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Elements Influencing the Caliber of Electronic Logistics Services in Vietnam

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Abstract

This study investigated the factors influencing the quality of electronic logistics (E-logistics) services in Da Nang, Vietnam, aiming to assist service providers in improving their operations. The purpose of the study was to identify key determinants of E-logistics service quality to provide actionable insights for service enhancement. The research utilized both qualitative and quantitative methods, starting with qualitative research involving interviews with 20 managers to refine the scale and survey questions tailored to the Vietnamese context. Subsequently, quantitative analysis was conducted using data from 196 respondents, evaluated through linear regression models. The findings revealed six key factors significantly impacting E-logistics service quality in Da Nang: customer perception, technology and security, legal infrastructure, intellectual property and consumer protection, electronic payment systems, and human resources. Together, these factors explained 80% of the variance in E-logistics service quality. Among these, human resources (β=0.464, $p<0.001$) and customer perception (β=0.226, $p<0.001$) were found to be the most influential, followed by technology and security (β=0.143, $p<0.05$), electronic payment systems (β=0.125, $p<0.05$), legal infrastructure (β=-0.016, $p>0.05$), and intellectual property and consumer protection (β=0.046, $p>0.05$). The reliability of the measurement scales was high, with Cronbach's alphas ranging from 0.832 to 0.857. The novelty of this research lies in its comprehensive analysis of E-logistics service quality within the context of an emerging market, providing valuable insights for both academic and practical applications. The results underscore the importance of businesses adapting their strategies in response to digital transformation to enhance service quality and meet evolving customer expectations. Future research should focus on longitudinal studies to assess the impact of these factors over time and explore additional variables that may influence E-logistics service quality in different regional contexts.

Keywords: Da Nang, E-logistics, Services Quality, Linear Regression, Vietnam

1. Introduction

E-commerce is revolutionizing logistics, introducing unprecedented risks and complications for logistics service experts, underscoring the urgency for adaptation to maintain a competitive edge in the industry [1]. Vietnam's burgeoning e-commerce sector, with an annual growth rate of about 25%, is catalyzing the expansion of e-logistics, making it an attractive investment sector. Despite its relatively modest logistics market, Vietnam is experiencing rapid growth, estimated at 20% to 25% annually, driven by the proliferation of online retail and the global shift towards e-logistics, suggesting imminent significant transformations. Da Nang, recognized for its strategic location and potential in developing the logistics industry, aspires to become the central region's logistics hub. The city has integrated logistics development strategies with its Smart City Project, prioritizing overcoming challenges and fostering the growth of the e-logistics industry [2]. Significant upgrades and expansions at Da Nang Port and the establishment of the Da Nang Hi-Tech Park and Information Technology Park have boosted the city's logistics capabilities, attracting numerous logistics and e-commerce companies [3].

The entry of over 50 e-logistics service providers in 2017 prompted the Vietnamese government to issue Decree No. 163/2017/ND-CP to regulate logistics services businesses and attract foreign investment [4]. These regulatory measures aim to streamline logistics operations and ensure quality service delivery across the country, including in Da Nang. However, Vietnam's e-logistics services still face challenges, particularly among SMEs dependent on basic technology and limited resources in IT and finance.

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By 2025, the e-commerce market in Vietnam is forecasted to hit $15 billion USD, making it the second-fastest-growing e-commerce market after Indonesia [5]. This rapid growth underscores the necessity for thorough research and analysis of e-logistics. Analytical and research work focusing on enhancing the e-logistics system at the enterprise level remains scarce, highlighting the need for studies on factors affecting e-logistics service quality and exploring the impact and utilization of e-logistics services by businesses in Da Nang.

2. Literature Review

2.1. E-logistic and Service Quality

E-logistics refers to the application of internet technologies to streamline logistics processes, offering value-added services such as public warehousing, contract warehousing, transport services, distribution management, and freight consolidation. This concept is vital for improving efficiency and customer satisfaction in the logistics sector. By integrating advanced digital tools, e-logistics enables real-time tracking and management of inventory, optimizing supply chain operations and reducing costs. Additionally, e-logistics facilitates seamless communication and coordination among different stakeholders, ensuring timely and accurate delivery of goods. The adoption of e-logistics also supports scalability, allowing businesses to expand their operations without significant infrastructure investments. Moreover, it enhances data analytics capabilities, providing valuable insights into customer behavior and market trends, which can inform strategic decision-making. Overall, e-logistics represents a transformative approach to logistics, leveraging technology to create a more responsive, efficient, and customer-centric supply chain ecosystem [1].

