



Research on Smart Development Strategies for Comprehensive Passenger Transport Hubs in the Context of “AI + Transportation”

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Abstract. Comprehensive passenger transport hubs are key nodes in comprehensive transportation systems and important places for public travel and transfers. As China’s economy and society transition toward high-quality development, public demand for high-quality services at comprehensive passenger transport hubs continues to increase. Meanwhile, with the rapid advancement of next-generation information technologies represented by artificial intelligence, smart development has become a new direction for leading the high-quality development of comprehensive passenger transport hubs. It will continuously enhance hub service capacity and operational efficiency, and is also an inevitable requirement for the construction of smart cities. Therefore, it is necessary to conduct research on smart development strategies for comprehensive passenger transport hubs. This paper first reviews typical cases from both domestic and international sources. Based on theoretical research findings in smart transportation, it proposes the connotation, characteristics, and constituent elements of smart passenger transport hubs and preliminarily establishes a theoretical framework for their smart development. In view of existing shortcomings and future development trends, the paper presents the overall ideas, main objectives, and evaluation indicators for the smart development of China’s comprehensive passenger transport hubs during the “15th Five-Year Plan” period. Furthermore, it designs development paths and implementation measures from five aspects: facilities and equipment, travel services, operation management, emergency support, and data governance. This research will effectively support the formulation of hub development plans by MOT for the “15th Five-Year Plan” period, and also provide guidance for hub enterprise operations and the construction of national comprehensive transportation hub cities.

Keywords: Comprehensive Passenger Transport Hub, Smart Development, Artificial Intelligence, Transportation, Strategies.

1 Introduction

As key nodes of comprehensive transportation system, comprehensive passenger transport hubs are important places for public travel and transfers. Their operational

efficiency and service levels directly reflect the quality and efficiency of the comprehensive transportation system. For a long time, transportation authorities at all levels in China have attached great importance to the efficient connection of multiple transportation modes within comprehensive passenger transport hubs. By the end of 2025, passenger passage efficiency at hubs has been significantly improved. The average transfer distance among different transportation modes in over 85% of newly built comprehensive passenger transport hubs has been reduced to within 200 meters, and all newly built comprehensive passenger transport hubs have achieved accessibility from the hub to the city center within 30 minutes. Indicators are shown in Table 1. Meanwhile, in recent years, some newly built large-scale comprehensive passenger transport hubs in China have introduced digital and intelligent concepts at the planning and design stage and have carried out practices in smart hub construction and operation, providing valuable experience for other passenger transport hubs. However, overall, the digital and intelligent level of China's comprehensive passenger transport hubs remains relatively low. Weak capabilities in integrated travel planning and insufficient supply of high-quality services are still prominent. The contradiction between these shortcomings and the continuously rising public demand for travel services under the background of high-quality economic and social development remains acute. These deficiencies are also inconsistent with the requirements of smart city development.

Table 1. Completion of development indicators for China's comprehensive passenger transport hubs.

No.	Indicator	Unit	2020	2025	14th Target	Five-Year Plan
1	Average transfer distance of newly built comprehensive passenger transport hubs	m	/	<300		<300
2	Proportion of newly built hubs accessible to city center within 30 minutes	%	/	100		90
3	Proportion of newly built hubs with integrated connection of multiple transportation modes	%	22.5	37.5		/
4	Rail transit access rate of hub airports	%	68	80.9		80

In recent years, relevant national authorities have successively issued a series of policies to promote smart development across all sectors of transportation. Both the *Outline for Building China's Strength in Transportation* and the *Outline of National Comprehensive Three-Dimensional Transportation Network Planning* call for the deep integration of new technologies such as big data, Internet, and artificial intelligence with the transportation industry, the vigorous development of smart transportation, and the advancement of digital and connected transportation infrastructure. In September

2025, seven departments, including the Ministry of Transport and the National Development and Reform Commission, and others, jointly issued the *Implementation Opinions on "Artificial Intelligence + Transportation"*, which outlines 16 specific tasks across four major areas: increasing the supply of key technologies, accelerating the enabling of innovative scenarios, strengthening the provision of core elements, and optimizing the industrial development ecosystem. Within the section on "accelerating the enablement of innovative scenarios", it proposes to "promote the deep integration of artificial intelligence with hub planning, construction, and operation management, supporting the efficient coordinated operation and (near-)zero emissions of hub clusters".

