International Journal on Advanced Science Engineering Information Technology

Vol.15 (2025) No. 1
ISSN: 2088-5334

The Role of Aviation Transport Infrastructure in the Air Freight Logistics Service Chain: A Case Study in Vietnam

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***Abstract*—In recent years, the aviation sector has been strongly developing in all cities of Vietnam. However, the government management and infrastructure seem not to satisfy the growth of aviation transport, showing that proper policies are needed to boost the aviation sector's development. This study evaluates the role of government management and aviation transport infrastructure in the air freight logistics service chain, with an empirical investigation conducted in Vietnam. Data was collected through surveys of 700 enterprises that had shipped goods via air freight forwarders or air cargo agents. Measurement scales were assessed using Cronbach's Alpha, exploratory factor analysis, confirmatory factor analysis, and hypothesis testing through structural equation modelling. The analysis results indicate that government management of air logistics positively influences air cargo handling and forwarding services as well as air freight transport services. Aviation transport infrastructure significantly affects air cargo handling and forwarding services and air freight transport services. Moreover, air cargo handling and forwarding services positively impact air freight transport services. Both air cargo handling and forwarding services, along with air freight transport services, strongly influence the operational efficiency of the air freight logistics service chain. Based on the research findings, several implications are proposed for government agencies to enhance the role of state management and develop aviation transport infrastructure. Additionally, recommendations are provided for managers within the air freight logistics service chain to improve operational efficiency.**

***Keywords*— Air logistics service chain; air freight transportation; aviation transport infrastructure; air cargo forwarding services.**

Manuscript received 11 Aug. 2024; revised 17 Nov. 2024; accepted 12 Dec. 2024. Date of publication 28 Feb. 2025.

I. INTRODUCTION

The air freight logistics service chain plays a pivotal role in ensuring the efficiency of global supply chains. Logistics operations in the air freight sector encompass forwarding, warehousing, and cargo transportation services, but are limited to those related to air freight. The air freight logistics service chain comprises three primary services: air cargo forwarding, air cargo services, and air cargo transportation. These core services are supported by government management of air logistics and aviation transport infrastructure [1]. Government management refers to the organized and legal regulatory influence of the state on the activities of organizations within the air logistics service system. Aviation transport infrastructure includes airport systems, flight operations facilities, and the transportation networks connecting to airports. Effective coordination among the components of the air logistics service chain is a prerequisite for optimizing costs, reducing transit times, providing value-added services, expediting cargo handling, and facilitating the integration of air transport with other modes of transportation [2].

In the air freight logistics service chain, government management plays a crucial role in enhancing operational efficiency through supportive policies and specific regulations regarding airports. This includes the development of infrastructure to optimize transport processes, ensure the efficiency of the air supply chain, build smart logistics networks, and support the operations of businesses [3].

Moreover, the role of government management extends beyond merely supervising and regulating activities. It also encompasses the upgrading of infrastructure, the development of multimodal logistics centers, and the support of airports to strengthen connectivity within the supply chain. These efforts foster public-private partnership strategies, enhance competitiveness, and facilitate the growth of air cargo hubs [4], [5]. Additionally, government management influences technological advancements and process improvements to meet the growing demands of international air transport. This ensures the stability of the air freight supply chain amidst the volatile conditions of the global market [6].

In the air freight logistics service chain, aviation transport infrastructure encompasses airport systems, flight operation facilities, and transportation networks connecting to airports. Among these, airport systems represent a critical component of infrastructure. Logistics services at airports include warehousing, cargo handling, and other support services, all of which significantly influence the economic efficiency of the air freight supply chain. The integration of these services with broader logistics operations enhances the speed and reliability of freight transportation [3]. Furthermore, in air freight operations, airports are not merely logistics hubs but also play a vital role in providing value-added services, supply chain management, and specialized services such as cold storage to meet unique transportation requirements [7], [8]. Additionally, airports connect with other modes of transport, fostering flexibility and enabling collaboration with logistics entities to reduce transportation costs and improve service quality [9]. State management and aviation transport infrastructure play a crucial role in the operations and development of the air freight logistics service chain. The objective of this study is to evaluate the impact of state management and aviation transport infrastructure on the components of the air freight logistics service chain, while also assessing the chain's operational efficiency through the influence of these factors. To achieve this objective, an empirical study was conducted in Vietnam by examining the perceptions of enterprises that have shipped goods via air freight forwarders or air cargo agents. The findings serve as a basis for proposing recommendations to government authorities and managers within the air logistics service chain to address development requirements and enhance the operational efficiency of the air freight logistics service chain in Vietnam.