Service quality in logistics is directly linked to a company's performance and customer satisfaction. A study highlighted those attitudes toward logistics services are secondary measures of satisfaction in e-logistics [1]. They found that the level of service provided by employees is crucial for advancing logistics automation and enhancing e-logistics operations [2]. High-quality service in logistics not only ensures the efficient and timely delivery of goods but also builds trust and reliability among customers. Employee training and development are essential in this context, as well-trained staff can better utilize technological tools, address customer concerns promptly, and adapt to dynamic logistics environments. Moreover, consistent service quality can lead to increased customer loyalty, repeat business, and a stronger competitive position in the market. As e-logistics continues to evolve, the focus on maintaining high service standards will be key to leveraging technology for superior operational performance and customer satisfaction.

2.2. Customer Perception and Technology and Security

Customer perception significantly influences their decisions to purchase products or utilize services. [3] emphasized that perception involves the selection, organization, and interpretation of sensory input from sight, sound, smell, and touch. Factors such as website usability, ease of use, personal identity, security, trust, and perceived value affect consumers' attitudes towards online shopping [4]. A well-designed, user-friendly website enhances the shopping experience by making navigation intuitive and efficient, which can positively impact customer satisfaction and loyalty. Personal identity and customization options allow customers to feel more connected to the brand, fostering a sense of belonging and preference. Security and trust are paramount, as customers need assurance that their personal and financial information is protected during transactions. Perceived value, which encompasses the overall benefits received versus the cost incurred, plays a critical role in shaping consumer decisions. High perceived value can lead to increased customer retention and positive word-of-mouth referrals. In summary, a comprehensive understanding of customer perception and the factors influencing it is essential for businesses aiming to succeed in the competitive online marketplace.

H1: Customer Perception affects the quality of E-logistics in Da Nang city.

Technology and security are pivotal in shaping the effectiveness of logistics services. [5] pointed out that technological advancements facilitate the exchange of information among supply chain partners, streamlining transportation and storage processes. The critical role of information systems in integrating operational areas was also highlighted [6]. Furthermore, [7] emphasized the importance of investing in technology and securing connections between e-logistics and e-commerce [8]. These technological advancements enable real-time tracking and monitoring of shipments, improving transparency and accountability across the supply chain. Efficient information systems allow for better coordination between different logistics functions, such as inventory management, order processing, and delivery

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scheduling. Investing in secure technology is crucial to protect sensitive data and maintain the integrity of transactions. Secure connections and robust cybersecurity measures ensure that data exchanged between e-logistics and e-commerce platforms is protected from potential threats, fostering trust and reliability among business partners and customers. Overall, the strategic implementation of technology and security measures enhances the efficiency, accuracy, and dependability of logistics services, driving operational excellence and customer satisfaction.

H2: Technology and Security affects the quality of E-logistics in Da Nang city.

2.3. Legal Infrastructure and Intellectual Property and Consumer Protection

Legal infrastructure in e-logistics involves the physical and technological conditions legally used to support production activities. Vietnam's logistics firms face several challenges, including competition from foreign logistics companies that hold a significant market share (Logistic and Supply Chain Management). Developing a robust legal framework is essential for supporting logistics operations and ensuring quality service delivery [9]. This framework should address regulations related to transportation, warehousing, data protection, and cybersecurity to create a level playing field for both domestic and foreign companies. Additionally, it should facilitate the adoption of international best practices and standards, ensuring that local firms can compete effectively on a global scale. By enhancing the legal infrastructure, Vietnam can attract more investments in its logistics sector, boost efficiency, and improve overall service quality. Effective legal policies can also help mitigate risks associated with cross-border logistics, such as customs procedures and compliance with international trade regulations, thereby fostering a more integrated and competitive logistics environment.

H3: Legal Infrastructure affects the quality of E-logistics in Da Nang city.

The rise of e-commerce has led to significant challenges in protecting consumers' rights, especially in cross-border transactions. [10] noted that international sellers often bypass quality checks and present difficulties in tax regulation, posing challenges for regulatory bodies globally. Enhancing the legal framework concerning e-commerce and e-logistics is crucial for better protecting consumers and their data [11]. Strengthening regulations can ensure that products meet safety and quality standards, and provide mechanisms for addressing consumer grievances effectively. Furthermore, clear tax regulations and compliance requirements can help in reducing tax evasion and ensuring fair competition among sellers.

In addition, robust data protection laws are essential to safeguard consumers' personal and financial information from cyber threats and misuse. This includes implementing stringent measures for data encryption, secure transactions, and regular audits to ensure compliance with privacy standards. International cooperation among regulatory bodies can also play a significant role in harmonizing e-commerce regulations, making it easier to manage cross-border transactions and resolve disputes. By building a comprehensive legal framework, governments can enhance consumer confidence in e-commerce, leading to increased adoption and growth in the sector.

