence other factors, while effects are influenced by other factors (Torbacki and Kijewska, 2019). Based on this division, the technique creates a network of interdependence between the factors (Aliei *et al.*, 2020). In this way, logistics factors that may have an influence on the buying decision process of a customer in online retail can be listed (Campos *et al.*, 2021; Raj and Sah, 2019). There are many studies that use DEMATEL in logistics and show effective results in decision making (Du, 2023; Maden and Alptekin, 2020; Shoaib *et al.*, 2022; Shokouhyar *et al.*, 2022). However, there are few studies that use this methodology to relate logistical factors that impact the consumer's decision making when buying from an online retailer (Hua and Fang, 2022; Ou, 2020; Shahraki Moghadam *et al.*, 2021; Tian *et al.*, 2019).

This study aims to analyze logistics determinants affecting online purchasing behavior through the DEMATEL methodology. Given the growing importance of logistics in e-commerce competitiveness, understanding which factors have the greatest impact on consumer decisions is essential for strategic planning. Retailers must adopt a strategic mindset regarding service offerings, performance optimization, and customer retention efforts in digital sales channels. By applying DEMATEL, this study contributes to the field by identifying the most critical logistics factors and their interrelationships, thereby offering actionable insights for e-commerce businesses.

2 RESEARCH METHODOLOGY

This study employs the Decision-Making Trial and Evaluation Laboratory (DEMATEL) methodology to identify and evaluate the logistics factors that influence online purchasing decisions. The methodology follows a structured process that includes factor identification, expert selection, data collection, DEMATEL analysis, and interpretation of results.

2.1 Justification for the Choice of DEMATEL

Logistics plays a critical role in e-commerce, directly influencing customer satisfaction and purchase decisions. Several studies have examined logistics service attributes that impact consumer behavior, identifying factors such as delivery speed, tracking visibility, shipping cost, reliability, and flexibility as key determinants (Jensen *et al.*, 2021; Kawa & Światowiec-Szczepańska, 2021; Wang *et al.*, 2021). While these studies provide valuable insights, many fail to analyze the interdependencies among logistics determinants (Souza *et al.*, 2024). They typically rely on correlation-based approaches, measuring associations between variables rather than identifying causal relationships. This gap in the literature necessitates methodologies that can systematically evaluate how logistics factors influence each other, making multi-criteria decision-making (MCDM) techniques, such as DEMATEL, highly relevant.

The selection of the Decision-Making Trial and Evaluation Laboratory (DEMATEL) methodology for this study is justified by its unique ability to identify and visualize causal relationships among logistical determinants influencing online purchasing decisions (Bouzon *et al.*, 2018; Govindan and Bouzon, 2018, Campos *et al.*, 2021). The DEMATEL method has been widely recognized as an effective approach for uncovering causal relationships among factors, thereby supporting more informed and strategic decision-making. As discussed by Bai and Sarkis (2013), this technique plays a significant role in transforming strategic objectives into practical actions by structuring knowledge through causal analysis. Furthermore, DEMATEL stands out by allowing varying degrees of influence between factors, unlike methods such as ISM, which rely on binary levels. In contrast to AHP, which assumes unidirectional relationships and requires multiple separate matrices, DEMATEL accommodates bidirectional and interdependent connections, offering a more nuanced and realistic view of systemic complexity (Zhu *et al.*, 2011; Bai and Sarkis, 2013). Compared to other multi-criteria decision-making (MCDM) techniques, DEMATEL stands out due to its capacity to structurally analyze interdependencies between variables, which is crucial in the dynamic and interconnected nature of e-commerce logistics (Ling *et al.*, 2021). Despite its notable advantages, DEMATEL has limitations, particularly in handling uncertainty and incomplete information (Bouzon *et al.*, 2020). In the context of this study, its application is justified by the need to deeply understand the interactions among logistical factors, especially in scenarios where expert responses are variable and data may be imprecise. Given this context, DEMATEL proved to be an appropriate method to structure expert perceptions and support the analysis of causal relationships in a systematic and visually interpretable manner.

Several studies have applied DEMATEL to logistics issues. For example, DEMATEL has been employed to assess barriers in reverse logistics implementation, identifying key drivers that influence efficiency in product returns and recycling processes (Bouzon *et al.*, 2018; Campos *et al.*, 2021). Additionally, it has been used to evaluate environmental and economic trade-offs in logistics, assisting organizations in balancing cost efficiency with sustainability objectives (Shoaib *et al.*, 2022). Furthermore, DEMATEL has provided insights into factors critical to optimizing delivery networks and reducing last-mile inefficiencies (Shokouhyar *et al.*, 2022; Raj & Sah, 2019).

One of DEMATEL's primary advantages is its ability to distinguish between cause and effect factors, providing a more strategic perspective for logistics and e-commerce managers (Torbacki and Kijewska, 2019). Unlike the Analytic Hierarchy Process (AHP), which merely assigns relative weights to variables without explicitly defining causal links, DEMATEL structures logistical factors into a causal diagram (Du, 2023). This enables the identification of key drivers that have a significant influence on the system and those that are predominantly impacted.

Another major advantage of DEMATEL is its capability to capture complex interdependencies between the analyzed factors (Ou, 2020). However, in e-commerce logistics, factors are not isolated but rather interact dynamically (Souza *et al.*, 2022b). For instance, consumers' perceptions of delivery reliability may be influenced not only by shipping speed but also by the retailer's ability to provide real-time tracking. DEMATEL acknowledges and quantifies these mutual influences, allowing for a more profound understanding of the dynamic relationships among logistical determinants in online purchasing decisions (Shoaib *et al.*, 2022).

