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Article

# Transit-Oriented Development in China: A Comparative Content Analysis of the Spatial Plans of High-Speed Railway Station Areas

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**Abstract:** With rapid high-speed railway (HSR) developments in China, HSR-based transit-oriented development (TOD) has proliferated across the country. Although local governments claim that HSR station areas are planned according to TOD principles, some scholars argue that these station areas actually contribute to unsustainable development. This study investigates two main questions: (1) what success factors should be included in a TOD plan for HSR station areas? (2) to what extent are these factors considered in the plans of Chinese HSR station areas? To answer these questions, we use content analysis to compare spatial plans for 15 HSR station areas across China, triangulating the findings via in-depth interviews and field investigations. This study reveals that most of the factors in the plans for HSR station areas deviate from TOD principles, especially in small- and medium-sized cities. We find that Chinese local governments mainly use TODs as a tool to promote suburban expansion around HSR stations.

**Keywords:** TOD; high-speed railway; station area; spatial plan; content analysis

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## 1. Introduction

Sustainable development has been adopted by urbanizing cities around the world as a fundamental goal of their planning and governance [1]. To achieve sustainable development goals and curb car-oriented sprawl, transit-oriented development (TOD) has been proposed as an effective planning strategy [2–5]. TOD can be defined as the integration of transportation and land-use planning that maximizes the efficiency of transit services by focusing urban development around exchanges, stations, and stops, while also improving mobility, accessibility, and pedestrian and cycling friendliness [6–8]. In recent decades, TOD planning practices and academic discussion have emerged around the world, especially in North America, Europe, Australia, and Asia [9–15].

The TOD concept has been widely used in Chinese cities to develop communities around mass rapid transit, including heavy rail, light rail, and bus rapid transit (BRT), and prevent car-driven suburbanization and urban sprawl [16]. Local governments (e.g., Guangzhou, Shenzhen, Shanghai, Hangzhou, Wuhan, and Nanjing) have realized that integrated transport and land-use development can help them reach sustainable urbanization objectives [17]. China's national government has also promoted the development of TOD. For example, the Transit Metropolis Programme (gongjiao dushi) was launched by the Ministry of Transport to develop low-carbon rail-based transport systems [18]. The Ministry of Housing and Urban Construction released "Planning and Design Guidelines for Areas along Urban Rail Lines" in 2015, with the goal to boost transit efficiency and foster integrated railway and land developments.

Scholars regard TOD as an effective strategy to tackle the challenges faced by Chinese cities, and they also believe the Chinese context has provided a unique testing ground for examining the policy transfer and application of the TOD concept [4,19–21]. The first reason is that, in contrast to Western Europe and North America, China is still experiencing rapid urbanization and the level of car use is relatively low [17,22]. Second, national policies have shifted to promote and invest in public transport and focus on the environmental impacts of projects [23]. Moreover, the rapid development of high-speed railways (HSRs) in China provides opportunities for the application of TODs [24]. Chinese planners have promoted a popular concept called HSR-based TOD, and most HSR stations in China are claimed to be planned according to TOD principles [25,26].

However, scholars have found that Chinese local governments and their planners revise TOD principles to fit their context and depart from the TOD concept [11,19,20,27]. TOD planning practices in China have become transit adjacent developments (TADs), which are geographically close to transport nodes but fail to leverage this closeness to encourage transit ridership [28]. Especially in the development of HSR station areas, most local governments and planners have promoted their programs as supporting and following TOD principles; however, their plans actually contradict the core concepts of TOD in terms of functional mix, vitality, diversity, livability, and walkability [29,30]. In contrast to the regeneration around existing stations in Europe and Japan, most Chinese HSR station areas are located in suburban regions and occupy large areas of land [31,32]. These HSR new towns are planned to catalyze urbanization and transform the economic structure, which has been criticized by scholars for causing urban sprawl [22,25,33].

The widespread TOD principles were set for urban rail systems, and how they can be adapted and applied to HSR systems does not seem to have been carefully examined by Chinese planners [26]. Despite the fact that plans regarding Chinese HSR station areas have been criticized, little is known about the content of their plans and how they take the prerequisites and characteristics of successful TODs into consideration. Therefore, this study addresses two questions:

(1) What success factors should be included in a TOD plan for HSR station areas?
(2) To what extent are these factors indeed considered in the plans for Chinese HSR station areas?

Spatial plans are crucial for the successful implementation of TODs since they underpin the whole project [15]. A comprehensive examination of station area plans can provide insight into the aims and strategies of local actors in spurring urban growth and their understanding of TOD [34]. It can also explain the underperformance of Chinese HSR station areas since the spatial plans prescribe all subsequent programs [35]. A comparative analysis between cities can shed light on the gaps between Chinese planning practices and TOD theoretical principles [36].

In the following sections, we review the literature on the factors that contribute to effective TOD plans and propose a framework for coding the plans of Chinese HSR station areas. Fifteen spatial plans for station areas are analyzed and coded through content and discourse analysis methods. To cover all types of Chinese HSR stations, we select plans for five national hubs, five regional interchange stations, and five medium-sized and small stations. The results are demonstrated in tables and figures to show the TOD factors at different levels of Chinese HSR station areas.

## 2. Success Factors in a TOD Plan for a HSR Station Area

We mainly reviewed two strands of literature: the research on success factors of TOD plans and studies on good HSR station area planning. The conditions of cities and their governance are the foundation for the planning and development of TODs in HSR station areas [2,37–39]. The planning of TODs is known to be based on three main concepts known as the "3 Ds" (density, diversity, and design), which have been subsequently updated to the

"5 Ds" with the inclusion of distance to transit and destination accessibility [40–42]. The station area is a node in the transport network and a place in the city [43]. The new "2 Ds" focus on transport planning, while the "3 Ds" emphasize land development. Therefore, we divided the factors in the literature into three categories: urban context and governance, transport and interchange, and land-use planning.

### 2.1. Urban Context and Governance

Mega infrastructures, especially HSR, have been built in cities to show their urban modernity and accessibility, and are aimed at attracting investments and encouraging regeneration or new developments around station areas [44–46]. However, for the infrastructure and new accessibility to really create developmental opportunities, public actors need to grasp them by devising supplementary and effective strategies [47].

One of the most important preconditions for station area development is a clearly publicized, understood, and systematized long-term vision [39]. A smart and powerful vision can help actors achieve good governance for TODs [7,17,37,48]. Scholars argue that the identification of a clear vision and measures to deliver the vision lead to the successful development of European stations, such as Lille station and Rotterdam central station [49,50]. The lack of a long-term vision in the plans resulted in few Chinese cities achieving "true transit-oriented" rather than "transit-adjacent" developments [51]. Most of the plans aimed to address urgent practical problems with a strong emphasis on market-based development.

Furthermore, the impacts of HSRs and the development of TODs differ across cities; therefore, plans should be designed based on the local context [52,53]. The local context consists of the role a city has within its region, its size and population [52,54,55], the conditions and diversity of economic activities and the real estate market [56,57], policies constraining car purchase and use [58,59], as well as strategies facilitating transport and land use [22,38,60].