H4: Intellectual Property and Consumer Protection affects the quality of E-logistics in Da Nang city.

2.4. Electronic Payment Systems and Human Resources

Electronic payment systems are central to e-logistics, providing practical and outstanding benefits to businesses. Efficient electronic payment systems can save time, optimize procedures, and limit risks associated with money theft and counterfeit money [12]. These systems streamline financial transactions by enabling quick and secure payments, reducing the need for manual handling of cash, and minimizing errors associated with traditional payment methods. Developing advanced electronic payment systems is vital for enhancing service quality and customer satisfaction [13]. These systems offer customers the convenience of making payments from anywhere at any time, which is particularly important in the fast-paced world of e-commerce and e-logistics. Features such as real-time payment processing, multiple payment options (credit cards, digital wallets, bank transfers), and seamless integration with mobile devices improve the overall shopping experience.

Moreover, cutting-edge electronic payment systems can offer strong security features, including encryption, two-factor authentication, and fraud detection, to safeguard against unauthorized transactions and cyber risks. The inclusion of these security features fosters customer trust and promotes more frequent online transactions. Enhanced business

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operations can be achieved through efficient electronic payment systems, which improve customer satisfaction. By analyzing this data, businesses can gain valuable insights into customer purchasing behavior, personalize their offerings, and optimize their marketing strategies. Sophisticated electronic payment systems are essential for the success of e-logistics, as they directly influence operational efficiency, security, and customer satisfaction.

H5: Electronic Payment System affects the quality of E-logistics in Da Nang city.

Human resources play a critical role in the e-logistics industry. As Vietnam undergoes digital transformation, the demand for qualified e-logistics personnel will increase [14]. The shortage of skilled workers in logistics significantly affects service quality and business operations. Therefore, developing logistics personnel with additional knowledge of information technology and electronics is essential for improving e-logistics service quality [15]. To address this shortage, it is crucial to invest in comprehensive training programs that equip logistics professionals with the necessary skills to handle advanced technologies and digital tools. This includes understanding the intricacies of supply chain management software, data analytics, automated systems, and cybersecurity measures. By enhancing their technical proficiency, logistics personnel can efficiently manage e-logistics operations, ensuring timely and accurate delivery of services.

Moreover, promoting a culture of ongoing learning and professional growth can ensure that the workforce stays informed about industry trends and technological advancements. The collaboration of educational institutions, industry leaders, and government bodies can help establish specialized curricula and certification programs that meet the requirements of the e-logistics sector. Besides technical skills, soft skills such as problem-solving, communication, and adaptability are of equal importance. As logistics continue to change, employees must navigate complexity, collaborate across departments, and adapt to new processes and technologies. Developing a skilled and versatile workforce will help Vietnam enhance its e-logistics service quality, improve operational efficiency, and remain competitive in the global market. Human resource investment goes beyond current needs to prepare for future challenges in e-logistics.

H6: Human Resources affects the quality of E-logistics in Da Nang city.

The figure 1 show Proposed research model with six hypotheses

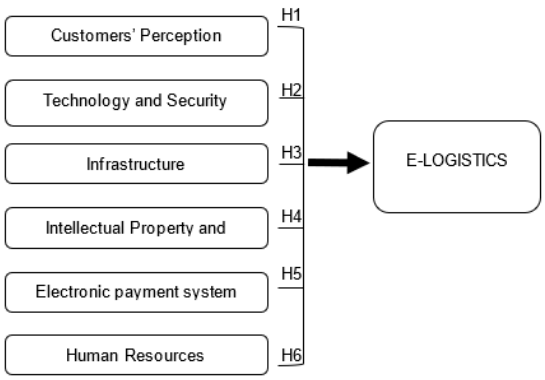

Figure 1. Research Model

3. Methods

The research follows a structured process consisting of seven steps: identifying the research problem, reviewing the literature, formulating a hypothesis, creating a research plan, conducting the research process, preparing research results, and reporting research findings. Identifying the Research Problem: This initial step involves pinpointing the specific issue or question that the research aims to address. It sets the direction and focus of the study. Reviewing the Literature: In this phase, existing research and relevant literature are examined to understand the current state of knowledge on the topic. This helps in identifying gaps that the new research can fill and provides a theoretical framework for the study.

