Research on the evaluation index system of intelligent railway passenger station

Shaofu Lin1,2*, Qianwen Wei2, Sibin Xia2

1Beijing Advanced Innovation Center for Future Internet Technology, Beijing, 100124, China
2College of Software Engineering, Beijing University of Technology, Beijing, 100124, China
*Corresponding author, e-mail: linshaofu@bjut.edu.cn

Abstract. The evaluation index system of intelligent railway passenger station is a set of scientific and systematic evaluation index system, a method standard for scientific evaluation and quantitative calculation of passenger station construction, and a concrete embodiment of evaluation results of intelligent railway passenger station construction, playing a leading, guiding and testing role. This paper analyses the basic connotation and definition of intelligent railway passenger station and reference to the relevant field index system design experience, extracting the basic framework of intelligent railway passenger station evaluation index system, taking "Beijing-Zhangjiakou High Speed Railway" as the application case and combining with the actual needs to propose relevant suggestions and countermeasures, thus providing a basis for the planning and management of intelligent passenger station.

1. Introduction
The passenger station is the main window for the interaction between the railway and the passengers. It is responsible for the whole process of passengers entering the station-waiting-outbound. With the development of informatization and the innovative development mode of the transportation industry, the passenger transportation service is intelligent, the informatization of passenger transportation services, diversified functions and the business district of the station have become an important direction for the development of stations. Smart stations use modern technology such as big data, cloud computing, and Internet of Things to effectively reduce station operating costs, improve service levels and quality, and reduce environmental pollution in a business, problem-demanding, and technology-driven manner. However, in the construction of intelligent railways at home and abroad, a complete and standardized intelligent passenger station evaluation index system has not been developed to assist the state in the intelligent management and dispatch of intelligent railways. The intelligent passenger station evaluation index system is a method system for quantitative calculation and scientific evaluation of intelligent railway construction achievements. It is a concrete manifestation of testing the results of intelligent railway construction, and can also promote the construction process of intelligent transportation efficiently. It is essential and necessary to carry out the research work on the evaluation index system of the intelligent passenger station, which has important scientific research value and social significance.
2. The concept and development status of intelligent railway passenger station

2.1. Basic Concepts and Definitions of Intelligent Railway Passenger Station
Intelligent railway passenger as the subsystem of the intelligent traffic system in the intelligent railway, new generations of information technology such as big data, cloud computing, Internet of Things, artificial intelligence, next-generation communication, Beidou satellite navigation, BIM, and robots are widely integrated in the planning, construction, operation, service and management of passenger stations, with the goal of convenient travel by passengers, warm service of stations, efficient production organization, safe real-time protection, energy saving and environmental protection of equipment. It comprehensively utilizes all the mobile, fixed, space, time, manpower and other resources of the railway to realize the planning, construction, organization and transportation of the railway passenger station, and the high degree of informatization, automation and intelligence of the whole life cycle. It is an important support for realizing the intelligent transportation infrastructure and promoting the sustainable development of the transportation industry. It is also an important part of smart city construction.

2.2. Research and development of relevant industry evaluation indicators system at home and abroad
The evaluation index system is the basis for the ranking and optimization of the evaluation objects, and is the key support for improving the practice process and optimizing management measures. For example, internationally, the IBM Urban Intelligence Assessment White Paper states that assessing a city's core systems and activities is the most fundamental content in the smart city strategic planning phase. In addition, China has continuously explored the research topics of the “smart city” evaluation index system. For example, the Nanjing Information Centre published the “Study on the Evaluation Index System of “Smart City” in 2010, the “Smart City Construction Evaluation Index System 2.0” issued by Shanghai Pudong New Area, etc. It provides the main basis for the development of smart city evaluation in China, and is an important means to guide the healthy development of smart cities across China. In addition, "Evaluation standard of Zhejiang local standard town " comprehensively use the basic theories of urban and rural planning, urban economics, environmental science, ecology and systems science to reflect the comprehensive level of development of characteristic towns. An overview of the research on the evaluation index system of related fields, as shown in Table 1, the analysis of the commonality and personality points of the first-level indicators in the relevant field evaluation index system, as shown in Table 2.