The development and implementation of spatial plans for HSR station areas is a complex process that involves various actors with different interests [25,61,62]. In a decentralized context, Chinese local governments play a more important role in planning and developing HSR station areas because the land around the station and part of the funds are owned by local governments [32]. The location of the HSR station is a result of negotiations between China Railway (CR)[1], provincial governments, and local governments. The spatial plan for a station area is mainly drafted by the local government; it is not only responsible for providing public transport connections but also for developing the station area. The spatial plan is critical to the operation of the project since it serves as the foundation for the rules and regulations that will be implemented throughout the operation stage [35]. An analysis of the various factors related to TOD in the spatial plan helps to understand the local government's view of TOD and its "real" development intentions [34]. It also helps to bridge the gap between TOD principles and Chinese planning practices.

### 2.2. Transport and Interchange

The quality and design of transit services are fundamental to the successful implementation of a TOD plan [63]. Measuring transportation characteristics has been the focus of many studies [64,65]. The accessibility of the station within national and regional railway networks, as well as the characteristics of HSR services, such as the types of railways, capacity, and frequency, have been used as important indicators, as they determine the passenger numbers in and around the station [66,67]. Furthermore, the location of HSR stations in cities is vital for TOD implementation because it influences the distance to transit and destination accessibility, for example, schools, hospitals, and firms [68–70]. Experiences in the UK, France, Spain, Germany, and China have shown that, compared to stations in the center, peripheral stations have difficulty succeeding in urban development [34,47,60,71,72].

Moreover, other scholars have emphasized the importance of efficient connectivity with other transport modes, which can catalyze the development of surrounding areas [9,73]. A high frequency, comfortable, and attractive public transport system is another essential factor for TOD since high-quality public transport can compete with private vehicles [11,74–76]. The seamless interchange between public transport methods has also been emphasized since it can increase the efficiency of individual trips and reduce total socio-economic costs [77]. Meanwhile, it is crucial to supply optimum parking areas for cars rather than completely remove them [3,78]. Large areas of surface parking should be avoided since they impede the integration of the station and the surrounding area [79]. In addition, easy access to the station by walking and cycling is important for TOD plans [11,80,81].

### *2.3. Land-Use Planning*

Sustainability has been reflected in different planning theories, such as New Urbanism, Smart Growth, and TOD [82]. The consensus amongst these theories is that land use in the form of high density, diversity, and high-quality design can promote sustainability [40,42,81,83,84]. TOD is viewed by planners as a way to accommodate urban growth in a compact area, the competitiveness of which can be improved through good accessibility and mixed-use development [74]. Urban density can be increased by enhancing employment opportunities and housing around transit stations, which can support the effective use of the transit system and curb urban sprawl [63,85]. Diversity can be achieved through a land-use mix of retail shops, hospitals, banks, restaurants, public space, and housing within walking distance of stations, which can create a sustained and balanced passenger flow [63,86]. In addition, the research suggests that the real estate market should provide diverse types of housing for effective TODs, such as affordable housing, commercial housing, different sizes of houses, and houses for sale and rent [17]. The high accessibility of the station area can spur the price of housing and land [87–89]. A large number of Chinese HSR stations are built in suburban or rural areas, where a large number of farmers have lost their land and lack the income to buy new properties [32,54]. Their resettlement should also be considered as an important context for TOD planning.

Studies in urban design have considered physical design as critical to successful TODs [90–92]. Urban aesthetics contribute to the identity and image of station areas; therefore, they are consciously used as an economic development tool in a globalized and competitive environment [93,94]. Especially in HSR station areas, planners usually create an international business image suitable for attracting knowledge economy functions, such as finance and creative industries [95]. The elements of urban quality include mixed land use, high-density, safe and convenient walkways and biking facilities, interconnected street patterns, public space and squares for street life and informal meetings, and place-making for urban culture [15,39,91,96,97].

According to the review in Sections 2.1–2.3, we summarized factors based on the overlaps and common indicators mentioned in the literature of successful TOD factors and good HSR station area planning. Then, we drafted codes for the content analysis of spatial plans for HSR station areas (Table 1).

**Table 1.** Critical success factors in the TOD plan for HSR station areas.

| | Factors in the Literature | Explanation | Codes in Plans |
|---|---|---|---|
| Context and Governance | Local context | Carefully consider the spatial/locational and economic characteristics | City area |
| | | | Population of the city |
| | | | GDP of the city |
| | Vision | Clear, smart, and strong<br>Long term, consistent | Visions |

**Table 1.** *Cont.*

| | Factors in the Literature | Explanation | Codes in Plans |
|---|---|---|---|
| Transport and Interchange | Service level of HSR stations | Good level of HSR services | Passenger number |
| | | | Station level |
| | | | Connected HSR lines |
| | Destination accessibility | Good accessibility of services in cities | Distance to city center |
| | Accessibility to the station | Efficient road system<br>Good public transit connections and intermodal choices<br>Avoid barriers, such as large parking lots and highways<br>Parking supply | Road system |
| | | | Road width |
| | | | Planning of local transport methods |
| | | | Public transport priority |
| | | | Traffic volume of different methods |
| | Seamless interchange | Convenient transfer between transport methods | Seamless transfer |
| | Pedestrian- and bicycle-friendly systems | Good pedestrian and bicycle access to the station<br>Provide pedestrian friendly street networks | Pedestrian priority |
| | | | Pedestrian–vehicle separation |
| Land-Use Planning | Density | High-density urban development<br>Taper densities with distance from a station | Station Area |
| | | | Land use percentage |
| | | | Floor–area ratio |
| | Diversity | Mix of land-use functions and activities<br>Mix of housing types<br>Design in small blocks | Land-use types |
| | | | Land use before development |
| | | | Housing types |
| | Design | Public space for people to congregate<br>High-quality architecture | Design of public space |
| | | | Architecture aesthetics |

## 3. Methodology

### *3.1. Data Collection*

The spatial plans reflect the government's long-term vision and strategic direction, serving as a formalized method for actors to convey their views [15]. Therefore, they can provide a reliable dataset for analyzing how local governments and planners comprehend the TOD concept. Furthermore, the consistent framework of planning texts allows researchers to compare different cases in an objective manner. Due to the practical constraints, such as data accessibility, time, and resource limitations, it is nearly impossible to explore how each station embodies and deviates from the TOD principles throughout planning and construction. Thus, spatial plans emerge as the most suitable choice for a systematic analysis of the problem.

However, the planning documents for HSR station areas are non-public information and difficult to access in China; we collected 38 planning documents through our personal network. First, we identified 34 spatial plans for HSR station areas rather than architecture or transport-specific plans. Second, we read all the plans carefully and selected 26 plans that explicitly mentioned TOD. Then, for representativeness and comparability, we selected spatial plans for five national hubs (Hangzhou East Station, Nanjing South Station, Shanghai Hongqiao Station, Guangzhou South Station, and Shenzhen North Station), five regional interchange stations (Luoyang Longmen Station, Foshan West Station, Changzhou North Station, Huzhou Station, and Bengbu North Station), and five medium-sized and small stations (Jinjiang Station, Xinyu North Station, Fuyang Station, Tonglu Station, and Haining West Station) to cover all types of stations (Figure 1).

