Public Space Optimization Through Station and City Integration: The Case of the Hub Area of Shenzhen North Railway Station

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Abstract: The provision and optimization of public spaces in rail hub areas is confronted with the challenges due to the absence of systematic methods to address various planning situations. These challenges include significant variations in population flows, complex relationships between spatial scales and spatial layout, and difficulties in achieving space use efficiency and spatial quality. Drawing on the theory of station and city integration, this paper establishes a methodology for designing public spaces that encompasses the model of space provision, systematic construction, and scenario development. Shenzhen North Railway Station is examined empirically to illustrate the application of the methodology. Based on the research findings, the paper recommends the introduction of design standards for public spaces in highspeed rail hub areas, specifying per capita indices, composite indices, and spatial dimension of key elements such as evacuation widths, pedestrian passage, transfer distances, three-dimensional parks, and corridors.

Keywords: hub; one station city; public space; quality optimization; scale supply

With the characteristics of fast speed, large capacity and low freight cost, rail transportation has now become the backbone of the passenger transportation system of China's large cities and mega-cities. Based on the superior accessibility of rail transit, urban development around high-speed rail hubs has become a mature path for urban development. Since the focus is mostly on the efficiency of traffic and people flow, a large number of ramps are built around the hubs to connect with the surrounding roads, and at the same time, they are connected to the urban railways in a three-dimensional way. This development pattern emphasizes the throughput capacity of passenger flow, and the functions and spaces are usually single, engineered and specific, but ignores the objective needs of daily users for convenience, continuity and perception of spatial qualities, and reduces the effectiveness of the use of public space in the hub area. In addition, it will bring secondary problems such as urban space fragmentation and frequent congestion in the area, making it difficult to fully realize the compound value of the high-speed rail hub.

On the other hand, as China's urbanization process enters the mid- to late-stage, projects developed and constructed under the prior interest-oriented approach often suffer from a lack of public space, which further squeezes the places for urban public activities in the context of the increasingly tight incremental space in the central part of the city. Infrastructures such as large transportation facilities, which have a single function and occupy a large area, have become a potential source of space for public activities. In recent years, the optimization and transformation of large-scale transportation facilities into daily and public spaces (i.e., urbanism mentioned in Infrastructural urbanism addressing the

in-between) has become the new normal, and has also become an important part of the human-centered approach to enhance the quality and experience of urban spatial environments. The targets for renovation include not only abandoned transportation facilities, but also hub facilities in use. For example, the Jiaxing Railway Station renovation project integrates the station with the surrounding parks, residences, hospitals, and offices, aiming to create a high-quality urban public space that blends in with nature; the Seoul Railway Station High Line Park renovation project exploits the potential of the abandoned viaduct space and creates a three-dimensional public garden that is intertwined and blended with the cityscape; and the Shenzhen Bay Sports Training Base forms a very dynamic public sports and recreational park for the public through the renovation of the former metro hub's rooftop space. The Shenzhen Bay Sports Training Base, through the transformation of the rooftop space of the former metro hub, has formed a very dynamic public sports and leisure park for the citizens.

From the existing practical experience, upgrading and transforming large-scale transportation facilities such as high-speed rail stations and the surrounding public space can effectively improve the experience of using the facilities and urban space, and enhance the composite value of the area. There are differences in the degree of difficulty in transforming and optimizing transportation facilities of different spatial scales and traffic flows in terms of daily routine and public space. Transportation facilities with smaller scale and traffic flow, such as elevated corridors and under-bridge spaces, can often be upgraded by engineering means only. For transportation facilities with larger scale, such as high-speed rail stations and large-scale rail hubs, systematic optimization of public space is required from multiple scales and dimensions: not only to reasonably analyze and determine the demand and scale of public space layout from the perspective of users, but also to formulate a multi-path and multi-level public space supply strategy by combining with the overall spatial function of the high-speed rail hub area, and finally to combine with the intelligent means to implement the public space of high efficiency, traffic conversion and high-quality scene experience. Finally, it should be combined with intelligent means to realize the public space shaping with high efficiency, traffic conversion and high-quality scene experience. Therefore, from the perspective of station-city integration, this paper discusses the systematic optimization method of public space in the high-speed rail station hub area, aiming to provide technical references for the humanized transformation of similar station-city integrated public space.