II. Materials and Method

A. The Air Freight Logistics Service Chain

The logistics service chain is a central concept in business management and is approached from various perspectives. Michael E. Porter [10] posits that from a corporate standpoint, a service chain encompasses activities ranging from research, design, production, to marketing and distribution, all aimed at creating value. At the industry level, Kaplinsky & Morris [11] and Zhou & Huang [12] expanded this definition, describing the service chain as a comprehensive process from the initial idea to the final consumption of the product within the context of globalization.

In logistics, Christopher [13] emphasizes that the service chain extends beyond the transportation of goods to include value-added services such as information management and cost optimization. The air freight logistics service chain focuses on specific activities within the aviation industry, including freight forwarding, storage, and cargo transportation, aiming to link the components of the supply chain. With the involvement of various enterprises in the aviation sector, this chain ensures integration among freight forwarding services, air cargo services, and air freight transportation services.

1) Air Cargo Forwarding Services

Air cargo forwarding services involve receiving goods from shippers or other forwarders to handle procedures and related services for air transportation. This service focuses on specific activities within the aviation industry, including freight forwarding, storage, and timely transportation. It plays a strategic role in cost optimization and enhancing transport efficiency. According to Angelelli et al. [14], forwarding services enhance coordination capabilities, facilitate global transport planning, and flexibly meet market demands. Additionally, forwarders often prioritize selecting optimal transport routes and carriers to reduce costs and ensure timely delivery [15], [16].

2) Air Cargo Services

Cargo services in air transportation encompass the entire process of handling goods at airport terminals before and after flights, including security screening, packaging, storage, and completing necessary customs procedures. These services are not limited to on-site airport operations but also play a critical role in facilitating connectivity, optimizing the transportation chain, and enhancing competitiveness to better meet market demands [16].

3) Air Freight Transportation Services

Air freight transport services commence when the airline issues the air waybill and conclude when the cargo is delivered after the flight. Flight routes are a critical factor in ensuring the efficiency and speed of the service, connecting distant markets and extending service coverage from major airports to surrounding areas [17]. Additionally, pricing policies play a vital role in balancing competitiveness and profit optimization while maintaining customer loyalty amidst intense competition and high operating costs [18], [19]. Moreover, supplementary airline services, such as flight frequency and quality, significantly influence customer satisfaction and loyalty, contributing to the overall quality of air freight transport services [20], [21].

B. Hypotheses and Research Model

1) State Management and the Air Freight Logistics Chain:

The role of government management in the air freight logistics chain is analyzed through the lens of Public Administration Theory. According to this theory, government management plays a critical role in creating a conducive environment for economic activities through planning, policy formulation, oversight, and infrastructure provision. State-issued regulations and policies have far-reaching impacts, shaping opportunities and challenges for the air freight industry [22], [23]. These measures not only protect customer rights but also encourage aviation enterprises to enhance competitiveness by adopting quality standards [24]–[26]. Additionally, governments contribute to logistics development by investing in aviation infrastructure, such as airports, interconnected transport systems, and supporting technical equipment [27], [28]. Policies related to workforce training are particularly crucial, enabling logistics enterprises to improve service quality and management capabilities [29]. These analyses highlight the positive impact of government management on the efficiency of the air freight logistics service chain, forming the basis for the following research hypotheses:

H_1: State management has a positive impact on air cargo forwarding and handling services.

H_2: State management has a positive impact on air freight transportation services.

2) Aviation Transport Infrastructure and the Air Freight Logistics Chain:

Aviation theory [8], [9], [30] emphasizes the critical role of aviation infrastructure as a determinant of regional and national competitiveness, logistics efficiency, and supply chain performance. Aviation transport infrastructure includes airport systems, flight operation facilities, and the transportation networks connecting airports to surrounding areas. Among these, airports serve as central hubs in the supply chain, facilitating logistics services, particularly in cargo handling and customs clearance [31]. Furthermore, airports are not merely transportation hubs but also strategic assets for regional and national competition, connecting remote areas with major economic centers [32], [33]. Beyond their impact on transportation, airports contribute to regional and global economic development and provide significant competitive advantages in air logistics [8], [9], [30]. Overall, aviation infrastructure plays a decisive role in enhancing the efficiency of the air freight logistics service chain. Based on these considerations, the following two hypotheses are proposed:

H_3: Aviation transport infrastructure has a positive impact on air cargo forwarding and handling services.

