Chinese urbanisation powered by high-speed rail: challenges for hyper densities and diversities

Shan He
Bachelor of Architecture (Zhejiang University)
Diploma in Architecture (Cambridge University)

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(Text)

This thesis is presented for the degree of Doctor of Philosophy of The University of Western Australia School of Design Architecture 2017
DECLARATION

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This thesis has been substantially accomplished during enrolment in the degree.

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ABSTRACT

This thesis focuses on the urbanisation phenomenon powered by the rapidly expanding high-speed rail (HSR) network in contemporary China, specifically on the widely emerging urbanities around station nodes summarised as ‘HSR oriented new town’ (HONT). Based upon recent criticisms and doubts of many HONT development cases across China, this study, through an architectural lens, attempts to understand the challenges and features of HONT practices, as well as to theorise the principles of urban planning and design to improve the qualities of future HONT living.

The research starts with decoding the ‘urban quality’ understanding of the nodal development area around a railway station, arguing that ‘high density’ and ‘rich diversity’ achieved through fully integrated relationship between rail infrastructure and urban living are fundamental principles in a HONT development. This argument is supported by both theoretical discussions defining ‘density’ and ‘diversity’ in a rail oriented urban context, as well as case examinations of Europe and Japan to demonstrate successful and unsuccessful examples of established rail-city relationships.

The rail-city relationships that have been shaped in China are then further studied through reviewing cases selected from both historical and geological dimensions, as well as comparing with their counterparts in America and Europe. By decoding the historic rail-city relationships in and beyond China, the research builds a theoretic framework to systematically analyse the HONT planning and designing practices.

A dichotomous approach focusing on HONT studies is implemented in the following section, where ‘density’ and ‘diversity’, as concluded by the above discussions, are employed as themes to investigate the spatial and functional integrations between the HSR station and urban HONT. Three HONT examples located in the Lower Yangtze Delta region are used to facilitate a comparative study, which finds that the theorised integration between rail and city is not achieved in any of the cases.

The final part summarises the principles of planning and designing a HONT that is in agreement with achieving rail-city integration and customised to the unique urbanisation context of China. These principles are also tested by applying them to an urban design case based on a selected HONT site. Through comparing the design outcomes with the original scheme, the values of this research are verified by improved quality of urban living. At the end, the thesis is concluded by reviewing its findings, theoretical impacts, limitations and potential of future developments.
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PART ONE:

INTRODUCTION
Chapter One

Research Challenge: Current high-speed-rail oriented new town (HONT) practices in China

1.1.0 Introduction

Home to the world’s largest population, China is currently experiencing a rapid and massive urbanisation process. The past three decades have seen the most dramatic urban population growth in Chinese history, with city populations increasing from approximately 250 million people in 1985 to nearly 750 million in 2014 (NBSC, National Bureau of Statistics of China); during this period, the urbanisation ratio increased from 23% to 55% (NBSC) (Figure 1.01). Forecasts predict that by 2030, 65% of China’s population will reside in urban locales, due to an additional 300 million individuals making the move from rural areas to cities (Xu, 2012: 4).

In parallel with this massive urban transition, the Chinese government has prioritised investment in high-speed rail (HSR) infrastructure. In 2008, the Ministry of Railways released an amended national plan for the HSR network, which covers most major cities and consists of 16,000 kilometres of track, making it the world’s largest HSR network (Fan et al., 2015) (Figure 1.02). By 2020, this network is predicted to further grow to include 32,000 kilometres of track (Li-ren and Li, 2010: 44-45).

The Chinese HSR network is designed to reduce urbanisation pressures by powering urban development in areas adjacent to stations. Therefore, in the vicinity of nearly every HSR station, an HSR-oriented new town (HONT) is proposed. For example, Dong (2011: 34-35) reports that of the 24 stations along the 1,318-kilometre Beijing–Shanghai HSR line, almost every station has an associated ‘new town’ proposal, 16 of which are currently under construction (Figure 1.03).

On a national scale, planners of HSR infrastructure weigh distribution requirements according to economic and population importance (Wang and Ding, 2011: 50). For individual cities, on the other hand, HSR station nodes can trigger urbanisation and facilitate suburbanisation in a polycentric pattern for conventional, single-centre-layout Chinese cities (Lin et al., 2010: 662). Such urbanisation is achieved through the construction of HONT projects, which present enormous commercial development potential (Chen, 2012).

1.2.0 Challenges of current HONT practices

There are three general features of Chinese HONTs.

First, the location of an HSR station is typically removed from established urban centres. According to statistics on stations along the Shanghai-Hangzhou HSR line, the average distance between an HSR station and the centre of its parent city is mostly around nine-ten kilometres; Haining Station represents the maximum distance at 36 kilometres from the city centre (Figure 1.04). This indicates that most
HONTs are situated on the fringe of, or even external to, the existing urban footprint. HONT planning is commonly designed as a strong node within a polycentric urban network.

Second, the site selection of HSR stations is often under pressure from competing efforts to preserve agricultural land resources, as growing scarcity impinges on food security. In 2008, the State Council of China has set a national target to preserve 1.805 billion mu (120.3 million ha) of cultivatable land by 2020⁴. However, according to the MLR (Ministry of Land and Resources of the People’s Republic of China), 253,000 ha of cultivatable land was developed for construction purposes in 2011 alone, further pushing the 2020 target figure to 1.826 billion mu (121.7 million ha) (Huang et al., 2011). While there are no available statistics on agricultural land ‘consumed’ by HSR and related development, siting stations on cultivable lands—as was the cases with four illustrated stations (Figure 1.05)—rapidly increases land values and will exacerbate growing pressures to balance land demands between food production and urban development.

Third, the design of HSR infrastructure is a considerable improvement over conventional rail systems, attracting large numbers of passengers to station nodes. For example, the new HSR station in Hangzhou has a daily capacity of 200,000 users, which is approximately four times the capacity of the conventional Hangzhou station located in the city centre (Figure 1.06). These tides of increased passenger flows create substantial development opportunities in areas around station nodes.

These features have led Chinese planning theorists and professionals to become widely optimistic about the potential of HONT development, especially in terms of achieving compact urban development patterns. Duan (2009) and Yu et al. (2009) support the argument that HSR stations have great potential for new urban development. Wang et al. (2012: 1073-1074) further add that HSR development spurs the construction of urban towns with high density and mixed-use lands, thereby shaping new nodes of urban development.

Recently, however, HONT practices have been frequently questioned in media reports, which often refer to ‘dead town’ worries (Bao et al., 2014; Li et al., 2014; Fu, 2014) (Figure 1.07). Further comments indicate that, aside from criticisms relating to oversized scale and remote locations, concerns exist regarding the disconnect between stations and their immediate urban areas (Lan et al., 2014; Fu, 2014). Clearly, this outstanding problem demands a solution, as achieving ‘compactness’ is urgent for the proper planning and designing of HONTs (Feng, 2014).

According to the author’s observations and studies, the aforementioned questions are the result of a series of issues embedded in HONT practices, which are sampled below.

First, the significant distances between HONTs and their parent cities challenge the efficient connectivity of both. This rings particularly true, as urban rail (including metro) infrastructures were not well developed in most Chinese cities prior to the arrival of HSR. Urban roads are heavily utilised to facilitate

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local traffic to and from HSR stations, which are more difficult to access than conventional stations located within cities. For example, Chen (2012: 315) cites one experience between Shanghai and Haining, a midway town on the Shanghai-Hangzhou HSR line. On conventional rail, travel time to Haining’s city centre was 70 minutes, compared to 40 minutes on HSR to the remote new station; however, poor accessibility to the new station added an additional 2 hours to the commute to central Haining. This distance presents a huge obstacle for potential users who seek to travel between cities and urban HONTs, and makes the latter option much less attractive to urban residents.

Second, despite a potential land crisis between development and cultivation, many HONTs are planned with potential footprints of tens of square kilometres, some even extending “beyond actual local urbanisation demands” (Shi et al., 2014: 3). Further, many HONT planning schemes are far from achieving efficient land development. According to data gathered from a study of HONTs in Guangzhou, Changsha, Shanghai, and Wuxi, proposed average floor area ratio (AFAR) figures are approximately half of conventional central areas, typically as Jing’an, a District of Shanghai. It is difficult to describe HONT planning in terms of features such as ‘density’ and ‘compactness,’ which is language traditionally used by theorists and professionals.

Third, China’s top-down statutory planning system is not flexible enough to meet the demands of fast-paced urban development, especially considering the unique nature of unprecedented HONTs. As a result, HONT planning is framed primarily by ‘new town’ templates established through decades of Chinese urbanisation. Both spatial and functional structures of HONT planning are nearly identical to many other familiar ‘new town’ features, such as extensive axial streets which penetrate central areas and cluster around commercial retail shops, as well as mono-functional land plots encircled by artery roads. It is difficult to identify unique urban spaces and life patterns directly powered by HSR infrastructure. Refer to section 2.2.3 of Chapter Two for details about the political factors in shaping the Chinese ‘new town’ development template.

The above problems are further discussed in following chapters. The templated planning practices do not allow HONTs to expose their unique attractiveness to potential urban users; however, the inherent deficiencies of HONTs, such as being far from established city centres, having inadequate support for urban development, and demonstrating ambiguity of identity, are highlighted and amplified. These factors contribute to considerable criticisms of current HONT practices.

This thesis attempts to examine future HONT living with respect to qualitative factors such as urban qualities and questions of identity. Through in-depth studies of the relationship between rail infrastructure and urban development/urban life, this thesis also seeks to evaluate the many challenges of developing a theoretical framework for HONT planning and design.

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2 The original text in Chinese is ‘超出当地城镇化的实际需求’.
1.3.0 A brief review of research on HSR station node development

As a highly intensified and efficient means of transportation, rail infrastructure has facilitated and powered the development of many cities. With the introduction of advanced technologies to upgrade noisy and smoky steam engines, locomotives have become quieter and cleaner, thus limiting the negative impact of conventional trains on the urban environment. Trains are no longer sources of dust and noise in the heart of a city. Consequently, the increased number of users has triggered the urban development of areas around stations. Today, ‘railway transport is an important [factor of] urban space growth, and railway stations [have] become major nodes of urban development’ [Zhang and Cao, 2007: 7]

Globally, the history of the relationship between rail and cities has experienced dramatic fluctuations over the past few centuries. The introduction of the first train to England in 1829 led to a booming period of rail development in Europe, America, and Japan which carried into the mid-1900s, when different mechanisms were observed tying rail infrastructure to urban development (Chapter Three contains discussions on this topic). However, the importance of rail to urban life shrank dramatically due to soaring rates of private vehicle ownership following the Second World War. Only in the past twenty years have developers in Europe, Asia, and America begun to rethink the role of rail in urban life (Bertolini and Spit, 1998: 21-29; Priemus, 2007: 17-18). Worldwide interest of the development of HSR networks is especially fascinating, as HSR substantially exceeds conventional rail in terms of efficiency; as such, rail infrastructure presents unparalleled opportunity and potential for urban cities.

Japan and Europe are the only two regions that China can look to for precedents with regard to large scale HSR operations. Over half a century of HSR experiences have shaped the specific and stable rail-city relationships in these two regions.