1 Conceptual overview and research significance

"Transit-oriented development (TOD) is a concept put forward by Japanese scholars in 1929 in the context of the expansion of the Tokyo metropolitan area, the essence of which is "a development model centered on a hub station, with rail transit and the city complementing each other, spatial composite agglomeration, and station-city co-development". Its essence is "a development mode centered on a hub station, with rail transit and city complementing each other, spatial composite agglomeration, and joint development of station and city". In practice, efficient public space design is often used to integrate transportation, commercial value, public space and human life into one, maximize the value of land development in the area around the transportation hub, and satisfy the

needs of multiple groups of people. The key of "station-city integration" is to connect and integrate "station" and "city" in an orderly manner, while the shaping of public space in the station area is to connect the station to the city life and make the "station" better connected to the city life. "The shaping of public space in the station area is the fundamental way to connect the station to urban life, better integrate the station into the vibrant atmosphere of the surrounding city, and enhance the continuity of urban space. The public space system of the transportation hub interacts with external factors such as complex urban functions, high-intensity land development and diversified people, forming a space system with unique structural logic and place quality, so the public space of the hub area under the guidance of "station-city integration" has the spatial characteristics of multi-dimensional, multi-dimensional composite and personalized identification. Therefore, the public space in the hub area oriented by "station-city integration" has the spatial characteristics of multi-dimensional, multi-compound and personalized identification.

Existing studies on public space in rail hubs at home and abroad mainly focus on the optimization principle of public space, the construction method of public space subsystems and the comprehensive evaluation of public space. For example, Bélanger believes that transportation infrastructure should be integrated with other urban systems through the optimization of public space to become a carrier with composite functions, so as to make the different behavioral processes embedded in it relate and create more possibilities for the humanization of infrastructure; AnaConceição believes that the station area can be strengthened through the integration of the public space and the surrounding urban environment, thus becoming a station city; AnaConceição believes that the station area can become a station city through the integration of the public space and the surrounding urban environment, thus becoming a station city. Triggianese et al. argue that high-speed rail hubs can bring greater passenger and freight traffic and expand the urban functions of station areas, which should be further transformed into station-city integration and interactive public spaces; Van Nes et al. use the spatial syntax method to evaluate the street space around several stations in the northern part of the Netherlands, verifying that there is a relationship between the mix of functions around the station, street scale and station composite value; Xu Leiqing et al. selected three indicators such as area, density and coefficient of public space to assess the supply of public space in the rail station area, and at the same time selected three indicators such as spatial enclosure, the proportion of business in the interface, and sit-able facilities to assess the quality of the public space, and then argued about the influence of the two on the stopover activities; Wu Liang et al. systematically analyzed the Umeda in Osaka, the Central in Hong Kong, and the Government House in Singapore walking space, Wu Liang and others systematically analyzed the way of constructing pedestrian system in Osaka Umeda, Hong Kong Central and Singapore Government Building, and concluded that the construction of pedestrian system in rail hub area cannot be separated from the three characteristics of networking, relevance and inclusiveness; Wang Rongrong took the pedestrian system around high-speed rail station as the research object, and summed up the common ways of organizing the pedestrian space and the general strategy of space form design. From the point of view of the relevant studies that have been carried out, the research on public space in station-city integrated area often focuses on the integrated construction of public space under the guidance of slow-moving

transportation, and fewer scholars study the construction and shaping of public space in the transportation hub area from the perspectives of system construction and technical means. Therefore, this paper explores the optimization mode of public space in station-city integrated area from the system perspective.