Furthermore, DEMATEL enhances the interpretability of the analysis by generating a visual diagram of influence relationships. The use of a causal influence map facilitates the communication of results to logistics managers, enabling them to clearly visualize which factors should be prioritized to optimize e-commerce logistics performance (Du, 2023). Another key strength of DEMATEL is its ability to integrate both qualitative and quantitative factors, making it a more flexible method for analyzing consumer perceptions of logistics services (Du, 2023).

2.2 Factor identification

In the first stage, a literature review was conducted to identify the logistics factors that influence online consumer purchasing decisions. Relevant studies in the fields of e-commerce logistics, last-mile delivery, customer satisfaction, and logistics service quality were analyzed to compile a comprehensive list of determinants. The final selection of factors was based on their frequency and relevance in previous research, ensuring that only the most critical and widely recognized logistics variables were included in the analysis. These factors were validated by experts before proceeding with the DEMATEL analysis. In view of this, table 1 shows the factors, as well as the studies that point to these factors as being strategic.

Table 1 - Factors

Factors	Authors
A. Strong previous logistic experience of buying from th customer at the same site	(Gibson *et al.*, 2022; Tsai & Tiwasing, 2021; Tueanrat *et al.*, 2021)
B. Delivery-related feedba from close people	(Lim *et al.*, 2018; Mishra *et al.*, 2022; Zhou *et al.*, 2020)
C. Internet searches related t other users' experiences	(Buldeo Rai *et al.*, 2019; Levina & Razumova, 2019; Salvietti *et al.*, 2022)
D. Knowledge to compa transport offerings betwee different retailers	(Aktas *et al.*, 2020; Buldeo Rai *et al.*, 2021; Lim & Winkenbach, 201 Shrestha *et al.*, 2021)
E. Need for faster delivery	(Buldeo Rai, Verlinde, & Macharis, 2019; Castillo *et al.*, 2018; Vakulenko *al.*, 2019)
F. Priority for buying from a si that you already buy from	(Schubert *et al.*, 2020; Weber & Badenhorst-Weiss, 2018)
G. Customer expectation discounts on logistics value	(Gruchmann *et al.*, 2020; Gupta *et al.*, 2019; Vivaldini & Pires, 2013)
H. Customer informatic regarding the technologic tracking level of the retailer	(Jones *et al.*, 2021; Riley & Klein, 2019)
I. Customer's knowledge which carriers work with th retailer	(Cui *et al.*, 2013; Santos & Sánchez-Díaz, 2016; Sawangwong Chaopaisarn, 2021)

2.3 Expert Selection Process

The selection of experts represents a critical methodological step in ensuring the validity and credibility of studies utilizing the DEMATEL approach, which heavily relies on expert judgment to assess the causal relationships among factors. In this study, experts were selected based on four key criteria: (i) proven professional experience in e-commerce logistics; (ii) direct involvement in logistics strategy formulation or operational decision-making; (iii) advanced academic qualifications (at least postgraduate level); and (iv) active employment in leading e-commerce companies operating in the Brazilian market.

A total of eight experts participated in the study. This number is methodologically justified by the cognitive demands of DEMATEL (Govindan & Bouzon, 2018; Wu & Lee, 2007; Li *et al.*, 2019), which involves complex pairwise comparisons across multiple factors (Zhang and Deng, 2019). According to methodological literature (Shokouhyar *et al.*, 2022; Raj & Sah, 2019), small but highly qualified expert panels (typically ranging from 5 to 15 members) are considered sufficient and even preferable in multi-criteria decision-making (MCDM) methods like DEMATEL, as they enable deeper insights, reduce response inconsistency, and ensure the feasibility of judgment aggregation (Govindan & Bouzon, 2018; Wu & Lee, 2007; Li *et al.*, 2019).

Furthermore, the selection of eight experts ensures a balance between data richness and analytical tractability, providing diverse perspectives without compromising the quality or interpretability of the influence matrices. This size aligns with established best practices in similar studies involving logistics and supply chain decision-making using DEMATEL, where focused expertise is prioritized over statistical generalization (e.g., Bouzon *et al.*, 2018; Campos *et al.*, 2021). The expert profiles are presented in Table 2, detailing their demographic characteristics, academic background, current professional roles, and years of experience in e-commerce logistics, thereby reinforcing the robustness and relevance of the collected judgments.

Table 2 - Specialists

Expert profile	Gender	Age	Education	Current position	Time in the ecommerce area	Time in current position
Specialist 1	Female	32	Postgraduate	Ecommerce Coordinator	10	4
Specialist 2	Female	42	Postgraduate	Ecommerce Manager	15	5
Specialist 3	Female	33	Postgraduate	Digital Logistics Analyst	11	3
Specialist 4	Female	34	Postgraduate	Digital Logistics Supervisor	12	4
Specialist 5	Female	28	Postgraduate	Marketplace Analyst	6	4
Specialist 6	Female	27	Postgraduate	Ecommerce Analyst	5	2
Specialist 7	Female	32	Postgraduate	Ecommerce Analyst	10	7
Specialist 8	Female	29	Postgraduate	Ecommerce Analyst	7	2

To address the applied nature of this research, the study deliberately incorporates insights from professionals directly engaged in real-world e-commerce logistics operations (Zhang and Deng, 2019). While the study is theoretically grounded, it seeks to ensure practical relevance by involving experts who are actively involved in decision-making processes within major e-commerce companies (Govindan & Bouzon, 2018; Wu & Lee, 2007; Li *et al.*, 2019). This approach enables the integration of empirical knowledge with methodological rigor, bridging the gap between theoretical modeling and operational practice (Li *et al.*, 2019). Although primary operational datasets were not available, expert elicitation served as a robust proxy for capturing current industry dynamics, strategic considerations, and practical constraints faced by companies. Such integration reinforces the study's applied orientation and enhances the credibility and transferability of the results to real-world logistics scenarios (Shoaib *et al.*, 2022).