In Japan, conventional central cities have reinforced their positions in the urban hierarchy through the establishment of HSR infrastructure. Economic models show that HSR is important for the urban agglomeration of Tokyo and Osaka (Daluwatte and Ando, 1994). Conversely, researchers have found that denser networks will not necessarily contribute to regional dispersion (Sasaki et al., 1997). In a review of Japanese rail and cities, Murayama (1994) suggests that the nation-wide expansion of rail networks has transformed Japanese cities into an integrated urban system.

European cities have benefited from HSR through a rejuvenation of their historic centres. For example, Kuklowsky and Provan (2011) suggest that Lille, France has been renewed by the Eurostar HSR service. Mazzeo (2010) conducted an in depth examination of the hierarchy of European cities, and concludes that HSR infrastructure has difficulties to compete with the ‘strong persistence’ of the established and mature European urban structure; to a certain extent, this answers the question of why HSR plays a different role in the urbanisation of Japanese spaces.

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3 The original text in Chinese is: ‘铁路交通是城市空间增长的重要方式, 而火车站, 则成为城市发展的重要节点.’
Further discussion of the relationship between rail and cities in Japan and Europe are provided in Chapter Two. For HONT practices, however, these precedent experiences should be examined while maintaining an understanding of the hugely different role played by HSR in Chinese urban life. Fundamentally, the remote placement of most Chinese HSR stations establishes a different geographical station-city relationship than that enjoyed by most Japanese and European counterparts, whose systems are often placed inside urban areas. Beyond issues of distance, the urbanisation targets set for the development of Chinese HSR infrastructure are unprecedented in the global history of HSR; never before has a nation sought to develop HSR on a comparable scale or schedule. Chinese rail infrastructure has been largely envisaged to facilitate long distance travel, which presents another significant difference between Chinese HSR and Western commuting trains. Following chapters further discuss the motivating factors and outcomes of China’s modern rail-city relationship. It can, however, be concluded that a study of Chinese rail-city relationships is of equal or greater importance to the examination of overseas HSR systems.

Unfortunately, the typical Chinese phenomena of ‘speed oriented development’ and ‘fast urbanisation’ did not allow sufficient time to develop sophisticated HONT research prior to the implementation of planning and design schemes. HONTs have been proposed and built in parallel with the development of nationwide HSR networks. This lack of understanding and insufficient research into HONT characteristics has, in all likelihood, contributed to the overwhelming effect of Chinese ‘new town’ templates on HONT practices.

A study of recent research into Chinese HONTs reveals that it focuses on two geographical scales. The first, macro, scale covers the entire city or a cluster of cities in the HSR network (Wang and Long, 2009; Su et al., 2009; Yu et al., 2011). Research at this scale investigates the economic, social, and spatial growth that HSR will potentially bring to urban areas. The second, micro, scale more narrowly focuses on the HSR infrastructure at a single node. Studies at this scale focus on organising efficient hybrid connections between HSR and other forms of transport inside station hubs such as buses and cars (Bai, 2006; Cheng et al., 2010).

Limited research outcomes exist regarding specific planning and design methods for HONTs. Such outcomes either replicate western urban design theories without fully recognising Chinese-specific contexts or generate conclusions from poor conceptualisations of theory. For example, Ye (2010) recommends a long list of ‘ring-zone theory, transit oriented development (TOD) theory, and urban catalyst development theory’ to guide HONT planning. These theories, of European and American origin, were not established in accordance with Chinese urban contexts; therefore, Chinese needs must be analysed, decoded, and re-oriented for HONT planning practices, which are unfortunately missing from or only superficially discussed in many theoretical studies. The third portion of this thesis contains a discussion of the ring-zone theory, which was developed from a European theoretical model, and examines how it contributes to an understanding of rail’s influence on surrounding urban areas.
In addition to theoretical studies, the following Chinese literature focuses on gathering data to serve HSR oriented research. Chen et al. (2012) investigate and compare passenger preferences between HSR and conventional train and coach services within the Yangtze Delta area. Additionally, scientific modelling is introduced to assess HSR and related developments. Jiang (2012) attempts to optimise HSR station site selection through the ‘Integer Programming Model’, while Guo et al. (2010) suggest formulas and parameters for the evaluation of connections between HSR and local transportation. Lin (2011) quantifies the development of areas surrounding 17 Chinese HSR stations using the Lille European Station as a reference to examine the driving forces and factors of urban development around HSR stations.

It is difficult to apply Western theories and precedent experiences of HSR-related urban development in Japan and Europe to current HONT practices in China. Clearly, there is an urgent need to establish a dedicated theoretical framework to direct the ongoing planning and design of new towns emerging along China’s burgeoning HSR network. This framework should be built upon the study of established rail-city relationships and an evaluation of both successful and unsuccessful cases within and outside China. Theoretical research into rail-city relationships conducted by both Chinese and overseas scholars should also be consulted. Most importantly, the unique nature of Chinese HSR infrastructure, as well as China’s unprecedented rates of urbanisation should be fully taken into account in order to customise future HONT to maintain distinct character and attractive qualities.

1.4.0 Research targets and methodology

Research Targets

This research targets the development of a theoretical framework to define major principal guidelines for future HONT planning and design and aims to create dynamic and quality experiences for future residents of urban HONTs. The author hypothesises that ‘high density’ and ‘rich diversity’ are substantial features of Chinese HONT development and urban life. This view is further argued through a review of historical and current rail-city relationships in China, as well as a criticism of HONT planning and design proposals.

It must be clarified that definitions of ‘urban planning’ and ‘urban design’ are comprised of a wide range of specifications. In China, a complete research plan covers a long list of issues such as society, environment, and sustainability, to name a few. In this research study, however, the author’s limited knowledge and skill competencies restrict an extensive exploration or inclusive study of every planning and design topic relating to HONT. This thesis, therefore, focuses its interest on an investigation of the spatial and functional relationships between an HSR station and urban HONT, which inspires a brief theoretical framework to guide future planning and design practices. However, the presence of such issues demands future research into this subject.
Research Methodology

The proposed research will follow a hypothesis-data analysis-principal guidance application-and-verification structure; to this end, a series of research methods will be applied at each stage.

During the data collection stage, an examination of literature (mainly from English language and Chinese resources) and site/case visits represent the main methods of gathering raw materials. English literature is collected primarily from the library of the University of Western Australia and is supported by internet resources. Chinese literature is mostly accessed through the Chinese web of knowledge, and additional Chinese webpages are consulted as needed. Further, local libraries in Perth, Australia (the State Library of Western Australia) and Hangzhou, China (the Hangzhou Public Library and the Zhejiang Library) are utilised.

It should also be pointed out that, in this thesis, the author delivers an extensive study of Chinese literature, most of which has been rarely exposed in current English research context according to the author’s knowledge and experience. By taking this research opportunity, it is highly valuable to introduce outcomes of Chinese studies during past decades, although some of them have been developed upon data from western researches, for example, the Chinese studies of American and European railway histories in Chapter Three (section 3.2.0). By studying the re-interpreted western researches through Chinese lenses, it also helps the author to understand the relevance of rail-city phenomenon in China and the westernised world.

As a supplement to comply with the thesis examination requirement of English literature, the author has also included relevant information of western studies. For example, extra European sources are provided in the historical study of rail development in Europe, in Chapter Three.

During the four years of the author’s candidature, six trips to China were made to study various railway stations and their surrounding urban areas. Additionally, the author made one trip to Japan and one to Europe to gather relevant case data.

In the analytical stage, comparisons provide the primary method of examining cases drawn both from Chinese and overseas contexts. Furthermore, archival research of published planning documents and HONT projects was conducted to draw provisional guidelines for the following stage.

The application stage has required an adoption of the provisional guidelines into an urban design practice. The design will be developed in the context of a planning scheme from a selected HSR town in China. The outcome of this design will be compared to the original urban design scheme, and will focus on changes made during the application of the guidelines; following this evaluation, conclusions will be drawn.

4 中国知网, available online through: http://www.cnki.net
The above design method has been widely applied in architectural teaching and research practices, as demonstrated in 2001 by the award winning project *Barking and Dagenham, The New Civic Industrial Culture* by the Diploma of Architecture Studio 1, University of Cambridge. This author was part of the team that examined urban metabolism theories through urban planning and design exercises.

1.5.0 Thesis structure

This thesis consists of four parts and eight chapters, with two chapters dedicated to each part.

Part One (Chapters One and Two) establishes the research background. Part One includes this chapter’s discussion of Chinese urbanisation and HSR development, as well as recent challenges relating to HONT practices. Additionally, a brief review of station-city relationship research is followed by a statement of the research target.

Chapter Two focuses on the argument that ‘density’ and ‘diversity’ are substantial features of HONT development and urban life. Chapter Two begins with a literature review to examine theories relating to urban ‘density’ and ‘diversity’ and to discuss their meaning in the context of urban areas surrounding railway station nodes. This is followed by a review of Chinese ‘new town’ practices implemented since 1949 and evaluates widely criticised problems of excessive size, low density, and mono-functionality. By studying the historical relevancies and current operations of Chinese ‘new towns,’ the author was able to make findings to explain the ‘density’ and ‘diversity’ crisis. The argument is further supported by a comparison of Japanese and European cases, which demonstrate both successful and unsuccessful station-city relationships at different scales and in various contexts. To conclude, an examination of the principles of densified and diversified urbanities around station nodes facilitates a better understanding of the HONT phenomenon.

Part Two (Chapters Three and Four) reviews the established Chinese rail-city relationship. This review is developed with a dichotomous approach from both historical and geographical perspectives. Chapter Three examines historical research in building a ‘chronological section.’ This is accomplished via a comparative study of rail-city relationships developed during the early years of rail in America/Europe and China, in order to understand how rail infrastructure has powered urban development on large (national/regional) and small (urban/metropolitan) scales. A case study of Hangzhou City is introduced as an example of how different relationships between rail systems and urban residents were developed throughout the past century. This chapter concludes with a discussion of HONT challenges, taking a historical view of the Chinese rail-city relationship.

Chapter Four approaches the research from another perspective, building a ‘geographical section’ by examining the current rail-city relationship and discussing the concept of station-influenced development areas (SIDA). SIDA typically applies to conventional inner-city stations and their immediate urban areas and is a counterpart to HONT, which emerge on city peripherals and outskirts. This study is

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5 Part II Commendation, the President’s Medals Student Awards 2002, RIBA, available online through: [http://www.presidentsmedals.com/Entry-10811](http://www.presidentsmedals.com/Entry-10811), viewed 18 August 2016.
detailed through an examination of three major SIDAs in Xi’an, Beijing, and Shanghai, chosen from a selection of 32 stations in 24 cities across China. The rich variety of samples supports an in-depth understanding of contemporary rail-city relationships in China, which are shaped by different urban contexts.

Part Three (Chapters Five and Six) builds upon knowledge from previous chapters and further investigates HONT practices through an analysis of ‘density’ and ‘diversity’ approaches to Chinese HONTs. Three planning and design proposals representing HONTs at different scales, locations (to parent cities), and levels of importance (on the HSR network) are illustrated in this section. Chapter Five addresses the ‘density’ topic and considers the development potential of urban HONTs powered by different ‘flows,’ or urban transports connecting the HSR infrastructure. Both theoretical and case studies included in this chapter indicate that current transport planning of HONTs comprises heavy investments into connections between regional urban nodes and HSR stations/urban HONTs. These studies also suggest that currently planned transportation systems within urban HONTs are potentially insufficient to support physical developments.

