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Functional Enhancement and Development Strategies of the Shanghai International Aviation Hub

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Abstract: After nearly two decades of development, Shanghai's international aviation hub has largely established its local collection and distribution capabilities and prioritized its position as an air cargo hub. However, its transfer function as a gateway air hub for China still requires further enhancement, and its international transfer capacity remains insufficient. This paper outlines the current development of Shanghai's international aviation hub and presents an analysis of its developmental objectives with the extent to its planned functions from three perspectives: core indicators, functional positioning, and functional configuration. Through a comparative analysis with major international airports that integrate both passenger and cargo operations, the paper highlights the strength and gaps of Shanghai's international aviation hub. Based on this assessment, targeted development strategies are proposed: first, enhance local collection and distribution functions by accelerating the development of the rail transit system and optimizing surrounding road networks; second, strengthen its role as a gateway of China by improving international airline network connectivity, increasing flight frequency, and promoting high-level intermodal transfers; third, consolidate its air cargo hub by improving the layout of cargo zones and advancing customs clearance efficiency and the level of informatization; fourth, enhance its international transfer capacity by upgrading transfer infrastructure, optimizing airline network structure, and improving flight connectivity. **DOI:** 10.13813/j.cn11-5141/u.2025.0201-en

Keywords: international aviation hub; air cargo; collection and distribution system; airline network; Shanghai

0 Introduction

As a core node in the global transportation network, an international aviation hub not only serves as a vital engine facilitating the efficient flow of passengers, logistics, information, and capital, but also acts as a key metric for measuring the comprehensive competitiveness of regions and even nations. Amidst the challenging and uncertain globalization, international aviation hubs play a crucial role in underpinning and facilitating regional economic and social development. The level and airline network advantages of international aviation hubs hold irreplaceable significance in attracting global investment, promoting industrial upgrading, and driving regional economic growth. Therefore, prioritizing the functional enhancement of international aviation hubs and strengthening their competitive edge in the global arena have become critical components of development strategies for nations and regions worldwide.

Over the past two decades, Shanghai International Aviation Hub has experienced substantial growth, with its service capabilities significantly enhanced. Both passenger throughput as well as cargo and mail throughput have achieved leapfrog development. Confronted with heightened demands from national strategies and regional development, as well as fierce competition among airports in the Asia-Pacific region, Shanghai International Aviation Hub must further identify strengths and weaknesses, forge competitive advantages while addressing deficiencies, thereby enhancing its international competitiveness and achieving higher-quality development. Through analyzing the current status of Shanghai International Aviation Hub and benchmarking against globally representative international aviation hubs, this paper provides an in-depth exploration of functional enhancement and development strategies for Shanghai International Aviation Hub within the context of globalization, which offers strategic support for Shanghai, even China's air transport industry and regional economic development.

1 Development profile of Shanghai International Aviation Hub

1.1 Infrastructure capacity

Shanghai International Aviation Hub has established "a city with two airports" system comprising Shanghai Hongqiao International Airport (hereafter "Hongqiao Airport") and Shanghai Pudong International Airport (hereafter "Pudong Airport"). Hongqiao Airport operates two passenger terminals, two runways, and two cargo zones. It is

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designed to accommodate a passenger throughput of 40 million people per annum (Mppa), a cargo and mail throughput of one million tons per annum (Mtpa), and a peak hourly capacity of 50 aircraft movements per hour. Pudong Airport possesses two passenger terminals, one independent satellite terminal, three cargo zones, and four runways (the fifth runway not yet operational for air transport). It is designed to accommodate a passenger throughput of 80 Mppa, a cargo and mail throughput of 4.2 Mtpa, and a peak hourly capacity of 92 aircraft movements per hour. Besides, Pudong Airport is currently implementing the fourth-phase expansion project [1].

1.2 Airline network and traffic volume

Hongqiao Airport and Pudong Airport collectively serve 291 destinations across 48 countries and regions, including 176 domestic destinations (covering Mainland China, Hong Kong, Macau, and Taiwan) and 115 international destinations. In 2024, the combined operational metrics of two airports reached 800 thousand aircraft movements per annum, 125 Mppa of passenger throughput, and 4.21 Mtpa of cargo and mail throughput, with Pudong Airport alone contributing 3.77 Mtpa to the total cargo volume.