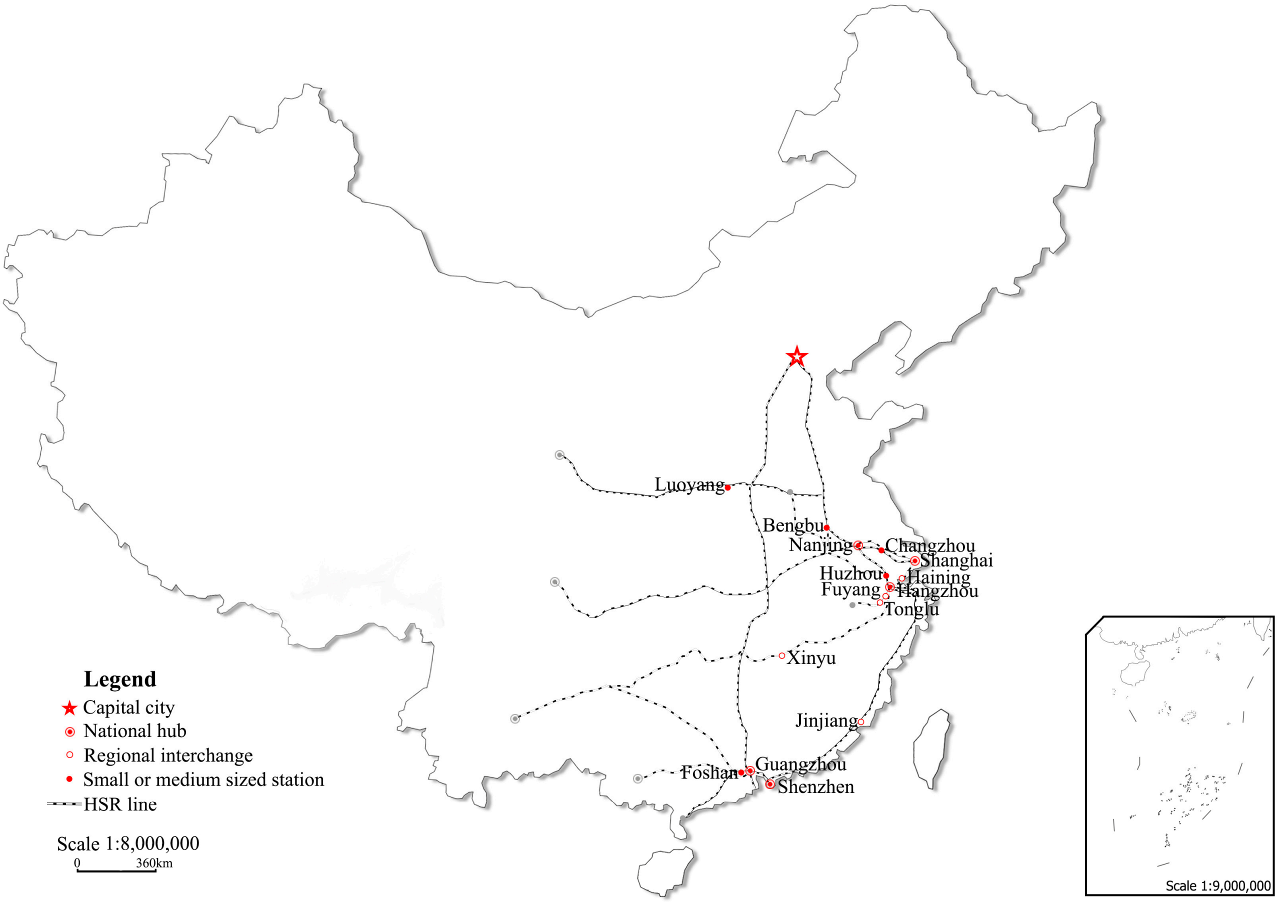


**Figure 1.** Location of 15 HSR station areas (source: the authors).

The examples of each type of HSR station provide a better picture of the overall situation in China. CR grades HSR stations based on passenger numbers, technical operations, and their position on the national railway, political, and economic networks (Table 2). The investment of TOD varies with city size; therefore, the plans should be consistent with the size, population, and economic situation of cities for successful TODs [52,53]. We selected the most representative cases: the five national hubs that were the largest HSR stations in Asia that received support from the national government. The regional interchange stations play important roles in their regions. Moreover, China started constructing HSRs in 2008; therefore, all cases were planned during the decade from 2010 to 2020, and all plans are currently in force, which is also important for the comparative analysis. These plans were analyzed via a content analysis method.

To further validate and gain deeper insights into the findings from the content analysis, semi-structured interviews and field investigations were conducted from December 2018 to March 2019, in October 2019, and in January 2020. Nineteen interviews were completed with relevant actors in China Railway, China Railway design and survey groups, architectural firms, urban planning institutes, universities, and local governments (see Table S1 for list of interviewees). The interviewees included representatives from local governments of a medium-sized city and a large city in China (specific locations are withheld due to confidentiality agreements). Field investigations in Shanghai Hongqiao HSR Station, Guangzhou South Station, and Shenzhen North Station provided on-the-ground observations of the challenges and progress in implementing TOD principles.

**Table 2.** Stations, cities, and documents for analysis.

| Station | Station Level | City | City Area | City Population | City GDP/CNY (in 2010) | Planning Documents |
|---|---|---|---|---|---|---|
| Hangzhou East Station | National hub | Zhejiang Province Hangzhou City | 16,853.5 km$^2$ (City 3068 km$^2$) | 10.36 million (City 5.3 million) | 594,582 million | Hangzhou East Station Concept Planning and Chengdong New Town Core Area Urban Design |
| Nanjing South Station | National hub | Jiangsu Province Nanjing City | 6587 km$^2$ | 9.31 million | 519,820 million | Nanjing South HSR Station Area Comprehensive Planning |
| Shanghai Hongqiao Station | National hub | Shanghai City | 6340.5 km$^2$ | 24.87 million | 1,687,242 million | Shanghai Hongqiao Comprehensive Transportation Hub Planning and Design and Hongqiao Business Core Urban Design and Control Detailed Planning |
| Guangzhou South Station | National hub | Guangdong Province Guangzhou City | 7434.4 km$^2$ | 18.68 million | 1,060,448 million | Guangzhou New Passenger Station Area Planning and Design |
| Shenzhen North Station | National hub | Guangdong Province Shenzhen City | 1997.5 km$^2$ | 17.56 million | 951,091 million | New Shenzhen Station Area Urban design |
| Luoyang Longmen Station | Regional interchange | Henan Province Luoyang City | 15,230 km$^2$ | 6.92 million | 232,120 million | Luoyang South Station Area Concept Planning and Urban Design |
| Foshan West Station | Regional interchange | Guangdong Province Foshan City | 3848 km$^2$ | 6 million | 565,152 million | Foshan West Station New Town Planning and Design |
| Changzhou North Station | Regional interchange | Jiangsu Province Changzhou City | 4385 km$^2$ | 5.27 million | 297,670 million | Beijing–Shanghai HSR Changzhou Station Core Area Constructional Detailed Planning |
| Huzhou Station | Regional interchange | Zhejiang Province Huzhou City | 5820 km$^2$ | 3.36 million | 130,156 million | Huzhou City Train Station Area Urban Design |
| Bengbu North Station | Regional interchange | Anhui Province Bengbu City | 5951 km$^2$ | 3.30 million | 63,805 million | Bengbu HSR Station Area Concept Planning and Urban Design |
| Jinjiang Station | Medium station | Fujian Province Quanzhou City Jinjiang County-level city | 649 km$^2$ | 2.06 million | 94,114 million | Fuxia HSR Jinjiang Station Comprehensive Economic Zone Control Detailed Planning |
| Xinyu North Station | Medium station | Jiangxi Province Xinyu City | 3178 km$^2$ | 1.2 million | 63,122 million | Xinyu HSR Station Area Urban Design |
| Fuyang Station | Medium station | Zhejiang Province Hangzhou City Fuyang County-Level City | 1831 km$^2$ | 0.66 million | 41,567 million | Hanghuang HSR Fuyang Station and Surrounding Area Urban Design |
| Tonglu Station | Medium station | Zhejiang Province Hangzhou City Tonglu County-Level City | 1829.59 km$^2$ | 0.41 million | 19,793 million | Hangzhou Tonglu HSR Station Complex Concept Planning |
| Haining West Station | Small station | Zhejiang Province Jiaxing City Haining County-Level City | 863 km$^2$ | 1 million | 45,583 million | Zhejiang Haining West Station Area Planning |