HONT ‘diversity’ is the topic of Chapter Six, which examines the functions and land uses of HSR stations and urban HONTs. The author investigates two tightly connected concepts, the ‘urbanisation of stations’ and the ‘stationisation of cities,’ to analyse the functional relationship between stations and cities in HONT scenarios. By critiquing observed disconnections between HSR stations and urban areas as they relate to HONTs, the author argues that diversified urban living only occurs in a HONT with maximum translation between station users and urban users.

Part Four (Chapters Seven and Eight) summarises the theoretical argument and visualises future HONTs through an urban design strategy. In Chapter Seven, an existing HONT planning scheme is selected and developed into a brief urban design proposal, applying the theoretical framework according to principles summarised in previous chapters. This theoretical application further allows the author to qualitatively assess the theory in a real world project context.

Chapter Eight concludes this thesis through summarising its findings, theoretical impacts, and research limitations. The future development of this research is also discussed in the last chapter to illuminate further efforts in understanding HONT developments.

The thesis structure is also presented in Table 1.01, through summarising the research questions of Chapters One to Seven, as well as the answers to the questions.
1.6.0 Terms and definitions

High-speed rail (HSR)

According to the UIC (International Union of Railways), HSR refers to ‘a complex reality involving various technical aspects such as infrastructure, rolling stock and operations and crosssector issues such as financial, commercial, managerial and training aspects.’ As defined by the European Union, rolling stocks operating in a high speed rail network regularly travel at or above 250 km/h on new tracks, or 200 km/h on existing tracks (UIC).

According to the NRA (National Railway Administration of China), HSR refers to rail infrastructure operating at or beyond 250 km/h and dedicated solely to passenger transport. This partially explains why the entire Chinese HSR network was built independently of old rail tracks. However, most major HSR terminals combine both HSR and conventional rail services.

According to the UIC and NRA, the total global length of HSR tracks spanned 29,792 kilometres as of April 2015, of which over 19,000 kilometres are in China. Of the 1.6 billion global travellers who utilise HSR trains annually, half are in China.

HSR is developed by various companies across Japan and Europe, which are summarised for later discussion:

Japan: Shinkansen; Germany: ICE; France: TGV; Spain: AVE
HSR oriented new town (HONT)

There are two preconditions to the definition of HONT as it relates to this research. First, an HSR station serves as the core of infrastructure and development, and in most circumstances also represents the geographical gravity center. The operation of HSR infrastructure generates direct power for urban economic and physical development. Second, a ‘new town’ describes the main entity of development and refers to an urbanity that develops from HSR; in most cases, the urban area is built on lands which fringe or are external to existing footprints and are lacking pre-existing urban development. Within the Chinese statutory land ownership structure, this practice implies an ownership transfer from collective (rural land) to state (urban land) through an official planning process.

The understanding of HONT should be clarified from urban developments oriented at other types of main transport infrastructure, typically the ‘aerotropolis’ as discussed by Kasarda and Lindsay (2011), and the transit oriented developments (TOD) which have been widely discussed during recent decades. In these scenarios, the transport infrastructure is generally theorised as igniting and continuously powering the economy and developments around the node area, but in further looking into the scale of infrastructure and the relationship between infrastructure and city, the author argues that HONT presents a clearly different case compared with the ‘aerotropolis’ and TOD.

According to Kasarda and Lindsay (2011), the ‘aerotropolis’, or the ‘airport city’ as defined by Kasarda (2010), is conceptualised upon the global aviation network, which supports businesses and industries that require close connectivity to their customers and suppliers from long distances. By employing the aviation network as an efficient infrastructure to facilitate this demand in a global context, the airports are expected to become nodal ‘urbanities’ that accommodate the related economies. Compared with the railway stations, however, airport terminals are widely observed to be significantly isolated from their nearby urbanities, mostly due to the physical barriers of runways and artery roads around the terminal buildings. This barrier prevents tight integration, in both spatial and functional dimensions, between the terminal building and its immediate urban precincts, which is nevertheless highly appreciated in a HONT scenario as discussed in Chapters Five and Six. Consequently, developments around an airport are much less densified and diversified than those around a railway station, which can be well exemplified by different urban proposals around the HSR terminal and airport terminal of Shanghai Hongqiao Terminals, a unique project combining both rail and aerial infrastructures (refer to the case study of Hongqiao in Chapters Five and Six for details).

According to 中华人民共和国宪法 (the Constitution Law of the People’s Republic of China) (issued in 1982), Chinese land is publicly owned and ownership is divided between ‘state ownership’ and ‘rural collective ownership.’ The latter system is structured through village administrations, whose members collectively own the land. This form of ownership allows for the building of dwelling houses and the development of agricultural production activities such as cultivation and grazing by villagers (members). Rural land rights are not permitted to be traded on the market or leased for non-agricultural purposes. State ownership covers all other land not claimed by any village collective; state owned land can be developed according to planning or other statutory documents. Individuals/organisations from within or outside China are allowed to exercise rights over state owned land through lease, which can be traded on the market.
TOD as initially theorised by Calthorpe (1993) proposed that urban public transport should be encouraged to diversify the homogeneous sprawling suburbs in America that had been dominated by private cars. Cevero (1998) has further developed this theory in a much expanded context of global cities, arguing that a ‘fit’ relationship between the ‘transit services and built forms’ (page 72) should be achieved around an urban public transport station node, through a principle of ‘3-Ds [...]: density, diversity, and design’ (page 72). TOD was introduced to China during the early 2000s (Wang, 2012), and has attracted wide research interests in customising particular knowledge that is applicable to Chinese cities, such as urban spatial structure (Pan, 2007; Guan and Cui, 2003), urban land use (Lai, 2005; Du and Zhou, 2006), and planning practice (Lu and Zhao, 2008).

By comparing in a theoretical way, a HONT can be distinguished from a TOD development in two typical dimensions. First, the HSR infrastructure operates at a much extended scale compared to the transit services of a city, which potentially integrate their related developments with resources/hinterlands at very different scales. This also means there is a user difference involved in a HONT and TOD living, which, according to the discussion of Chapters Five and Six, normally leads to varied results of ‘density’ and ‘diversity’ of urban experiences. Second, the capacity and efficiency of the HSR infrastructure, much beyond the conventional urban transit system, requires a HONT to consider supplementary local/regional systems in its transport planning to achieve integration between rail and city (refer to Chapter Five for details of this topic). This impact, from urban development to shape the transport, is hardly observed from most TOD practices, where transport modes normally dictate the urban development pattern.

**Urban planning (in China)**

The current statutory planning system was defined by regulations issued by the Ministry of Housing and Urban-Rural Development of the People’s Republic of China via 中华人民共和国城乡规划法 (the Urban and Rural Planning Law of the People’s Republic of China), issued in 2008, and 城市规划编制办法 (the Methods of Urban Planning Making), issued in 2006. Based on these statutory codes, Wu (2009: 219) interprets that ‘urban planning is a future development target of cities and towns envisaged by government, aimed at improving urban dwelling environments, regulating population size, land use, resource conservation, environment protection, all development and construction activities in areas with highly intensive agglomerations of non-agriculture economic, social, cultural and recreational activities. [It also involves] comprehensive coordination and detailed implementation of urban development. Statutory planning is an important public policy that protects public interests and implements co-development of [a city’s] economics, society and environment.’

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7 The original text in Chinese is: ‘城市规划是政府确定城镇未来发展目标,改善城镇人居环境,调整控制非农业经济、社会、文化、游憩活动高度聚集域内地域人口规模、土地使用、资源节约、环境保护和各项开发与建设行为,以及对城镇发展进行综合协调和具体安排;依法确定的城市规划是维护公共利益、实现经济、社会和环境协调发展的重大公共政策’.
Within the Chinese top-down hierarchical system, statutory planning practice is strictly implemented across governmental strata. According to the Methods of Urban Planning Making, current urban planning practice is carried out in two general stages: Master Planning (总体规划) and Detailed Planning (详细规划). The master planning phase ‘should follow the national city and town system planning, provincial city and town system planning, and other upper level planning documents as statutory basis’ (Clause 21). This level of planning typically involves large scale issues such as planning scheme scope, protected development areas (such as cultivated land and scenic areas), buildable land areas, infrastructure and public facilities, historical and cultural heritage sites, biological and environmental protection policies, and disaster prevention projects (Clause 32).

The detailed planning stage is normally split into Statutory Regulative Planning (控制性详细规划) and Constructive Regulative Planning (修建性详细规划). The former regulates such individual land plot issues as land use, building footprint percentage, building height, floor area ratio, vegetation coverage, and infrastructure and public facility concerns. The latter focuses on the assessment of land plots, including build-ability and feasibility studies with accompanying techno-economic index figures, solar-gaining analysis, traffic circulation analysis, municipal pipeline proposal, ground elevation proposal, and investment and revenue analysis (Clauses 42 and 43).

**Urban design (in China)**

Compared with the formal statutory concepts of ‘urban planning,’ the practice of ‘urban design’ in China is non-statutory and informal. Researchers such as Hu (2002), Zou (2003), Zhuang (2004), Lu (2005) and Li (2005) have made many attempts to develop both academic and practical definitions of ‘urban design’ in a Chinese context; however, ambiguity remains between planners and architects.

Drawing on the author’s nine years of experience practicing planning and architecture in China, this thesis defines ‘urban design’ as an intermediate design approach that connects statutory urban planning and architectural design. This definition stems from observed deficiencies in planning scheme implementation, especially those flaws relating to the fact that most statutory planning documents are delivered in abstract numbers and two-dimensional diagrams (Li, 2006). Often there is not enough information to guide the architectural design of individual land plots. Meanwhile, there is no convincing method to comprehensively test and verify planning proposals.

In this context, ‘urban design’ develops the principles of statutory planning to build and space forms within a designated project boundary. It delivers preliminary architectural designs and complies with planning requirements such as land use, floor area ratio, building footprint percentage, building height limits, and site entrance/exit locations. Furthermore, the ‘urban design’ scheme examines the layout of public urban spaces and major infrastructures in an effort to study their influence on urban users.

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8 The original text in Chinese is: ‘应当以全国城镇体系规划、省域城镇体系规划以及其它上层次法定规划为依据’.
As a method of categorising statutory planning into three dimensional diagrams, urban design schemes can be used to test and verify those principles established through planning documents, or can be used as evidence to justify planning amendments. Conversely, a widely recognised urban design proposal can facilitate the adoption of policies or detailed guidelines for individual projects in an effort to achieve improved overall design quality.

**Urban life (in China)**

In general terms, ‘urban life’ refers to all activities, repetitive or random, that take place in the indoor or outdoor spaces of a city or town, and that involve the area’s residents and visitors. Such activities include, but are not limited to: living, working, shopping, recreating, meeting, touring, traveling, and commuting. Hillier (1996: 53-56) describes urban activities as ‘contacts’ between the people of a city—contacts that are shaped by a ‘mechanism’ involving the construction of ‘interfaces between scales of movement.’

The concept of ‘urban life’ is described in contrast to the other major mode of human dwelling, ‘rural life.’ Weber (1968: 1213, 1226) distinguishes urban from rural life by defining two features of the former. First, the local urban economy is structured according to multiple trade markets which allow ‘inhabitants [to] live primarily from commerce and the trades rather than from agriculture’ (page 1213). Second, the political character of urban life should be defined as a ‘commune’ structure with ‘at least partial autonomy and autocephaly, which includes administration by authorities in whose appointment the burghers could in some form participate’ (page 1226). However, Weber argues that these features demand strong occidental understanding and are not applicable to most cities in the orient, including those in China. This implies that the definition of ‘urban life,’ as it relates to Chinese cities, should be interpreted through an examination of urban participants, as is described in the following section.

