Analysis of place function and spatial distribution on HSR station area: A case study of Jinanxi Station

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Abstract. The HSR station area not only assumes the function of the city's external communication, but also is an important public space, which plays an important role in the urban development. Based on the relevant theories, this paper analyzes and evaluates the status quo of the site functions in the Jinanxi Station area by combining the on-site survey and POI data. It is concluded that the site functions in the Jinanxi Station area are formed relatively slowly, with strong characteristics of circle structure and single residential function, showing unbalanced characteristics, but it will have huge space for future development. So in order to achieve an integrated development between station and city, it should avoid a single residential function, and achieve diversified functional development, require planning guidance and government guidance as well as further support and orderly promotion of policy funds.

1. Introduction

In addition to undertaking the transportation function, the high-speed railway (HSR) station is an important public place, and plays important social communication functions, promotes economic development of the city and improves the quality of urban life[1]. As an important space carrier, the HSR station area development depends on whether various facilities are perfect and can provide sufficient and diverse services to meet the needs of passengers in the stop and transfer at the station, such as dining, leisure, entertainment, shopping and other needs; On the other hand, by planning large residential communities, science and technology parks, industrial parks or other forms, HSR station areas are further developed, bringing population and industrial agglomeration, improving the efficiency of land use and regional growth, achieving the integration of industry and city, and become a new functional mixed area of the city. Therefore, evaluations on place quality of the station should be carried out from three dimensions: one is the spatial dimension, relating to urban space aesthetics, two is the economic dimension, relating to economic activity agglomeration and three is the experience dimension, relating to social psychological experience [1].

Moreover, due to the influence of various factors, such as the scale, location and nature of the cities, the regional development model of the HSR station presents a very big difference [6]. Generally speaking, in large and medium-sized cities, there are more population, and the construction scale of high-speed rail station areas the larger. In order to relieve some of the functions and population of the city, the new HSR station areas are generally planned and designed a new district or new city, while in small cities station area are mainly based on traffic functions. Therefore, the coordinated development and mutual support between the station and the city depends on the influence of many factors such as administrative system, city scale and planning implementation [6]. Due to lacking of integrated and reasonable planning, some station areas are in a separation situation between station and city functions. Therefore, it is necessary to study the site functions in the urban context and clarify the planning standards such as the scope of influence, land layout, development intensity and connection traffic, so as to enhance the site function value. It is of great significance to play an active role in the intensive, efficient and sustainable development of the city and promote the coordinated development between the HSR station and city.

2. Methods

2.1. Fieldwork

In order to further understand and master site functions of Jinanxi station, the author carried out a special and detailed fieldwork survey. It was divided into two sessions. The first one was conducted in early November.
2020, mainly focusing on the business types and development of Jinanxi station and its surrounding areas, its scope was within 3km vertical distance from HSR station in different directions (that is within 1km, 1~2km and 2~3km distance from HSR station) and got the detailed records one by one. The second one was conducted in the beginning of December 2020. It was conducted in-depth investigation on the business function and supplementary for the core area of the HSR station within 1km (Red area in Fig. 1), focusing on the in-depth interview survey on the occupancy situation of each office building.

![Fig. 1 Survey path and zoning diagram of Jinanxi station(Source: Author's own drawing)](image)

2.2. IPO data analysis

In order to more accurately grasp the spatial structure characteristics of business types in Jinanxi station, the author applied ARCGIS query and point density analysis to find the key business types within 3km from Jinanxi station based on the POI data of Jinan City in October 2020. The distributions of catering services, residential services, accommodation services and public services were discussed.

3. Site function analysis

3.1. Fieldwork data analysis

Total of 464 records within 1km, 335 records in 1~2km, and 364 records in 2~3km were found and its business types mainly focus on food service, retail shops, recreation and fitness and various schools.

After survey, we found that the area around the HSR station is divided into three circles, and types of business density are not the same in different distance. Specifically, within 1km the business types are mainly concentrated in catering, retail convenience stores, recreation and fitness, hotels, education and training, and banking and communication. Within 1~2km, the main business types are concentrated in catering, retail convenience stores, leisure, entertainment and fitness, photography, laundry, maintenance and other life services, education and training and hotels; Within 2~3km, the main business types are retail convenience stores, catering, education and training, leisure and entertainment, fitness, hairdressing, laundry, photography, pets and other life service types.