2 Technical route

Considering the characteristics of public space in station-city integrated area, its organization mode should focus on its wholeness, coherence and identifiability, which mainly involves three scales: macro, meso and micro. Therefore, this paper mainly starts from the perspective of urban design and comprehensive transportation, and constructs a planning and design method for the construction and optimization of public space in the hub area based on the three levels of macro-city-medium-scaled block-micro building (Fig. 1), and at the same time, explores the relationship between the open space in the hub area and the integration of the urban public space with multi-dimensional integration.

2.1 Macro level: building a functional public space for composite growth

At the macro level, the main goal is to build and integrate the station city and sort out the functional order of building various types of public space in the city. It is necessary to understand the public space needs of the hub area through field research, questionnaires, talks and interviews, data analysis and other methods. First, pay attention to the regional planning layout and space scale demand, determine the public space supply standard, and allocate the scale of public space according to the activity characteristics; second, coordinate the positioning and function of hub public space within the city, so as to diversify the area around the hub; third, the hub public space should be made to fully display the natural and humanistic characteristics of the city, pay attention to the integration of the hub public space with the urban ecology, and highlight the city's cultural Characteristics of the city culture. The transportation hub function under the guidance of station-city integration is a functional complex based on the transportation function and the common development of commercial, business and leisure functions. In addition to serving pedestrians and tourists, the transportation hub also radiates a large number of people living in the surrounding area. The hub area brings together different groups of people, including commuters, working people, regional visitors, and local residents. This requires that the public space be of multiple types, including circulation space, interaction and recreation space, vitality space, and service space. Public space does not exist in isolation, but is closely related to various system elements in the district. In the process of organizing and constructing public space, it should be integrated with community services, child-friendly facilities, barrier-free facilities, green infrastructure, etc. (Table 1) to encourage spatial diversity.

2.2 Meso level: Building an integrated multi-dimensional linkage of public space

2.2.1 Smooth and efficient linkage flow line

The public space in the hub area often carries strong traffic connection functions, and should coordinate the traffic relationship with the traffic hub during the design process to form a smooth and efficient traffic flow line, optimize the transfer paths of various modes of transportation, and improve the transfer efficiency. Therefore, it is necessary to comprehensively sort out the primary and secondary relationships of various functions in the layout, clarify the traffic flow space, reasonably plan the horizontal flow space and vertical

transportation facilities, and comprehensively improve the travel efficiency and spatial experience.

2.2.2 Multi-dimensional integrated roaming network

In addition to fast access and connecting facilities, the station city space also needs to provide people using various urban functions with street space and return paths that can roam the city and create spatial points of interest; taking the station as a hub, linking up the multi-dimensional public space network through vertical conversion, penetrating into the periphery through the three-dimensional slow-moving system to build a complete three-dimensional public neighborhood network, increasing the returnability of the passengers in the periphery of the station, thereby breaking the the railroad may bring urban fragmentation and further enhance the value of land around the hub.

2.3 Micro level: shaping uniquely attractive and iconic spatial places

2.3.1 Recognizable and iconic public space

At the micro level, the public space of a station/city hub can be recognized not only through landmark buildings, but also through the establishment of a unique place and space with inherent "growth power," which can enhance regional cohesion and realize the continuation of culture and history. For example, the plaza in front of Umekita Station at Osaka Station is a large plaza characterized by the theme of "water," and the public space between buildings is created through three-dimensional space corridors, with a very comfortable scale and effective functional configuration.

2.3.2 Localization, sustainable place characteristics

In the specific station city public space shaping combined with the current terrain and environmental design, the regional culture, terrain characteristics, neighborhood symbols into the public space, get rid of the "one side of the city" inherent image, fully highlight the regional characteristics, strengthen the user's sense of identity and sense of belonging, in order to create the station city space into the most dynamic and cohesive charm! It is only through positive dialogues with regional traditions that the sustainable development of ecology and cultural lineage can be realized, and the image of the city gateway with characteristics can be manifested.