Driven by the industry demands and the policy environments, smart development will become an inevitable trend for the development of China's comprehensive passenger transport hubs during the "15th Five-Year Plan" period and beyond. However, current research on the theory and policies of smart development for passenger transport hubs is still relatively scarce. Existing research has primarily focused on the planning methods of passenger transport hubs within the context of smart city development and their interaction with the host city (Odile, M. and Florida D. C., 2018; Denis Vlasov and Anna Terekhova, 2019; Yun, L., et al., 2023; Sewenet, A.D. and Pisano, P., 2023; Zhang, S.T., et al., 2024; Panagiotis, P., et al., 2025) as well as the specific construction plans for smart passenger transport hubs and their information systems (Hu Z. H., 2022; Liu H. Y., 2024; Zhao W. H., 2024), and the design schemes for intelligent hub facilities and equipment (e.g., heating system) (He, Z. Y., et al., 2025). A small number of studies have proposed smart development strategies for specific types of hubs or specific development models. For example, Zhu, J. H. et al. (2020) proposed construction goals, development paths, and a dynamic evaluation system for smart hubs based on the station-city integration model. Mei, H. Y. et al. (2023) proposed smart low-carbon development paths and specific strategies for railway-dominated comprehensive passenger transport hubs in severe cold regions.

The above studies tend to focus on specific construction plans or planning methods for the smart development of individual or certain types of passenger transport hubs. However, they lack top-level design and directional guidance for the smart development of comprehensive passenger transport hubs at the national level, and the theoretical framework of smart passenger transport hubs also requires further deepening and improvement. This paper attempts to explore these aspects. By summarizing typical practical experiences and reviewing theoretical research findings, it clarifies the connotation, characteristics, and constituent elements of smart development for passenger transport hubs. Based on an analysis of future trends and existing problems, it proposes the ideas, objectives, and evaluation indicators for the smart development of China's comprehensive passenger transport hubs during the "15th Five-Year Plan" period, and further designs implementation pathways and specific measures, thereby preliminarily establishing a strategic framework for promoting the smart development of comprehensive passenger transport hubs at the national level.

2 Typical Domestic and International Cases

2.1 New York Grand Central Terminal (USA)

As a historic landmark opened in 1913, the core challenge of the smart renovation of New York Grand Central Terminal lies in balancing the preservation of historical features and the provision of smart services. First, “non-destructive construction” techniques are adopted to add various intelligent sensing facilities and charging interfaces, improving the basic capacity for smart services. Second, a “full-domain perception + precise analysis + personalized service” passenger flow management system is established. Based on multi-source data fusion for passenger flow monitoring, the system enhances travel service levels and emergency response capabilities. Third, a smart energy system featuring “renewable energy utilization + intelligent energy consumption control + carbon footprint tracking” is built, enabling air conditioning and lighting systems to autonomously adjust according to the environment and passenger flow, making it the first “near-zero carbon” large-scale transportation hub in North America.

2.2 Paris-Charles de Gaulle Airport Hub (France)

As the second largest aviation hub in Europe, Charles de Gaulle Airport’s smart development is highlighted by the application of digital twin technology across all scenarios. In 2022, the airport completed its full-hub digital twin system, becoming the first aviation hub in Europe to achieve real-time physical-virtual mapping. Leveraging the digital twin system and AI algorithms, the airport predicts flight punctuality rates and optimizes resource allocation. The system also enables intelligent baggage sorting and handling, along with intelligent control of terminal air conditioning and lighting. Through the integration of unmanned inspection equipment and AI prediction algorithms, the airport has shifted from reactive repair to proactive prevention. Moreover, a multi-functional service robot ecosystem has been deployed, creating an unmanned service network that covers the entire passenger journey—guidance, security checks, waiting, and transfer.