1.3 Home base carriers

The home base carriers of Shanghai International Aviation Hub include China Eastern Airlines Group Co., Ltd. (hereafter "China Eastern Airlines"), Spring Airlines Co., Ltd., and Juneyao Airlines Co., Ltd. China Eastern Airlines, with a fleet exceeding 800 aircraft (ranking among the global top 10), deploys 70% of its wide-body passenger aircraft and 90% of its all-cargo aircraft in Shanghai and operates flights to nearly 170 destinations across 32 countries and regions from Shanghai, aiming to become a super carrier in air transport [2]. Spring Airlines and Juneyao Airlines, both headquartered in Shanghai and established in 2005 and 2006, respectively, have progressively increased their share of passenger throughput, thus forming a complementary development pattern with China Eastern Airlines through differentiated market positioning.

1.4 Collection and distribution system

Since the completion of Hongqiao integrated transport hub in 2010, Hongqiao Airport's collection and distribution system has achieved significant capacity enhancement. Regionally, the hub has established railway corridors connecting Shanghai with Nanjing, Hangzhou, Nantong, and Huzhou, with Shanghai–Suzhou–Huzhou High-Speed Railway commencing operation in late 2024, further expanding Hongqiao Airport's regional coverage. As the Eastern Hub project "Shanghai East Railway Station" progresses, seamless integration between Pudong International Airport and the new station will be achieved, further improving the efficiency and connectivity of transportation services across the Yangtze River Delta regions. For intra-city connectivity, both Hongqiao Airport and Pudong Airport have integrated Metro Line 2, 10, 17, and Shanghai Suburban Railway Airport Link Line (hereinafter referred to as the "Shanghai Airport Link Line"). With Jiamin Line, Nanhui Line, and Shanghai Demonstration Zone Line currently under construction, post-completion accessibility from the airports to Shanghai metropolitan areas and neighboring provinces will be substantially upgraded (Table 1). Additionally, Shanghai's external railway network has formed a "four-direction, seven-line" pattern ①, while its expressway system reached a total length of 900 kilometers by 2024.

Tab. 1 Collection and distribution system of Shanghai International Aviation Hub

Collection and distribution system	Hongqiao Airport	Pudong Airpor
Trunk railways	Beijing–Shanghai High-Speed Railway; Shanghai–Nanjing Intercity Railway; Shanghai–Kunming High-Speed Railway; Shanghai–Suzhou–Huzhou High-Speed Railway; Phase I of Shanghai–Suzhou–Nantong Railway	Phase II of Shanghai–Nantong Railway (under construction, official name pending)
Intracity/ suburban railways	Shanghai Suburban Railway Airport Link Line; Jiamin Line (under construction); Shanghai Demonstration Zone Line (under construction)	Shanghai Suburban Railway Airport Link Line; Nanhui Line (under construction)
Urban rail transit	Metro Line 2; Metro Line 10; Metro Line 17	Metro Line 2; Metro Line 21 East Extension (under construction); Shanghai Maglev Line
Backbone road network	Four East-West Corridors: Beijing–Shanghai Expressway; Beidi Elevated Road; Songze Elevated Road; Shanghai–Chongqing Expressway Three North-South Corridors: Shenyang–Haikou Expressway; Jiamin Elevated Road; S20 Outer Ring Expressway	Five East-West Corridors: Longdong Elevated Road; Huaxia Elevated Road; Yingbin Expressway; Zhoudeng Expressway (under construction); Shanghai–Jiaxing–Huzhou Expressway Two North-South Corridors: Shanghai Ring Expressway; North-South Access Road-Lianggang Avenue

2 Development goals and implementation status of planning function

2.1 Achievement rate of core indicators

Based on the core indicators outlined in the *Shanghai Aviation Hub Strategic Plan* (2004 edition) [3] (hereinafter referred to as the *Strategic Plan*), and incorporating the requirements for Shanghai International Aviation Hub construction from *the 12th, 13th, and 14th Five-Year Plans for Shanghai's National Economic and Social Development*, a comprehensive analysis indicates that the phased goals for Shanghai International Aviation Hub development have been largely achieved on schedule (Fig. 1). By the end of the 13th Five-Year Plan period, Shanghai had essentially established itself as a major Asia-Pacific International Aviation Hub, with infrastructure capacity generally meeting the demands of air transport development. Both passenger and cargo throughput ranked among the highest globally. However, looking ahead, there remains significant room for improvement in areas such as coordinated ground-air facility support, allocation of critical resource elements, and coverage of intercontinental route networks (Table 2).