### *3.2. Data Analysis*

We adopted content analysis as a method to analyze the spatial plans of HSR station areas. Content analysis has advantages in analyzing documents and graphs because it efficiently organizes the materials in a systematic manner, highlighting the similarities, differences, and connections across a wide range of aspects [98,99]. Qualitative content analysis is suitable in this regard because its three characteristics are data reduction, systematicity, and flexibility [100]. Each spatial plan for the HSR station area has more than 100 pages. The content analysis helped us focus on the parts relevant to the main research questions. The method also requires coding in a systematic way twice to avoid ambiguity.

In addition, the method is flexible because it combines concept-driven and data-driven categories within one coding frame. As Table 1 shows, we analyzed both concept-driven texts, such as visions, and data-driven texts, such as passenger numbers.

The first step in the content analysis was to build a coding frame [99]. In the second section, we illustrated how we built the coding frame according to the literature. We defined three main categories and ten main factors. Second, we conducted trial coding on spatial plans in the software NVivo 11. We evaluated and modified the coding frame, as the third column in Table 1 shows. When a text segment was deemed meaningful and relevant, it was coded and compared to the existing codes to determine whether it was new, existed previously, or could be merged with the existing codes. Then, the first author applied the coding frame to all materials twice to improve the reliability. One round was conducted in July 2021 and the other round was completed in October 2021. A total of 24 nodes in three main categories were developed at the top level, and many "child nodes" were created at a lower level. The full table of nodes is presented in Table S2 and the detailed coding for each plan is shown in Table S3. In the following section, we present our results and analysis of the 15 HSR station area spatial plans.

## 4. Analysis

### *4.1. Context and Governance*

Table 3 summarizes the general information collected on the stations and station areas. A comparison with the information on the local context in Table 2 shows that station size is determined by the local context, while the location of the station in the city and station area are not planned for each local context. Station size, which consists of the station floor area and station layers, closely correlates with station level, connected railway lines, and passenger numbers because it is mainly decided by CR according to passenger demand. In contrast, as a result of the negotiations between railway and urban actors, these HSR station areas are all far removed from city centers. The average distance between these stations and city centers is 10.1 km. This average distance is 12.6 km for national hubs, 8.7 km for regional interchanges, and 11.1 km for small- and medium-sized cities. The non-central location of HSR stations reduces their accessibility because of longer access times, difficult transfers between transport methods, and a lack of walkability. At the same time, the urban and economic developments of station areas are impeded because they are far from the built-up urban areas. Wang et al. [32] explained that there was little space left in the built-up areas of megacities and large cities, and demolition costs were unaffordably high for local governments. Railway actors would prefer to keep railway lines straight, and because stations for small- and medium-sized cities are regarded as unimportant nodes, they are usually located far away from those cities. Meanwhile, local governments would prefer to use this opportunity to promote urbanization.

The goals of local governments are also reflected by the size of the station areas in Table 3, which are all large, regardless of the city size, GDP, and population. Whether the HSR station area varies with city size can be directly expressed by dividing the area of the HSR station by the population of the city. Ribalaygua and Perez-Del-Caño [101] analyzed 12 Spanish HSR station areas and found their relative sizes varied from 0.5 to 1.5. In contrast, the relative size of Chinese HSR station areas fluctuated between 0.13 and 24.53. The most striking result was that the station areas of national hubs in megacities were planned at a relatively small size at the beginning of projects, which were all below 1, though Nanjing South and Shanghai Hongqiao were extended after a few years. The relative sizes of regional hubs in large cities were comparatively large, around 1.5, except for Bengbu North Station, which was 6.52. The relative size of medium-sized and small station areas was disproportionately large, varying from 1.85 to 24.52. This suggests that these local governments in China did not plan their HSR station areas according to the local context, such as population and economic conditions, but rather attempted to maximize their HSR station areas. In Section 4.3, we analyzed the reasons for this situation in relation to land use.