2.3 Beijing Sub-Center Station (China)

Beijing Sub-Center Station is a landmark project identified in the “Beijing Urban Master Plan (2016-2035)”. It is designed to implement the national strategy for the coordinated development of the Beijing-Tianjin-Hebei region and to relieve Beijing of non-capital functions. The overall positioning of its smart hub construction is to create an “operation brain” for the comprehensive transportation hub, serving the overall operation and management of the hub and its surrounding areas, while also providing passengers with integrated services. It includes four major systems: an “intelligent management” system centered on a digital twin, an “intelligent service” system based on comprehensive information integration and intelligent diversified services, an “in-

telligent maintenance” system aimed at improving the quality and efficiency of all systems, and an “intelligent carbon” system designed to create a zero-carbon hub.

2.4 Hangzhou West Station Comprehensive Passenger Transport Hub (China)

As a key node of the “Yangtze River Delta on Rails,” Hangzhou West Station plays a crucial role in the regional transportation pattern. The biggest highlight is the construction of a powerful smart operation brain centered on technologies such as digital twins, AI, and 5G. First, a full-station digital twin model has been established, enabling real-time reflection of passenger flow, equipment operation status, and the operational conditions of various transportation modes within the hub. Second, by integrating AI technologies with the digital twin platform, functions have been developed such as intelligent dispatching of all transportation modes, congestion warning and guidance, and smart lighting management, thereby improving operational efficiency. Third, a travel service agent on the mobile side has been developed, which interacts with the intelligent robots deployed within the hub to provide full-scenario travel services, including integrated travel planning, transfer guidance within the hub, ticket booking, inquiry, parking, and ride-hailing, greatly enhancing the passenger travel experience. Figure 1 (A) shows a smart robot providing services within the hub.

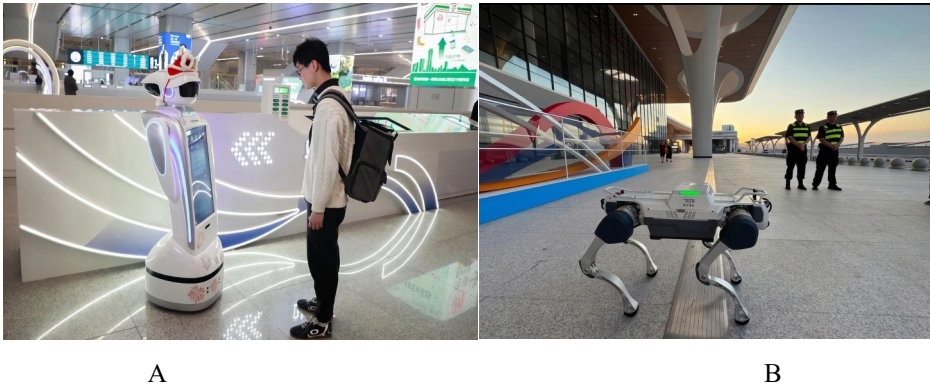


Fig. 1. (A) A smart robot interacting with a passenger in Hangzhou West Station hub. (B) A robot dog patrolling the plaza of Chongqing East Station hub.

2.5 Chongqing East Station Comprehensive Passenger Transport Hub (China)

As a newly built large-scale passenger transport hub (operational in June 2025), Chongqing East Station Comprehensive Passenger Transport Hub is a new benchmark for smart hub construction and operation. Its highlights are mainly reflected in smart information sharing, intelligent upgrade of passenger services, intelligent security, intelligent equipment operation and maintenance, and smart energy management. First,

it has built a “hub brain” data platform to achieve real-time data exchange and sharing among subsystems such as railway 12306, urban rail transit operation, bus dispatching, taxi and ride-hailing operation, and parking lot berth management. It is also connected to Chongqing’s “city brain” to achieve efficient coordination between data information and management decisions. Second, it has developed a “smart travel APP” integrating functions such as ticket inquiry, real-time navigation, transfer guidance, parking space guidance, and one-click calling, providing passengers with a more efficient and convenient travel experience. Third, based on a digital twin platform and embodied intelligent robots (including robot dogs) and drones, it has built an intelligent security system for the hub. Figure 1(B) shows a robot dog patrolling the plaza of the hub. Fourth, based on multi-source sensing and AI algorithms, it has built a smart operation and maintenance and energy management system, reducing equipment maintenance response time by 50% and overall hub energy consumption by 30%.