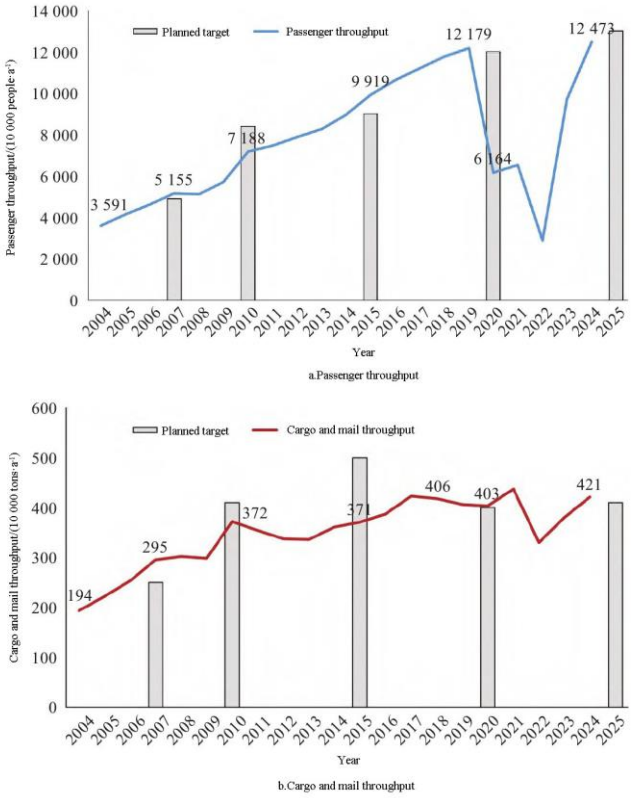

Fig. 1 Passenger and cargo throughput of Shanghai International Aviation Hub from 2004 to 2024

Tab. 2 Realization of core indicators for Shanghai international aviation hub

Target requirements (2035)			Implementation status (2024)	Achievement rate
Business scale	Passenger throughput of Hongqiao and Pudong Airports/(100 Mppa)	1.80	1.25	Relatively high
	Inbound and outbound passengers proportion of Hongqiao and Pudong Airports/%	38	28	Relatively high
	Passengers transfer proportion of Pudong Airport/%	19	16	High
	Cargo and mail throughput of Hongqiao and Pudong Airports/(10 000 tons·a^{-1})	650	421	Relatively high
Route network structure	Number of destinations of Hongqiao and Pudong Airports	400	291	Relatively high
	International destinations of Pudong Airport	185	115	Relatively high
	Intercontinental destinations of Pudong Airport	80	39	Average
Transport capacity assurance	Passenger capacity of Hongqiao and Pudong Airports/(100 Mppa)	1.7	1.2	Relatively high
	Cargo and mail capacity of Hongqiao and Pudong Airports/(10 000 tons·a^{-1})	800	520	Relatively high
	Peak hour capacity of Pudong Airport/(aircraft movements per hour)	135	92	Relatively high

Business scale indicators sourced from Reference [4]; other indicators sourced from Reference [5].

2.2 Achievement rate of functional positioning

According to the *Strategic Plan*, the functional positioning of Shanghai International Aviation Hub is defined as a large-scale composite aviation hub integrating the local collection and distribution hub, gateway hub, and China's/international transfer hub. The plan prioritizes establishing the local collection and distribution hub as its fundamental role, consolidating the gateway hub as the core mission, and developing the international transfer hub as the potential function, with explicit emphasis on securing its status as an international air cargo hub. After nearly two decades of development, the local collection and distribution function of Shanghai International Aviation Hub has been established and refined, and its status as an air cargo hub has been consolidated. However, challenges remain in strengthening its gateway hub transfer capacity and addressing insufficient international transfer capabilities (Tab. 3).