Formulating a Hypothesis: Based on the literature review, a hypothesis is developed. This is a tentative statement predicting the relationship between variables, which the research will test. Creating a Research Plan: A detailed plan

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is crafted outlining the research design, methods, and procedures for data collection and analysis. This ensures a systematic approach to the study. Conducting the Research Process: This step involves implementing the research plan, collecting data according to the predefined methods, and ensuring the integrity and reliability of the data. Preparing Research Results: After data collection, the data is analyzed to derive meaningful insights and patterns. The results are then organized and prepared for presentation. Reporting Research Findings: The final step is to compile the research findings into a comprehensive report. This report includes the research problem, methodology, results, and conclusions, providing a complete overview of the study and its outcomes.

3.1. The General Research Process

In any scholarly work, the significance of the research process cannot be overstated. It involves a series of scientific stages that are both interconnected and follow a specific sequence. For the purposes of this study, we adhere to a structured approach consisting of seven steps in this figure 2.

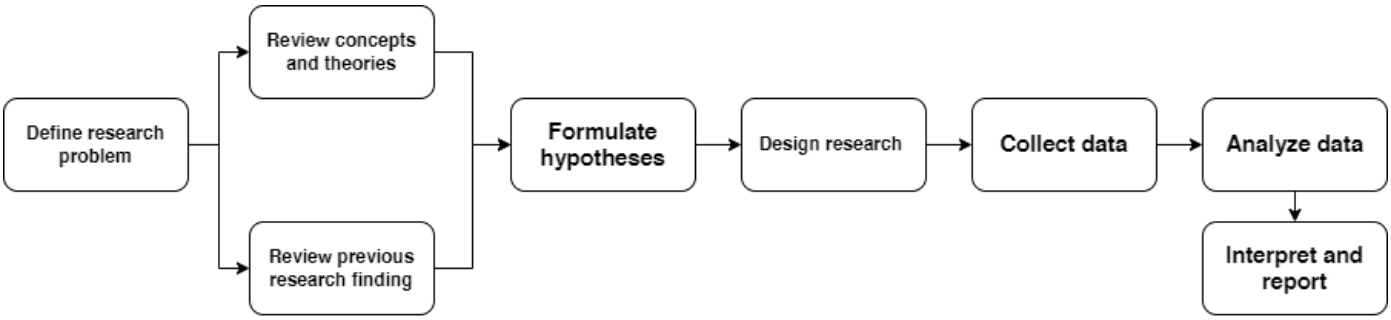

Figure 2. Research Process

Step 1: Identifying and Defining the Research Problem The first and most crucial step in the research process is to identify and clearly define the research problem. This involves carefully examining the issue or phenomenon you wish to investigate and articulating the specific questions or objectives that will guide your study. It's important to ensure the research problem is significant, relevant, and feasible to address within the scope of your study. This step lays the foundation for the entire research endeavor, so it's essential to devote time and attention to thoroughly understand and frame the problem.

Step 2: Reviewing the Literature Once the research problem has been defined, the next step is to conduct a thorough review of the existing literature on the topic. This involves systematically searching for, accessing, and critically analyzing relevant scholarly sources, such as journal articles, books, conference proceedings, and other publications. The goals of the literature review are to gain a comprehensive understanding of the current state of knowledge in the field, identify gaps or areas that require further investigation, and situate your own research within the broader context of existing studies. This step helps you build a strong theoretical and conceptual foundation for your study.

Step 3: Formulating a Hypothesis Based on your understanding of the research problem and the insights gained from the literature review, you can then formulate a hypothesis or set of hypotheses. A hypothesis is a testable statement or prediction about the relationship between two or more variables. It serves as a tentative explanation for the phenomenon under investigation and guides the design and implementation of your research. Developing a well-crafted hypothesis not only helps you focus your research efforts but also provides a clear framework for analyzing and interpreting your findings.

Step 4: Creating a Research Plan With the research problem, literature review, and hypothesis in place, the next step is to develop a comprehensive research plan. This involves determining the appropriate research methodology, selecting the data collection methods, and outlining the specific steps and procedures you will follow to conduct your study. The research plan should consider factors such as the available resources, ethical considerations, and any potential limitations or constraints that may influence the research process.

Step 5: Carrying Out the Research Process Once the research plan has been established, you can proceed to the data collection and analysis stage. This step involves implementing the selected research methods, gathering the necessary data, and analyzing the information using appropriate statistical or qualitative techniques. This phase may involve a

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range of activities, such as conducting experiments, administering surveys, performing observations, or analyzing secondary data sources. Careful attention to data quality, reliability, and validity is crucial during this stage.

Step 6: Preparing Research Results After completing the data collection and analysis, the next step is to organize and prepare the research results. This may involve summarizing the key findings, visualizing the data through tables, graphs, or other representations, and identifying any patterns, trends, or relationships that emerge from the analysis. This step is crucial for making sense of the data and laying the groundwork for the final step of reporting the research findings.