**Urbanisation (in China)**

‘Urbanisation’ is the process by which rural residents are transferred to urban environments, normally in parallel with the growth of an urban population and, in most situations, the expansion of an urban footprint. The re-housed population generates the internal power of urban growth, which is externally represented by physical sprawl and development. Such a process is substantially defined by the transfer of people rather than the growth of a city. In China’s current social migration system, which is heavily regulated by the ‘urban-rural dual household registration’ policy, the urbanisation of rural residents can occur in one of two ways: through ‘migrated urbanisation’ or ‘localised urbanisation.’

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9 This policy was established by 中华人民共和国户口登记条例 (the Residence Registration Act of the People’s Republic of China) in 1958. This act grants citizens of China either a ‘rural household’ or an ‘urban household’ registration according to the major family member’s career (for instance, worker/cadre: urban; peasant: rural) and residence. In the era of planned economy, the ‘registration’ of each household was the most important factor in the distribution of food and daily necessities. Initially, rural registered families, comprising the majority of the population, were supplied by their Collective Production Communes (集体生产大队) with food from their own cultivation. The minority urban registered population was supported by the state through the taxing of rural productions. The two
‘Migrated urbanisation’ refers to the relocation of rural residents to urban dwellings. However, the household registration control policy does not allow many rural immigrants to freely transfer their registration to urban status or to directly access the rights enjoyed by registered urban residents, such as social benefits for unemployment, education, pension, and medical services. Most governmental services available to rural immigrants remain linked to their original village if their registrations are not updated, and thus are not transferrable to their new urban life. As such, the process of ‘registration migration’ is substantially more difficult than that of ‘geographical migration’ in terms of population urbanisation. The threshold to qualify as a registered migrant in most Chinese cities is hugely demanding; often, an individual must possess a qualified university degree, military service, or property ownership of a recognised value. As a result, a large percentage of rural youths and adults move into cities to enjoy higher labour wages, but are compelled to leave their older and younger relatives behind in their home villages. This ‘floating’ population creates huge demographic tides between urban and rural China during annual festivals such as the Spring Festival, and exacerbates the unique phenomenon of ‘rural-rooted urbanisation.’

‘Localised urbanisation’ is generated by physical urban expansion, which transforms peripheral rural land (collectively owned by a village for cultivation) into urban land (state owned for construction). During this process, the original rural population is passively transferred into the urban population. This is a typical phenomenon widely seen in HONT practice. Chapter Six contains an in-depth discussion of the details of this process.

Imbalanced systems of supply created a huge gap between rural and urban dwellers during the planned economy era; a gap that remains to this day to a certain extent. Through strict supply controls, the creation of a ‘dual household registration’ policy was clearly intended to lock residents into their status. This was likely intended as an attempt to curb the feverish urban growth that occurred during the radical industrialisation campaign of the 1950s, widely known as the ‘Great Leap Forward.’ This policy was followed by a series of de-urbanisation campaigns during the 1960s and 70s to release the supply pressures of an increasing urban population, which demanded a wide range of social welfare services compared to the limited services available in rural areas. The sharp urban/rural differences exacerbated pressures to limit the migration of villagers to cities. However, the national economic reforms of the 1980s spurred a level of Chinese urbanisation that is unprecedented in human history.
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Chapter Two

Research Question: How should we define future HONT living in China?

2.1.0 Introduction

The concept of HONT (high-speed-rail oriented new town) is a combination of two factors. On one hand, the HSR (high-speed-rail) infrastructure shapes the town’s operational mechanism, specifically traffic flows in regional and local dimensions, in order to attract users to create and/or participate in activities around a station precinct. On the other hand, the ‘new town’ represents physical developments arising from the operational mechanism, which facilitate such activities and attract further users.

Given the high level of integration between the rail infrastructure and urban life, the author hypothesises that ‘high density’ and ‘rich diversity’ define the features of HONT development and living experiences. These features come from the quantitatively intensive and qualitatively mixed nature of the potential users of the infrastructure and urban aspects of a HONT precinct. This chapter defends this hypothesis from both theoretical and practical foundations, in an attempt to provide a solid basis for further discussions developed in the rest of this thesis.

The chapter begins with a general discussion of the concept and connotation of ‘density’ and ‘diversity’ in a railway station node context and their poor representation in both current Chinese HONT theories and the Chinese statutory planning system. A second theoretical review is developed in order to understand the Chinese ‘new town’ development pattern, one which is widely criticised for lacking qualities of ‘density’ and ‘diversity’. This includes a study of early ‘new town’ theory and practice from Westernised countries and the Soviet Union, as well as their influences on shaping the contemporary Chinese ‘new town’ development pattern.

Following the theoretical discussion, the chapter adduces cases from Japan and Europe to illustrate a variety of rail-city relationships, with a view particularly to decoding the ‘density’ and ‘diversity’ features from these cases, as well as understanding the HSR’s role and performance in developing a highly integrated rail-city relationship. This learning is highly valuable for acquiring knowledge about Chinese HONT practices.

2.2.0 Theoretical basis (literature review)

Summarising the viewpoints of Jacobs (1961) and Grant (2002), Trip (2007: 69) suggests that ‘relatively high or very high densities’ of developments and ‘mixed-use’ urban functions represent the urban quality of the railway station nodal area.

Here, ‘density’ refers to the physicality of urban spaces, and ‘diversity’ indicates the functionality of urban activities. This relationship is described by Hillier (1996: 41) as a ‘means-ends system’, ‘in which the means are physical and the ends functional’. The element that bridges the gap from physical spaces
to functional activities is the space grid system of a city, as well as the ‘natural movements’ that take place in this grid. According to Hillier’s theory, the urban grid defines and restricts internal movements, thus shaping the ‘land use and building density’ in a city. Applying Hillier’s ‘space syntax’ language, the space of a city itself generates global principles to guide the random movements of individuals in the discrete system within it. This can be interpreted through the space syntax as a ‘genotype’ (Hillier and Hanson, 1984) of the space, which, under certain conditions of density and integration of the grid structure, will be developed through ‘multiplier’ effects into the ‘phenotype’ (Hillier and Hanson, 1984) of a city related to its density and land use, i.e. its physical expression or materiality.

The author does not intend to interpret HONT planning schemes using the ‘space syntax’ language, but by applying this theory to the urban scenario of railway station-node development, it may be seen that ‘high density’ and ‘rich diversity’ are the ‘phenotype’ developed from the space’s ‘genotype’, consisting of the intense movements aggregated by the station’s locational advantage. As Hiller (1996: 53) asserts, the ‘multiplier effect’ from the physical density in turn powers further growth of density and function.

For railway stations with a large number of commuting services, the ‘movements’ within the urban grid of the nodal area generate active impulses to density and diversity. This is because the movement pattern around the station, in Hillier’s terms, is ‘symmetric’ and has ‘less depth’. ‘Symmetric’ means a direct connection between station and destination, not involving a third space. This is normally true for many passengers commuting between the station and their workplaces in the city. As Hillier and Hanson (1984: 96-97) suggest, ‘the more descriptions are symmetric […], then the more there will be a tendency to the integration of social categories.’ On the other hand, intensive agglomeration of urban destinations around a station means fewer straight lines, or ‘depths’, occur in the movement and consequently an increased ‘integration value’ (Hillier, 1997: 47) of the spaces around the station to power the benefits of development.

Thus, both the ‘high density’ and ‘rich diversity’ features of station node area exhibit the agglomeration effect of large population flows around the rail infrastructure (and other integrated transport modes). The ‘density’ feature represents the quantity of people gathering in both time and geographical dimensions; while the ‘diversity’ feature comes from the qualitative bio-diversity and social diversity of the people involved in the urban lives of a station and its immediate urban areas.

In Chinese urbanisation, ‘high density’ and ‘rich diversity’ are fundamental demands. Drawing on a large amount of statistical data on Chinese urban development, Qiu (2006) has criticised the prodigious low-

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10 There are two reasons for not using ‘space syntax’ theory for the present HONT analysis. First, as Wu et al. (2014: 96) have discovered when applying this methodology in his Suzhou urban planning study, it demands a huge amount of time and effort, which is much beyond the author’s individual capacity. Second, ‘space syntax’ is widely questioned for its known ‘defects’ in relation to planning practices, especially its applicability to Chinese cities that are undergoing substantial spatial changes. Wu et al. (2014: 104) conclude that the reliability of a model built through space syntax methodology needs further testing; and Zhang et al. (2014: 85) believe the difficulties it presents in surveying real three-dimensional spaces will lead to a result lacking comprehensiveness and accuracy.
density urban sprawl, in the context that China is fast losing its agricultural lands, presenting a challenge to the security of the nation’s food supply. Meanwhile, the rigid planning system and out-dated concepts of development have been producing functionally homogeneous areas that fail to foster dynamic lifestyles. Qiu concludes that ‘the compactness of development land and the diversity of urban areas should be the core concepts of sustainable developments in Chinese cities’\textsuperscript{11} (page 18). For the HONT developments, the argued ‘compactness’ and ‘diversity’ features are even urgent to achieve through planning and design practices.

In the following sections, this paper further investigates the concepts of ‘density’ and ‘diversity’ in urban life, especially their meanings as defined by station-node area development, as well as the origin and patterns of ‘new town’ development in contemporary China.

2.2.1 Theories of ‘high density’

Density as a physical dimension

Urban density is a physical concept that refers to the total built volume within a defined geographical boundary. According to Pont and Haupt (2010: 11), Unwin (1909) has used the ‘density’ concept to oppose overcrowding of urban dwellings, suggesting a maximum standard of 30 houses per hectare. About half a century later, in a criticism of low-rise urban sprawl across America, Jacobs (1962) asserts that urban residential ‘density’ should be no lower than 250 dwellings per hectare. More recently, in regard to compact and high density urban living, MVRDV (1998, 2005) have further physicalised the ‘density’ concept, computing future dwelling models to arrive at the highest possible urban ‘density’ for human habitation.

This quantified ‘density’ concept based upon built floor area and the respective site area is widely applied in urban planning and architectural design practice, despite descriptive variations across territories. For example, Churchman (1999)\textsuperscript{12} has identified different ‘density’ descriptions as ‘parcel density, net-net density, net and gross residential density, general density and community density’. In the Chinese planning system, urban density is measured as a ‘floor area ratio’ index, which defines the permitted building volume of a development project. In addition, there are other indices of ‘building density’ (footprint percentage of the site) and ‘building height’ to further control the size parameters of a building project.

Density as a quality dimension

Pont and Haupt (2010: 12) point out that density figures do not represent the true qualities of urban spaces. In fact, the same floor area of one urban land plot can be developed into substantially different design schemes (Figure 2.01). It is difficult to fully and precisely describe urban life by regulating abstract figures; a liveable ‘urban density’ must be further defined with a quality dimension.

\textsuperscript{11} The original text in Chinese is: ‘建设用地的紧凑度和城市的多样性应该是我国城市可持续发展的核心理念.’