| Table 1. Overview of research on evaluation index system in related fields |
|---------------------------|-----------------|-------------------|-----------------|
| Index name                | index system                             | index principle                           |
| EU medium-sized cities smart ranking evaluation indicators | 6 first-level indicators, 31 second-level indicators, and 74 third-level indicators. | -- |
| IBM Smart City Assessment Criteria and Elements | 7 first-level indicators and 28 secondary indicators. | tailored, holistic, comprehensive, comparable |
| Nanjing City Information Centre Smart City Evaluation Index System | 4 first-level indicators and 23 second-level indicators. | collectability, additivity, cognition |
| Pudong New Area Smart City Indicator System 2.0 | 6 first-level indicators, 18 second-level indicators, and 37 third-level indicators. | collectability, representativeness, comparability |
| Evaluation standard of Zhejiang local standard town | evaluation of the combination of commonality and personality evaluation indicators | Scientific, systematic, operability, etc. |
Table 2. Analysis of commonality and personality point of the first-level index

| Index name                                      | Common first level index                                      | Personality first level index                  |
|-----------------------------------------------|-------------------------------------------------------------|-----------------------------------------------|
| EU medium-sized cities smart ranking evaluation indicators | smart city infrastructure construction, smart city public management and service, smart environment construction, intelligent humanities construction, smart government construction | Smart People and Mobility                        |
| IBM Smart City Assessment Criteria and Elements | Smart building                                              | Smart building                                 |
| Nanjing City Information Centre Smart City Evaluation Index System | Internet and smart industry                                 | Internet and smart industry                     |
| Pudong New Area Smart City Indicator System 2.0 | Wisdom city perception of democracy Smart city soft environment construction | Wisdom city perception of democracy Smart city soft environment construction |
| Evaluation standard of Zhejiang local standard town | --                                                          | Function "gather together"、Form is "small and beautiful"、System is "new and live" |

Although China has formed a complete evaluation index and application guideline for the standard system in the smart city, it lacks in the construction of the urban intelligent traffic evaluation system, especially in the construction of the evaluation index system of the intelligent railway passenger station. The perfect intelligent railway passenger station evaluation index system can be used to guide the public travel demand information, and provide strong support for the pre-control, coordination and resilience of transportation operations.

3. Basic ideas for establishing evaluation index system of intelligent railway passenger station

3.1. Design basis

3.1.1. Policy basis. The evaluation of the intelligent passenger station evaluation index system is based on the “13th Five-Year Plan for the Development of Modern Integrated Transportation System” (Guo Fa [2017] No. 11), “Smarter Transportation Makes More Easy Action Plan (2017-2020)” and the spirit of the report of the 19th National Congress is the policy basis.

3.1.2. Theoretical. Basis theories of information management, passenger station management, operation management, public service management, and information resource management at home and abroad are the main theoretical basis for the development of the evaluation index system for intelligent passenger stations.

3.1.3. realistic basis. When designing the evaluation index system of intelligent passenger station, it is necessary to fully consider the basic requirements of the construction of intelligent passenger vehicles in the political, economic, cultural and social macro-development environments, as well as the status quo of China's smart railway construction and the demand characteristics of different types of urban railway construction, and then put forward relevant index items and evaluation criteria.

3.2. Design Principles

This paper constructs the evaluation index system of intelligent railway passenger station. Based on the design principles of evaluation indicators in relevant fields, the comprehensive consideration of the
development goals of smart railway makes the evaluation of intelligent passenger station objective, comprehensive and scientific.

3.2.1. Guiding principle. Taking the construction target of the intelligent passenger station as the standard, the evaluation index system will be guided by the national policy spirit, the railway development plan and the actual needs. It is necessary to reflect the construction requirements of the railway station for the intelligent station construction, and to reflect the development focus of the intelligent passenger station in the index element project and weight arrangement.

3.2.2. Systematic principles. The evaluation index system of the intelligent passenger station should be a well-defined whole. The index items of different dimensions should be at different levels, forming a certain order, and there is an inherent logical relationship between the index layer and the index layer and the indicators at the same level.

3.2.3. Scientific principles. Science is the soul of the indicator system. The preparation process of the intelligent passenger station indicator system should be as objective as possible, and the influence of subjective consciousness should be excluded as much as possible, with quantitative indicators as the main factor and qualitative indicators as the supplement. In addition, the indicator system should be able to scientifically and accurately reflect the existing strength and future potential of smart stations.