Step 7: Reporting Research Findings The final step in the research process is to report the research findings. This typically involves writing a comprehensive research report or paper that presents the study's background, methodology, results, and implications. The report should be structured in a clear and logical manner, with the findings and conclusions supported by the data and analysis. Effective communication of the research findings is essential for sharing the knowledge gained and contributing to the broader scholarly discourse in the field.

As highlighted in the introduction, the core aim of this investigation is to pinpoint the elements influencing the quality of logistics services in Da Nang City. This research intends to provide businesses with enhanced insights into the determinants affecting logistics services, enabling them to develop relevant strategies, support, and customer service. The methodologies for data analysis applied in this investigation include Cronbach's alpha and EFA, alongside correlation and regression analysis. Findings indicate that six key factors impact the quality of logistics services in Da Nang.

Qualitative research embodies a comprehensive methodology focused on exploration. Initial steps involve creating early versions of questionnaires and conducting interviews with managers from logistics services, e-commerce, and related sectors within Da Nang. This process gathers insights, uncovers new facets, and incorporates additional observational variables. The outcomes serve as the foundation for developing a structured interview questionnaire designed to evaluate a model with six independent variables, ensuring objectivity and supporting the validity of conclusions.

The interviewees were selected using purposive sampling to ensure a diverse representation of perspectives within the logistics and e-commerce sectors in Da Nang. A total of 20 interviews were conducted with key stakeholders, including logistics service managers, e-commerce business owners, and IT specialists involved in e-logistics operations. The selection criteria were based on their experience, roles, and involvement in the logistics sector, ensuring that the data collected would be rich and relevant to the study's objectives.

Quantitative research employs a 5-point Likert scale to measure agreement levels of participants. Data was collected using non-probability sampling methods. A sample calculation method, using Cochran's formula was applied to estimate the minimum sample size of 196 respondents, representing the minimum sample size required for this investigation with an error margin of ±7% [3]. Table 1 show Scales of each factor in Proposed Research Model

Table 1. Official Scale

No.	Factor	Core	Item	Source
1.	Customers' Perception	C1	The financial utility derived from e-logistics usage	[1]
		C2	This e-logistics service is convenient to use	[2], [3]
		C3	Comfortable to use e-logistics system	[4], [1]
2.	Technology and Security	T1	The security system of information technology in E-logistics is important	[5]
		T2	It is necessary to apply AI technology to E-logistics	[6]
		T3	Applying information technology to E-logistics makes shipping orders faster and more convenient	[5]
3.	Infrastructure	L1	Infrastructure in E-logistics plays an important role	[7]
		L2	Our country's infrastructure in E-logistics is still underdeveloped	[8]
		L3	E-logistics infrastructure will be heavily invested in the future	[9]
4.		I1	The level of safety and security of customer information is important	[10]

	Intellectual Property and Consumer Protection	I2	Supplier's trademarks and trademarks are required	[10]
		I3	Procedures for dealing with piracy and correct disclosure of information are required	[10]
5.	Electronic payment system	E1	Electronic payment E-logistics in e-commerce is very important for businesses	[11]
		E2	Electronic payment E-logistics brings many practical and outstanding benefits to businesses	[12]
		E3	The development potential of E-logistics electronic payment in the future is extremely large	[13]
6.	Human Resources	H1	Labor demand in the E-logistics industry needs to be ensured and promptly responded to the general development of the business	[14]
		H2	The shortage of E-logistics labor brings many consequences, slowing down the development of enterprises	[15]
		H3	The quality and qualification requirements of E-logistics workers are always high and need assurance	[16]
7.	E-logistics service quality	Y1	Satisfied with the quality of E-logistics service	[17]
		Y2	Will continue to use E-logistics service	[17]
		Y3	Will gladly recommend this quality E-logistics to others	[17]

2.2. Sampling

The findings are derived from a sample size of n=196 participants, which represents the minimum sample size required for this investigation, with an error margin of ±7%. The study includes 196 samples in its results. [18] suggested that, for the majority of research projects, the sample size should exceed 30 but not surpass 500 [19]. The sample size of 196 respondents was determined using [18] which is widely accepted for calculating sample sizes in social science research. The formula used is:

$$N=\frac{Z^2.p.(1-p)}{e^2} \quad (1)$$

Where:

N is the required sample size.

Z is the Z-value (1.96 for a 95% confidence level).

p is the estimated proportion of the population (0.5 in this case to ensure maximum variability).

e is the margin of error (0.07 or ±7%).