**Table 3.** General information of stations and station areas.

| Station | Open Year | Railway Lines | Passenger Number | Distance to City Center | Station Area | Relative Size (km²/Million Population) | Station Floor Area | Station Layers |
|---|---|---|---|---|---|---|---|---|
| Hangzhou East Station | 2013 | Shanghai–Kunming HSR; Hangzhou–Ningbo HSR; Nanjing–Hangzhou HSR | 54 million in 2020 (estimated) | 11.6 km | Chengdong New Town 9.3 km$^2$; Chengdong New Town Core Area 2.7 km$^2$; Hangzhou East Station Area 0.45 km$^2$ | 0.89 | 1,482,000 m$^2$ | 5 layers |
| Nanjing South Station | 2011 | Beijing–Shanghai HSR; Shanghai–Wuhan–Chengdu HSR; Nanjing–Hangzhou HSR; Nanjing–Anqing intercity railway; Hefei–Nanjing HSR | 44.13 million in 2020 (estimated) | 12 km | 6 km$^2$ in plan (extended to 66 km$^2$ later) | 0.64 (7.09) | 730,000 m$^2$ | 6 layers |
| Shanghai Hongqiao Station | 2010 | Beijing–Shanghai HSR; Shanghai–Wuhan–Chengdu HSR; Shanghai–Kunming HSR; | 52.72 million in 2020 (estimated) | 13 km | Core Station Area 4.76 km$^2$; Business Area 26.26 km$^2$; (Extended to 86.6 km$^2$ later) | 0.19 (3.48) | 440,000 m$^2$ | 5 layers |
| Guangzhou South Station | 2010 | Beijing–Guangzhou HSR; Guangzhou–Shenzhen–Hongkong HSR; Guiyang–Guangzhou HSR; Nanning–Guangzhou HSR; Guangzhou–Zhuhai intercity railway; Guangdong West Coastal HSR | 163 million in 2018 | 17 km | 2.51 km$^2$ | 0.13 | 615,000 m$^2$ | 6 layers |
| Shenzhen North Station | 2011 | Guangzhou–Shenzhen–Hongkong HSR; Hangzhou–Fuzhou–Shenzhen HSR; Ganzhou–Shenzhen HSR | 44.50 million in 2020 (estimated) | 9.3 km | Planned Area 6.1 km$^2$; Station Area 0.83 km$^2$; Core Station Area 0.47 km$^2$ | 0.35 | 182,000 m$^2$ | 4 layers |
| Luoyang Longmen Station | 2010 | Xuzhou–Lanzhou HSR | 7.28 million in 2020 (estimated) | 2.5 km | Station Area 10 km$^2$; Core Station Area 5 km$^2$ | 1.45 | 24,509 m$^2$ | 3 layers |
| Foshan West Station | 2017 | Nanning–Guangzhou HSR; Guangzhou–Foshan Intercity Railway | 54.7 million in 2020 (estimated) | 7.8 km | 8.6 km$^2$ | 1.43 | 68,000 m$^2$ | 3 layers |
| Changzhou North Station | 2011 | Beijing–Shanghai HSR | 11 million in 2020 (estimated) | 8 km | Planned Area 4.5 km$^2$; Station Area 0.87 km$^2$; Core Station Area 0.6 km$^2$ (extended to 56 km$^2$ HSR new town) | 0.85 (10.63) | 39,600 m$^2$ | 2 layers |
| Huzhou Station | 2013 | Hefei–Hangzhou HSR | 3 million in 2020 (estimated) | 7.5 km | 6.9 km$^2$ | 2.05 | 19,920 m$^2$ | 3 layers |
| Bengbu North Station | 2011 | Beijing–Shanghai HSR; Hefei–Bengbu HSR | 4.9 million in 2020 (estimated) | 7.5 km | 21.5 km$^2$ | 6.52 | 20,000 m$^2$ | 3 layers |
| Jinjiang Station | 2010 | Fuzhou–Xiamen Railway | 4.38 million in 2018 | 10 km | 4.61 km$^2$ | 2.23 | 10,657 m$^2$ | 2 layers |
| Xinyu North Station | 2014 | Shanghai–Kunming HSR | 1.44 million in 2018 | 10 km | 2.22 km$^2$ | 1.85 | 9995 m$^2$ | 2 layers |
| Fuyang Station | 2018 | Hangzhou–Huangshan HSR | 1.7 million in 2020 (estimated) | 6 km | 2.42 km$^2$ | 3.67 | 12,000 m$^2$ | 2 layers |
| Tonglu Station | 2018 | Hangzhou–Huangshan HSR | 2.69 million in 2020 (estimated) | 4.5 km | 10.06 km$^2$ | 24.53 | 12,000 m$^2$ | 3 layers |
| Haining West Station | 2010 | Shanghai–Kunming HSR | 7.78 million in 2020 (estimated) | 25 km | 3.58 km$^2$ | 3.58 | 17,027 m$^2$ | 1 layers |

The visions of station areas depend on the local context, resources, and the aims of local governments [79]. After coding the 15 station area plans, we found six types of visions promoted by local governments, namely, integrated transportation hub, new city center or sub-center, new town, commercial and business centers, tourism and travel-related service center, and city gateway and landmarks (Table S2). Each plan contained two to three of these visions (see Table S3 for details). The first feature of the visions of these HSR station areas was that most of them were positioned as integrated transportation hubs, emphasizing the primary function of HSR station areas as the integration of multiple transport modes. Second, Chinese local governments expected the HSR station areas to change the urban structure from monocentric to polycentric. Megacities, where national hubs are located, mainly plan HSR station areas as new city centers or sub-centers, while large cities, where regional interchanges are located, and medium-sized and small cities mainly plan HSR station areas as new towns. The centers of monocentric cities often face traffic congestion and pollution problems because their business and commercial activities in city centers generate a large amount of traffic, which is beyond the capacity of the road networks [17]. Polycentric urban forms can theoretically reduce traffic density around former city centers by spreading out the flow of people to different centers. Local governments in China aspire to use the dense traffic in HSR station areas to create new urban centers and alleviate the traffic congestion in their urban areas.

Furthermore, all local governments regard HSR stations as an important opportunity to attract commercial and real estate developments. The vision of a successful commercial and business center has been outlined in most plans; though, the type of development varies by city. Pol [102] found that the visions of European HSR station areas could be divided into two categories: international service cities using HSR station areas to attract knowledge economy-related and service industries, such as Amsterdam, Rotterdam, Barcelona; and Lyon, whereas cities in transition expected the HSR station areas to create changes to their economic structure, such as Utrecht and Lille. The Chinese HSR station areas also followed this pattern. Station areas in megacities were designated to provide services for entire urban clusters, such as the Yangtze River Delta, or even the entire country, and attract international financial and business companies. Large cities sought to transform their economic structures from primary and secondary industries to service industries; therefore, their HSR station areas were envisaged as urban gateways and new landmarks to enhance their city image, demonstrate modernity, and attract urban investments. Small- and medium-sized cities tend to position their HSR station areas as a tourism-related service center. They expect their natural resources to attract tourists and stimulate local service industries.

Although all plans mentioned that they were planned according to the TOD concept, most of the plans did not clearly reflect a TOD vision, such as environmentally sustainable, compact development, and walkability, except for Shanghai Hongqiao Station, which was proposed to be the first low-carbon business community in Shanghai. Similar to Xu et al. [51], we found that the vision of TOD in the Chinese HSR station area primarily focused on market-based growth. One of the reasons for this phenomenon is that planners have attempted to transfer successful TOD policies from other countries. They cited station area developments in other countries, such as Yokohama Station and Osaka Station in Japan, Berlin Station in Germany, and Lille Station in France, as “best practices” to demonstrate that HSR station areas are suitable for financial, business, and commercial functions. However, many TOD policy transfer studies have noticed distortions and unintended consequences in both the ways information is “sent” and “received” [15]. Chinese planners did not carefully scrutinize the successful development of HSR station areas in Europe and Japan in these plans. They ignored the local context and supportive policies, and simply concluded that the HSR station area was suitable for commercial and business developments.

### *4.2. Transport and Interchange*

As shown in Table 4, the proportion of the railway area in the whole HSR station area is small for each case. Especially in small, medium, and large cities, the proportion does not exceed 8%. Some of the experts we interviewed from the CR used this indicator to evaluate the integration of the station and surrounding area, which was problematic (interviewees 1, 2, and 6). Ribalaygua and Perez-Del-Caño [101] found that the proportion of railway areas did not exceed 10% for 12 Spanish HSR stations because the tracks were laid underground to address the barrier effect of the railroad. In the case of China, the railways were laid at ground level. As previously analyzed, the main reason for the low percentage of railway areas was that the size of the stations was reasonable, while the area around the HSR stations was planned to be large. These tracks still separate parts of the city and pose obstacles to the integration of the station and surrounding areas.