2.3.3 Exchangeable and humanized place experience

Hub area public space is also the main public interaction and activities of the public, the use of people is more important, the micro station city public space design requirements more humane and sustainable value. To focus on creating comfortable, personalized activity places, we need to pay attention to and respond to the different levels of users, the use of different times of the day, to enhance the public's sense of experience and sense of well-being; to promote the scenario of the place space, and commercial, cultural, entertainment and other functions, to create a pleasant scale of rest and activity space, emphasizing the green ecology, vitality and fun, the future of the experience.

3 Empirical Study--Taking Shenzhen North Railway Station Hub Area Public Space as an Example

This study selects Shenzhen North Railway Station Hub Area (hereinafter referred to as North Railway Station Area) as the research object. The North Railway Station Area is located in the middle of Shenzhen and the south of Longhua District, with rich ecological elements in

the surrounding area, forming a general structure of "mountain, station, city and water" from the west to the east, with obvious advantages in ecological pattern, and is the key node of Shenzhen's "Central Superiority and Northern Expansion", with the characteristics of "transportation hub + business center", "transportation hub + business center", and "business center". It has the dual attributes of "transportation hub + business center", bringing together important functions such as image display, external transportation, business center and high-level public services. After more than ten years of planning and construction, the North Railway Station Area has become one of the most popular and economically dynamic areas in Longhua District.

3.1 Perception of the current situation

From the perspective of daily public space use, the following three problems currently exist in the current situation and planning and construction of the North Station Area: first, spatial fragmentation. Specifically, the current situation of the North Station area is characterized by the dense weaving of railroads and urban elevated rail lines, resulting in the severance of the city and nature. At the same time, occupying a huge station building weakens the spatial connection between the east and west squares of the North Station. In addition, high-grade urban roads are also very easy to divide the current park or green corridor, resulting in the continuity of public space is blocked. Second, traffic congestion. As the largest planning in Shenzhen, the most complete connecting function, the largest passenger flow of the integrated railroad hub, non-holiday period, the North Station peak day sent 200,000 people, the Spring Festival sent up to 300,000 people per day. The huge demand for railroad passenger traffic, the higher development intensity of the surrounding area, and the convergence of multiple external roads in the North Station hub have led to frequent traffic congestion in the North Station area. During the Spring Festival in 2018, the delay of the train group, due to the serious lack of waiting and evacuation space in the North Station, led to the failure to reasonably guide the evacuation of passenger flow, and hundreds of thousands of people were stranded in the waiting halls and the plaza in front of the station. Third, the quality is not high. North Station area has been built five parks and squares, the total size of 50 hm2, but there are problems such as low accessibility, single landscape, poor experience, etc., and there is more room for improvement. See Table 2.

3.2 Planning Cognition

At present, the compiled and in-progress plans of the North Station Area cover various levels and aspects such as road transportation, urban design and land development. Due to the special geographic conditions and the demand for interchange of large-scale transportation hubs, the North Railway Station Area has made it clear from the very beginning of the planning and construction that it is necessary to organically connect various functional plates through the construction of a "three-dimensional city". The public green space on the northeast side of Shenzhen North Railway Station is planned to become an urban supercore of pioneering landmarks and energetic portals, and its construction has been launched in 2022.

The general framework of public space in the North Station area has formed a consensus in the relevant superior planning, and five areas have been formed, such as the east, west, south, north and middle. However, from the perspective of public space, the following deficiencies still exist in the compiled plan: First, insufficient consideration of the

composite needs of diverse populations. As a high-density development of the integrated station-city area, there are nearly 240,000 local residents and 174,000 office workers in the North Station area, with a peak distribution of up to 715,000 people. The plan has only taken into account the needs of the resident population, and has not taken into account the needs of other types of people, such as offices and distribution centers.

Secondly, the spatial distribution imbalance under the scale difference of the area. The development and construction of the north station area is mainly concentrated in the east side of the railroad station, and the development intensity of the west side is lower. In the compiled plan, the west side of the area is planned to have a larger scale of public space, and the north and east areas are planned to have a smaller scale of public space.