3.2.4. Principle of operability. The evaluation index of the intelligent passenger station should be an indicator that is easy to quantify in the actual operation, so as to facilitate quantitative evaluation and comparison of the intelligent passenger station. In addition, data or information reflecting the assessment indicators should be easily collected to fully reflect their actual application value and operational possibilities.

3.2.5. The principle of scalability. The intelligent passenger station is a dynamic development process. The evaluation index system of the intelligent station should also be based on the evolution of the “smart station” development path, and at the same time weigh the current development of the railway and timely supplement and adjust it dynamically.

3.3. The basic framework of the evaluation index system for intelligent railway passenger station
According to the definition, development status and construction goals of the intelligent railway passenger station. The indicator system framework is divided into three levels, including 4 first-level indicators, 19 second-level indicators, as shown in Figure 1.
4. Application demonstration of indicator system in Beijing-Zhangjiakou High-speed Railway

The Beijing-Zhangjiakou High-speed Railway is the world's first high-speed railway built with intelligent technology. According to the above-mentioned evaluation, the overall framework of the system is designed, and the application scenarios are designed and the implementation plan is formulated.

4.1. Application scenario design

4.1.1. Benchmark evaluation. The benchmarking assessment comprehensively evaluates intelligent passenger stations nationwide from the aspects of intelligent infrastructure, intelligent management, and intelligent services, facilitating horizontal comparison of stations between cities. According to the evaluation results of the benchmarking, the station can find out its own gaps and deficiencies, determine the construction direction and construction focus of the next stage, and thus improve the competitiveness of the station. In addition, through the evaluation of the target, we can understand the current status of the construction of smart passenger stations in various places, and provide the basis for input-output benefit.
for decision-making by government departments, so as to formulate corresponding guiding policies or opinions.

4.1.2. Diagnostic assessment. The diagnostic evaluation of the indicator system should cover the whole process of planning, construction and operation of the intelligent passenger station in combination with the actual situation of urban development and the urban strategic objectives. Among them, the diagnostic assessment of the construction process includes the fit of key projects and urban needs, and the standardization and controllability of the construction process. The diagnostic assessment of the operational process includes whether the operational model is coordinated with the economic and social development of the city, and how effective the operation is. According to the results of the diagnosis and evaluation, not only can the problems existing in the passenger station be solved in time, the solutions can be formulated in a targeted manner, and the advantageous resources can be used to make up and improve.

4.1.3. Performance appraisal. With performance as the driving force, it can effectively improve the operational effects of various service management departments at the station. First, the evaluation indicators should extract the commonalities of different service management areas, grasp the performance level of different areas as a whole, and carry out transformation according to the evaluation results. Secondly, in different places, different fields, even different departments in the same field or the same place, there are significant differences in business scope and service items. The evaluation indicators should be deepened within the field, combined with the business characteristics of each department to refine the details of service management. Finally, for cross-disciplinary and cross-sectoral businesses and services to be assessed separately, the focus should be on resource sharing and coordination.

4.2. Application management workflow

Establishing an application management system framework in the system is conducive to accelerating the development of regulations, policies, technical standards, management systems and other regulations for the construction of intelligent passenger stations. The main processes of application management work are as follows:

4.2.1. Evaluation preparation. The evaluation management team promotes the formation of the evaluation expert group and the implementation group, and publishes the evaluation plan for the intelligent passenger station, which clarifies the evaluation scope, region, and time. According to the objectives and management needs of the development and construction of the intelligent passenger station, the implementation group will set the index weights, form the corresponding data collection list, questionnaire, clear evaluation indicators, evaluation criteria and filling requirements, etc., and submit them to the expert group for review and report to the development management group.

4.2.2. Data collection. The review implementation team will publish a data collection list and a questionnaire, and the organization will be reported by the organization. The receiving unit shall report the internal audit of the data, and report it to the management team and the implementation team. The implementation team supervised and guided the whole process of data collection and coordinated communication problems in a timely manner.

4.2.3. Evaluation execution. The evaluation of the intelligent passenger station is carried out in two stages of initial evaluation and re-evaluation. The evaluation implementation group summarizes and counts the indicator data reported by the evaluated units according to the established rules, and organizes the level of the evaluation indicators of the initial evaluation of the expert group. The expert group reviews the initial evaluation results with reference to the level characteristics of each level, and gives specific scores. For those who do not have obvious characteristics, adjust the corresponding
level. The leader of the expert group will summarize the scores of each evaluation index, calculate the total score, and determine the evaluation level of the evaluated unit.