**Table 4.** Land use and percentage [1].

| Station | Urban Construction Land | Road Area | Square and Parking Area [2] | Railway Area | Residential Area | Commercial Area | Business and Financial Area | Tourism and Entertainment | Green Area |
|---|---|---|---|---|---|---|---|---|---|
| Hangzhou East Station | 2.74 km$^2$ | 21.1% | 6% | 22.4% | 7.6% | 3.8% | 15.6% | 8.3% | 8.8% |
| Nanjing South Station | 5.26 km$^2$ | 26.2% | | 9.1% | 25.6% | 21.7% | | | 16.9% |
| Shanghai Hongqiao Station | 3.93 km$^2$ | 17.61% | 2.26% | - | 5% | 8% | 47.5% | 2.9% | 12.5% |
| Guangzhou South Station | 2.5 km$^2$ | 22.8% | 4.2% | 13.2% | 14.8% | 9% | 9.7% | 0.6% | 25.7% |
| Shenzhen North Station | 4.68 km$^2$ | 28.63% | 10.07% | 13.96% | 21.9% | 14.06% | 7.68% | - | - |
| Luoyang Longmen Station | 5.3 km$^2$ | 24.61% | 2.44% | 5.52% | 5.7% | 9.27% | 20.61% | 2.28% | 29.57% |
| Foshan West Station | 8.32 km$^2$ | 28.73% | 2.3% | 5.8% | 14.5% | 10.51% | 13% | 6.65% | 12% |
| Changzhou North Station | 56 km$^2$ | - | 1.6% | 1.5% | 13.33% | 9.35% | 24.22% | 7.55% | 4.1% |
| Huzhou Station | 6.9 km$^2$ | - | - | 1.45% | 6.66% | 2.49% | 8.82% | 2.57% | - |
| Bengbu North Station | 21.5 km$^2$ | 15.75% | | 2.83% | 22.25% | 3.56% | 2.69% | 1.62% | 26.96% |
| Jinjiang Station | 4.59 km$^2$ | 20.48% | 1.23% | 3.03% | 1.82% | 5.6% | 28.5% | - | 19.22% |
| Xinyu North Station | 2.12 km$^2$ | 25.15% | 4.57% | 4.09% | 10.22% | 6.03% | 20.74% | 9.86% | 15.11% |
| Fuyang Station | 2.42 km$^2$ | - | - | 7.52% | 25.6% | 15.97% | | | - |
| Tonglu Station | 8.99 km$^2$ | 27.6% | 12.23% | 4.42% | 13.63% | 3.94% | 13.85% | 8.38% | 20.69% |
| Haining West Station | 3.58 km$^2$ | 25.89% | 2.1% | 3.29% | 4.78% | 6.67% | 5.21% | 6.3% | 37.48% |

[1] The table does not include water and other non-construction land. [2] Land-use area of parking area only contains the parking area on the ground level. Underground parking areas in multi-layer stations are not included.

In contrast, road areas occupied more than 20% of the HSR station area in most cases. In the TOD standard, it is recommended that the total road area used for vehicle travel should be less than 15% of the station area [82]. However, since Chinese HSR station areas were too far from the urban area, and there were no connecting local public transport networks, many new roads were needed to connect the station to the built-up areas. These road systems can increase the accessibility of the station area because people can have easier access to their destinations in the city center, such as hospitals and schools. In addition, we found that, regardless of city size, the main roads in the station area were designed to be 60 m wide, and one of the main roads in the Fuyang Station area was even planned to be 100 m wide. These roads were designed as six lanes in both directions, with some small cities, such as Jinjiang, planning to expand the roads to eight lanes. Such wide roads not only waste land and encourage private car travel, but also prevent pedestrians from crossing the road and reduce the walkability of the area.

The planning concept of public transport priority in TOD was clearly stated in nine plans, three megacities, three large cities, and three small- and medium-sized cities. The predominant mode of public transport is the bus, and it is worth noting that the bus also includes long-distance buses in China, which can reach other cities that are not accessible by HSRs. In most plans, 70% of the total passenger traffic is planned to be carried by public transport modes, including the metro, BRT, and buses. Most cities expect the metro to carry the most passengers, at around 50%. The share of buses was about 40% in megacities and large cities and this percentage decreased to around 20% in small- and medium-sized cities. Meanwhile, the proportion of taxis in the plans increased from 8% to 20%. This indicates that the smaller the city, the lower the proportion of public transportation and the more it relies on taxis and private cars. Megacities and large cities better fulfill the principle of using public transportation advocated by TOD, while small- and medium-sized cities deviate from this principle. Moreover, the extent to which public transportation use is conducted as planned is still a prominent question. Interviewees 7 and 9 pointed out that, due to institutional and technical complexities, local public transportation often lags behind the opening of HSRs in large- and medium-sized cities. For example, the metro at Luoyang Longmen Station opened ten years after the operation of the HSR, and the time lag for Changzhou North Station was eight years. In the first few years after the opening of the HSR, it was still necessary to rely on taxis and private cars to reach the HSR stations in these cities. It is worth studying whether people's travel behaviors can change after the opening of public transportation.

Experts in transport planning often suggest the integration of different transportation modes (mainly the bus, subway, and rail) and consider this integration to take precedence over the integration of stations and land use [103,104]. They argue that providing "seamless transfers" between modes can increase the proportion of trips made using public transport and, therefore, reduce car travel and the pressure on road networks. The importance of seamless transfers was clearly recognized in 11 cases. Nanjing South Station was the first transportation hub in China to achieve a seamless transfer through vertical interchange. Its "vertical interchange" design concept has been promoted and used by the CR nationwide. As shown in Table 3, all these stations are multi-layered, with passengers interchanging between different transport modes on different floors via elevators and escalators. One of the advantages of this design is that large parking areas are designed underground and do not become a barrier to the station and its surroundings. Private car users can also easily transfer to other public transport modes inside the station. However, Chen and Wei [31] argue that such transfers are not genuinely seamless, as the station itself is so large that passengers need to walk for more than ten minutes to actually make the transfer. Additionally, interviewee 18 highlighted that a significant obstacle to seamless transfers was the need for double security checks when transferring between the metro and HSR. Since the CR is in charge of the HSR services in China and the local governments are in charge of the metros, there is a lack of coordination between these systems. As a result, passengers often have to experience through security checks twice, which is inconvenient and time-consuming.

Urban planners often assert that the measure of a successful sustainable transportation policy should be an overall reduction in the travel distance, replaced by frequent travel on foot and by bicycle, and long-distance travel by public transportation [105]. However, only five cases proposed pedestrian priority, and eight plans emphasized pedestrian–vehicle separation in station areas. Although pedestrian routes were planned in 11 stations, most of them focused on the interior of the station, while walking and cycling networks in the station area were rarely mentioned. Three case stations, Hangzhou East Station, Guangzhou South Station, and Changzhou Station, planned complete pedestrian networks, bicycle lanes, and bicycle parking facilities. Complete and safe cycling and walking networks are emphasized in the TOD concept [82]. Most plans for Chinese HSR station areas ignore this principle.