2.3 Achievement rate of functional layout

According to the *Strategic Plan*, a hub-oriented route network and connection waves are constructed primarily at Pudong Airport. Hongqiao Airport plays a subsidiary role in the hub structure, focusing on point-to-point operations [3]. After years of development, Pudong Airport has optimized its route network, with China Eastern Airlines establishing a "four-arrival and four-departure connection wave" system at the airport. Meanwhile, Hongqiao Airport has further strengthened its niche as a business-class boutique hub, with boutique routes and flights accounting for over 70% of its total flight volume (Tab. 4). In 2019, the *Integrated Development Plan for the Yangtze River Delta Region* designated a new airport in Nantong as an important component of Shanghai International Aviation Hub [6], and preliminary work for its construction is underway.

Tab. 3 Realization of functional positioning for Shanghai International Aviation Hub

Functional positioning	Implementation status (2024)	Achievement rate
Local collection and distribution	1) A comprehensive Hongqiao transportation hub was established, integrating multiple modes of transportation including aviation, high-speed railway, intercity rail, metro, and public buses in one location 2) Rail transit played a dominant role in airport access and dispersal, with over 50% of passengers at Hongqiao Airport choosing rail transit	High
Gateway in China	1) The number of inbound and outbound travelers ranked first in mainland China for 22 consecutive years 2) China Eastern Airlines' "through flights" at Pudong Airport covered nearly 70 destinations in China and abroad	Relatively high
International transfer	In 2024, the passenger transfer proportion at Pudong Airport approached 16%, below the expectations set by the Strategic Plan (30%) and the target outlined in the Shanghai Master Plan (2017–2035) (19%) [4]; the proportion of air cargo transfer at Pudong Airport remained below 2%	Average
Air cargo	The cargo and mail throughput at Pudong Airport ranked first in mainland China, and globally it is second only to Hong Kong International Airport, with figures comparable to those of Memphis International Airport	High

Tab. 4 Realization of functional configuration in Shanghai's international aviation hub

Airport	Functional layout	Implementation status (2024)	Achievement rate
Hongqiao Airport	1) Designed passenger throughput of 40 Mppa and cargo and mail throughput of 1 Mtpa [7] 2) Primarily operating point-to-point routes [3]	1) Passenger throughput exceeded the designed one, while the utilization rate of cargo and mail handling capacity was around 50% 2) Approximately 90 routes in China were in operation, and charter services to Tokyo Haneda and Gimpo International Airports were provided. Business boutique routes accounted for over 70% of total flights	High
Pudong Airport	1) Designed passenger throughput of 130 Mppa and cargo and mail throughput of 5.9 Mtpa [8] 2) Building a hub route network and "five-arrival and five-departure" connection waves [3]	1) The Phase III expansion project was completed, with a designed passenger throughput of 80 Mppa and cargo and mail throughput of 4.2 Mtpa. The implementation rate was between 60% and 70%, and the planned targets will be achieved upon completion of the Phase IV expansion project 2) A total of 279 routes in China and abroad cover 45 countries and 242 cities worldwide [9] China Eastern Airlines established "four-arrival and four-departure" connection waves	Relatively high

Source: compiled from References [3, 7–9].

3 International experience and comparative analysis of strengths and weaknesses

3.1 Selection of benchmark airports

Shanghai International Aviation Hub was compared with representative integrated passenger-and-cargo airports, such as Tokyo Narita International Airport, Seoul Incheon International Airport, Hong Kong International Airport, Paris Charles de Gaulle Airport, Frankfurt International Airport, and Amsterdam Schiphol International Airport. Specialized cargo airports, such as Memphis International Airport and Louisville Muhammad Ali International Airport, as well as passenger-dominated airports, such as London Heathrow International Airport and Hartsfield-Jackson Atlanta International Airport, were not considered as objects of study. The passenger throughput, cargo and mail throughput, and the passenger-to-cargo ratio (the ratio of passenger throughput to cargo and mail throughput) of major airports worldwide in 2023 are shown in Tab. 5.

Tab. 5 Comparison of passenger and cargo indicators of major global airports in 2023