2.4 Data collection

Data was collected through structured questionnaires designed based on the logistics factors identified in the literature review. The questionnaire was structured into two sections: expert Profile (background information, including industry experience, job role, and years in e-commerce logistics) and logistics factor evaluation (experts were asked to evaluate the interrelationships between logistics factors using a pairwise comparison scale (ranging from 0 = No Influence to 4 = Very High Influence)).

The survey was conducted via Google Forms in January 2023, and all responses were collected anonymously to ensure unbiased assessments. Experts provided evaluations based on their professional insights and company strategies, ensuring that real-world logistics challenges were considered in the analysis.

2.5 Dematel analysis

The DEMATEL (Decision Making Trial and Evaluation Laboratory) technique is applied to calculate the importance weights of the studied factors (Ricci *et al.*, 2022). According to (Zhang and Deng, 2019), DEMATEL is an effective method to analyze the results of direct and indirect results of relationship between the the components of a system as to their type and severity.

Using the survey and the answers collected, a direct relationship matrix was developed. Using DEMATEL's multicriteria decision making method, the cause factor, effect factor, and degree of preeminence of the obstacles are discovered (Silva, 2022). DEMATEL is a comprehensive technique for analyzing the interrelationships between system factors and emphasizing the key determinants

(Curtis *et al.*, 2021; Govindan and Bouzon, 2018).

In addition, the impact relationship map is presented to visualize the relationship links with numbers representing the degree of influence and arrows representing the direction of influence (Du and Li, 2021; Ricci *et al.*, 2022). The DEMATEL steps (Ricci *et al.*, 2022) used in this research are presented in the sequencie according to Sivakumar *et al.* (2018).

Step 1: Create the inicial relationship matrix for every specialist . This matrix a comparison generated using the scale (0 - No influence, 1 - Very low influence, 2 - Low influence, 3 - Medium influence, 4 - High influence, 5 - Very high influence), to represent the interrelationship of factors (according to Table 3). The matrix is obtained from each expert where each element represents the influence of barrier i on j, according to the total number of factors considered. Furthermore, the diagonal has a value of 0, meaning that the factors have no influence on itself. The number of matrices obtained epends on the number of experts (Curtis *et al.*, 2021; Govindan and Bouzon, 2018).

Table 3 - Relationship Matrix

Degree of influence	Numeric value
No influence	0
Low influence	1
Medium influence	2
High influence	3
Very high influence	4

Step 2: The general direct relationship matrix (A) is the step that integrates the opinion of all experts, that is, an arithmetic average of the answers is made Eq. (1).

$$A = \frac{1}{n}\sum_{k=1}^{n} A_{ij}^{k} \quad (1)$$

Step 3: The normalized general direct relationship matrix (X), that is, divide the number of each cell by the maximum number of the row sum Eq. (2).

$$X = k.A, onde\ k = \frac{1}{\max\limits_{1\le i\le n} \sum_{j=1}^{n} a_{ij}}, \quad i,j = 1,2,\ldots,n \quad (2)$$

Step 4: The total ratio matrix (T), that is, you take matrix X and multiply it by the inverse of the subtraction of itself (X) by the identity matrix (I) Eq. (3).

$$T = X(I - X)^{-1} \quad (3)$$

Step 5: The row sum and column sum are calculated, indicated separately as R (column sum and separately as R (column sum) and D (row sum) within the total ratio total relationship.

Step 6: A causal diagram is drawn by mapping the values of (D+R, D-R), where the horizontal axis refers to the values of (D+R) while the vertical axis refers to the values of (D-R).

Step 7: The average values of all elements present in matrix T are summed and divided by the number of elements present in the matrix to provide the threshold value.

Step 8: A directed graph is drawn to understand the interrelationships between the barriers. The values in matrix T that meet or exceed the threshold value are considered to have a significant influential force. The influential strength matrix is used to draw the directed graph.

2.6 Interpretation and Practical Implications

Once the DEMATEL analysis was completed, the results were interpreted to identify key logistics factors that drive online purchasing decisions. The most influential factors were categorized as “cause” factors (which influence others) and “effect” factors (which are influenced by others). This classification helps online retailers prioritize logistics improvements based on their strategic impact on customer purchasing behavior. By applying DEMATEL, this study contributes to the field by offering an evidence-based approach to improving logistics strategies in e-commerce, helping businesses enhance their competitiveness and customer satisfaction.

3 RESULTS

Applying the methodology proposed in this study, Table 4 was created, which presents the questionnaire applied to the specialists described in Table 3. So that it is evaluated according to the criteria in table 2, taking into account the impact of the X axis factor on the Y axis.