\textsuperscript{12} According to Pont and Haupt, 2010: 13
Gehl (2010: 69) suggests that high quality is associated with high density in an urban context. In an interview (Li, 2012), Professor Yu Hai argues that the density of ‘social interaction’ reveals the nature of living in a densified urban area. Thus, interaction between people is the essence of a ‘high density’ concept, which encourages the shaping of a sophisticated interpersonal social network. Professor Yu describes this phenomenon as the ‘organic attribute’ of a society.

Kuang (2012: 6) interprets the sophistication of ‘high density’ in the context of Chinese urbanisation. Apart from the index figures, Kuang recommends that ‘a systematic understanding should be applied to read urban high density with interconnected relationships of transport, space morphology, infrastructure construction, industrial function, and information communication.’ This means ‘high density’ urban living is supported by intensively agglomerated multiple resources, including both physical facilities such as transport and building and social activities such as communication and culture. From this perspective, it would logically follow that the ‘high density’ concept, with combined physical and social features, is an appropriate term to describe, or indicate, the quality of urban life.

Density of railway station node urban developments and HONT

Both European theories and Japanese practices have investigated the relationship between railway station nodes and urban developments.

Bertolini suggests a ‘node-place model’ (1999: 202, also see Figure 2.02) to theorise the potential of developing ‘places’ around transport node areas. He argues that an equilibrium between ‘node’ and ‘place’ could be achieved in the long term, such that ‘the demand for transportation services from the activity place and the demand for activities from the transportation node will find a (temporary) balance’ (Bertolini, 1999: 203). This model covers a wide range of rail nodes, including the HSR infrastructure, which is a typical example of a ‘strong node’ (van Hagen and de Bruyn, 2002: 5-6) and therefore has potential for an equivalent performance in ‘place’ development.

Bertolini and Spit (1998: 31-35) have also pointed out the importance of incorporating different local connections in a station node. In other words, the infrastructure’s potential for powering urban development is not defined by one single transport mode, such as HSR. Despite its high capacity and efficiency, an HSR system without strong support from local connections will become a low-efficiency and unattractive infrastructure. The case of Haining in Chapter One, which demonstrated that travelling between a remote HSR station and the city centre takes much longer than on an HSR service from Shanghai to Haining, is a good example of this.

Priemus (2007: 26-27) also supports the argument that smooth connections in local transport are important for synchronising infrastructure operation and urban development. An HSR node without enough support from local connections is limited in its potential to develop a relationship with the city.

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13 The original text in Chinese is: ‘要以系统地眼光看待高密度环境下城市的交通、空间形态、基础设施建设、产业功能和信息沟通等方面的耦合关系’

14 The original text in Dutch is: ‘Zeer groot station.’
Only a well-connected node that is effectively integrated with nearby urban areas has the potential to trigger densification. Case studies which are developed later in this chapter from Japan and Europe, also echo this view.

In addition to the above European theories, a Japanese perspective is presented by the Nikken Sekkei ISCD Study Team (2013), which argues that the driving force for urban development is the integration of stations (including Shinkansen stations) and cities. It is worth noting that this study emphasised the ‘compact city’ effects shaped by rail-based transport systems, which aimed to increase urban densities by reducing automobile usage and by promoting rail- and metro-based public transport.

In HONT practices, ‘high density’ synthesises physical volumes and social lives generated by station users from a wide geographical range, from national and regional to local and metropolitan, that is served by the HSR infrastructure and its local connection network. Such integration of multiple transport modes presents a huge potential for high density living around station nodes, which needs to be supported by intensified urban developments. Consequently, HONT presents a unique practice pattern diametrically opposed to the conventional Chinese ‘new town’ practice, which attracts residents by building on vacant land. The HSR infrastructure brings people into proposed HONT areas even before most of the developments have been constructed. With HONT, there is pre-existing demand for urban facilities.

Chinese researchers widely endorse the ‘high density’ development potential around HSR station nodes. According to current literature, however, this ‘high density’ is normally interpreted as a high volume of floor area development, that is, ‘physical density’, rather than the density of urban lives, or ‘social density’. For example, Pan and Chen (2010: 129) explain the ‘high density’ planning of urban areas around HSR station nodes as ‘overall high density land use’ to shape a high ‘development intensity’. Xing (2013: 226) employs the term ‘land development intensity’ to describe the urban built volume around an HSR station. This includes ‘the building development volume and [its footprint] coverage density, which can be controlled by three indices of floor area ratio, building density and building height.’ Lin and Ma (2012: 43) have further calculated the floor area ratio in seven development project cases around HSR nodes, and finds the average to be 3.34.

The ‘high density’ of a HONT is probably the result of Chinese statutory planning practice, which is a management system based on index parameters. However, as argued above, this physical description of density does not deliver a clear understanding of urban life. According to the diagram of Pont and Haupt (2010: 13, also Figure 2.01), the same density index can potentially lead to widely different urban morphologies and spaces, which will shape urban living experiences that differ substantially in quantity.

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15 The original text in Chinese is: ‘整体高密度土地使用.’
16 The original text in Chinese is: ‘开发强度.’
17 The original text in Chinese is: ‘用地开发强度.’
18 The original text in Chinese is: ‘土地的建筑开发容量和建筑覆盖密度，可用容积率、建筑密度和建筑高度三个指标来进行控制.’
and quality dimensions, such as the single tower apartment versus the multistorey estate. In short, the same density index can yield different ‘social densities’.

In a HONT scenario, unprecedented passenger flows in a station create a huge potential to shape intensive social communication at various scales. This potential should be the focus of any planning and design practice relating to a HONT. From another perspective, rich urban living experiences are supported by dense building and urban spaces, although the reverse is not true. The widely emerging ‘ghost towns’ in China, composed of closely packed but desolate tower forests, exemplify the point.

2.2.2 Theories of ‘rich diversity’

*Diversity in an urban context*

Jacobs (1962: 144) identifies the ‘mixture of uses’ of a city as ‘the first question – and [...] by far the most important question’ to define ‘civilization’. Jacobs delivered her ‘diversity’ argument in a rational structure, elaborating through carefully considered urban experiences such as ‘small blocks’, ‘aged buildings’, and ‘concentration’. It is, however, clear that the actual scenario that Jacobs was trying to show is an urban image with all its elements, both physical and empirical, highly integrated and interconnected, which makes it almost impossible to categorise and slice the image for ‘rational’ study. The picture of the city that Jacobs painted is of a dynamic urban experience, rich in forms, contents, colours, patterns and scales.

Similarly, Gehl (2010: 63) has emphasised that ‘varied and complex city life’ is one of the qualities of a ‘lively city’, which can be achieved by encouraging walking to increase participation in urban life. Qiu (2006: 21) asserts that the ‘culture, resource, and industrial diversity’19 in the city itself largely determines the capacity for sustainable developments. In the context of Chinese urbanisation, Qiu (2012: 2-3) further cites five features of diversity for a Chinese city: ‘street style diversity, space layout diversity, architectural and garden vegetation diversity, industrial diversity, and circulatory, as well as urban and rural environment diversity.’20 Such systematic interpretations have greatly enriched and extended the concept of urban diversity.

*Diversity in station node urban developments*

Does this ‘diversity’ concept apply to urban areas in immediate proximity to a railway station? The ‘diversity’ of urban life is a direct result of ‘the fact that in cities so many people are so close together, and among them contain so many different tastes, skills, needs, supplies and bees in their bonnets’ (Jacobs, 1962: 147). The rail infrastructure also boasts its users’ great numbers and rich diversity. Given that a railway station’s passengers are invited into urban lives around the station node, their varied social backgrounds are naturally translated into potential activities in the city. That is, the physical agglomeration of people from a wide geographical area shapes the urban diversities around the node.

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19 The original text in Chinese is: ‘文化、资源和产业多样性.’

20 The original text in Chinese is: ‘街道风格的多样性；空间格局的多样性；建筑与园林绿色多样性；产业的多样性及循环性；城乡环境的多样性.’
European research has devised an integrated theoretical framework for understanding urban diversities around railway station nodes.

Trip (2007: 30-31) has reviewed the definitions of urban life ‘quality’ by synthesising Florida (2002, 2005a, 2005b), Kloosterman (2001), Glaeser et al. (2001) and Gertler (2004), concluding that ‘diversity’ is among the key factors that shape the ‘quality’ of an urban place, comprising a broad range of aspects from social economy to space morphology, and from security to comfort. The urban diversity in areas immediately around the station comes from ‘the combination of transport and location functions’ (Trip, 2007: 72). Accordingly, the mixed functions of urban areas around the station are interlinked with the diversity of station users.

Pol (2002: 15) advances the understanding of urban functions around a rail infrastructure node, pointing out that homogeneous function does not shape attractive urban lives. Instead, ‘diversified economy, diversified districts, multi-modality, minimising nuisance of transport (infrastructure), attractive public spaces and buildings in harmony with the city size and nature’ are necessary to create sustainable prosperity around a station.

Bertolini and Spit (1998: 42) investigate station-city integration from a practical perspective, recommending that decision making should be based on an understanding of the locational features of stations attained through a ‘feasibility study’ and ‘market survey’, as well as considerations of future economic and social benefits. Bertolini and Spit (1998: 39) also explore potential functions that would fabricate urban lives around a European railway station, suggesting that ‘offices and shops are in all development plans, but sport, recreational and cultural facilities, exhibition and convention centres, hotels, government buildings, housing and – to a lesser extent – light industry may also be present.’ As a result, 24-hour-running economic centres will be possible around future European stations.

**Diversity in HONT practice**

By contrast, the diversity of urban lives is a factor widely overlooked in Chinese statutory planning practices that feature strict hierarchical management. In this system, the urban functions of land are proposed from a top-down perspective, while bottom-up perspectives based on actual experiences of urban living are normally absent from statutory documents. Therefore, it is interesting to consider, from two angles, the ‘diversity’ quality generated by discrete individuals in Chinese HONT planning theories.

On the one hand, the ‘diversity’ concept imported from Western theories is widely interpreted in the form of land diagrams with multiple uses and hybrid functions. For example, Pan and Chen (2010: 129) list ‘diversified functions’ and ‘mixed land uses’ among the principles suggested for HONT planning. Of these, the former means ‘configuring integrated service, business, commercial and residential functions’, to achieve ‘balanced development which is harmonised with the overall urban structure’.

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21 The original texts in Chinese are: ‘多元功能’ and ‘用地混合.’
22 The original text in Chinese is: ‘配置综合性的服务功能、商务、商业和居住功能．’
23 The original text in Chinese is: ‘区域中实现平和发展，并与城市整体结构相互协调．’
and the latter means ‘focusing on land use flexibilities to maximise its development potential’\textsuperscript{24}, leading to ‘integrated distribution of various functions.’\textsuperscript{25}

On the other hand, established Chinese planning theories, especially those based on conventional zoning diagram practices, have a strong impact on the development of today’s understanding of and approach to diversification. For instance, considering the ring-zone structure of land use diagrams (as detailed in Chapters Five and Six) around the HSR station node, Yin (2009: 29) supports a land use model of ‘mixing land plots of residential and public services’\textsuperscript{26} in the extended influence areas of a HONT. Xing (2013: 225) provides a list of land use types for HONT planning, including ‘business office land, commercial service land, conference and exhibition land, entertainment and recreational land, residential land.’ A ring-zone structure is also recommended to locate these functional land plots according to their relationships with the station at the centre.

In general, urban diversification is decoded and represented as mixed-zoning diagrams in Chinese planning theories, meaning that urban richness is structured by mixing land plots that are individually mono-functioned. Chapter Six has a further in-depth study of this phenomenon and its influences in HONT planning practices.