H_4: Aviation transport infrastructure has a positive impact on air freight transportation services.

3) The Role of Air Cargo Forwarding and Handling Services:

Air freight forwarding and handling services play a crucial role in connecting customers, air carriers, and other stakeholders within the supply chain. This role ensures close coordination, timely operations, and efficiency across the entire system. According to the Resource-Based View (RBV) theory, the capability to deliver high-quality forwarding services is a strategic asset that enables air carriers to build sustainable competitive advantages. Additionally, the Supply Chain Management (SCM) and Transaction Cost Theory emphasize that forwarding activities are essential for optimizing freight transport performance, minimizing costs, and enhancing operational reliability. Reports from the International Air Transport Association (IATA) highlight that improvements in forwarding services can significantly reduce cargo handling times at airports, thereby enhancing overall efficiency. Furthermore, Seuring and Müller [34] assert that high-quality forwarding and handling activities not only improve delivery accuracy but also strengthen the integration among components of the air supply chain. These factors collectively ensure smooth and efficient air freight transport services. Based on these arguments, the following two hypotheses are proposed:

H_5: Air cargo forwarding and handling services have a positive impact on air freight transportation services.

H_6: Air cargo forwarding and handling services have a positive impact on the operational efficiency of the air freight logistics service chain.

4) The Role of Air Freight Transportation Services:

Air freight transportation plays a pivotal role in the freight logistics chain, responsible for transporting goods between the initial and final points of the supply chain. According to Supply Chain Integration Theory, close collaboration between the links in the supply chain optimizes the overall operational efficiency of the system. With its high speed and ability to expand market reach, air freight transportation not only shortens delivery times but also enhances service quality. The World Bank Logistics Performance Index (LPI) report highlights that the efficiency of air freight transportation is crucial in improving national logistics rankings, particularly in countries with robust import-export trade. Moreover, research by Yuan et al. [35]emphasizes that improving the quality of air freight transportation services enhances competitiveness and efficiency within the international logistics chain. Based on these analyses, the final hypothesis is proposed:

H_7: Air freight transportation services have a positive impact on the operational efficiency of the air freight logistics service chain.

The proposed hypotheses are summarized and presented in the research model depicted in Fig. 1 below.

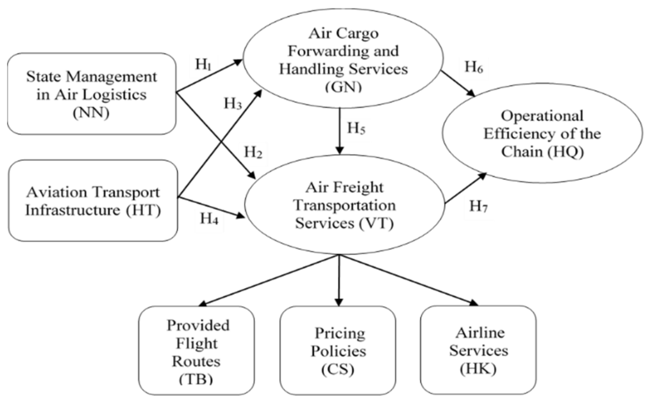

Fig. 1 Research Model (Source: Compiled from the hypotheses)

C. Research Design

1) Measurement scale:

The measurement scales were designed based on concepts derived and adapted from studies related to the present research. Specifically, HT, GN, TB, CS, HK, and HQ were adapted from the work of Chu [15], while NN was based on the study by Nguyen Hai Quang [1]. These scales were then discussed with a panel of 10 experts, comprising 7 senior managers from air freight logistics service providers and 3 experienced academics specializing in transportation, logistics, and supply chain management. As a result, 36 variables were selected for 7 concepts, including NN (5 variables), HT (6 variables), GN (8 variables), TB (6 variables), CS (3 variables), HK (3 variables), and HQ (5 variables). The questionnaire was divided into two sections: general information about the respondents and their evaluations of statements related to the identified concepts. These statements were developed from the 36 variables and measured using a 5-point Likert scale, ranging from 1 ("strongly disagree") to 5 ("strongly agree").