Substituting these values:

$$N=\frac{1.96^2\ X\ 0.5\ X\ (1-0.5)}{0.07^2}=196 \quad (2)$$

This sample size ensures a confidence level of 95% with a margin of error of ±7%, which is appropriate for the exploratory nature of this study. Additionally, [18] suggested that6 a sample size between 30 and 500 is generally sufficient for most research projects. Our sample size falls within this recommended range, providing robust and reliable data for analysis. This approach aligns with industry standards and ensures that our findings are statistically significant and generalizable to the larger population of e-logistics service users in Da Nang.

4. Result

4.1. Assessing the trust ability of the Scale (Cronbach's Alpha)

The assessment of reliability using Cronbach's alpha indicated that variables with a new Cronbach's measure below 0.7 and a total matched variables correlation measure below 0.3 are considered. This means that any variable that does not meet these thresholds is closely examined for potential issues with consistency or internal coherence within the scale. Variables that fall below these benchmarks may indicate a lack of uniformity in the responses, suggesting that they

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might not be measuring the intended construct reliably. Consequently, such variables are scrutinized, and necessary adjustments or eliminations are made to enhance the overall reliability of the scale.

Once these considerations are addressed, the scale is reevaluated. The final version of the scale, having excluded or adjusted problematic variables, should demonstrate improved reliability scores. Therefore, the scale is deemed satisfactory and conforms to established reliability criteria. This ensures that the scale produces consistent and dependable results across different administrations and sample groups, making it a robust tool for measuring the intended constructs accurately. The satisfactory reliability further implies that the scale is likely to yield valid results, enhancing the credibility and validity of the findings derived from its use. This table 2 show result of Cronbach alpha for scales.

Table 2. Summary table of Cronbach's Alpha coefficients of the scales

No.	Items	N of Items	Cronbach's Alpha
1.	Customers' Perception	3	0.832
2.	Technology and Security	3	0.844
3.	Infrastructure	3	0.845
4.	Intellectual Property and Consumer Protection	3	0.842
5.	Electronic payment system	3	0.834
6.	Human Resources	3	0.857

3.2. Exploratory factor analysis

The initial EFA indicated a Kaiser-Meyer-Olkin (KMO) value of 0.961 and a highly significant Bartlett's Test value of 0.000, suggesting that the sample was suitable for factor analysis and that the correlations between variables were sufficiently large for EFA. During this phase, some variables were eliminated based on their performance and contribution to the factor structure. After this elimination process, 12 observed variables remained for further EFA.

A second round of EFA was conducted with these 12 remaining variables to ensure the appropriateness and robustness of the factor analysis. The results confirmed the suitability of the data for factor analysis, with a KMO value of 0.945, indicating excellent sampling adequacy, and a Bartlett's Test significance value of 0.000, reaffirming the factorability of the correlation matrix. These indicators collectively suggest that the retained variables are well-suited for underlying factor extraction, supporting the validity and reliability of the subsequent factor solution. This table 3 show EFA of all factors in Research model

Table 3. Exploratory Factor Analysis (EFA) for Independent Variable

Item	Factors
H1	0.771 (Factor 1)
E3	0.769 (Factor 1)
L1	0.768 (Factor 1)
T3	0.741 (Factor 1)
C3	0.808 (Factor 2)
T1	0.718 (Factor 2)
I1	0.784 (Factor 3)
L3	0.643 (Factor 3)
I3	0.751 (Factor 4)
L2	0.585 (Factor 4)
E2	0.709 (Factor 5)
H3	0.541 (Factor 6)

The rotation matrix outcomes reveal that the 12 observed variables were organized into 6 factors: X1 comprises H1 and E3; X2 consists of L1 and T3; X3 includes C3 and T1; X4 encompasses I1 and L3; X5 contains I3 and L2; and X6

involves E2 and H3. Each observed variable demonstrates Factor Loading values below 0.5, with no variables identified as problematic.

Therefore, the exploratory factor analysis (EFA) of the independent variables was conducted in two stages. Initially, 18 observed variables were analyzed. During this first stage, 6 variables were eliminated due to non-fulfillment of prerequisites, such as low communalities or cross-loadings that did not support a clear factor structure.

In the subsequent phase, the remaining 12 observed variables were subjected to further EFA. This refined analysis successfully classified these 12 variables into 6 distinct factors. Each factor represented a coherent grouping of variables that collectively explained a significant portion of the variance in the data. This two-stage process ensured a robust factor structure, enhancing the interpretability and validity of the independent variables in the context of the study. This table 4 show EFA of dependent factor

Upon completion of the analysis, EFA successfully identified a singular factor from among the observed variables.