2.2.3 Development of the Chinese ‘new town’ template

Since it was established in 1949, the People’s Republic of China has experienced two very different stages of ‘new town’ developments. The first period, between the 1950s and 1960s, featured a strong emphasis on industrialisation. ‘New towns’ were built to serve emerging new industrial centres, especially serving the heavy industries. During the planned economy era, these ‘new towns’ were part of national development plans, and therefore received government investment. Most of them were away from conventional cities and, being dedicated to industrial production, offered a minimum standard of living facilities, some of which scarcely matched up to ‘urban’ standards. Soviet planning theories were extensively referenced for the ‘new town’ practice of that age.

The second period of ‘new towns’ was ushered in by the soaring growth in the economy and urbanisation since the early 1990s. The main purposes for building new urban centres in this period were to reduce the pressure of population in central cities and to introduce new economies and industries. In the new market economy climate, a different model of practice was tested and established. Instead of investing in every project in every ‘new town’, the government decided to create a statutory framework for the new developments, with investment from a variety of public and private sources to generate individual projects. This was a model learned from the experiences of Westernised countries. Thus, China’s ‘new town’ practice has been influenced by the practice and theory of different systems from around the world.

\textsuperscript{24} The original text in Chinese is: ‘强调弹性使用土地，发挥土地的最大效用．’
\textsuperscript{25} The original text in Chinese is: ‘实现各种用途交错分布．’
\textsuperscript{26} The original text in Chinese is: ‘居住和公共服务用地相混合．’
'New town’ theory and practice development in Westernised states

The ‘garden city’ concept initiated by Howard27 is widely recognised in China as the origin of the modern ‘new town’ (Zhao and Wang, 2011; Xie, 2010; Yao and Guo, 2007). This highly hypothetical theory argues for building independent new settlements outside major cities, buffered by green belts and connected by transport links, in order to redistribute the population (Yao and Guo, 2007) and eliminate the differences between urban and rural areas (Xie, 2010: 49). Unwin (1909) further develops the ‘garden city’ principles into a satellite model around urban centres, based on the challenges facing London at that time (also see: Yao and Guo, 2007: 102), notably the overcrowded urban populations of the late 1800s and early 1900s (Xie, 2010: 47). The first of a ring of first-generation ‘new towns’ was Stevenage, about 45 kilometres north of central London, built in 1946. During the two decades that followed, 32 ‘new towns’ (TCPA, 2014: 2) were developed across the UK, representing the evolution of three ‘generations’ (Planning Brookes and DCLG, 2006: 4) (Figure 2.03): from early homogeneous ‘sleep towns’ to a later independent ‘city’ model, integrating economic enterprises and comprehensive facilities, such as the last ‘new town’, Milton Keynes, built in 1967 (Zhao and Wang, 2011: 66).

The British ‘new town’ experience was much emulated in the second half of the 20th century in areas such as France, Japan and Hong Kong. Zhao and Wang (2011: 67) have compared the ‘new town’ practices of France with those of Britain, concluding that ‘[the former] is larger in size, and is concentrated on integrating and balancing multiple urban functions and activities, such as business, services, research, entertainment, education and light industries.’28 In Japan, new urban dwellings were proposed, together with urban rail lines. Private rail companies were authorised by the government to develop lands around their new lines, thereby shaping urban living patterns fully oriented towards rail services. In Hong Kong, public housing (affordable housing) was integrated into ‘new town’ schemes built on transit-oriented development (TOD) structures. The new urban centres were envisaged with specific industries and functions, so as to form an overall harmonious hierarchy of main city and satellites.

Despite the variety of approaches to development, there is one common model underpinning Westernised ‘new town’ practices: a diversified investment pattern managed by the government. The government takes responsibility for making laws and formulating policies and for shaping statutory planning frameworks, such as the New Town Act in the UK in 1946 and the Schéma Directeur d’Aménagement et d’Urbanisme de la Région de Paris (Master Plan for Urban Planning and Development of the Paris Region) in Paris in 1965. After this, investment from wealthy sources acting from various motives has been encouraged, such as private capital channelled into Japan with an eye on profit and public financing in Hong Kong for social welfare.

27 Howard, Ebenezer, 1902, Garden Cities of Tomorrow, Sonnenschein & Co., Ltd.
28 The original text in Chinese is: ‘规模较大,更注重功能综合和多元平衡,城内集聚了众多的商务、服务、研发、娱乐、教育以及轻工业等产业活动.’
'New town’ theory and practice in the Soviet Union

In parallel, the Soviet Union developed ‘new town’ theories and models with their own characteristics, despite having the ‘garden city’ theories in common as background. Yang (1988) gives a detailed introduction to early concepts that emerged in the 1920s and 1930s, including the ‘disurbanist axial population distribution model’ by Leonidov²⁹ in 1930, suggesting a distribution of the industrial and agricultural populations and dwellings along a large spatial axis (Figure 2.04); the ‘urbanist constellation city’ model by Sakulin³⁰ in 1918, proposing satellite centres around Moscow (Figure 2.05, this model was raised earlier in response to Unwin’s suggestions for London); the medium-small city of collective living based on ‘commune’ units proposed by Sabsovich³¹ and Vesnin³² brothers in 1930 (Figure 2.06); and the ‘dynamic development structure’ model with industries and residential areas arising out of the conventional city promoted by Ladosvsky³³ in 1932 (Figure 2.07).

Cooke (2000) discusses in further detail the argument between the ‘urbanist’ notion, represented by Sabsovich, and the ‘disurbanist’ view, represented by Okhitovich. Hou (2008: 106) implies that ‘the so called urbanist is in fact not significantly different from the disurbanist’³⁴, as both of them were targeting utopian communist urban templates with absolute equities, as well as eliminating differences between ‘urban and rural, worker and peasant, physical and mental’³⁵.

Although the ‘disurbanists’ won victories in the theoretical argument over the ‘urbanists’, thanks to support from the Central Committee of the Communist Party of the Soviet Union (CPSU) both theories ‘have exerted substantial influence on shaping the theoretical frameworks of Socialist planning’³⁶ (Hou, 2008: 106), which heavily influenced Chinese planning theories during later years. The ‘disurbanist’ approach, which typically involved factories and dwellings planned to ‘fuse’ with the natural environment, resulted in many new industrial islands detached from established cities. The urbanist concept was translated into a commune living model, each development housing over a thousand people and sharing various facilities such as kitchen, dining, library, club, kindergarten and school. This model was promoted to replace the conventional family household structure to become a ‘fundamental unit of social structure’³⁷ (Hou, 2008: 106), which was ‘developed into a residential compound pattern in Socialist countries’³⁸ (Hou, 2008: 107).

Between 1931 and 1932, the CPSU decided to re-orient urban planning in a practical direction and correct the utopian ideological trend (Yang, 1988: 13). This re-orientation had a substantial influence

²⁹ The original text in Chinese is: ‘列昂尼托夫’.
³⁰ The original text in Chinese is: ‘萨库林’.
³¹ The original text in Chinese is: ‘萨波索维奇’.
³² The original text in Chinese is: ‘维斯尼内’.
³³ The original text in Chinese is: ‘拉多夫斯基’.
³⁴ The original text in Chinese is: ‘所谓的“城市主义者”实际上和反城市主义者差别不大’
³⁵ The original text in Chinese is: ‘城乡之间、工农之间、体力劳动者和脑力劳动者之间’.
³⁶ The original text in Chinese is: ‘对建立社会主义规划理论框架的影响却不可低估’.
³⁷ The original text in Chinese is: ‘社会组织基本单位’.
³⁸ The original text in Chinese is: ‘二战以后逐渐形成社会主义国家所普遍应用的“小区”’.
over the massive new urban developments after 1955. Two types of ‘new towns’ were developed in this period. The first were satellite towns around a central city, designed to balance population growth, such as the nine new edge towns around Moscow (Yang, 1988: 17). The second were new industrial towns emerging around large manufacturing centres (Yang, 1979: 23).

Yang (1988: 23-25) enumerates the planning features of new urban developments in the Soviet Union. First, large urban spaces were proposed, especially for political squares in city centres, as an indication of their ideological importance. For example, Moscow’s Red Square has an approximately 8-hectare footprint, while its satellite, Zelenograd, built in the 1960s, has a central square of over 80 hectares; and the new industrial centre of Tolyatti, built in the 1970s, has an even larger square of 150 hectares (Figure 2.08). Second, the architecturally enclosed urban spaces of central squares in traditional centres were re-envisioned as open spaces, to maximise visibility and to exhibit an image of ‘grandeur’. A typical case is Tashkent (Figure 2.09). Third, a linear space cutting through the urban pattern was constructed to form a strong ceremonial axis. This axis is normally between 300 and 600 metres wide and extends up to several kilometres in length (Figure 2.10). Tolyatti and Nizhnevartovsk are good examples of this feature.

Development of ‘new town’ theory and practice in China since 1949

The 中苏友好同盟互助条约 (China-Soviet Treaty of Friendship), signed in 1950, was designed to cement a close military and political alliance between the then fledgling People’s Republic of China and the Soviet Union. ‘Comprehensively learning from the Soviets’39 (Li, 2014: 74) became a national strategy underpinning a massive rebuild of China after World War II. By this means, the theories and management system of Soviet urban planning were introduced to China. Large numbers of planning experts, including Mukhin40 and Baragin41 (Zhao, 1999) were sent to China to consult on planning for both traditional cities like Beijing (Figure 2.11) and new industrial centres like Baotou. Meanwhile, the Soviet statutory planning system was re-established in China by means of a series of translated urban planning and design books, such as 苏联城市规划设计手册 (the Soviet Urban Planning and Design Manual) and 苏联区域规划设计手册 (the Soviet Regional Planning and Design Manual) (Zhao et al., 2013: 112).

Zhao et al. (2013) explore Soviet influence in great detail. First, urban planning is found to be ‘production oriented and an implementation of the [national] plans’42 (page 113). This ‘production’ orientation is clearly set out in an article entitled ‘把消费城市变为生产城市’ (Transform consumption cities into production cities), published in the 17 March 1949 issue of 人民日报 (People’s Daily), which was later developed into a state policy of prioritising heavy industries (see Chapter Three for more on this history). In the planned economy, urban planning was essentially ‘a regional strategy subordinate to

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39 The original text in Chinese is: ‘全面向苏联学习.’
40 The original text in Chinese is: ‘穆欣’
41 The original text in Chinese is: ‘巴拉金’
42 The original text in Chinese is: ‘生产性导向和计划的延续落实.’
the national economic plan, which is also a one-way and passive spatial implementation of the plans\(^{43}\) (page 113). In short, planning activity was a practical step in executing state decisions in the top-down hierarchy, and planners were not involved in decision making (page 113) (Figure 2.12).

Second, emulating the Soviet system, the Chinese built a preliminary statutory planning framework of their own. The ‘two-stage planning’ system, from ‘master planning’ at regional level to ‘detailed planning’ at local level (see section 1.6.0 of Chapter One for further information), was established by this framework, in which lower-level planning undoubtedly obeyed and implemented the decisions made at the higher level. In the 1990s, land zoning theories from America were introduced into China, which gave birth to new concepts and practices of ‘statutory regulative planning’ and ‘constructive regulative planning’, but the top-down hierarchy of planning and implementation persisted unchanged.