Thirdly, it is difficult to reflect the future qualities and gateway characteristics of the North Station area in the shaping of specific public space. At present, the relevant plans have been compiled only from the structural and functional perspective to delineate the five major areas, clearly defined the North Railway Station Area, "remote view of the mountains and water, dual-core interaction, three valleys through the corridor through the" public space structure and the core theme of business, innovation, public space has not been carried out on a detailed scale of the spatial design of the public space, the guiding public space construction is limited. Limited.

Under the background of maturing urbanization in Shenzhen, quality improvement is becoming the main theme, Longhua District is fully implementing the "medium-excellent" strategy put forward by Shenzhen Land and Space Planning, comprehensively constructing Digital Longhua, and advancing to the level of "characteristics, culture and taste", which is the main feature of North Station Area. Combined with the main features of the North Railway Station Area and the main problems in the planning and construction of public space, this study focuses on three core issues: firstly, how to build an efficient and interconnected public space system; secondly, how to satisfy the composite demand for public space from multiple groups of people; and thirdly, how to shape the characteristics and improve the quality.

4 Strategies for Enhancing Public Space in the North Railway Station Hub

4.1 Multi-way space supply under diversified demands

In order to cope with the overall demand for public space under the huge population scale of the North Railway Station Area and the individualized public space demand of diversified groups of people, and to realize the multi-way supply of public space in the area on the basis of diversified demand, a three-step supply strategy has been formulated for this purpose: firstly, to determine a reasonable per capita scale of public space; secondly, to calculate the overall scale of demand by combining the intensity of development, the vitality of public facilities, and the differences in the demand of different groups of people; thirdly, to formulate a diversified supply strategy according to The third is to formulate a diversified supply strategy based on the characteristics of the district.

4.1.1 Determining the scale of public space per capita

The planning modes of urban public open space include random mode, quantitative mode, systematic mode and morphological mode, in which the planning cases and configuration standards related to the quantitative mode differ from the specific objects and

control scales, and thus the per capita scale is different. See Table 3.

From the viewpoint of domestic and international practical experience, the quantitative configuration of public space mainly presents two characteristics: first, hierarchical configuration. The configuration of public space is generally divided into urban level, street level, community level or city level, community level, residential district or neighborhood level, and the configuration scale decreases step by step from regional, municipal and then community and neighborhood, of which the street level is generally 30%-50% of the urban level, and the community level is generally 10%-15% of the urban level.

The second is the relationship between the scope of conceptualization and per capita size. The definition of the scope of public space is different, its per capita scale will also have a difference, the wider the coverage, the larger the per capita scale.

The North Station area is similar in scale to the street, and is an important transportation hub and gateway area with significant three-dimensional characteristics. In the process of researching its public space demand, not only should we consider parks, squares and other independent occupation of public space, but also should consider the plot allotment green space, characteristic streets and other non-independent occupation of public space. Therefore, the size of public space per capita in the North Station area should be moderately adjusted upward at the street level. In addition, relevant standards and norms mainly consider the public space needs of the resident population, while this study will consider the needs of the working and temporary visiting population in the area on the basis of the resident population, and finally determine the per capita scale of public space in the North Station Area to be 4m^2/person.