2) Data:

To achieve the research objectives, the target population was identified as enterprises that have shipped goods via air freight through freight forwarders or air cargo agents. Given the inability to define the entire population, a non-probability convenience sampling method was applied. Additionally, determining an appropriate sample size to ensure quality and rigor is crucial. This study adopted the "10 times rule" for the number of survey questions, as suggested by Hair et al. [36].

Accordingly, 700 survey questionnaires were distributed directly to enterprises that had previously shipped goods via air freight, resulting in 672 responses (a response rate of 96%). After excluding 22 invalid responses during data entry, 650 valid responses were retained for analysis using SPSS/IBM 24 software with the support of AMOS 24. The characteristics of the research sample are summarized in Table 1.

TABLE I
SUMMARY OF THE SAMPLE

Category		Count	Percentage (%)
Headquarters	Ho Chi Minh City	285	43.8
	Hanoi	236	36.3
	Da Nang	83	12.8
	Others	46	7.1
Type of Enterprise	Limited Liability Company	294	45.2
	Joint-Stock Company	233	35.8
	Private Company	87	13.4
	Others	36	5.5
Employee Scale	Less than 50 employees	80	12.3
	From 50 to 100 employees	303	46.6
	From 100 to 150 employees	223	34.3
	Over 150 employees	44	6.8
Total Annual Cargo Volume	Less than 500 tons	86	13.2
	From 500 to less than 1000 tons	293	45.1
	From 1000 to less than 1500 tons	205	31.5
	Over 1500 tons	66	10.2
Total		**650**	**100**

Source: Survey Data Analysis

III. Results and Discussion

A. Scale Evaluation

As the measurement scales were adapted from various sources, it was necessary to evaluate their reliability in this study. Accordingly, the scales were assessed using Cronbach's Alpha, Exploratory Factor Analysis (EFA), and Confirmatory Factor Analysis (CFA). Table 2 below summarizes the results of scale reliability assessment through Cronbach's Alpha and EFA.

According to Table 2, the variables exhibit item-total correlation coefficients ranging from 0.596 to 0.735, exceeding the threshold of 0.3, and Cronbach's Alpha coefficients for the constructs range from 0.781 to 0.890, falling within the acceptable range of 0.7 to 0.95 to ensure consistency and discriminant validity as per Hair et al. [36]. Therefore, all variables were included in the EFA analysis.

The results of the EFA, conducted using the Principal Axis Factoring extraction method with Promax rotation and Kaiser Normalization, as shown in Table 2, indicate that 36 observed variables were extracted into 7 factors as initially proposed, with a total variance explained of 56.144%, exceeding the 50% threshold. Furthermore, the factor loadings of all variables on their respective constructs were greater than 0.5, demonstrating a strong relationship with the constructs, consistent with the criteria of Hair et al. [36]. Subsequently, the measurement scales were evaluated using Confirmatory Factor Analysis (CFA) within the critical model (see Fig. 2). In this context, air freight transportation services are modeled as a second-order construct, treated as a reflective model due to its ease of constructing observable variables compared to formative models and its compatibility with AMOS software.

Key indicators meet the standards of Hair et al. [36], including: significance level (p) = 0.000 < 0.05; CMIN/df = 2.370 < 3.00; Comparative Fit Index (CFI) = 0.981; Tucker-Lewis Index (TLI) = 0.975 > 0.9; and Root Mean Square Error of Approximation (RMSEA) = 0.046 < 0.08. Thus, the model is deemed appropriate. Figure 2 also indicates that all factor loadings exceed 0.5.