Chart 4 - Questionnaire applied to the experts

Factors	A	B	C	D	E	F	G	H	I
A. Strong previous logistical experience of buying from the customer at the same site	0								
B. Delivery-related feedback from close people		0							
C. Internet searches related to other users' experiences			0						
D. Knowledge to compare transport offerings between different retailers				0					
E. Need for faster delivery					0				
F. Priority for buying from a site that you already buy from						0			
G. Customer expectation of discounts on logistics value							0		
H. Customer information regarding the technological tracking level of the retailer								0	
I. Customer's knowledge of which carriers work with the retailer									0

Using the results from the 8 specialists, we performed the step of generating the direct relation matrix of the answers (presented in table 5) according to step 2 of the proposed methodology. The direct relation matrix of the answers aims to stimulate multidimensional thinking through the systematic investigation of the relations between two or more sets of data. Besides indicating the presence, it also shows the intensity of the relationships between the analyzed factors. The most important point in using it is to decide how to combine the sets of phenomena and corresponding factors (Liu *et al.*, 2017).

Chart 5 - The general direct relationship matrix (A)

X	A	B	C	D	E	F	G	H	I
A	0	4	4	3	1	4	3	4	4
B	4	0	4	2	3	4	3	3	3
C	4	4	0	4	3	2	2	2	4
D	4	3	2	0	4	4	3	4	3
E	2	3	4	4	0	3	2	3	3
F	1	3	4	3	3	0	1	2	1
G	1	3	1	4	4	2	0	3	4
H	4	4	4	2	4	2	3	0	4
I	4	3	4	3	2	4	2	4	0

Step 3 consisted of performing the normalization of the matrix performed earlier in Table 5 that allows the interpretation of the average of the values of the variable in the neighbors for the spatial lag (Li *et al.*, 2022). The denominator for this study was 27, as shown in Figure 1. The result of this step is presented in Figure 2.

X	A	B	C	D	E	F	G	H	I	$\sum_{j=1}^{n} a_{ij}$
A	0	4	4	3	1	4	3	4	4	27
B	4	0	4	2	3	4	3	3	3	26
C	4	4	0	4	3	2	2	2	4	25
D	4	3	2	0	4	4	3	4	3	27
E	2	3	4	4	0	3	2	3	3	24
F	1	3	4	3	3	0	1	2	1	18
G	1	3	1	4	4	2	0	3	4	22
H	4	4	4	2	4	2	3	0	4	27
I	4	3	4	3	2	4	2	4	0	26

Figure 1 - Normalizing the matrix of general direct relationship matrix (X)

X	A	B	C	D	E	F	G	H	I
A	0	0,15	0,15	0,11	0,04	0,15	0,11	0,15	0,15
B	0,15	0	0,15	0,07	0,11	0,15	0,11	0,11	0,11
C	0,15	0,15	0	0,15	0,11	0,07	0,07	0,07	0,15
D	0,15	0,11	0,07	0	0,15	0,15	0,11	0,15	0,11
E	0,07	0,11	0,15	0,15	0	0,11	0,07	0,11	0,11
F	0,04	0,11	0,15	0,11	0,11	0	0,04	0,07	0,04
G	0,04	0,11	0,04	0,15	0,15	0,07	0	0,11	0,15
H	0,15	0,15	0,15	0,07	0,15	0,07	0,11	0	0,15
I	0,15	0,11	0,15	0,11	0,07	0,15	0,07	0,15	0

Figure 2 -Normalized general direct relationship matrix (X)

In order to find the matrix T, described in the methodology as step 4, we start by subtracting X from the identity matrix (I), represented in Figure 3. Next, we calculate the inverse of the result of this matrix, shown in Figure 4. Finally, we obtained the matrix T shown in Figure 5.

(I-X)	A	B	C	D	E	F	H	G	I
A	1,00	-0,15	-0,15	-0,11	-0,04	-0,15	-0,11	-0,15	-0,15
B	-0,15	1,00	-0,15	-0,07	-0,11	-0,15	-0,11	-0,11	-0,11
C	-0,15	-0,15	1,00	-0,15	-0,11	-0,07	-0,07	-0,07	-0,15
D	-0,15	-0,11	-0,07	1,00	-0,15	-0,15	-0,11	-0,15	-0,11
E	-0,07	-0,11	-0,15	-0,15	1,00	-0,11	-0,07	-0,11	-0,11
F	-0,04	-0,11	-0,15	-0,11	-0,11	1,00	-0,04	-0,07	-0,04
G	-0,04	-0,11	-0,04	-0,15	-0,15	-0,07	1,00	-0,11	-0,15
H	-0,15	-0,15	-0,15	-0,07	-0,15	-0,07	-0,11	1,00	-0,15
I	-0,15	-0,11	-0,15	-0,11	-0,07	-0,15	-0,07	-0,15	1,00

Figure 3 - Subtracting X from the identity matrix (I)

Inverse of (I-X)	A	B	C	D	E	F	H	G	I
A	2,2139	1,4509	1,4686	1,3142	1,2131	1,3663	1,0561	1,3527	1,3951
B	1,2893	2,2678	1,4156	1,2390	1,2230	1,3154	1,0158	1,2723	1,3140
C	1,2829	1,3812	2,2698	1,2830	1,2083	1,2481	0,9781	1,2342	1,3306
D	1,3323	1,4148	1,4052	2,2116	1,2982	1,3622	1,0523	1,3497	1,3590
E	1,1661	1,2915	1,3375	1,2291	2,0610	1,2164	0,9322	1,2040	1,2415
F	0,8807	1,0151	1,0584	0,9449	0,9161	1,8561	0,7000	0,9142	0,9147
G	1,0521	1,2003	1,1571	1,1473	1,1152	1,1059	1,8001	1,1266	1,1866
H	1,3560	1,4648	1,4844	1,3009	1,3116	1,3203	1,0672	2,2377	1,4123
I	1,3050	1,3807	1,4288	1,2769	1,2042	1,3275	0,9954	1,3142	2,2254