Table 4. Exploratory Factor Analysis (EFA) for Dependent Variable

	Factor loading
Y1	0.903
Y2	0.895
Y3	0.894
The coefficients satisfy the conditions	
Eigenvalue	2.415
Cronbach's Alpha	0.878
Cumulative %	80.484
KMO	0.744
Sig	0.000

4.3. Correlation Matrix

Table 5 presents the Pearson correlation coefficients between the dependent variable Y and six independent variables (X1 to X6). The table reveals strong, positive correlations between Y and all the independent variables, with correlation values ranging from 0.705 to 0.861, all statistically significant at the 0.01 level (**). Notably, X6 shows the highest correlation with Y (0.861), indicating a particularly strong relationship. Similarly, inter-correlations among the independent variables are also significant and moderately high, ranging from 0.662 to 0.801, suggesting potential multicollinearity issues. This analysis highlights the interdependencies between the variables and their collective impact on Y.

Table 5. Pearson Correlation

		Y	**X1**	**X2**	**X3**	**X4**	**X5**	**X6**
Y	Pearson Correlation	1.000	0.788**	0.763**	0.705**	0.724**	0.793**	0.861**
X1	Pearson Correlation	0.788**	1.000	0.712**	0.662**	0.743**	0.744**	0.753**
X2	Pearson Correlation	0.763**	0.712**	1.000	0.692**	0.732**	0.753**	0.744**
X3	Pearson Correlation	0.705**	0.662**	0.692**	1.000	0.748**	0.716**	0.720**
X4	Pearson Correlation	0.724**	0.743**	0.732**	0.748**	1.000	0.715**	0.742**
X5	Pearson Correlation	0.793**	0.744**	0.753**	0.716**	0.715**	1.000	0.801**
X6	Pearson Correlation	0.861**	0.753**	0.744**	0.720**	0.742**	0.801**	1.000

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Because the Sig significance level is less than 0.05, the correlation matrix in the table above shows a linear association between Y dependent variables and independent variables X1, X2, X3, X4, X5, and X6. As a result, it is suitable to apply the linear regression analysis variables.

4.4. Multiple Regression Analysis

Table 6 presents the beta coefficients of a regression model estimated using the Enter method, detailing the relationships between the dependent variable and six independent variables (X1 to X6). The table includes unstandardized coefficients (B), standardized coefficients (Beta), t-values, significance levels (Sig.), and collinearity statistics (Tolerance and VIF). Significant predictors of the dependent variable are X1 (Beta = 0.226, p = 0.000), X2 (Beta = 0.143, p = 0.011), X5 (Beta = 0.125, p = 0.044), and X6 (Beta = 0.464, p = 0.000), indicating their strong influence. The model shows an Adjusted R Square of 0.800, suggesting that 80% of the variance in the dependent variable is explained by these predictors. The ANOVA test confirms the model's overall significance (F = 130.966, p = 0.000), and the Durbin-Watson statistic of 1.733 indicates acceptable independence of residuals. Collinearity statistics suggest moderate multicollinearity among predictors.

Table 6. Estimate the beta coefficient of the model by the Enter method

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(constant)	0.056	0.153		0.365	0.715		
X1	0.124	0.053	0.226	4.023	0.000	0.326	3.071
X2	0.135	0.053	0.143	2.557	0.011	0.326	3.065
X3	0.046	0.054	0.046	0.854	0.394	0.354	2.825
X4	-0.015	0.057	-0.016	-0.273	0.785	0.297	3.370
X5	0.122	0.060	0.125	2.026	0.044	0.271	3.684
X6	0.484	0.065	0.464	7.431	0.000	0.264	3.793

The ANOVA analysis results show that with an F-value of 130.966 and a significance level (sig) of 0.000, the regression model fits the data set well. A Durbin-Watson coefficient of 1.7333 suggests no correlation between the model's variables. The adjusted R-squared value of 0.800 indicates that 80% of the variability in the dependent variable can be explained by the independent variables. It is noted that the variable X3, with a significance level of 0.394, and another instance of X3 with a significance level of 0.785, do not significantly contribute to the model, as both values exceed the 0.05 threshold. The standardized regression formula is given as Y = 0.464X6 + 0.226X1 + 0.143X2 + 0.125X5. The regression analysis results reveal that the independent variables significantly contribute to the quality of e-logistics services in Da Nang, explaining 80% of the variability in the dependent variable, as indicated by the adjusted R-squared value of 0.800. Human Resources (X6) emerged as the most influential factor, with a standardized coefficient of 0.484 and a significance level (p-value) of less than 0.000. This finding highlights the critical importance of skilled and knowledgeable personnel in enhancing service quality. Companies should focus on extensive training programs, recruitment of qualified professionals, and continuous professional development to ensure a high-quality workforce.