3 Theoretical Analysis of Smart Passenger Transport Hubs

3.1 Connotation and Characteristics of Smart Passenger Transport Hubs

Based on a review of theoretical research results in smart transportation, we focus on the integration and interaction between smart transportation and passenger transport hubs, and propose the definition and connotation of a smart passenger transport hub: a smart passenger transport hub is a new form of passenger transport hub driven by the new generation of information technologies such as AI, the Internet of Things (IoT), big data, and cloud computing. It maximizes the autonomous perception, analysis, prediction, and decision-making capabilities of various facilities and equipment, enabling them to replace manual work in hub service and management, thereby reducing labor consumption and achieving comprehensive improvements in operational efficiency, service level, safety assurance, network collaboration, green and low-carbon development, and sustainability, ultimately promoting high-quality development of the hub. Its connotation is a development model driven by the new generation of information technologies, with data as the core production factor and the improvement of operational efficiency and service capacity as the goal.

Furthermore, the main characteristics of a smart passenger transport hub are proposed, including nine aspects: (1) digital and intelligent facilities and equipment; (2) ubiquitous network connectivity; (3) dynamic intermodal dispatching; (4) personalized travel services; (5) proactive risk prevention; (6) precise energy control; (7) autonomous management and decision-making; (8) platform-based comprehensive governance; (9) integrated station-city development.

3.2 Key Elements of Smart Passenger Transport Hubs

Through the above analysis of the connotation and characteristics of smart passenger transport hubs, combined with the review of typical domestic and international cases, we believe that a smart passenger transport hub consists of five aspects, namely: digital and intelligent facilities and equipment, human-centered travel services, coordinated

and precise operation management, intelligent and efficient emergency support, and standardized data governance. Through further in-depth analysis, the key elements of a smart passenger transport hub can be obtained, as shown in Figure 2.

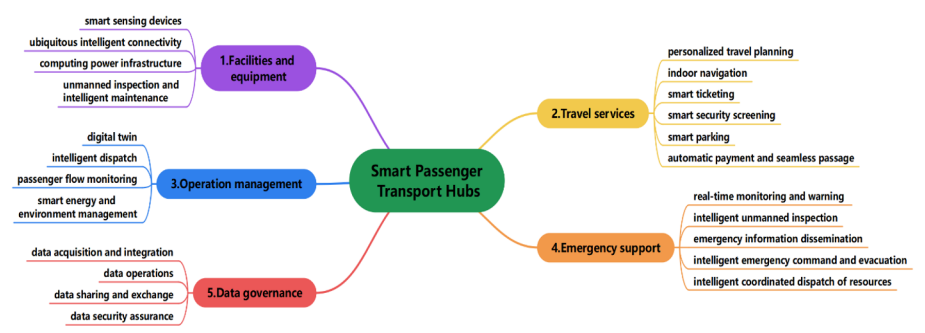


Fig. 2. Key elements of a smart passenger transport hub.

4 Top-Leve Design for Smart Development of Comprehensive Passenger Transport Hubs during the “15th Five-year Plan” Period

Based on the above theoretical analysis and summary of practical experiences on smart development of comprehensive passenger transport hubs, and following the research route of analyzing future trends - identifying existing problems - formulating overall ideas - determining goals and indicators - designing implementation paths - proposing specific measures, the top-level design is carried out, as shown in Figure 3.