TABLE II
CRONBACH'S ALPHA AND EFA LOADINGS

Concept	Variable	Mean	Cronbach's Alpha		EFA	
			Corrected Item-Total Correlation	Cronbach's Alpha	Total Correlation	Factor Loading
NN	NN1	2.87	0.695	0.866	1.978	0.742
	NN2	2.88	0.707			0.800
	NN3	2.91	0.701			0.749
	NN4	3.71	0.704			0.770
	NN5	3.11	0.637			0.588
HT	HT1	3.16	0.694	0.876	2.675	0.721
	HT2	3.17	0.656			0.688
	HT3	3.19	0.733			0.783
	HT4	3.16	0.721			0.773
	HT5	3.46	0.615			0.690
	HT6	3.45	0.682			0.771
GN	GN1	2.63	0.660	0.890	12.141	0.670
	GN2	2.72	0.664			0.722
	GN3	2.68	0.667			0.734
	GN4	2.62	0.657			0.730
	GN5	2.66	0.654			0.692
	GN6	3.83	0.668			0.672
	GN7	3.96	0.676			0.674
	GN8	3.89	0.661			0.644
TB	TB1	3.96	0.630	0.875	2.530	0.625
	TB2	3.95	0.617			0.642
	TB3	3.33	0.712			0.706
	TB4	3.34	0.719			0.839
	TB5	3.25	0.706			0.737
	TB6	3.43	0.698			0.755
CS	CS1	3.66	0.596	0.781	1.082	0.728
	CS2	3.42	0.689			0.760
	CS3	3.40	0.735			0.786
HK	HK1	3.40	0.694	0.831	1.348	0.729
	HK2	3.40	0.708			0.801
	HK3	3.38	0.670			0.694
HQ	HQ1	3.69	0.621	0.866	1.455	0.567
	HQ2	3.96	0.655			0.618
	HQ3	4.12	0.725			0.845
	HQ4	4.15	0.725			0.805
	HQ5	4.13	0.717			0.806
Kaiser-Meyer-Olkin (KMO) = 0.947. Sig. = 0.000						

Source: Cronbach's Alpha and EFA Analysis

Finally, Table 3 reports the statistical results of the CFA assessment of the measurement scales. The composite reliability (CR) ranges from 0.831 to 0.890, and the average variance extracted (AVE) ranges from 0.502 to 0.621, exceeding the thresholds of 0.7 and 0.5, respectively, to ensure reliability and convergent validity. Moreover, the maximum shared variance (MSV) values are smaller than the AVE values, and the off-diagonal values in the correlation matrix are smaller than the diagonal values, confirming discriminant validity, as per the standards of Hair et al. [36].

TABLE III
SCALE EVALUATION STATISTICS USING CFA

	CR	**AVE**	**MSV**	**MaxR(H)**	GN	HT	HQ	NN	VT
GN	0.890	0.502	0.447	0.832	**0.709**				
HT	0.878	0.547	0.299	0.814	0.524	**0.740**			
HQ	0.868	0.570	0.447	0.863	0.668	0.377	**0.755**		
NN	0.867	0.566	0.417	0.852	0.552	0.481	0.405	**0.753**	
VT	0.831	0.621	0.419	0.875	0.632	0.547	0.647	0.646	**0.788**

Note: The second-order scale components of VT include three elements: TB, CS, and HK.
Source: CFA Analysis