Third, aesthetically, Chinese planning largely inherited the ‘grandiose image’ approach from the Soviet Union (page 114), where it was adopted to make manifest the power of the political regime. Ideology lent strong political meanings to urban spaces. ‘One of the major aims of urban planning was to highlight the Socialist proletariat regime and the harmonies of collective living, and urban spaces were employed to characterise this specific ideology of the great age and the great society’\(^{44}\) (page 114). This planning aim was achieved through large scales and strong spatial languages, such as symmetry, closure and axis, applied to major urban spaces, such as city centre and railway station squares, in principal cities across China. The Tiananmen Square (天安门) is a classic example of this principle, measuring 500 metres east-west and 880 metres north-south, and having a total area of 44 hectares. The ceremonial meaning of this space is enhanced by the large new landmark buildings, the Great Hall of the People (人民大会堂) and the National Museum, that border it. The 120-metre wide and 50-kilometre long Chang’an Avenue (长安街) in front of Tiananmen Square constitutes the most important political axis across Beijing (Figure 2.13).

Fourth, in spatial structure planning, the ‘commune’ pattern conceptualised by Soviet ‘urbanists’ was redeveloped into a ‘compound’ structure and heavily promoted as a change to collective urban living. The compounds developed according to each unit, whether a social institution, an organisation or an enterprise – all of which were state-owned – providing accommodation for their employees and families. The residents shared most of the facilities in the compound. This template was reproduced far and wide, restructuring cities as enclosed and homogeneous ‘cells’, each occupying a few hectares of land. This structure was most obvious in Beijing, where most institutions were established (Figure 2.14).

Fifth, in the planning implementation, the Soviet ‘quantified index system’ substantially influenced Chinese practices. Many of today’s index concepts in planning, such as the ‘per capita living area index’ and the ‘urban facility size index per thousand capita’, were defined during the early days, especially by

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\(^{43}\) The original text in Chinese is: ‘从属于国民经济计划的地域设计工作，是对计划单向、被动的空间落实；’

\(^{44}\) The original text in Chinese is: ‘城市规划的重要任务之一即是彰显社会主义无产阶级政权和集体生活的和睦氛围，通过城市空间来表征特定意识形态以展示时代与社会的伟大。’
Ya. P. Levchenko, *城市规划: 技术经济之指标及计算* (Urban Planning: the Technical and Economic Index and Calculation) (translated into Chinese and published in 1953) (page 115). Supported by the new quantified planning methods, China was able to develop urban ‘prototypes’ customised to her own circumstances. For example, the emerging ‘workers’ village’ prototypes around new remote factories were developed and coded into today’s residential planning structure of ‘residential zone—residential subzone—residential building grouping’ (page 115), aided by index definitions of ‘per capita land size’, ‘floor area’ and ‘facility size’.

Although political and military disputes resulted in a cooling of the relationship between China and the Soviet Union from the 1960s onwards, Soviet influence on the Chinese statutory planning system has persisted until today. In the current market economy, planning index figures are commonly used to manage the development potential of urban lands.

In addition, the domination of political power in planning practice has had an influence in Chinese ‘new town’ developments. The English concept of ‘city’ is equivalent to a two-character word, ‘城市’, in the Chinese language. Of the characters, ‘城’ (cheng) originally referred to an artificially walled area serving for political administration and military defence. A ‘城’ in most cases formally encircles a royal palace or official government building, which sits in its geometrical centre. The other character, ‘市’ (shi), refers to ‘market’, which is traditionally a modest and insignificant space within a ‘城’. In a ‘王城’ (phonetically ‘Wangcheng’; literally ‘king’s Cheng’) template (Figure 2.15), the market sits to the north (a negative and humble location) and has an area of one ‘夫’ (phonetically ‘fu’, literally ‘man’, meaning an area cultivatable by one male labourer, equivalent to about 100 square metres)48. This market was an informal place primarily used by the king’s family, although the size of ‘市’ expanded and its position became formalised with growing numbers of users (local people from both urban and rural areas), such as the west and east markets found in Chang’an (长安), the capital of the Tang Dynasty (618-907 AD) (Figure 2.16), and the open street market without curfew in Bianliang(汴梁), the capital of the Northern Song Dynasty (960-1127 AD) (Figure 2.17). However, the precinct of ‘市’ has been long understood as supplementary to the ‘城’ and as representing the political status of a city49. As a result, most ‘市’ were found alongside or external to the city walls, even during late imperial times. (The next chapter has three examples of the marginal/enclaved markets in Nanjing, Wuhan and Hangzhou.)

The dominance of political power over cities did not disappear with the imperial dynasties. Zhou (2006: 95-98) argues that today’s urban planning practice still actively serves the demands of the governing

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45 The original text in Chinese is: ‘雅·普·列普琴柯’.
46 The original text in Chinese is: ‘居住区-居住小区-居住组团.’
47 The ‘王城’ template was shaped by 穀梁 (Zhou Li, a book initiated during the Zhou Dynasty (1046-256 BC) to regulate the rites and bureaucracy systems; the principles defined by this book were later developed into many hierarchical systems of imperial China).
48 The original text in Chinese is: ‘匠人营国, [...]，面朝后市，市朝一夫.’
49 One important reason for this was the prioritisation of agriculture (production) and a bias towards trading (consumption) in the feudal periods, which was promoted by the Confucian theories.
powers, which is in sharp contrast to that of Westernised cities. Chen and Liu (2014) point out, from a historical perspective, that both the ‘production’-oriented urbanisation/de-urbanisation during the 1950s and 1960s and the appetite for the development of ‘new towns’ since the 1990s were clearly based on the desire to uphold the power of incumbent authorities. Initially, the city formed part of ideological campaigns; and its growth or decline was not determined by the voices of the city dwellers (if heard). Later, governments enthusiastically encouraged urban developments as an effective way of boosting local economic growth, which replaced ideology as the main focus of China’s political interests.

The ‘new town’ developments since the 1990s have deeply embedded influences from power structures, which are physically manifested by the ‘images of grandiose.’ Expansive central squares, wide axial urban streets (many were proposed as pedestrian shopping streets) and large land blocks are repetitively apparent in almost every ‘new town’ scheme (Figure 2.18). The marginal areas house residential blocks spread over tens of hectares, which are the main source of profits for commercial developers. This ‘image’-oriented ‘new town’ template has come in for much criticism as a considerable waste of land resources, as well as for providing lower development densities. Meanwhile, critics also complain of the sameness of ‘new towns’, which they say have ‘no clear urban character, [and] all towns display the same face’50 (Zhou, 2006: 92).

On the other hand, Westernised ‘capitalist’ models are applied in project implementation, which means for-profit investments from both private and public sources are invited for individual projects. After the planning is finalised and approved, most available lands51 in a ‘new town’ will be marketed at auction to interested developers. Typical projects of this type are office, commercial/shopping, hotel and residential buildings. The facilities supporting major urban functions, such as schools, hospitals, community centres, municipal facilities and the like, are normally paid for from government budgets, but in some circumstances they are included in the developer’s package to control land prices.

The landmark building of a ‘new town’, mostly planned in its heart as a visual statement of ‘grandeur’, normally receives direct investment either from the government or from the developer, depending on the specific situation. In a HONT scenario, the HSR station, being part of the national rail network, is normally developed by shared investments between China Railway in Beijing and local governments. For most commercial towers52 in the ‘new town’ CBD, the projects are sold or transferred to developers. Many commercial or business projects in the CBD expect to achieve high visual impact with their façade, height or volume, but they are sold at similar or sometimes even lower prices to the apartments. Yu

50 The original text in Chinese is: ‘城市个性不突出，千城一面．’
51 There are a few requirements to be met before land plots become ‘available’: original buildings or constructions must be cleared (and owners/occupants compensated and moved), infrastructure has to be laid and land must be levelled.
52 ‘Commercial’ refers to a land use concept in Chinese statutory planning system, including most business oriented land uses, such as office, retail, hotel, restaurant, etc. In a new town’s central area, current commercial projects are often found as office towers or urban hybrid complexes of office/entertainment/shopping functions. Chapter Six has further discussion of this phenomenon in central HONTs. This ‘commercial’ concept is often used as a counterpart to the ‘residential’ lands, both of which are the most of lands available on market.
Shelton et al (2013) reports that in Shenzhen, apartments are generally more expensive than offices in the same location, in some extreme cases the former’s price is twice of the latter. This is not a random phenomenon, but widely observed in first tier cities like Beijing and Nanjing, as well as second tier city such as Qingdao (Yu, 2016; Zhu, 2013).

Data from the land market also verifies the above trend. TMSF collected data of commercial land and residential land sales of Hangzhou in 2015 (Figure 2.19). Despite very close floor area ratios between commercial and residential lands, which are 2.33 and 2.22 respectively, the price of per square metre buildable area are significantly different. The commercial land is sold at only 40% of residential land in general.

Above data does not differentiate market performances of new town and parent city, but it is safe to conclude that commercial land and residential land represent substantially different values for land buyers. In this context, although commercial projects normally have strong visual impacts, for developers, they are more difficult to generate profit returns than the ‘anonymous’ residential projects.

To sum up, China has developed a ‘new town’ planning and implementation practice model that is a mixture of the ‘socialist’ spatial structure and the ‘capitalist’ investment pattern. Superficially, the profit-driven nature of investment capital normally demands that land plots be fully developed in order to maximise their potential, which eventually leads to cities, especially their central areas, becoming intensively densified and agglomerated. In a top-down planning system, however, the spatial structure is firmly mandated and expressed by the controlling power. As Cooke (2000: 32) comments, socialist planning ‘was not actually based on any clear social aims, that is, on any plan of how people were to live or what was to be [...] their way of life.’ This planning practice disconnected from life experiences partly explains the low values found in a city’s central area, the profits being transferred to residential lands on the outskirts, thereby translating the ‘hunger for profit’ of capital into the ‘hunger for land’ in ‘new towns’. This is one reason why over-large ‘new town’ urban schemes have proliferated in modern China. This ‘new town’ wave is driven by dreams of urban grandeur, with a showy centre and outer districts infilled with sprawling, empty, homogeneous and lifeless commodity apartments.

2.2.4 Summary

‘High density’ and ‘rich diversity’ are important characteristics of HONT development and living. Both features are generated by population agglomeration around the station node area, in both time and geographical dimensions. Density represents the quantity of the population, and diversity comes from its quality. In urban planning and design practices, densified urban lives are accommodated by built urban spaces; therefore, ‘density’ is represented by physical densification. Diversified urban experiences are delivered through mixed urban programmes, where ‘diversity’ is represented by functional enrichment. HONT planning practice should consider and deliver both features.

Shelton et al (2013) have introduced the term of intensity to define ‘the combination of several urban qualities – of concentration, density, complexity and verticality’ (page 5). In the book, intensity is the
term employed to describe the densification in Hong Kong, through catalysing factors of large population, constrained urban footprint, highly elevated dwelling pattern, all together contribute to fabricate mixed urban activities. As a fact, much of the intensity stems from organic urban growth, instead of a ‘prescriptive planning’ typically from a top-down statutory planning system. In a HONT scenario, the author agrees that intensity, as interpreted from the above, delivers a combined urban quality achieved through ‘high density’ and ‘rich diversity’.