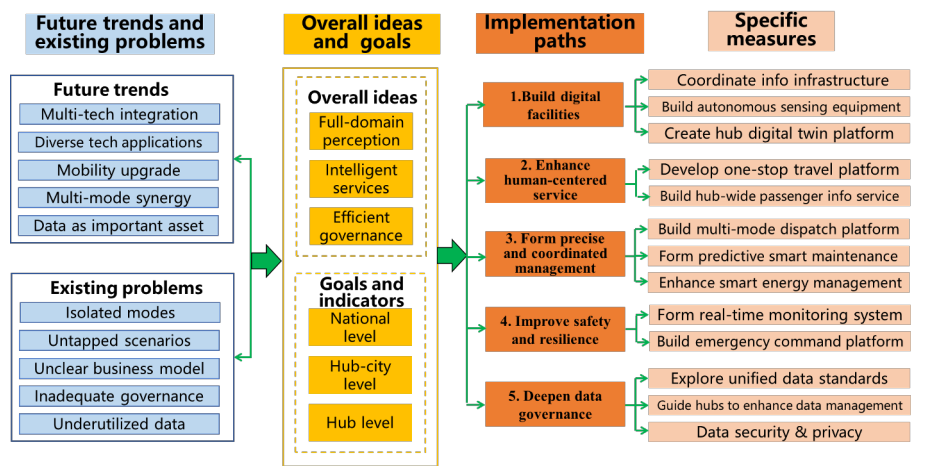


Fig. 3. Top-level design for the smart development of comprehensive passenger transport hubs during the “15th Five-Year Plan” period.

4.1 Future Trends and Existing Problems

Through literature review and field interviews, the future trends of smart development of comprehensive passenger transport hubs can be summarized in five aspects: (1) integrated application of multiple information technologies; (2) rich and diverse technology application scenarios; (3) comprehensive upgrade of travel services; (4) coordination and integration of multiple transportation modes and elements; (5) data and information becoming important assets.

At the same time, the problems and challenges faced by the current smart development practices of domestic comprehensive passenger transport hubs are identified: (1) lack of information exchange among different transportation modes; (2) untapped scenarios for advanced technologies; (3) unclear sustainable business models; (4) inadequate governance system; (5) insufficient value release of hub-related data.

4.2 Overall Ideas for the “15th Five-Year Plan” Period

During the “15th Five-Year Plan” period, efforts should be focused on the principles of “data-driven, smart-enabled, service-oriented, green and low-carbon, safe and resilient,” with the deep integration of next-generation information technologies such as artificial intelligence into hub operations as the main thread. Continuous efforts should be made in three aspects—full-domain perception, intelligent services, and efficient governance—to build a modern comprehensive hub system featuring “intelligent perception of facilities, convenient and human-centered services, efficient and green operations, fast and precise emergency response, and unified and integrated data.”

Full-domain perception: Focusing on hardware infrastructure, efforts should be made to build a digital and intelligent facilities and equipment system that enables all-element, all-weather, high-precision real-time perception of people, vehicles, objects, equipment, and environmental conditions within the hub. At the same time, information infrastructure—including 5G networks, data centers, computing centers, and IoT sensing terminals—should be reinforced to provide a robust foundation for smart hub development.

Intelligent services: Focusing on travel services, efforts should be made to promote the integration of next-generation information technologies into all travel scenarios within the hub. A one-stop, personalized integrated travel service platform and scenario-specific smart systems should be developed to form a full-scenario smart service system. At the same time, full-process seamless “face-only recognition” services and “one-click call” assisted services should be actively implemented to continuously improve passenger travel convenience, comfort, and satisfaction.

Efficient governance: Focusing on hub operation and management, efforts should be made to fully promote data interconnection among multiple transportation modes. Hub-level digital twin platforms, integrated dispatching and emergency command

platforms, smart energy and environment management systems, and other related systems should be developed. On this basis, a hub comprehensive governance information platform should be created and integrated with the city-level digital brain of the hub's host city. These efforts will ultimately help form a coordinated comprehensive governance system, a safety and resilience system combining active warning and rapid response, and a precise and efficient low-carbon management system.

4.3 Development Goals

During the “15th Five-Year Plan” period, the deep integration of next-generation information technologies—such as artificial intelligence, big data, and cloud computing—with hub operations should be accelerated. A smart passenger transport hub system is to be initially established, featuring intelligent facility perception, convenient and human-centered services, efficient and green operations, fast and precise emergency response, and unified data integration. A number of representative major projects are expected to be completed. It is recommended that by 2030, all newly built and renovated comprehensive passenger transport hubs in national comprehensive transportation hub cities be equipped with full-domain perception, intelligent services, and autonomous decision-making capabilities.