### *4.3. Land-Use Planning*

All 15 plans emphasized the high-density development of the HSR station areas. The station was surrounded by commercial and business buildings whose floor–area ratios (FARs) were 3.5–4.0. As the distance from the station increases, the FAR gradually decreases to less than 2.0. The development pattern is in line with the principle of high-density development; however, one of the compact principles advocated by TOD is that these developments are planned in vacant urban areas or brownfield sites [82]. According to our interviews, small- and medium-sized cities were eager to build several new districts or new towns to convert agricultural land into constructive land (interviewees 11, 12, and 14). However, a large area of land in these new towns was left vacant by developers because of the depressed local economy [106]. When the sites for the HSR stations were selected, most local governments in China did not use these vacant land areas to build the HSR stations, but instead chose to continue to expand the cities and build HSR new towns. In most cases, the land-use functions before the development of the 11 station areas were agricultural land, fish ponds, woodland, and residential land for farmers (Table S2). Therefore, the planning of these station areas did not follow the principle of compactness in terms of the whole city level, and it also resulted in a loss of farmland.

These HSR station areas are vast, especially in small, medium, and large cities. In addition to the road and railway areas, there are seven types of areas: commercial, business and financial, tourism and entertainment-related, residential, squares and parking, and green space. Commercial areas is planned for retail, shopping malls, and restaurants in station areas, while the business and financial areas include large office areas, exhibition and convention centers, and industrial parks. As shown in Table 4, each station area has a large area of commercial, business and financial, tourism, and entertainment land planned, with most station areas accounting for more than 20% of the total. Each city expects the HSR station area to demonstrate a sense of modernity and prosperity. Local governments and planners, especially of small, medium, and large cities, believe that the increased accessibility created by the HSR will generate development opportunities for their cities [107]. Surprisingly, regardless of local conditions in the cities, the economic development plans for HSR station areas were all designed to attract international company headquarters, financial companies, and high-tech industries, along with large convention and exhibition centers, trade centers, and theme parks. In the plans for the five megacities, planners systematically analyzed the economic bases of the whole city, other business centers in the city, and the complementary positioning of the HSR station area and other business centers. However, in practice, the economic development around Guangzhou South Station still lags behind planning expectations, and the level of commercial and business development is much lower than the targets in the plans [108]. Based on the land-use-change data from 232 European stations, Wenner and Thierstein [34] conclude that stations on the urban fringe rarely attract any development around them. It is dangerous for small, medium, and large cities to plan large commercial and business areas around HSR stations without clear and tailor-made goals, leading to large areas of unused land and being criticized in the media as “ghost towns”.

In Table 4, residential areas account for a large portion of the area, regardless of city size. According to Saunders and Smith [109], TOD frequently causes a spike in surrounding housing prices, and land developers recognize its potential. Xu et al. [110] studied metro stations in Wuhan, China, and reported that the price premium for commercial housing within 100–400 m of the station was about 8% and 16.76% within the buffer zone 100 m from the station. Land policy in China has undergone a series of reforms since 1994, turning urban space into a marketable commodity, while urban housing has also been rapidly commoditized. The decentralization of administrative and financial powers allowed local governments to retain the profits from the sale of land-use rights. Meanwhile, local governments are responsible for funding local development and local fiscal balance, so they exhibit entrepreneurial behavior [111], following a land-driven, fiscal-driven, and growth-promoting logic [112]. Local governments pursue the maximization of land finance and land speculation and rely on various land-based revenues [113,114]. The development of mega-projects, such as HSRs, provides excellent opportunities for local governments to speculate on the surrounding land, develop real estate, and gain fiscal revenues [115,116]. Thus, a large number of residential areas were planned in these HSR station area plans; however, in reality, these HSR new towns did not attract a large number of households due to a lack of other infrastructures. This phenomenon has been taken seriously by the Chinese central government, which has introduced policies to limit the scale of developments around HSR stations and prevent the debt risk of local governments [117].

Furthermore, scholars have suggested that rising housing prices around TODs may exclude low-income groups (who may be more likely to use public transport than higher-income residents) from living in TOD areas [17,109,118]. Social diversity and a mixed income should be a fundamental requirement for TODs [119]. However, in these 15 plans, we found that most of the planned residential areas were intended for high-end commercial housing, and there was no mention of affordable housing. Only three HSR stations, Nanjing South Station, Bengbu Station, and Haining West Station, explicitly mentioned new residential areas in the station area for the farmers who originally lived in the area and those with a low income. Almost all new developments near stations may be unaffordable for low-income households. Local governments should consider mixing housing types and arranging affordable housing while expecting revenue from commercial housing.

Although the plans emphasize mixed-use development, the arrangement of different functions is still structured as mono-functional mega-blocks. A function is concentrated in a large area without mixing with other functions. The TOD standard suggests the length of the longest block should not exceed 110 m, while the smallest blocks in these plans are around 200–300 m. As suggested by Pan et al. [16], there is an urgent need for China to adjust its planning codes to promote small blocks and mixed-use pedestrian-friendly environments.

The design of public space and architectural aesthetics occupy much of the space in each of the 15 plans (Table S2). The reason is that local governments expect the HSR station area to enhance the image of the city, attract investments, and increase the competitiveness of the city. At the same time, these station areas are located far from the city; therefore, they have better natural attractions for tourism, such as the Luoyang Longmen Station, which is adjacent to the Longmen Grottoes, a World Heritage Site. Green space also accounts for a large proportion of the area. Many stations are adjacent to water bodies; therefore, waterfront conditions are utilized in the design of public spaces. Moreover, these HSR stations attach great importance to the design of the station squares because station squares not only assume part of the interchange function, but also assume the function of accommodating a high number of passengers during special periods, such as the Spring Festival and summer holidays. The squares also connect the station and the city. Conventional railway stations in China are typically separated from cities by large hard-surfaced squares. In the HSR station area plans studied here, planners have taken note of this issue by incorporating soft surfaces, such as water bodies and green areas, into the station squares. Moreover, in these plans, the main building of each station has a symbolic meaning that reflects the local cultural characteristics. For example, the building of Guangzhou South Station represents the "banana leaf" of its regional culture. However, these symbolic meanings are generally not easily recognized by passengers because of the grand scale of the stations.

## 5. Conclusions

A good station area plan underpins the successful operation of an HSR station [79]. Chinese local governments claim that HSR station areas are planned according to TOD principles and promote HSR-based TODs; however, scholars, media, and passengers have criticized these station areas since their openings. They argue that the design of HSR station areas actually violates the basic principles of TODs and even causes urban sprawl. Therefore, this article focused on what success factors should be included in a good TOD plan for HSR station areas, and to what extent these factors were considered in the planning of HSR stations in China. We investigated to what extent the plans adhered to TOD principles, as clustered in Table 5. The spatial plans of 15 HSR station areas were compared, including national hubs in megacities, regional interchange hubs in large cities, and stations in small- and medium-sized cities. We compared the factors in these plans with the success factors of the TOD standard in terms of contexts and governance, transportation and interchange, and land-use planning, as well as the characteristics of the station plans of different city sizes.