Category	Classification criterion/ (10 000 people·10 000 tons^{-1})	Airport	Passenger throughput/ (10 000 people·a^{-1})	Cargo and mail throughput/ (10 000 tons·a^{-1})	Passenger-to-cargo ratio/ (10 000 people·10 000 tons^{-1})
Specialized cargo airport	Passenger-to-cargo ratio ≤ 10	Memphis International Airport	480	388	1
		Louisville Muhammad Ali International Airport	466	273	2
		Ted Stevens Anchorage International Airport	545	338	2
Integrated cargo-passenger airport	Passenger-to-cargo ratio >10–50	Hong Kong International Airport	3 950	433	9
		Pudong Airport	5 416	344	16
		Taiwan Taoyuan International Airport	3 535	210	17
		Tokyo Narita International Airport	3 118	187	17
		Seoul Incheon International Airport	5 613	274	20
		Doha Hamad International Airport	4 592	234	20
		Guangzhou Baiyun International Airport	6 317	203	31
		Frankfurt International Airport	5 936	193	31
		Singapore Changi International Airport	5 894	174	34
		Miami International Airport	5 234	253	21
		Paris Charles de Gaulle International Airport	6 742	182	37
		Chicago O'Hare International Airport	7 389	191	39
		Beijing Capital International Airport	5 290	119	44
		Amsterdam Schiphol International Airport	6 189	138	45
		Dubai International Airport	8 700	181	48
Passenger-dominated airport	Passenger-to-cargo ratio >50	London Heathrow International Airport	7 915	139	57
		Hartsfield-Jackson Atlanta International Airport	10 465	58	181

Note: data compiled from official airport websites and online sources. In 2023, the passenger throughput of Hong Kong International Airport was affected by the COVID-19 pandemic. Although the passenger-to-cargo ratio was nine, it was classified as an integrated cargo-passenger airport.

3.2 Common features of international air hubs

By comparing the key indicators of Pudong Airport with those of major integrated cargo-passenger airports worldwide in 2019 (Tab. 6), six common characteristics of international air hubs can be summarized. First, they have a large scale of operations, with strong ground and air infrastructure capacity and globally top-ranked passenger and cargo throughput. Second, they boast strong airlines. The market share of the home base airlines is generally above 40%, with a large scale of fleet, strong operation capacity, and a high level of hub operations. Third, they possess good transfer networks, with a hub-and-spoke route network that provides a wide range of flight connection opportunities. The minimum connecting time (MCT) is generally lower than 60 minutes, and the transfer passenger proportion is above 20%. Fourth, they have high operational efficiency, with efficient aircraft takeoffs, landings, and taxiing, as well as strong air traffic management capacity. Fifth, with a wide coverage, they are efficiently connected with expressways, high-speed railways, urban rail transit, and other modes of transportation, thus enabling large-scale, high-efficiency collection and distribution. Finally, they are located in favorable regions, typically in economic, financial, or transportation centers with a favorable geographical location, a prosperous economy, developed industries, and high aviation demand.

3.3 Advantages and gaps in development of Shanghai International Air Hub

1) Development advantages

As for scale, both Hongqiao Airport and Pudong Airport rank among the top in the world in passenger throughput as well as cargo and mail throughput. For facilities, Pudong Airport boasts world-class terminal areas, cargo areas, runways, parking stands, and other hardware resources. Geographically, driven by Shanghai, China's economic center, and by the economically robust Yangtze River Delta region, the demand for air travel and cargo transportation is extremely high. In terms of airlines, the home base airline, China Eastern Airlines, ranked 6th globally in capacity in 2024. With its strong capacity and route network organization, it can further consolidate Shanghai's position as a key international air hub in the global aviation network. In management, Shanghai's airport management institutions have extensive experience in airport operations, and both Hongqiao and Pudong Airports have won prestigious awards.

2) Development gaps

In the route network, according to *Megahubs 2024: Most Connected Airports in the World* released by the Official Airline Guide (OAG), Pudong Airport ranks 17th, while airports such as Amsterdam Schiphol, Seoul Incheon, and Paris Charles de Gaulle are among the top 10 globally [10]. In transfer services, MCT for transfers within China at Pudong Airport is 90 minutes (China Eastern Airlines has reduced it to 85 minutes), which is significantly longer compared to that at international hubs (typically 45–60 minutes). Moreover, the scale and proportion of transfer passengers at Pudong are not high. In efficiency, Pudong Airport's peak hourly capacity (80 aircraft movements per hour) is notably lower than that of Paris Charles de Gaulle and Frankfurt Airports, both with four runways. The cargo handling process at Pudong is complex, leading to lower transfer efficiency and longer overall clearance time for imported goods. In collection and distribution, Pudong Airport is located by the East China Sea, far from the city center of Shanghai and other cities in the Yangtze River Delta, and its ground transportation is somewhat lacking in speed.