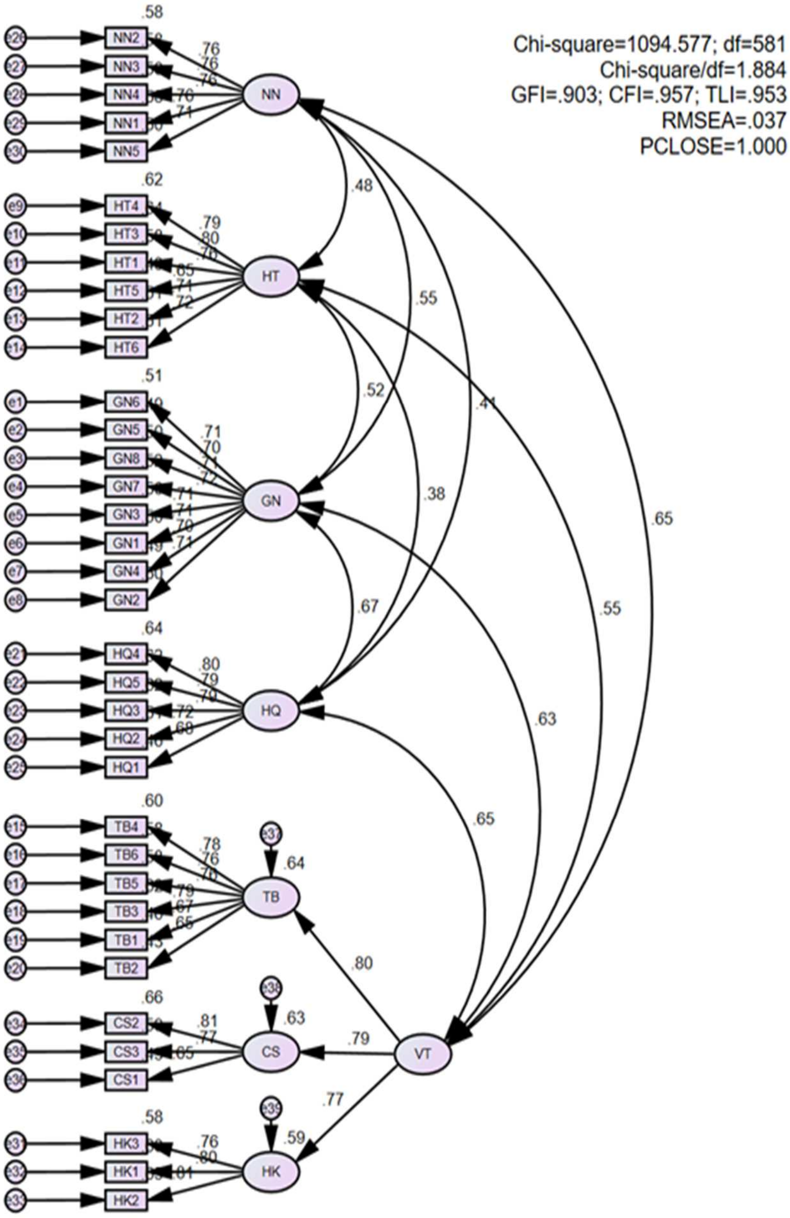

Fig. 2 CFA Test Results (Source: CFA Analysis)

B. Hypothesis Testing

To estimate the SEM model with mediating effects, direct estimation was first performed, followed by testing for indirect effects using the "Indirect, direct, and total effects" tool as proposed by Collier [37], with 1,500 bootstrap resamples. Table 4 provides a summary of the direct parameter estimates in the SEM model. The unstandardized coefficients are all positive and statistically significant at the 1% level, supporting all seven hypotheses: H_1, H_2, H_3, H_4, H_5, H_6, and H_7. Detailed standardized impact coefficients of the SEM model are illustrated in Fig. 3.

TABLE IV
PARAMETER ESTIMATION RESULTS

Hypothesis	Direction of Impact	Unstandardized Estimate				Standardized Estimate	Test Results
		Coefficient	SE	CR	Sig.		
H_1	NN → GN	0.353	0.044	8.033	0.000	0.385	Accepted
H_2	NN → VT	0.257	0.038	6.787	0.000	0.358	Accepted
H_3	HT → GN	0.306	0.042	7.203	0.000	0.334	Accepted
H_4	HT → VT	0.137	0.035	3.957	0.000	0.191	Accepted
H_5	GN → VT	0.264	0.042	6.286	0.000	0,337	Accepted
H_6	GN → HQ	0.373	0.046	8.193	0.000	0.444	Accepted
H_7	VT → HQ	0.375	0.060	6.244	0.000	0.349	Accepted