At the same time, we could also find that within 1km, the density is the highest although there are few types of business, while within 1~2km, business types are the most. Within 1km, there are 15 categories of major business types and 30 sub-categories are involved and its total number is 464, more 100 records than within 1~2km and 2~3km, nearly 30%, because within 1~2km, 25 categories of major business types and 57 sub-categories are involved; within 2~3km, 24 categories of business types and 41 sub-categories are involved. Among them, the most types of food and beverage category are 159 within 1km, 91 within 1~2km, and 56 within 2~3km.

Within the increase of distance from the HSR station, number of business type is less and less, that is, as the distance increases, the impact on region by HSR becomes smaller and smaller. From the distribution of main business types, within 1km, there are more hotels and inns because they serve HSR passengers. At the same time there are office buildings concentrated here because of convenient transportation, there are more employees employed. So there is the greatest demand for catering. Within 1~2km, the types of businesses that provide high-quality life services and community services to citizens have increased significantly. For example, administrative services such as marriage registration, party and mass services, street offices, police stations, and urban services such as science and technology museums, libraries, art galleries, and cultural theatres have gradually reflected diversified place functions. Within 2~3km, the impact of the HSR station is very small, almost no impact. Because it maintains the original edge shape of the western urban area of Jinan.

Secondly, the impact of HSR station varies in different directions. So we divided the high-speed rail station area into four quadrants. That is, the Central Line of Square is the X axis, and the HSR line is the Y axis, which is divided into four parts (southeast, northeast southwest and northwest). It is found that the northeast and southeast directions are the entrance and exit of the HSR station, which are connected with the main urban area of the city, and became the focus of the HSR station area development, the business types in the northeast is currently showing a very unequal situation under the external factors of planning and investment choice. The southeast direction is mostly hotels, and the northwest direction is mostly restaurants, indicating that the southeast direction plays a greater role in the service function of the HSR station and serves tourists, while the northeast direction is mostly catering, they serve the nearby residents, and the community development is relatively perfect. The northwest and southwest areas are located on the west side of the HSR line and have a natural barrier with the central city, which is currently developing slowly. There are several residential buildings, office buildings and primary and secondary school projects under construction within 1km from the HSR station in the northwest. The southwest direction is almost undeveloped. There is an large amount of open space and no road framework, which is reserved for the future development of HSR station.

Thirdly, from the in-depth investigation of the core area of HSR station, the enterprises settled are mainly...
scientific and technological enterprise, accounting for more than 90%, mainly covering engineering consulting management, education technology, biomedical technology, energy and environmental protection technology, restaurant and hotel management, cultural communication, automobile sales, real estate development management, accounting and legal consulting. In addition, the source areas of enterprises are mainly in the province, accounting for more than 95%. Outside the province are mainly Beijing, Shanghai, Hebei (2.3%, 1.1%, 1.1%, respectively). Among the enterprises settled in the province, Jinan is the main one, accounting for more than 90%.

Fourthly, the successful development of core area in Jinanxi station depended on good planning and strong government investment. Many Advanced and modern buildings, such as Shanxin Building, greenbelt "Qilu Gate", Xicheng Building, Newspaper Building have been built adjacent to station, they were developed into hotels, offices, business cooperation and other types, forming a business convention and exhibition centre; Relying on the Lushan River, a natural water body running north and south, it forms an important landscape belt and main road. On its east side, many large-scale public service facilities such as Shandong Science and Technology Museum, Shandong Provincial capital Grand Theatre, library, art museum and group art Museum have been built to form a cultural and art centre. On the whole, Jinanxi station area in the industrial function positioning and spatial layout is more reasonable, the development speed is appropriate. But as the distance from the high-speed rail station increases, the development gradually weakens.

3.2. POI data analysis

3.2.1 Distribution of catering services

The distribution of catering services around Jinanxi station is unbalanced. Within 1km, the northeast direction of 1-2km and 2-3km catering services are relatively dense. While in the core business district and urban development axis of the HSR area planned in the east of Jinanxi station numbers of catering services are relatively small (Fig.2). From the point density distribution of catering services, it can be seen that there are several obvious clustering areas in the spatial distribution of catering services (Fig.3).