Tab. 6 Comparison of key indicators between Shanghai Pudong International Airport and major international airports that integrate both passenger and cargo operations in 2019

Key indicators	Tokyo Narita International Airport	Seoul Incheon International Airport	Paris Charles de Gaulle International Airport	Frankfurt International Airport	Amsterdam Schiphol International Airport	Hong Kong International Airport	Pudong Airport
Number of runways	2	4	4	4	5	2	4
Number of aircraft stands	171	212	317	203	223	238	340
Peak hourly capacity/ (aircraft movements per hour)	60	70	100	100	112	68	80
Number of arrival and departure ports		Eight arrivals and six departures	our arrivals and 11 departures	Four arrivals and six departures	14 arrivals and nine departures	Nine arrivals and seven departures	Four arrivals and five departures
Passenger throughput/(10 000 people·a^{-1})	7 117	4 435	7 615	7 056	7 171	7 150	7 615
Cargo and mail throughput/(10 000 tons·a^{-1})	204	276	210	209	157	480	344
Number of international destinations	98	178	163	154	117	186	127
Number of intercontinental destinations;	39	63	103	102	78	46	49
Intercontinental flights/(flights per week)	528	541	890	710	660	597	463
Number of freighter destinations	21	36	26	61	43	69	40
Home base carrier and its market share/%	ANA Group 35	Korean Air 26	Air France-KLM Group 57	Lufthansa Group 62	Air France-KLM Group 49	Cathay Pacific Airways Limited 54	China Eastern Airlines 38
Passenger transfer proportion/%	15	12		54	36	30	13
MCT between flights in China and international flights/min	60	45	60	45	45		90

Note: data compiled from official airport websites and online sources. Due to regional variations in the recovery from the COVID-19 pandemic before the end of 2024, data in 2019 was selected for better comparability.

In summary, Shanghai International Air Hub exhibits a large scale of passenger and cargo throughput, but its international competitiveness is not strong. The underlying reasons are complex and varied: 1) the support for key elements such as air rights, slots, and airspace needs to be strengthened; 2) the functional layout and facilities of the airports should be optimized to keep up with the demands for passenger and cargo transfers and improve aircraft operational efficiency; 3) due to the relatively sufficient local passenger and cargo sources in the Yangtze River Delta, carriers and freight forwarders have limited motivation to organize transit cargo; 4) appropriate policies and resources are needed for the home base airline to further improve the hub operation; 5) the level of cooperation and coordination among the airport, airlines, customs, and air traffic control units needs improvement.

4 Development strategies

4.1 Improve local collection and distribution function

In accordance with the requirements for deep integration and efficient intermodal transport, a multi-level rail transport system should be constructed as the backbone of the collection and distribution network to enhance the radiation and service capacity of Shanghai International Aviation Hub towards Shanghai and the Yangtze River Delta region. An aviation hub transportation network, through which downtown Shanghai can be accessed within 30–60 minutes, the suburban Shanghai and areas surrounding Shanghai covered within 60 minutes, metropolitan areas covered within 90 minutes, and major cities in the Yangtze River Delta covered within 120 minutes, should be established.

The main strategies are as follows: 1) accelerating the construction of multi-level rail transport corridors, including trunk railways, intercity railways, intracity/suburban railways, and urban rail transit. Investigating the necessity of a high-speed rail line connecting the airport to the city; 2) optimizing the road network around the Hongqiao Business District and Pudong Airport and appropriately separating the collection and distribution traffic of the aviation hub; 3) improving the comprehensive transportation services of the aviation hub, strengthening information interoperability, developing various intermodal transport products, and providing “aviation + urban transport” (Mobility as a Service, MaaS); 4) constructing on-demand airport city terminals in downtown Shanghai, five new towns, and the Shanghai metropolitan area and providing functions such as check-in, baggage check-in, transportation connections, and comprehensive services; 5) for industrial parks and comprehensive bonded zones, planning air-forward cargo stations with customs and security functions and implementing full-process safety supervision to avoid “secondary security checks” at airport cargo terminals and improve logistics efficiency.

4.2 Strengthen gateway function within China

Competitiveness by benchmarking against aviation hubs in neighboring countries such as Japan and South Korea should be enhanced. The gaps in intercontinental routes for Shanghai International Aviation Hub should be addressed, and efforts should be taken to build a high-level intercontinental route network in Asia. The advantages of the surrounding route network should be strengthened, and the integration of routes in China and abroad should be promoted. The air-rail intermodal transport can be employed to expand the services of the aviation hub. This will enhance Shanghai’s role as a key link in the dual circulation strategy.