Figure 4 - Calculating the inverse matrix

	A	B	C	D	E	F	H	G	I
A	1,2139	1,4509	1,4686	1,3142	1,2131	1,3663	1,0561	1,3527	1,3951
B	1,2893	1,2678	1,4156	1,2390	1,2230	1,3154	1,0158	1,2723	1,3140
C	1,2829	1,3812	1,2698	1,2830	1,2083	1,2481	0,9781	1,2342	1,3306
D	1,3323	1,4148	1,4052	1,2116	1,2982	1,3622	1,0523	1,3497	1,3590
E	1,1661	1,2915	1,3375	1,2291	1,0610	1,2164	0,9322	1,2040	1,2415
F	0,8807	1,0151	1,0584	0,9449	0,9161	0,8561	0,7000	0,9142	0,9147
G	1,0521	1,2003	1,1571	1,1473	1,1152	1,1059	0,8001	1,1266	1,1866
H	1,3560	1,4648	1,4844	1,3009	1,3116	1,3203	1,0672	1,2377	1,4123
I	1,3050	1,3807	1,4288	1,2769	1,2042	1,3275	0,9954	1,3142	1,2254

Figure 5 - Matrix T

The result of step 5 of this methodology is shown in Figure 6. It consisted in obtaining the result of the sum of the horizontal and vertical columns. D being the result of the sum of the horizontal. R being the result of the vertical sum.

	A	B	C	D	E	F	H	G	I	*D*
A	1,2139	1,4509	1,4686	1,3142	1,2131	1,3663	1,0561	1,3527	1,3951	***1,4509***
B	1,2893	1,2678	1,4156	1,2390	1,2230	1,3154	1,0158	1,2723	1,3140	***1,2678***
C	1,2829	1,3812	1,2698	1,2830	1,2083	1,2481	0,9781	1,2342	1,3306	***1,3812***
D	1,3323	1,4148	1,4052	1,2116	1,2982	1,3622	1,0523	1,3497	1,3590	***1,4148***
E	1,1661	1,2915	1,3375	1,2291	1,0610	1,2164	0,9322	1,2040	1,2415	***1,2915***
F	0,8807	1,0151	1,0584	0,9449	0,9161	0,8561	0,7000	0,9142	0,9147	***1,0151***
G	1,0521	1,2003	1,1571	1,1473	1,1152	1,1059	0,8001	1,1266	1,1866	***1,2003***
H	1,3560	1,4648	1,4844	1,3009	1,3116	1,3203	1,0672	1,2377	1,4123	***1,4648***
I	1,3050	1,3807	1,4288	1,2769	1,2042	1,3275	0,9954	1,3142	1,2254	***1,3807***
R	***10,8783***	***11,8672***	***12,0255***	***10,9469***	***10,5507***	***11,1183***	***8,5971***	***11,0056***	***11,3792***	

Figure 6 - Step 5

Step 6 is shown in Figure 7. This step sought to perform the summation D+R and D-R. Where the result of D+R would indicate the importance and D-R the cause/effect (Aliei *et al.*, 2020; Du and Li, 2021).

	D	R	D+R (Importance)	D-R (Cause/Effect)
A	1,4509	10,8783	12,3292	-9,4274
B	1,2678	11,8672	13,1350	-10,5994
C	1,3812	12,0255	**13,4067**	**-10,6443**
D	1,4148	10,9469	12,3617	-9,5321
E	1,2915	10,5507	11,8422	-9,2591
F	1,0151	11,1183	12,1334	-10,1032
G	1,2003	8,5971	9,7975	**-7,3968**
H	1,4648	11,0056	12,4704	-9,5408
I	1,3807	11,3792	12,7599	-9,9985

Figure 7 - Step 6

In order to draw the causal diagram from step 6, we used the procedure from step 7. This consisted in determining the threshold, which is the sum of the medium and the pattern deviation. Obtaining this value, we present in Figure 8, all the values that are above the threshold. These values, identified in yellow, were used to draw the causal diagram, shown in figure 9.

Medium	1,2144
Pattern deviation	0,1700942756
Threshold	1,384494276

	A	B	C	D	E	F	H	G	I
A	1,2139	1,4509	1,4686	1,3142	1,2131	1,3663	1,0561	1,3527	1,3951
B	1,2893	1,2678	1,4156	1,2390	1,2230	1,3154	1,0158	1,2723	1,3140
C	1,2829	1,3812	1,2698	1,2830	1,2083	1,2481	0,9781	1,2342	1,3306
D	1,3323	1,4148	1,4052	1,2116	1,2982	1,3622	1,0523	1,3497	1,3590
E	1,1661	1,2915	1,3375	1,2291	1,0610	1,2164	0,9322	1,2040	1,2415
F	0,8807	1,0151	1,0584	0,9449	0,9161	0,8561	0,7000	0,9142	0,9147
G	1,0521	1,2003	1,1571	1,1473	1,1152	1,1059	0,8001	1,1266	1,1866
H	1,3560	1,4648	1,4844	1,3009	1,3116	1,3203	1,0672	1,2377	1,4123
I	1,3050	1,3807	1,4288	1,2769	1,2042	1,3275	0,9954	1,3142	1,2254

Figure 8 - Determining the threshold

Furthermore, with the results of step 6 and 7, we were able to obtain the causal diagram, which is shown without the arrows in Figure 9 and with the arrows in Figure 10, both figures are a graphical drawing of the relationship in yellow of the factors and their impacts on other factors in Figure 8. A causal diagram is a graphical tool used to illustrate the causal relationships between variables (Etminan *et al.*, 2020). In a causal diagram, variables are represented by nodes, and the relationships between them are represented by directed edges (Pearl, 2022). The direction of the arrows indicates the direction of causation (Pearl, 2022). For example, if variable A causes variable B, there will be an arrow pointing from A to B. Causal diagrams are useful for understanding complex systems and for identifying the most important variables to target in interventions or policy changes.