Note: SE: Standard Error; Sig.: Significance Level
Source: SEM Analysis

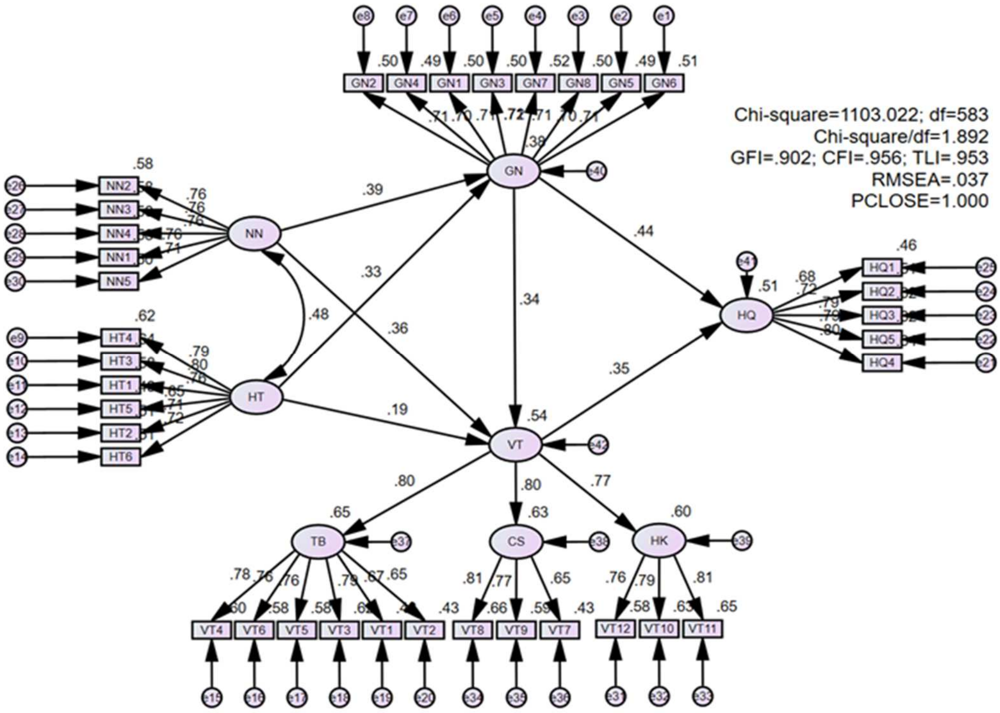

Fig. 3 Standardized SEM Estimation Results (Source: SEM Estimation)

These findings align with the results of similar studies, such as Chu [15], which emphasized the significant role of freight forwarding companies in influencing air freight transport services through route optimization, pricing strategies, and services provided by airlines. Similarly, Hamdam [9] highlighted the critical role and influence of airports on air freight transport services in terms of infrastructure, costs, and service offerings.

The findings of this study provide a foundation for policy recommendations aimed at enhancing the role of state management and developing aviation transport infrastructure to meet the developmental requirements of the air freight logistics service chain in Vietnam. Additionally, these results serve as a basis for managerial implications for stakeholders within the air freight logistics service chain to improve service processes, address customer demands, and enhance the operational efficiency of the air logistics service chain.

C. Managerial Implications

1) Managerial Implications of State Management for Air Logistics:

State management of air freight logistics operations, represented by five component variables, shows average values ranging from 2.87 to 3.71. Several implications can be drawn to enhance state management in the air freight logistics service chain:

a. Legislation: Enact specialized laws, decrees, and circulars addressing logistics in air freight transportation. Align Vietnam's legal framework with international standards, particularly in the context of global integration, to enhance the competitiveness of the air logistics sector.
b. Simplification of Procedures: Simplify licensing processes by reducing paperwork, minimizing waiting times, and eliminating unnecessary complexities.
c. Inspection and Oversight: Organize regular and ad-hoc inspections to ensure that all enterprises operating in the air logistics sector are monitored thoroughly and transparently.

2) Managerial Implications for Aviation Transport Infrastructure:

The aviation transport infrastructure scale, consisting of six component variables, shows average values ranging from 3.16 to 3.46. Several recommendations for enhancing the transport aviation infrastructure include:

a. Expansion of Key Airports: Prioritize the expansion of major airports, focusing on investment in Noi Bai, Tan Son Nhat, and Da Nang airports. Develop specialized logistics centers at these airports with comprehensive functions for warehousing, distribution, and multimodal transport connectivity.
b. Upgrading Domestic Airports: Modernize domestic airports to align with international standards, ensuring seamless regional connectivity and alleviating congestion at major airports.
c. Improvement of Transportation Infrastructure: Invest in the expansion and upgrading of transport infrastructure, including roads, highways, and multimodal transport systems, to facilitate the efficient movement of goods between airports and distribution centers.

3) Managerial Implications for Air Cargo Forwarding and Handling Services:

Air cargo handling and forwarding services, measured by eight observed variables, show average values ranging from 2.62 to 3.96. The following solutions are proposed to enhance these services:

a. Development of Online Tracking Platforms: Create an online tracking platform with real-time updates, allowing customers to easily monitor the status of their shipments.

b. Administrative Reforms: Streamline administrative processes in customs and cargo security procedures at airports.
c. Improvement of Handling Efficiency: Enhance the efficiency and accuracy of cargo handling processes at forwarding points, particularly for goods requiring urgent transportation.
d. Clear Compensation Policies: Establish transparent and fair compensation policies for cases involving delayed, damaged, or lost cargo.