4.1.2 Forecasting the scale of demand for public space

The scale of demand for different categories of people is predicted. From its own characteristics, the North Railway Station will be built into a new economic core for the smart manufacturing industry, with transportation hub, headquarters economy, science and technology innovation, modern services, and leisure and livability as its dominant functions. This study divides the future service population of the public space in the North Railway Station area into four categories: transportation interchange, work, regional visitors and local residents. Empirical studies on the use of public space by the population in the employment-intensive areas of Shenzhen show that the actual demand for public space by the employed population is lower than that of the resident population due to the difference in the length of stay. Along this line of thought, the low frequency of visits to the North Station area by the transportation transfer population and regional visitors will further reduce the actual demand for public space. Using the questionnaire survey (see Figure 2) and field observation mode, the current situation of the North Station area is investigated on the time of various groups of people stopping in the public space, and the time of stopping is used as the main basis for determining the demand of various groups of people for the use of public space. From the results of the questionnaire survey, the average daily time of using public space in the North Station area is about 1 h for the residential population, 15-30 min for the employed population, and 5-7 min for the visitors and commuters (basically equivalent to the commuting time). Due to the long stopping time of the residential population in the public space, the actual demand of the residential population is set as the standard demand, the demand of the employed population is set as 1/3 of the

standard demand, and the demand of the transportation transfer population and the visitor demand is set as 1/18 of the standard demand. At present, there are a total of 110,000 people residing in the North Station Area, 174,000 people employed, and 23,000 people who visit the area temporarily, including the transportation transfer population and the area visitors. The population of temporary visitors (including transportation interchange and district visitors) is 23 million. Calculated according to the above method, it can be seen that there is a total demand of 202,000 standard visits in the North Station area, and the overall demand for public space is 808,000 m2 .

Based on the spatial characteristics and functional layout, the North Station Hub is divided into five major areas. Combined with the results of quantitative analysis of standard attendance, facility vitality and development intensity of the five areas, and with reference to the existing planning practice experience, the public space allocation ratio of each area is further clarified, and the public space scale demand of each area is finally determined. See Table 4 and Figure 3.

From the perspective of the current scale of public space in the North Station Hub area, only the western and central areas have surplus, and there is currently a gap of about 170,000 square meters in the northern, southern and eastern areas. After balancing the public space scale within the area under the condition of satisfying the nearby accessibility, there is still a gap of 90,000 square meters.

4.1.3 Multi-way supply strategy

In view of the reality of the dilemma of little land in the North Station area, it is difficult to implement the traditional idea of adding new independent public space. Therefore, it is recommended to make up for the gap of public space through the three strategies of three-dimensionalization of public space, construction of new projects and creation of semi-public activity space. The three-dimensionalization strategy is to carry out three-dimensional construction in independent public space to increase the effective area of public space; the allocation of new projects refers to the provision of a corresponding proportion of public space in new projects in accordance with the requirements of the Shenzhen Urban Planning Standards and Guidelines; and the semi-public strategy refers to the creation of semi-public activity space to meet the needs of people using the building. Among them, three-dimensional development can provide 5%-20% more public space in independently occupied public space, and allocated public space in new projects can account for 5%-10% of the construction land area. From the compensation results, there is a small shortfall in the northern and eastern districts. It is recommended that while meeting the needs of people using the interior of buildings through semi-open public spaces such as roof terraces, mid-rise gardens, and sky corridors, it is encouraged to connect and integrate with the urban public space system, and be open to the public as much as possible. See Table 5.

4.2 Construction of multi-dimensional linked public space system

The three-dimensional spatial characteristics of the North Railway Station hub area and the diversified and complex crowd characteristics determine the integration relationship between the public space in the area and the city. Therefore, in the process of constructing the public space system of the North Railway Station, the main objective is to take "integration" and "composite" as the goal, and construct the public space system under the

guidance of multi-dimensional organic linkage.

4.2.1 Multi-level framework system

The public space in the integrated station-city area does not exist in isolation, but is closely related to the elements of various urban systems such as public services, green infrastructure and underground space. With the goal of integration, this study clarifies the overall structure of "one axis, two cores and three streets". Among them: one axis refers to the composite public axis starting from the North Station Center Park, passing through the North Station Station Hall, the North Station Supercore to the Minde Road; two cores refer to the two hub connectors of the North Station and the Supercore; and three streets refer to the three featured park streets of the Wisdom Creation Valley, Multi-dimensional Vitality Valley, and the Flavored Water Street. In addition, in order to stimulate the vibrant cityscape, point-like and line-like public spaces integrated with the site are constructed to enrich the level of public space.