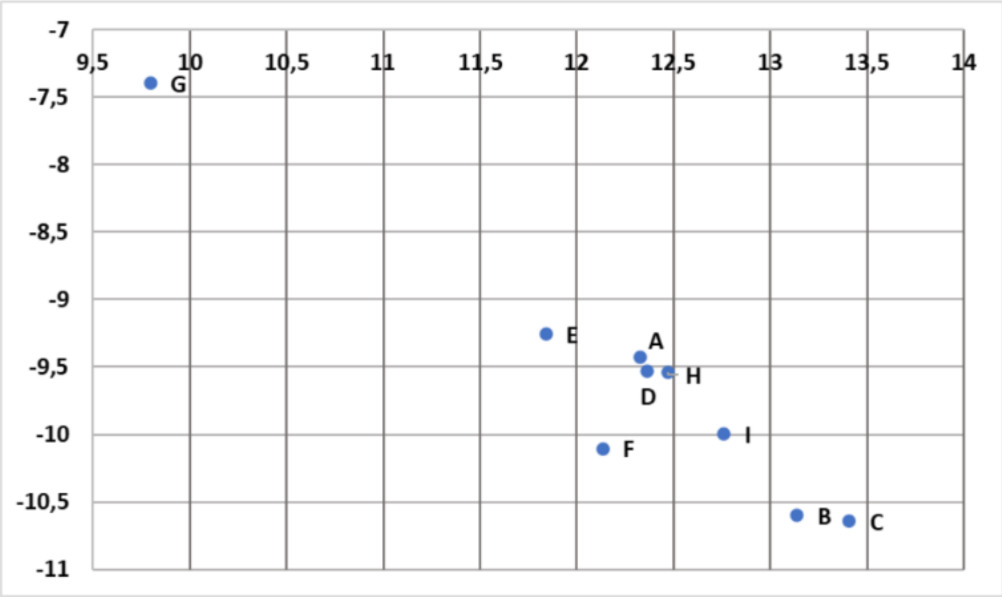

Figure 9 - Causal diagram without the relationship arrows

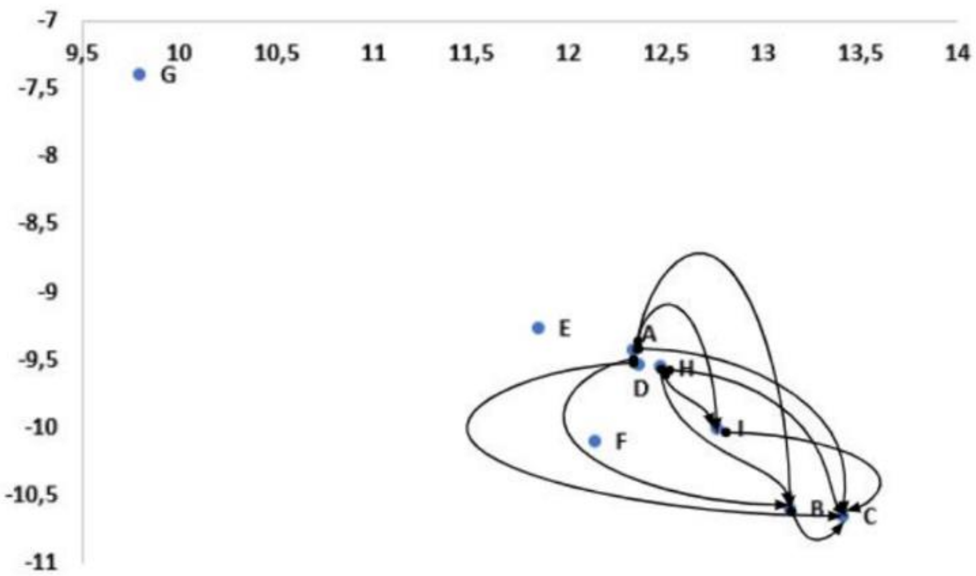

Figure 10 - Causal diagram with the relationship arrows

Finalizing the steps of this research, step 8 is presented in Figure 11, where relationship digraph is developed. It also seeks to represent the result of Figure 8, but from another perspective of representation. The relationship digraph is a type of graphical representation of relations between elements, commonly used in discrete mathematics and graph theory (Valdes *et al.*, 1979). The elements are represented by points or vertices, and the relations between them are represented by directed arrows or arcs connecting the points (Venkata Rao and Gandhi, 2002). Each arrow or arc indicates the direction of the relationship, indicating which element is the "origin" and which is the "destination" of the relationship (Chen, 2012).