Customer Perception (X1) is the second most impactful factor, with a standardized coefficient of 0.226 and a p-value also below 0.000. This indicates that how customers perceive the e-logistics services plays a crucial role in determining service quality. Businesses must strive to improve user experiences through reliable services, easy-to-navigate interfaces, and responsive customer support to meet and exceed customer expectations. Technology and Security (X2), with a coefficient of 0.143 and a significance level of 0.011, underscores the necessity of technological advancements and robust security measures. Investments in advanced technologies, such as artificial intelligence, secure information

technology systems, and cybersecurity protocols, are essential to enhance operational efficiency and build customer trust. The Electronic Payment System (X5), with a coefficient of 0.125 and a significance level of 0.044, further emphasizes the importance of efficient payment processes. Implementing seamless, secure, and user-friendly payment solutions can significantly improve transaction efficiency and customer satisfaction.

In contrast, Legal Infrastructure (X4) and Intellectual Property and Consumer Protection (X3) do not significantly affect e-logistics service quality in this model, as indicated by their non-significant p-values of 0.785 and 0.394, respectively. While these factors are crucial for overall business operations and compliance, they do not appear to be primary drivers of service quality within the context of this study.

5. Discussion

Based on the findings of this study on E-logistics in Da Nang, which examined six key factor groups and assessed the current situation, several strategic recommendations are proposed to enhance electronic logistics services: Build an integrated E-logistics model that connects with e-commerce activities. Develop a platform for real-time data sharing between logistics providers and e-commerce businesses. Pilot programs with major e-commerce players and gather customer feedback. Promote investment in science and technology applications. Invest in AI, IoT, and cybersecurity measures to optimize routes, tracking, warehouse management, and data protection. Collaborate with technology firms and research institutions to develop innovative solutions.

Establish a centralized logistics hub with modern facilities and infrastructure. Work with local government to improve roads, ports, and other critical infrastructure. Incorporate sustainability initiatives into the logistics center design. Develop a centralized network of industry enterprises for online transactions. Form a consortium of logistics providers, e-commerce companies, and stakeholders to share resources, best practices, and training programs. Implement shared online platforms for order processing, inventory management, and customer service. Enhance training and quality of industry human resources. Partner with universities and vocational schools to create specialized training and certification programs. Attract talent with competitive salaries, benefits, and career advancement opportunities.

The study has some limitations, such as sample size, limited scope of factors, cross-sectional design, and reliance on self-reported data. Future research should use longitudinal designs, explore additional factors, conduct comparative studies across regions, employ mixed-methods approaches, and investigate the impact of emerging technologies on e-logistics service quality.

6. Conclusion

This study identifies six key factors that significantly impact the quality of electronic logistics (E-logistics) services in Da Nang: customer perception, technology and security, legal infrastructure, intellectual property and consumer protection, electronic payment systems, and human resources. Enhancing user experiences through reliable services, easy-to-navigate interfaces, and responsive customer support is crucial to meet and exceed customer expectations. Investing in advanced technologies such as artificial intelligence, secure information technology systems, and cybersecurity protocols is essential to enhance operational efficiency and build customer trust. Developing a robust legal framework to support logistics operations and ensure compliance is vital for sustaining quality service delivery. Strengthening the protection of intellectual property rights and consumer data is necessary to build a trustworthy e-logistics environment. Implementing seamless, secure, and user-friendly payment solutions can significantly improve transaction efficiency and customer satisfaction. Focusing on extensive training programs, recruitment of qualified professionals, and continuous professional development ensures a high-quality workforce essential for delivering superior e-logistics services. By addressing these six factors, logistics service providers in Da Nang can enhance their service quality, adapt to digital transformation, and meet the evolving demands of their customers.

By addressing limitations and proposing areas for future research, this study offers a comprehensive analysis of e-logistics in Da Nang and paves the way for further investigations to enhance the findings. Implementing these recommendations can help logistics service providers and policymakers in Da Nang and beyond to optimize their operations, improve customer satisfaction, and maintain a competitive edge in the rapidly evolving e-commerce landscape.

7. Declarations

7.1. Author Contributions

Conceptualization: T.L.T. and T.M.T.; Methodology: T.L.T.; Software: T.M.T.; Validation: T.L.T. and T.M.T.; Formal Analysis: T.L.T. and T.M.T.; Investigation: T.L.T.; Resources: T.M.T.; Data Curation: T.M.T.; Writing Original Draft Preparation: T.L.T. and T.M.T.; Writing Review and Editing: T.M.T. and T.L.T.; Visualization: T.L.T.; All authors have read and agreed to the published version of the manuscript.

7.2. Data Availability Statement

The data presented in this study are available on request from the corresponding author.

7.3. Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

7.4. Institutional Review Board Statement

Not applicable.

7.5. Informed Consent Statement

Not applicable.

7.6. Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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