4.2.2 Multi-dimensional Spatial Links

Based on the highly three-dimensional site characteristics of the North Station Area, taking the north and the supercore as the hub, linking the underground, ground and aboveground public space networks through vertical conversion, forming a three-dimensional interactive space integrating the station city (see Figure 4), and enhancing the spatial capacity and access efficiency. Among them, the upper ground level mainly takes the two-story corridor system as a carrier to create a radial network; the ground level relies on one axis and three valleys to create a high-quality slow-moving space; and the underground level builds a cross dynamic line around the supercore to optimize the linkage of land parcels.

4.2.3 Multi-directional slow-moving connection

Carry out traffic simulation for the area, measure the slow-moving traffic and traffic distribution in the area, and identify the nodes with large slow-moving traffic. This simulation mainly uses the traffic four-phase method for traffic flow prediction. Traffic four-phase method is based on the resident travel survey (person trip survey), and consists of four phases: traffic generation (trip generation/attraction), traffic distribution (trip distribution), traffic mode division (model split), and traffic assignment (traffic assignment). traffic assignment) and other four stages.

(1) Traffic generation

In the traffic generation link, this study mainly uses the original unit method, that is, based on the status quo average travel rate (T/N, T is the amount of trip generation, N is the status quo resident population), as well as the planning population size of the area (M) Estimating the size of the area after the completion of the traffic generation and attraction (X), the specific method is as follows:

$$X = M \times T/N \text{ [unit: number of trips/(day-person)]} \quad (1)$$

Taking into account the special characteristics of the rail hub community, the occurrence and attraction of traffic is mainly based on the annual average daily arrival and departure of the passenger flow to be measured, the rest of the traffic community according to the development intensity.

(2) Traffic distribution prediction

Traffic distribution prediction link, mainly using the average growth rate method:

$$f(F_{Oi}^{m}, F_{Dj}^{m}) = (F_{Oi}^{m} + F_{Dj}^{m}) / 2 \quad (2)$$

Where F is the occurrence and attraction of traffic growth coefficients, O, D, respectively, for the beginning and end of traffic behavior, i, j refers to the traffic cell, m is the number of iterations. Set the convergence criterion e = 3%. After two iterations, the error of each coefficient is determined by convergence, and the growth coefficient of each traffic cell is measured.

(3) Traffic mode division

Traffic mode division using multiple choice LOGIT model, travel users in accordance with the principle of maximum utility travel mode division. Taking into account the rail hub area traffic to traffic interchange and occupational and residential traffic, in order to ensure that the access efficiency as the main principle, to determine the generalized cost model to the main time cost, freight prices as a supplement:

$$p_u = \exp x_u / \Sigma_{v=1}^{3} \exp x_v \quad (3)$$

(4) Traffic volume allocation

Based on the results of the above calculations, the capacity limitation-incremental allocation method is used to allocate the traffic flow, and based on the allocation results to clarify the size of the slow-moving population in each traffic district.

From the results of travel demand analysis, the basic formation of the network of pedestrian flow demand with the Supercore Plaza as the core, radiating each crowd gathering area. With the network node optimization as the guide, the conversion node system is optimized as a whole, and public space conversion nodes are set up in the slow traffic flow larger road sections (the public space conversion nodes mentioned in this paper are the places where pedestrians switch between different slow-moving network systems, which can effectively improve the access efficiency of the multi-dimensional public space network. The conversion nodes contain crossing facilities, platforms, elevators, etc.). The analysis results are shown in Figure 5.

Compared with the original scheme, the new scheme increases and elevates some of the conversion nodes in the supercore and well arterial intersection, which weakens the mixed situation of the ground level to a certain extent, and reduces the conflict between pedestrian routes and vehicular traffic, and at the same time creates a diverse and dynamic urban space in the area.