4.4 Evaluation Indicators

This study proposes major indicators for evaluating the smart development level of comprehensive passenger transport hubs at two levels: the individual hub level and the hub city level, as shown in Table 2. These indicators are intended to support both self-evaluation by hub enterprises, and assessment and supervision by management authorities. Specifically, at the individual hub level, there are 12 indicators covering four aspects: facilities and equipment, operation management, travel services, and data governance. At the hub city level, there are 3 indicators.

Table 2. Evaluation indicators for smart development of comprehensive passenger transport hubs.

	No.	Indicator category	Indicator name and content
Individual hub level	1	Facilities and equipment	Density of sensing devices: number of various sensor types deployed per square kilometer.
	2		Proportion of intelligent facilities and equipment.
	3		Upgrade frequency of digital systems: average annual number of upgrades of digital systems.
	4	Operation	Average emergency response time.
	5		Carbon emission intensity: carbon emissions per unit of building

	6	man- agement	area/land area.
			Smart and green energy management: ratio of self-generated green electricity used in the hub to total electricity consumption of the hub.
		7	Management efficiency improvement: reduction rate of management personnel, reduction rate of manual operation time for maintenance and repair.
	8		Seamless passage rate: proportion of scenarios in which passengers achieve fast passage through biometric recognition, automatic payment, etc., within the hub.
	9	Travel services	Green travel rate: share of transfers via urban bus, rail transit, cycling, and walking in the hub.
			Usage of hub travel service system: proportion of active users, user retention rate, average usage time per person, etc.
			10
	11	Data	Access rate to the city-level digital brain.
	12	govern- ance	Volume of data accessed by the hub comprehensive governance information platform and data update frequency.
Hub city level	1		Proportion of smart comprehensive passenger transport hubs in the city: proportion of comprehensive passenger transport hubs within the city that have full-domain perception, intelligent services, and autonomous decision-making capabilities.
	2		Total annual active users of the city's hub smart travel systems.
	3		Proportion of comprehensive passenger transport hubs connected to the city-level digital brain.

5 Implementation Paths for Smart Development of Comprehensive Passenger Transport Hubs during the “15th Five-year Plan” Period

To refine the above general ideas, and focusing on the integrated application of various smart technologies in different phases of comprehensive passenger transport hub development—including construction, operation, and management—this study proposes implementation paths and specific measures for the smart development of China’s comprehensive passenger transport hubs during the “15th Five-Year Plan” period. These are presented from five aspects: facilities and equipment, travel services, operation management, emergency support, and data governance. These measures are intended to guide hub operating enterprises and local management authorities in advancing the practice of smart hub construction.

5.1 Build a Full-domain Digital and Intelligent Facilities and Equipment System

First, promote the coordinated construction of information infrastructure. Actively promote the construction of communication networks, achieve high-quality deep coverage of 5G signals inside hubs, proactively deploy 5G-A (5G-Advanced) networks, simultaneously deploy Wi-Fi 6E/7 networks, and promote the construction of F5G (fifth generation fixed network) all-optical networks. Comprehensive data centers and edge computing nodes should be built to establish hub-level data center, supporting nearby data processing and rapid response to meet high real-time requirements such as safety and emergency response. Furthermore, the deep application of the Beidou Navigation Satellite System should be promoted, to achieve high-precision positioning services, thereby enhancing emergency support capabilities.

Second, comprehensively build an autonomous perception equipment system. Appropriate smart cameras, LiDAR, millimeter-wave radar, Wi-Fi probes, Bluetooth beacons, and various types of environmental sensors should be installed at key points within the hub. Promote the application of inspection robots, drones, intelligent maintenance equipment, and AR remote-assisted maintenance systems.

Third, actively develop a hub digital twin platform. Based on BIM and GIS, build a high-precision 3D model to form a visual digital baseboard consistent with the physical world and carrying spatiotemporal information. Further, use AI algorithms to develop dynamic data-driven and simulation deduction models.