3.2.2 Residential service distribution

As can be seen from Fig. 4, there is almost no residential service distribution within 1km around Jinanxi station, which means comprehensive transportation hub functions are dominant within 1km. The residential services are most densely distributed within 1–2km from Jinanxi station, while the residential services are sparsely distributed within 2–3km. From the point density distribution diagram of residential services (Fig.5), the residential services in the southeast of the high-speed railway station are the most intensive. In general, the distribution of residential services around Jinanxi station shows the characteristics of dispersion and balance.

3.2.3 Distribution of accommodation services

The accommodation services in Jinanxi station are mainly distributed within 2km of the HSR station, and no accommodation services are distributed beyond 2km, which reflects that the accommodation around Jinanxi station mainly serves HSR passengers, and the accommodation services are most densely distributed in the southeast of the HSR station (Fig. 6-7).

3.2.4 Public Service Distribution

Compared with the first three types of services, public services around Jinanxi station are more scarce and dispersed (Fig. 8). Public services near Jinanxi station are the most densely distributed, especially in the point density map (Fig. 9), while in other areas, the number is
small and the distribution is scattered, but the distribution is more balanced.

Fig.8 Public service distribution within 3 km around Jinanxi station

Fig.9 Density distribution of public service points within 3 km around Jinanxi

4. Conclusion and discussion

4.1. Conclusion

From the circle structure theory and node-place theory, combined with fieldwork research and POI data analysis, this paper studies and evaluates the integration process and the current overall development status of the place functions of Jinanxi station. The main contents and conclusions are as follows:

(1) The development mode of the station area is influenced by the "circle structure" theory, forming a core hub area and a peripheral impact area. Hub area is dominated by traffic function while the impact area is influenced by HSR and dominated by urban function. The development of the station area not only requires smooth traffic organization, reasonable use of ground and underground space, to achieve a three-dimensional, integrated and other compact layout mode, but also requires reasonable functions to meet the needs of passengers, residents and urban development. In terms of space construction, it realizes the design concept of urban public space, and realizes the "people-oriented", safe and harmonious "place space". As a transportation hub, the HSR station reflects the node function characteristics, and the HSR station area is an important "place" in the urban space. The balanced development of the two is crucial to the development of the station area.

(2) As a traffic node, Jinanxi station’s traffic function is very good. But as a place, its place function is very unbalanced. From the perspective of facility construction layout and business development, the northeast and southeast directions located at the main entrance and exit of the HSR station and adjacent side of the main urban area develop well, while the northwest and southwest directions of the HSR station develop slowly, and its place characteristics have not been formed.

(3) In different spatial range of the HSR station its’ business types are different and show different place characteristics. In the core area within 1km from the HSR station there are few types of business, mainly catering, retail convenience stores, hotels, offices, but have the highest density. The business types within 1~2km are the most, providing high-quality life services and community services for the public, such as marriage registration, party and mass services, street offices, police stations and other administrative services and urban services such as science and technology museums, libraries, art galleries, cultural theatres. However, with the increase of the distance from the HSR station, its’ impacts are becoming less and less. In the area of more than 2km, the business type maintains the original ones of the urban-rural fringe, and is not significantly affected by the HSR station. Its’ future development space are huge, but the pressure of realizing the integrated development of station and city is also relatively large.

(4) The office enterprises settled in the core area are scientific and technological services, accounting for more than 90%, mainly covering engineering consulting management, education technology, biomedical technology, energy and environmental protection technology, etc. The source areas of enterprises are mainly in Shandong province, accounting for more than 95%. Outside the province are mainly Beijing, Shanghai and Hebei, accounting for 2.3%, 1.1% and 1.1% respectively.

(5) The successful development of residential communities plays a decisive role in the process of place function formation. Because without the construction of a large number of more mature communities, the HSR station area will become a "ghost town" because of the lack of "popularity". However, the place function should avoid the single residential function, and should achieve diversified functional development, which requires planning and government guidance, as well as strong support and orderly promotion of policies.

References