The main strategies include: 1) Focusing on improving the accessibility and flight frequency of the international route network, gradually establishing premium fast lanes connecting major global economic centers; 2) Encouraging the home base airline and its alliance partners to open a wider range of international routes, optimizing baggage transfer services, and expanding the coverage of through flights; 3) Accelerating the construction of the Eastern Hub - Shanghai East Railway Station, fully utilizing the geographical advantages of the coastal major passage, and connecting to the national high-speed rail network through the Shanghai railway hub, enhancing Pudong Airport's connectivity and influence in the Yangtze River Delta and beyond; 4) Strengthening the application of new technologies such as automation and information technology to improve customs and immigration clearance efficiency.

4.3 Consolidate air cargo function

The high-quality development of the air cargo hub should be accelerated, and the cargo facility capacity should be enhanced, including leveraging the role of market entities, improving port environment, and increasing cargo transfer efficiency. On the basis of consolidating Pudong Airport’s role as the world’s third-largest cargo hub in 2023, efforts should be made to strive for further advancement.

The key strategies are as follows: 1) improving the functional layout of airport cargo areas and optimizing internal transfer and inspection processes; 2) accelerating the construction of intelligent, modern, and specialized cargo stations to enhance the capacity for handling cold chain, express, and e-commerce cargos; 3) upgrading the “Air Cargo Express” platform, establishing an information module for air cargo transfers based on the “single window” of international trade, and creating a public information platform to achieve data exchange, business connectivity, and customs supervision coordination; 4) promoting the development of air-rail intermodal transport, exploring new models of air-sea intermodal transport, and optimizing the “truck-aircraft” transfer system; 5) seeking pilot opportunities for policies of customs supervision and civil

aviation security and appropriately increasing slots of daytime cargo flights at Pudong Airport.

4.4 Enhance international transfers

By advancing stronger collaboration among airports, airlines, air traffic control units, and customs inspection agencies, improving flight connectivity, and reducing connection time, smoother and more convenient transfer processes for both passengers and cargo can be facilitated, thereby increasing transfer volumes.

The key strategies are as follows: 1) speeding up the construction of Terminal 3 at Pudong Airport and upgrading existing terminal transfer facilities to provide better conditions for international transfers; 2) appropriately allocating flight rights and slotting resources for home base carriers engaged in transfer operations. Encouraging the airlines to utilize "Sixth Freedom of the Air" to optimize arrangements for connection waves, increase the number of connecting flights, reduce MCT, and develop more competitive transfer products; 3) promoting the expansion of air right arrangements, including "Fifth Freedom of The Air" with countries and regions along the Belt and Road initiative and attracting airlines from these regions to operate stopover flights at Pudong Airport; 4) advancing international transshipment and consolidation for international cargo and express freight, boosting the direct transfer efficiency of aprons, and exploring transshipment of cross-airlines and cross-cargo stations.

5 Conclusions

Shanghai International Aviation Hub plays a pivotal role in national strategy and regional economic development. In the new development stage, Shanghai International Aviation Hub needs to closely align with the *Guiding Opinions on Promoting the Construction of International Aviation Hubs* (Civil Aviation Development [2024] No. 28) [11] issued by the Civil Aviation Administration of China and the National Development and Reform Commission. By accelerating the establishment of a collaborative mechanism involving airport management units, airlines, as well as departments engaged in civil aviation, air traffic control, customs, and transportation, a framework integrating multi-airport systems, super carriers, air traffic control, civil aviation industry, and collection and distribution networks should be constructed, which aims to build a comprehensive, multi-functional international aviation hub and achieve the upgrading from a large-scale Asia-Pacific aviation hub to the most influential world-class aviation hub.

① The "four-direction" indicates Nanjing, Hangzhou, Nantong, and Huzhou. The "seven-line" includes Beijing–Shanghai High-Speed Railway, Shanghai–Nanjing Intercity Railway, Beijing–Shanghai Railway, Shanghai–Kunming High-Speed Railway, Shanghai–Kunming Railway, Shanghai–Suzhou–Nantong Railway, and Shanghai–Suzhou–Huzhou High-Speed Railway.

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