4) Managerial Implications for Provided Flight Routes:

Flight routes, comprising six component variables, show average values ranging from 3.25 to 3.96. The following managerial implications are proposed:

a. Optimize Peak-Time Operations: Add more flights during peak hours or utilize aircraft with higher payload capacities to optimize transportation efficiency.
b. Expand Collaborative Networks: Freight forwarders and transport agents should expand partnerships with multiple airlines to enhance route selection flexibility.
c. Adapt to Demand: Flexibly adjust transport services according to demand at different times to optimize costs.
d. Leverage Major Hubs: Increase utilization of routes passing through major global cargo hubs.
e. Minimize Stops and Transits: Select and establish routes with minimal stops or transits to reduce transportation time and mitigate risks of cargo loss or damage.
f. Prioritize Direct Routes: Give priority to direct flights or connections through major transit hubs to improve efficiency and reliability.

5) Managerial Implications for Transportation Pricing Policies:

Pricing policies, comprising three component variables, show average values ranging from 3.40 to 3.66. The following implications for transport pricing policies are proposed:

a. Develop Transparent and Fair Pricing Structures: Establish clear and reasonable pricing schedules tailored to specific flight routes and cargo volumes.
b. Implement Loyalty Programs: Freight forwarders and transport agents should offer exclusive incentives for loyal customers.
c. Introduce Volume-Based Discounts: Develop discount policies based on cargo volume to encourage customers to ship larger consignments.
d. Provide Comprehensive Service Packages: Offer integrated service packages to customers with diverse transportation needs, including international, domestic, and combined cargo transport with warehousing services.

6) Managerial Implications for Airline Cargo Services:

Airline cargo services, comprising three component variables, show average values ranging from 3.38 to 3.40. The following recommendations are proposed:

a. Establish Robust Monitoring Procedures: Airlines should implement strict control and monitoring processes to ensure all terms in transportation contracts are fulfilled as committed.
b. Gather Customer Feedback: Regularly collect feedback from customers after each transaction to identify areas for improvement.
c. Conduct Regular Employee Training: Provide periodic training for employees on cargo handling procedures, customer communication, and aviation safety regulations to minimize errors.
d. Enhance Customer Support: Ensure customer inquiries are addressed promptly and diligently, even in cases of force majeure.

IV. Conclusion

The quantitative analysis using Cronbach's Alpha and Exploratory Factor Analysis (EFA) confirms that the measurement scales meet the required reliability standards. Confirmatory Factor Analysis (CFA) demonstrates the adequacy of the proposed research model. Structural Equation Modeling (SEM) analysis further validates that all hypothesized relationships in the research model are statistically significant. The findings reveal that the impact of air cargo handling and forwarding services on the operational efficiency of the air freight logistics service chain is the strongest ($\beta = 0.571$), followed by the impact of state management in air logistics on air cargo handling and forwarding services ($\beta = 0.385$). Next, the influence of state management in air logistics on air freight transport services is significant ($\beta = 0.358$), as well as the positive impact of air freight transport services on the operational efficiency of the air freight logistics service chain ($\beta = 0.349$). Furthermore, air cargo handling and forwarding services significantly affect air freight transport services ($\beta = 0.337$), followed by the influence of aviation transport infrastructure on air cargo handling and forwarding services ($\beta = 0.334$). Lastly, aviation transport infrastructure also affects air freight transport services ($\beta = 0.191$).

The study successfully achieved its objectives in developing measurement scales and assessing the impact of state management and aviation transport infrastructure on the elements within the air freight logistics service chain, as well as evaluating the chain's operational efficiency in Vietnam. However, the research has certain limitations. The proposed model was designed and applied exclusively to the air freight logistics sector, indicating the need for further studies and evaluations in other sectors and industries. Additionally, this study considered only two factors influencing the air freight logistics service chain: state management and aviation transport infrastructure. In practice, the logistics service chain in air freight is influenced and shaped by various other factors that were not addressed in this research. Moreover, the survey sample consisted solely of enterprises that had shipped goods via air freight through freight forwarders or agents, without including individual customers or other relevant stakeholders. These limitations present opportunities for future research, which could explore additional influencing factors and expand the scope of analysis to include other stakeholders in the air freight logistics service chain.

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