5.2 Create a Convenient and Human-centered Travel Service System

First, develop a one-stop integrated smart travel service platform. Break down information barriers among aviation, railway, road, and urban transportation departments to build a one-stop “travel service information pool.” Furthermore, travel service agents should be developed to establish a personalized travel planning service system for passengers.

Second, build a smart system covering all service scenarios of the hub. While ensuring safety and privacy, the application of biometric technology should be actively promoted to achieve “face-only recognition” for processes such as entry, check-in, security screening, boarding, and shopping. Comprehensively build various smart service systems such as smart ticketing, smart security checks, smart parking, and indoor navigation. Develop and deploy embodied intelligent robots in the hub to form a human-robot collaborative service ecosystem. Increase care for special groups, develop “one-click call” services and accessible intelligent navigation routes for the elderly and disabled. Carry out unmanned shuttle bus services and luggage transfer services, and explore the commercial application of intelligent connected vehicles in areas surrounding the hub.

5.3 Form a Precise and Coordinated Operation Management System

First, build a comprehensive dispatching and operation management platform with multiple transportation modes collaborative linkage. Actively build a “hub brain” that integrates information from multiple transportation modes as a unified platform for hub operation management, achieving “one-screen overview and integrated dispatching.” Build a dynamic passenger flow monitoring and warning system covering multiple transportation modes, as well as an intelligent collaborative dispatching and decision-making system. Vigorously promote docking with information platforms of local governments and relevant management departments (such as city-level digital brain, emergency management platforms, and public security surveillance systems) to achieve regional transportation collaborative governance and city-level emergency linkage.

Second, establish an intelligent preventive maintenance system for facilities and equipment. Develop and fully apply equipment health management models to transform “passive repair” into “active maintenance.” Introduce advanced intelligent equipment for inspection and maintenance operations to improve the safety and efficiency of maintenance work.

Third, establish a smart energy and environmental management system. Develop and fully apply a smart energy management system to maximize the proportion of green electricity use in the hub, helping to build a smart zero-carbon hub. Furthermore, create a smart environmental control system.

5.4 Facilitating the Construction of a Hub Safety and Resilience System

First, build a real-time hub monitoring and warning system. Build an active warning system for emergencies and abnormal situations, automatically identifying various safety risks and achieving second-level alarms. Develop a multi-factor risk warning model to comprehensively assess and provide early warnings for possible extreme weather, large passenger flow stampedes, public health events, etc.

Second, develop an intelligent emergency command and evacuation system. An emergency command platform featuring “one map” and “one network” should be built to achieve visualized and streamlined emergency command. Establish an intelligent dispatching system for emergency resources. In the event of an emergency, intelligently match and dispatch the nearest rescue forces and plan the optimal rescue path. Furthermore, build an intelligent emergency evacuation guidance system.

5.5 Develop a Standardized Hub Data Governance System

First, explore the formulation of unified data standards and specifications. Actively promote the construction of data sharing mechanisms among multiple transportation modes. Promote the establishment of data interface and sharing specifications among hub enterprises, and jointly develop new models such as intermodal passenger transport and customized passenger transport.

Second, guide hub enterprises to gradually improve their data management capabilities. Encourage enterprises to establish data aggregation and processing centers to accelerate the formation of high-quality data assets. Guide enterprises to comply with regulations in providing data services and interface opening and sharing. Support enterprises in continuously improving their data commercialization capabilities.

Third, strengthen data security and privacy protection. Promote the establishment of a data security lifecycle management system in hub enterprises, implementing full-chain security protection for data. Require enterprises to always follow legal and compliant principles and strictly prohibit the abuse of personal data.

6 Conclusions

This paper focuses on the top-level design and path planning for the smart development of comprehensive passenger transport hubs at the national level, within the context of deeply implementing the “Artificial Intelligence + Transportation” initiative. By reviewing typical practices from both domestic and international sources, and synthesizing theoretical research findings in smart transportation, this paper proposes the definition and characteristics of smart passenger transport hubs. It further constructs a key element system for such hubs, comprising five aspects: digital and intelligent facilities and equipment, human-centered travel services, coordinated and precise operation management, intelligent and efficient emergency support, and standardized data governance. On this basis, and taking into account future development trends while addressing existing shortcomings, this paper presents the overall ideas and main objectives for the smart development of China’s comprehensive passenger transport hubs during the “15th Five-Year Plan” period, and proposes evaluation indicators at both the individual hub level and the hub city level. Furthermore, it puts forward implementation paths and specific measures for the smart development of these hubs.