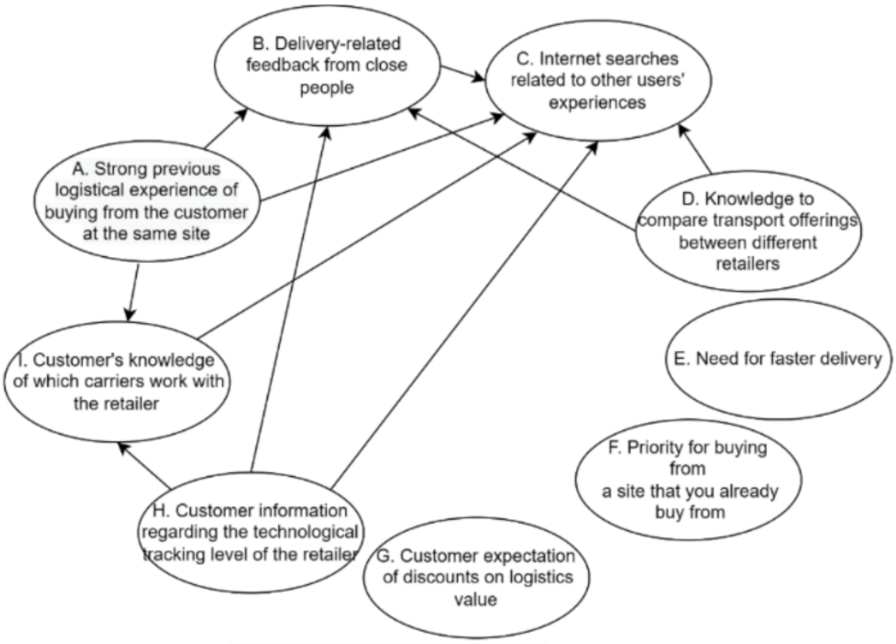

Figure 11 - Relationship digraph

4 DISCUSSION OF RESULTS

This study aimed to identify the most influential logistics determinants affecting online purchasing decisions and assess their interdependencies using the DEMATEL methodology. The results confirm that consumer trust in logistics services, the ability to compare shipping options, and tracking transparency play a decisive role in shaping purchasing behavior. The following discussion contextualizes these findings within the research objectives and their managerial implications.

The application of the DEMATEL methodology in this study provided a structured analysis of the logistics determinants that influence online purchasing decisions, allowing for the identification of causal and effect relationships among factors. The results indicate that the most influential factors in online purchase decisions are: Previous positive logistics experience with the retailer (Factor A), Comparison of shipping options between different retailers (Factor D) and The technological level of tracking services offered by the retailer (Factor H).

These findings align with previous studies that highlight the importance of logistics service quality in e-commerce (Jensen *et al.*, 2021; Chu *et al.*, 2021; Wang *et al.*, 2021). However, this study contributes to the literature by demonstrating that logistics perception is not merely an isolated factor in consumer decision-making, but rather a part of a causal network where certain logistics attributes directly shape consumer expectations and behaviors.

For instance, Factor A (previous logistics experience) emerged as the strongest determinant in the decision-making process. This confirms prior research emphasizing that consumer loyalty is heavily influenced by past delivery performance, reliability, and fulfillment efficiency (Kawa and Światowiec-Szczepańska, 2021; Weber and Badenhorst-Weiss, 2018). However, our study expands on this idea by showing that past logistics experiences also influence the way consumers evaluate future purchases, reinforcing the idea that retailers must consistently deliver high-quality service to retain customers.

The second most influential factor, Factor D (knowledge to compare transport offerings between different retailers), underscores the increasing transparency in e-commerce logistics. Consumers today have access to multiple platforms that allow them to compare not only prices but also shipping times, tracking capabilities, and delivery reliability. This aligns with the findings of Aktas *et al.* (2020) and Buldeo Rai *et al.* (2021), who suggest that shipping competition is no longer based solely on cost but also on perceived service quality.

An important divergence from previous studies is the relative influence of price-related logistics factors. While traditional logistics literature suggests that free shipping or discounts on delivery fees are among the primary drivers of online purchases (Gupta *et al.*, 2019; Vivaldini & Pires, 2013), our findings indicate that the ability to compare shipping options has a greater impact than direct price discounts. This suggests that, rather than simply offering low-cost shipping, retailers should focus on transparency and competitive differentiation in logistics services.

Factor H (the technological level of tracking services offered by the retailer) was identified as another key determinant in online purchase decisions. This finding aligns with previous research that emphasizes the importance of real-time tracking in reducing consumer uncertainty and enhancing the perceived reliability of a retailer's logistics services (Shrestha *et al.*, 2021; Zhou *et al.*, 2020).

However, our results offer a new insight: while past studies have primarily examined tracking as a complementary feature of logistics services, this study positions tracking as a causal factor that directly influences consumer trust and purchase intent. This suggests that investing in advanced tracking technologies—such as real-time GPS tracking, automated delivery updates, and AI-powered predictive ETAs—can significantly impact customer satisfaction and conversion rates.

Contrary to what might be expected, Factors E (need for faster delivery), F (preference for buying from a familiar retailer), and G (customer expectation of logistics-related discounts) did not emerge as strong determinants. This challenges the conventional notion that delivery speed is the primary driver of online purchases (Castillo *et al.*, 2018; Vakulenko *et al.*, 2019).

A possible explanation for this is that, while fast delivery is important, it is not necessarily the defining factor when compared to service reliability and tracking transparency. Consumers appear to prioritize a consistent and predictable delivery experience over absolute speed. This aligns with findings from Michalski and Montes-Botella (2022), who argue that in competitive online markets, predictability and communication may be more important than speed itself.

Similarly, the fact that Factor G (expectation of logistics-related discounts) was not highly influential suggests that consumers may be increasingly willing to pay for premium logistics services that guarantee better service levels. This is consistent with the recent trend of e-commerce retailers introducing paid membership programs that offer enhanced logistics services, such as Amazon Prime and Walmart+.