First, as shown in Table 5, the choices made in Chinese HSR station areas deviate from TOD principles; however, the causes of these deviations vary from one factor to another. Some important factors were ignored in the plans, such as pedestrian priority. Others were recognized and mentioned in the plans as important planning principles by planners, such as diversity and high density. However, the specific design of the land use deviated from these principles. Many actors were involved in the decision-making process; therefore, some factors, such as the location, were not decided by planners, and partly for that reason TOD planning principles were not followed [106]. Furthermore, there were factors, such as seamless interchanges, which were highlighted in the plans but hindered in practical implementation by the complexity of the institutions and the fragmentation of land ownership [107]. The divergence between factors in the plans and TOD standards caused the development of HSR station areas to change from the TOD as advertised to the TAD as practiced. Different solutions should be adopted for these different factors, rather than only considering this phenomenon as a planning-level problem.

**Table 5.** Summary of TOD factors in the plans of Chinese HSR station areas.

| | Factors in the Literature | Explanation | Factors in the Plans for HSR Station Areas |
|---|---|---|---|
| Context and Governance | Local context | Carefully consider the spatial/locational and economic characteristics | The size of stations matches local contexts; however, the size of station areas and the location of stations are not aligned with local contexts<br>Stations are far from city centers<br>Large station areas, especially in small- and medium-sized cities |
| | Vision | Clear, smart, and strong<br>Long-term, consistent | Focus on market-based growth visions rather than TOD visions<br>Unclear business development goals for large, medium, and small cities |
| Transport and Interchange | Service level of HSR station | Good level of HSR service | Railway areas occupy a small proportion of the whole area, while the railways operate at ground level creating a barrier in the city<br>National and regional hubs have a good level of HSR services; small- and medium-sized stations only connect to one HSR line |
| | Destination accessibility | Good accessibility of services in cities | Poor accessibility of services in cities because of their remote locations |
| | Accessibility to the station | Efficient road system<br>Good public transit connections and intermodal choices<br>Avoid barriers, such as large parking lots and highways<br>Parking supply | Many new roads planned; highways and other roads are very wide<br>Public transport priority and many intermodal choices (mega- and large cities better than small and medium cities); however, in reality, public transport often lags behind the opening of HSRs<br>Parking lots are underground, which does not create barriers |
| | Seamless interchange | Convenient transfer between transport methods | Promoting seamless transfer and vertical interchange<br>In reality, transfers are impeded by long walking distances and security checks |
| | Pedestrian- and bicycle-friendly systems | Good pedestrian and bicycle access to the station<br>Provide pedestrian-friendly street networks | Access to the station by cycling and walking is ignored in most plans<br>Most plans lack pedestrian-friendly networks |
| Land-Use Planning | Density | High-density urban development<br>Taper densities with distance from a station | HSR station areas are high and taper densities but not from the perspective of the whole city |
| | Diversity | Mix of land uses and activities<br>Mix of housing types<br>Design small blocks | Large areas for commerce, business, and real estate<br>Lack of mixed-housing types and affordable housing<br>No real mix of functions, mega-blocks |
| | Design | Public space for people to congregate<br>High-quality architecture | Large parts of the plans<br>Good design of public spaces includes soft surfaces<br>High-quality architecture |

Second, many cities regard these mega-projects as solutions to their urban development issues [44]. These HSR station area plans are considered to progress "urbanizing the suburbs." Shen and Wu [120] argued that the so-called TOD was used as a financing instrument to catalyze state-supported, transit-led suburbanization. The most significant characteristic of these station area plans was that they all aimed to be areas where the service industry and knowledge economy were booming, with a focus on market-based growth. These large station areas contain large commercial and business areas, as well as residential land. Local governments rely on the revenues generated by the sale of these land-use rights; however, this is an unsustainable mode of development. Many studies have shown that infrastructure and increased accessibility are development opportunities, and local governments need to grasp the opportunities through appropriate strategies and policies [47]. However, the commercial planning of the examined station areas is detached from the local economic foundations and lacks supporting policies, resulting in the failure of these HSR station areas to meet the planned goals. Moreover, large areas of agricultural land have been converted into construction land. To date, this is an irreversible process and has had an adverse impact on the environment and the amount of arable land. The social inequities caused by this process were not addressed in the plans either.

Third, the comparison revealed that the planning problems of regional interchanges in large cities and stations in small- and medium-sized cities were more significant than the national hubs in megacities, which received more attention from scholars [29,121]. As discussed in Section 4, not only the location and size of these HSR station areas, but also the commercial and business areas, were not developed in line with their local contexts. Meanwhile, the construction of many wide roads has demonstrated that these plans promote the use of private cars and taxis, which completely departs from the core concept of TOD. Moreover, residential areas predominate in these medium and small station areas; however, these cities are in fact reducing their populations [122]. Interviewee 12 from the local government of a medium-sized city stated: “We hope to attract and retain more people in our city through the new HSR station and surrounding development.” However, the research indicates that the opening of HSRs often leads to increased population and resource migration toward large cities and megacities [123]. Consequently, small- and medium-sized cities may face mounting challenges in retaining their populations, with large residential areas potentially going unused. TOD promotion in small- and medium-sized cities necessitates a different set of policy solutions than in megacities [51]. It is imperative for the national government to introduce supportive TOD policies tailored to these small- and medium-sized cities.

There is a lack of explicit recognition of specific features and performance standards to establish what represents effective TOD in Chinese plans, which has complicated the sharing of experiences between cities and monitoring TOD progress [51,118]. In this study, we summarized what we identified as the standards in the literature to compare TOD plans for different HSR station areas. We recommend that national planners devise national standards to ensure that national policies for TOD planning are reflected in the local planning schemes. These national TOD standards should differ for cities of different sizes, and they should include the percentage of public transport in the modal split, complete pedestrian and bicycle networks, and dramatically reduced block size. In addition, successful TOD implementations must be based on the specific political and economic circumstances and urban form of the city [15]. Local planners should design TOD solutions in conformity with specific local conditions, including funding potential and supplementary policies.

Furthermore, in order to further the integration of transport with land use, both national and local governments should consider institutional reform and promote the cooperation between railway and urban actors. At the present stage, the cooperation can be the mutual recognition of security checks between railway and subway actors, which would already simplify one procedure for passengers. In the long term, actors should establish a collaboration at the early planning stages to share responsibility for the design and operation of the HSR station area to facilitate the implementation of TODs. Finally, a major shortcoming of this study was that it did not discuss the decision-making process behind these plans or how interaction processes affected the implementation of TOD principles. We suggest that subsequent studies focus on these issues, especially in small- and medium-sized cities.

**Supplementary Materials:** The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/land12091818/s1, Table S1: Interviewees list; Table S2: Summary of the hierarchy of nodes; Table S3: Matrix of nodes and the 15 master plans.

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## Notes

[1] China Railway (CR) was formerly known as the Ministry of Railways of China, which was dismantled in 2013.

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