This study preliminarily answers questions such as what key elements constitute the smart development of comprehensive passenger transport hubs, what the priority areas and development goals are for the “15th Five-Year Plan” period, and what specific measures should be taken by enterprises and management authorities. It will effectively support the formulation of relevant national-level plans and provide directional guidance for hub enterprises, as well as for the construction of national comprehensive transportation hub cities. More in-depth research and empirical analysis on the evaluation indicators and methods for the smart development of comprehensive passenger transport hubs will be the focus of subsequent studies.

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Disclosure of Interests

The authors have no competing interests to declare that are relevant to the content of this article.

References

1. Odile, M. and Floridea D. C., "City-hubs for smarter cities. The case of Lille EuraFlandres interchange," *European Transport Research Review*, 2018, 10(1), doi: 10.1007/s12544-017-0283-3.
2. Denis Vlasov and Anna Terekhova, "Determination of regularities in the development of intermodal hubs' planning structure in smart cities," *E3S Web of Conferences* 97, 01007 (2019), doi: 10.1051/e3sconf/20199701007.
3. Yun, L., Chen, L., Tu, D., Zeng, Q.Q. et al., "Research on supply and demand matching model of transportation modes in MaaS system of integrated passenger transport hub based on deep learning," *Soft Computing*, 2023,27(4): p.5973-5983, doi: 10.1007/s00500-023-08065-4.
4. Sewenet, A.D. and Pisano, P., "Assess the Role of Green Information Systems (Green IS) for Smart Mobility in Smart Cities: a Case Study Approach," *ITAIS 2023 Proceedings*, 2023, 30: 1-18.
5. Zhang, S.T., Yang, L.N., Yang, and H. W., "Research on key technologies for block data governance in smart cities," *Fourth International Conference on Intelligent Traffic Systems and Smart City (ITSSC 2024)*, *Proc. of SPIE Vol. 13422*, 134222V, doi: 10.1117/12.3050799.
6. Panagiotis, P., Dimosthenis, P., Vasiliki, A., and Maria, S., "Public acceptance of smart and green mobility hubs in Attica, Greece," *Urban Science*, 2025, (9), doi: 10.3390/urbansci9020029.
7. Hu Z. H., "Analysis of requirement of smart integrated transport hubs and implementation solution," *China Railway*,2022, (4): p.58-63.
8. Liu H. Y., "Research on the intelligent design of urban comprehensive transportation hubs taking the Shenzhen Xili comprehensive transportation hub as a case study," *Modern Urban Transit*, 2024, (2): p.19-26.
9. Zhao W. H., "Integrated travel service scheme for comprehensive transportation hub," *AIAT 2024*, *LNEE 1389*, pp. 69–77, 2025, doi: 10.1007/978-981-96-3957-1_7.
10. He, Z. Y., Li, Z. M., Yuan Z. F., Yang, J. et al., "Design of intelligent induction heating system for public transportation hubs," *International Conference on Frontiers of Traffic and Transportation Engineering (FTTE 2025)*, *Proc. of SPIE Vol. 14060*, 1406038, doi: 10.1117/12.3101859.
11. Zhu, J. H., Sun, C., Lin, Y. L., and Xu Z. L., "Development path exploration of intelligent comprehensive transport hub under station-city integration model," *Collection of scientific and technological papers of the 15th China intelligent transportation annual conference*,2020: p.506-514.
12. Mei, H. Y., Chen Y.T., Gao, Y. T., and Yu, J. Y., "Research on the intelligent low carbon development path and strategy of large high-speed railway stations in cold regions--taking mudanjiang railway station as an example," *Railway Investigation and Surveying*,2023, 49(4): p.1-6.

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