4.3 Iconic intelligentized portal scene creation

The North Railway Station Hub Area is not only an important high-speed railway passenger transportation hub in Shenzhen, but also a gateway window to show the image of Shenzhen. In terms of iconic and recognizable public space shaping, the planning centers around the Shenzhen North Railway Station Hub and the city's green core park, focusing on shaping the "North Railway Station Supercore" as a super urban gateway landmark building cluster, and shaping the integration of multi-dimensional eco-roofs, parks and green areas, sunken plazas, urban floating belts, creative cultures, commercial consumption and other diversified spatial elements into a highly iconic and dynamic gateway exhibition venue, which will become the gateway to the Greater Bay Area. It will be an iconic and vibrant gateway

exhibition venue, and become a cohesive and attractive super landmark in the Greater Bay Area. In addition, the plan combines regional culture, topographic features, and the needs of the population, through the shaping of landscape corridors and U-shaped green valleys, to dissolve the negative experience of high density and high intensity in the region. At the same time, it utilizes the creation of road green belts, under-bridge spaces, and waterfront places to introduce nature into the city and shape the charming spatial scene of the green living room with immersive experience. See Figure 6.

At the same time, the North Railway Station Hub Area is also the key area of Longhua District's "Digital Longhua" intelligent city creation, in order to strengthen the intelligent creation of public space in the area, the plan builds a smart public space system with three major types and eight scenes. Among them, the three major types cover smart transportation (Figure 7), smart landscape and smart services, and the eight systems include smart travel, roads, carriers, projections and interactions. The sub-scenes under each scene classification can be used as basic elements similar to an urban design toolkit, which can be adapted and combined on their own according to the needs, and used to organize the public space system at different nodes. See Table 6.

Enhancing the identifiability of the public space in the North Station area through technological empowerment further improves the user experience on the basis of scale adaptation and structural optimization, and provides composite value for urban needs and services while meeting urban service demands.

5 Conclusion

The target population of the rail hub area is complex, the degree of three-dimensionality is high, and the development intensity is high, so in the process of organizing the public space, it is necessary to give full consideration to the complex needs of the diversified population, the three-dimensional composite spatial characteristics, and the gateway image that highlights the characteristics. This paper tries to construct a set of systematic planning and optimization methods for the public space of the hub area, and takes Shenzhen North Station hub area as an example to establish a multi-way supply mode under the background of diversified demands, multi-dimensional and efficient public space structure, and diversified characteristics and technology-enabled public space scenarios. Specifically, from the differentiated characteristics of the target population, the demand characteristics of the population are quantified through questionnaires and on-site surveys, and the demand is satisfied by the multiple supply modes; from the composite and three-dimensional characteristics of the station-city integrated area, the framework of the integrated public space structure above and below the ground is formulated, and the key nodes are optimized with the help of spatial metrology analysis tools; from the localized characteristics and the target vision, based on the existing urban design results, the public space structure is constructed. Based on the existing urban design results, a multi-level, recognizable and intelligent public space scene is constructed. In addition to large-scale transportation facilities represented by rail hubs, this paper also has some reference significance for the construction and optimization of public space systems in crowded areas such as hospitals and subway stations. In addition, through this study, it is suggested that from the perspective of improving the comfort and convenience of users and the safe

operation of the hub, in terms of planning standards, it is recommended to study and introduce guidelines on per capita index, pedestrian accessibility, and composite indexes for different types of public spaces in high-speed rail hubs; in terms of engineering design standards, it is recommended to follow up and introduce guidelines on the spatial scales, and the spatial scales and spatial scales of three-dimensional parks, two-level corridors, and so on, of the pedestrian passageways, three-dimensional parks, and second-level In terms of engineering design standards, it is recommended to follow up the study and introduce the normative requirements on space scale, evacuation width, interchange distance, etc. for pedestrian passages, three-dimensional parks, second-level corridors, etc. in high-speed rail hubs and high-intensity development areas, so as to provide practical guidance for planning and construction in similar areas in China.