4.2.4. Evaluation release. The evaluation implementation team prepares an evaluation report based on the evaluation results. The evaluation report shall include the scores of the evaluated units, the corresponding evaluation level, and the sub-items of each evaluation index. The evaluation report is submitted to the expert group for approval, and is submitted to the review management team for approval, and is released by the management team.

4.3. Implementation plan and recommendations

4.3.1. Improve the institutional mechanism and standard specification of application management of evaluation index system. The framework of the application management system mechanism should be refined according to the actual needs, clarify the division of responsible units and responsibilities at all levels, and evaluate the operational guarantee mechanism, and finally form an application management plan for the evaluation system of the intelligent passenger station to ensure the orderly evaluation. There are plans to proceed.

4.3.2. The weight of the evaluation index system and the basis for scoring. On the basis of the pilot application of the evaluation index system, the proportion of the importance of each evaluation index in the whole system should be divided, that is, the weight of the individual evaluation indicators. In addition, according to the top-level design and technical route of the intelligent passenger station, combined with the objective and technical system of the intelligent station and information construction of the passenger station and the actual construction of the station in the pilot application, the classification index of the evaluation index system is formed.

4.3.3. Evaluation and rating training work of the intelligent passenger station. The government department took the lead and the local authorities actively cooperated to carry out the application training of the standard system and evaluation index system of the intelligent passenger station, and selected a group of local standardization personnel to participate in the development of national standards and international standards for intelligent passenger stations. At the same time, through regular organization of publicity training courses, seminars and other activities, increase the publicity and development of intelligent passenger transport station development standards and evaluation indicators, improve the impact of the evaluation of intelligent passenger station evaluation, expand the training and introduction of intelligent passenger station evaluation work Talent.

4.3.4. Research and build a unified mobile cloud station real-time data monitoring unified cloud platform. The construction of intelligent passenger station will use a large amount of information technology. In order to facilitate the unified management of station data, it is necessary to build a unified research on real-time data monitoring and unified cloud platform to realize real-time data collection, aggregation, collation, statistics, release and visualization of national passenger stations. Function, constantly introducing cutting-edge science and technology, providing program and decision support for unified scheduling of station resources, global disaster prevention early warning, and inter-station business coordination.

5. Conclusions
Taking the demonstration application of Beijing-Zhangjiakou High-Speed Railway as the research object, this paper analyses and explores the evaluation index system of intelligent passenger station, and proposes relevant development ideas to ensure the passengers' full-service, integration, self-help and personalized travel service quality. However, the preparation of the indicator system is not a one-step process. The process itself is a dynamic process that is constantly revised and improved. In the
future, it is necessary to dynamically adjust the indicator system according to the deepening of the understanding of intelligent passenger stations and the practice of building intelligent passenger stations. Timely adjustment and improvement of the indicator system will provide strong institutional guarantee and scientific guidance for the construction and development of intelligent railway passenger stations in the future.

References

[1] De-Dao G U , Wen Q . Study on the Construction of Evaluation Index System of China's Smart City[J]. Future & Development, 2012.
[2] Ning B , Tang T , Gao Z , et al. Intelligent railway systems in China[J]. IEEE Intelligent Systems, 2006, 21(5):80-83.
[3] Jia L, Nie A, Wang F. Railway Intelligent Transportation System-State of Art, Challenges and Development[J]. Communication & Transportati0n Systems Engineering & Information, 2001, 1(3):207-211.
[4] Khekare G S , Sakhare A V . A smart city framework for intelligent traffic system using VANET[C]// International Multi-conference on Automation. IEEE, 2013.
[5] Liu Y , Luo X . A Study on Planning of Large Urban Road Passenger Station[C]// International Conference on Intelligent Computation Technology & Automation. IEEE Computer Society, 2008.
[6] Lanke N , Koul S , Lanke N , et al. Smart Traffic Management System[J]. International Journal of Computer Applications, 2014, 75(7):19-22.
[7] Yong Q, Jia L, Yuan Z. Railway intelligent transportation system and its applications[J]. Engineering Sciences, 2011, 09(1):53-59.
[8] Li P, Jia L M, Nie A X. Study on railway intelligent transportation system architecture[C]// Intelligent Transportation Systems, 2003. Proceedings. IEEE, 2003:1478-1481 vol.2.