4.1 Theoretical and Practical Implications

While the primary contribution of this study is theoretical—uncovering the causal relationships among logistics determinants in e-commerce—it directly informs several actionable strategies for practitioners operating in online retail environments. First, the causal diagram developed through DEMATEL reveals that logistics service transparency (e.g., tracking capabilities and carrier identification) exerts a significant influence on customer perceptions and purchase intent (Shrestha *et al.*, 2021; Zhou *et al.*, 2020). This insight suggests that investments in real-time tracking systems and the clear communication of delivery processes can serve as powerful differentiators. E-commerce managers should prioritize developing interfaces that allow customers to visualize and monitor their order’s progress in real time, supported by AI-based predictive tools for estimated delivery times (Castillo *et al.*, 2018; Vakulenko *et al.*, 2019).

Second, the analysis underscores that perceived reliability and consistency in fulfillment operations are more influential than sporadic fast delivery offerings. This challenges the current industry emphasis on express shipping at all costs (Kawa and Światowiec-Szczepańska, 2021; Weber and Badenhorst-Weiss, 2018). Instead, practitioners should focus on reducing variance in delivery performance, even if it means marginally longer standard delivery times. The operational implication is a shift from optimizing for speed to optimizing for dependability and transparency.

Third, the study finds that logistics-related information shared socially—such as word-of-mouth and peer reviews—has a substantial effect on consumer trust. This indicates an opportunity for platforms to integrate logistics performance data into customer feedback mechanisms, for example, by including logistics ratings or delivery satisfaction scores alongside product reviews (Weber and Badenhorst-Weiss, 2018). Such visibility transforms customer experience into a marketing asset.

Fourth, given the identified interdependencies, retailers should abandon isolated logistics upgrades and instead adopt a systems thinking approach, addressing logistics improvements as part of an integrated customer experience strategy. For instance, improving tracking without improving delivery consistency or communication may yield minimal benefits due to causal dependencies.

Finally, from a strategic perspective, managers should move beyond viewing logistics purely as a cost center. The findings suggest logistics functions play a central role in influencing purchase decisions, and thus should be treated as a competitive advantage rather than merely a support process. Investments in technological infrastructure (e.g., last-mile analytics, visibility platforms) should be aligned with customer perception metrics, not just internal KPIs.

By operationalizing these insights, e-commerce practitioners can align logistics performance with consumer expectations, thereby increasing conversion rates, reducing cart abandonment, and strengthening brand trust. This study thus not only contributes to academic discourse but offers a practical, evidence-based framework for logistics-driven value creation in online retail.

4.2 Limitations and Future Research Directions

While this study provides valuable insights into the logistics determinants of online purchasing decisions, some limitations must be acknowledged, as they may impact the generalizability of the findings. One key limitation is the reliance on expert judgment, which, while offering industry insights, may not fully capture consumer preferences. For instance, while previous logistics experience emerged as a key determinant, direct consumer data might reveal that convenience or brand trust plays an even greater role. Future research should complement expert-driven analyses with large-scale consumer surveys or behavioral studies to validate these insights.

Another limitation is the study's industry and geographic constraints. Logistics determinants can vary significantly across sectors and regions due to differences in infrastructure, regulations, and consumer expectations. Future studies should conduct cross-industry and cross-country comparisons to assess how logistics determinants shift based on market conditions and product categories.

The analysis is based on the judgment of eight experts, which, although aligned with methodological standards in DEMATEL studies, may limit the generalizability of the findings. While the selected experts possess deep domain expertise, a broader and more diverse expert panel could have captured additional perspectives, particularly from different retail formats and operational contexts. The findings may not fully account for the heterogeneity of logistics practices across varying retail environments or geographical regions, which could influence the applicability of the results. Third, although the study aims to provide applied insights, it remains primarily theoretically driven. The absence of operational or transactional data limits its empirical grounding. Future research could enhance practical relevance by triangulating expert-based causal analysis with real-world performance data and case evidence from different markets.

Finally, as logistics priorities evolve due to technological advancements and external disruptions, a longitudinal research approach would be beneficial. Future studies should track how emerging innovations, such as AI-driven logistics and autonomous delivery, influence consumer expectations over time. By addressing these gaps, research can enhance the understanding of logistics determinants in e-commerce and contribute to more effective retail strategies.

5 CONCLUSIONS

This study sought to apply the DEMATEL methodology with online retail specialists in order to understand which factors are determinant for a consumer to purchase online. Once during the COVID-19 pandemic the online retail purchases increased and this continued in a post-pandemic scenario, it automatically demands from the retailer new strategies that seek to increase the logistic service level for these customers, making the online sales channel attractive.

Among the factors evaluated and concluding the results of this research, it is important to highlight what has been present in the literature and what this study also seeks to determine. The consumer's experience is a determining factor in building customer loyalty, as well as impacting others around them. Since the study here refers to logistics, many retailers hire carriers to make their deliveries, thus, the consumer's experience is terminated by a third party, thus, the retailer in a strategic manner needs to be fully in synergy with these logistics operators.

The good logistics experience increases the level of customer service and is important because it can affect customer satisfaction and, consequently, the company's reputation. A prompt, efficient and trouble-free delivery can increase the likelihood of customer recommendation and customer loyalty, while delays, lost products or delivery problems can damage the brand image and generate negative feedback. In order to improve the logistics experience, companies can invest in package tracking technologies, such as real-time tracking codes, allowing customers to know the status of their deliveries. All these factors were evidenced by the application of the methodology of this research with the specialists.

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