To keep a consistent argument about ‘density’ and ‘diversity’, the term intensity is not used in the rest of this thesis. However, given missing understandings of combining ‘density’ and ‘diversity’ in contemporary planning practice in China, intensity is potentially a dimension to qualitatively assess the planning/design schemes in the future; especially in the HONT scenario, it could possibly bridge the gap between HONT in theory and the ‘new town’ in practice.

2.3.0 ‘Density’ and ‘diversity’ study of railway stations and nodal areas in Japan and Europe

Before investigating a possible bridge between HONT theory and practice, it is important to study precedent, in order to understand ‘high density’ and ‘rich diversity’ in a real rail-city relationship. Examples from Japan and Europe are employed for this study.

During December 2014, the author visited 14 railway stations in Japan, mostly in cities along the Tokaido Shinkansen between Tokyo and Osaka. Major stations in Hokkaido were also visited, where Shinkansen services were then not available. In addition, 28 railway stations across Europe were surveyed in July 2015, in Greece, Germany, the Netherlands, Belgium, France, Spain and Italy. The 42 stations in total were central and major termini, suburban stations or midway stops outside established urban areas. Both HSR and non-HSR stations were included, to qualitatively evaluate the argument of this thesis that HSR builds its relationship with the city through a complete rail infrastructure network. The non-HSR but connected stations are extending HSR influence into urban life, a factor that cannot be ignored in this research (Figure 2.20, Table 2.01).

Since the early 1900s, the rail network started to expand around major Japanese cities, such as Tokyo and Osaka, becoming the main instrument of spatial and population growth of urban Japan (Nikken Sekkei ISCD Study Team, 2013: 31). New residential suburbs were developed, along with the new rail lines, which connected back to the city centres. The railway stations, both in urban and suburban locations, became portals in and out of urban lives. For instance, Hankyu Umeda Station become the first stop in central Osaka reached by suburban rail commuters from new dwellings such as Muromachi of Ikeda, along the Hankyu Line (Figure 2.21). The unparalleled capacity and efficiency of urban rail

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53 The author also acknowledges that the Euston/Kings Cross Stations and their nearby areas in London represent typical examples of demonstrating established European rail-city relationships. However, these cases were not visited due to time and budget constraints during the author’s study trip in Europe, and therefore not included in the case studies as lacking of first-hand data compared with other visited cases.
compared with any other urban transport were able to support Japanese urban living featuring unprecedented densities and diversities.

In addition, the first Japanese HSR service, Tokaido Shinkansen, began operating in 1964. During the more than a half century that followed, Shinkansen has further extended its network to connect most major cities across Japan (Figure 2.20 a), and thus shaped its own relationship with urban lives.

By comparison, in Europe, where the first train was invented and first rail line was operated, the rail infrastructure acquired its influence on social and urban growth by powering the industrial revolution between the late 1800s and the early 1900s. As most cities adjusted to the ‘industrial’ character of early trains, which were noisy, dirty and caused vibrations to buildings around the station nodes (Nilsen, 2003: 25-26), tracks were slowly extending into core areas of European urban centres, considerably affecting the experiences of urban living (Figure 2.22). Meanwhile, along with the growing size of middle class, urban rail also served as a principal instrument to support suburban growth in Europe, as is further discussed in Chapter Three.

In 1981, France announced the first European HSR service between Paris and Lyon. In the next decade, further HSR lines were opened in Germany, Sweden, Finland and Belgium; and in the 2000s, Spain, Italy, the UK and Russia joined the club (Belov, 2009: 1-4). Today, the European HSR network covers most of its urban centres (Figure 2.20 b) and, unlike the linear routes of the Japanese Shinkansen, it has an extensive range, providing potentially more complex connections.

Both Japan and Europe have over a century’s record of rail operation, as well as decades of HSR history – long enough to shape mature relationships between their rail infrastructures and cities. Seen from a large-scale perspective, HSR has reinforced the position of central cities in their hierarchical urban structures. In Japan, strong agglomerations of population and resources in Tokyo and Osaka strengthened their top positions in relation to other Japanese cities (Zhang, 2009: 35-53); while in Europe, HSR supported the growth and transformation of urban industries and economies (Pol, 2011), without restructuring the existing city hierarchies (Mazzeo, 2010: 12-13).
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* : available; O : in proposal/construction

Above station service/train type information is synthesised through author’s observation and Google Maps, possibly incomplete and subject to change according to future operations.

### Table 2.01. Summary of railway stations visited in Japan and Europe

On the other hand, various rail-city relationships have been developed in Japan and Europe in the past century, typically as a result of different numbers of daily rail users. Bertolini and Spit (1998: 31) compare passenger flows in Paris and Tokyo, concluding that both HSR and normal rail infrastructures are attracting more users in Tokyo. For instance, Paris has about two million people commuting on its urban trains every day, as well as 35,000 and 100,000 passengers on TGV (HSR) and main line services, respectively. By contrast, Tokyo has a regular rail commuting population of 30 million, and an average of 300,000 daily travellers on the Shinkansen network (Bertolini and Spit, 1998: 31).

This significant user difference can be ascribed to several factors, such as the large gap between rail track length to population ratios in Japan and Europe (as an example, Tokyo has over 2,500 kilometre
urban rail track serving 135 million residents, compared with 220 kilometre of urban rail track for 24.8 million residents in Paris\(^{54}\), as well as different travelling patterns among urban residents (according to Bertolini and Spit, 1998: 31, rail commuting percentages are: Tokyo 75%, London 45%, Netherlands 21%). The impact of the rail infrastructure on the station node differs between urban areas in Japan and in Europe. This is evident in the case of smaller, midway stations, but it is also obvious for central termini integrating HSR and mainline services.

To perform a systematic comparison, the station and its immediate urban areas are considered separately hereafter to study the ‘density’ and ‘diversity’ features in Japanese and European cases\(^{55}\). In the study, ‘density’ refers to the physical developments with urban characteristics in a station precinct, which translates the intensity of infrastructural passengers into urban users. In parallel, ‘diversity’ focuses on the mixture of urban lives or functions in a station node precinct, converting the qualitative variety of passenger backgrounds into urban richness. On this basis, the physical density and functional diversity of transport, representing the ‘neutral’ nature of rail and local connections, are not much discussed.

The present study suffers from certain limitations, notably the brevity of the author’s surveys of the stations and their nearby urban areas, and language barriers. However, it is hoped that this discussion will serve as a platform for questions to be raised about HONT practice. Further arguments about ‘density’ and ‘diversity’ in a HONT scenario are developed in Chapters Five and Six.

2.3.1 Comparison of ‘density’ and ‘diversity’ in Japanese and European station nodes

*Japanese case study*

Of the stations in Japan visited most often, a common feature is the high degree of integration of urban facilities, typically commercial facilities, with railway station buildings. Nikken Sekkei ISCD Study Team (2013: 47) divides the development history of Japanese stations into six stages, evolving from early building a volume- and façade-oriented understanding of station design, through later commercialisation in both horizontal and vertical dimensions inside the station building, to today’s highly integrated and unique station-city mode (Figure 2.23). Beyond supplying facilities and services supporting commuters and travellers, the station frames itself as a destination in urban life, attracting users from metropolitan and regional areas. In this station-city development mode, more ‘staying’ spaces are envisaged than the ‘flowing’ spaces of a transport node, thus bringing a large number of passengers into high density urban activities inside a station building.

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\(^{54}\) Source: Baidu Baike

\(^{55}\) The physical scope of an inner-city railway station’s ‘immediate area’ should be defined by considering the station’s extended influences in urban developments and lives. Chapter Four has a discussion of this issue from both theoretical and case study perspectives, in relation to Chinese stations. The discussion about Japanese and European stations can do no more than illustrating the general features, based on a brief walk-through, during which the author did not attempt to precisely define each station’s ‘immediate area’.
The new extension of JR Osaka is a typical example of the station-city mode (Figure 2.24). According to Hu (2014), this tower, opened in 2011, with a total area of 216,000 square metres, integrates a large number of urban facilities, including a department store, a shopping centre, a gym, entertainment outlets, offices and a restaurant. These facilities attract clients by their exceptional size and established brands. For instance, the Isetan in JR Osaka is one of Osaka’s major shopping centres, incorporating 1,100 stores (Isetan Mitsukoshi Holdings), and representing collaboration between the trusted brands of Isetan, Mitsukoshi and JR-West. Meanwhile, the commercial offices and the membership facilities, such as the gym, generate regular visitors and shape highly intensive activities inside the station. Kyoto Station (Figure 2.25) and Sapporo Station (Figure 2.26) are also identical to this station-city model.

With regard to ‘diversity’, three features can be identified from the Japanese cases.

First, ‘commercialisation’ is an important characteristic of Japanese stations. Historically, the first step of fusing the railway station with the city was to incorporate department stores, which allowed the station to be the first and last stop for commuters between the city and the suburbs. This commercialisation was further developed in a vertical dimension, such as the growth of Tokyo Station (Figure 2.27), in which new infrastructures and facilities are laid on top of or beneath each other, and in a horizontal dimension, such as Sapporo Station, which extends through underground commercial clusters over 1.5 kilometres into the heart of the city and connects with other metro stations (Figure 2.28). In both patterns, a common principle is to invite non-rail users into the station precincts. By having users for multiple purposes, stations are able to reinforce their core importance in Japanese urban life.

Second, by further combining hybrid functions, stations can explore their potentials as precincts providing mixed urban life experiences. Having researched the facilities at JR Tokyo, JR Osaka and JR Kyoto Stations, Li (2012) finds retail, department stores, restaurants and hotels are commonly available inside station buildings; a few stations, such as JR Osaka, also incorporate cinemas and offices. Hybrid facilities lend an enriched usage pattern to railway stations by creating new ‘clients’. Apart from users from outside the station, internal users of one facility are highly likely to visit other facilities inside the station, for example office workers who buy lunch from station shops. Further integrated functions create sophistication in station life, representing a miniature version of real city living.

Third, there is also a high level of functional ‘interaction’ between a station and its immediate urban areas. On the one hand, the commercialisation observed at most major stations in Tokyo, Osaka, Kyoto and Sapporo echoes the commercialisation of central locations in these cities. On the other hand, some stations adapt themselves to other urban environments, such as the industries found around JR Fuji Station (Figure 2.29). The city is, in its own nature, a rich agglomeration of diverse lives, which demands that its stations exhibit corresponding compatibility and flexibility for co-developments. This is possibly the best interpretation of the concept of ‘urbanisation of the station’, which is detailed in Chapter Six.
European case study

The European stations, by comparison have, overall lower ‘densities’ integrated into their nodal areas, with a strong sense of homogeneous transport usage permeating their spaces.

Typically, this applies to most centrally located station terminals that were built in Europe in the early days of rail travel, such as Amsterdam Central Station, Roma Termini, Berlin Zoologischer Garten Station and several major stations in Paris (Gare du Nord, Gare de l’Est, Gare d’Austerlitz and Gare du Lyon). The rigid conservation of traditional stations has seriously restricted their flexibility to evolve and adapt to changing lives. According to the author’s observation, few urban facilities have developed in these stations within the conventional spatial frameworks, apart from scattered stalls serving passengers passing through. ‘Flows’ are the dominant activity and ‘stays’ are few and far between.

Antwerp Central Station, reopened in 2009 after renovation, is a typical case in point. This station, built in the early 1900s, and commissioned by King Leopold II, is ‘a monument to Belgian wealth and imperial confidence’ (Littlefield, 2010: 107), a factor that dictated the decision to retain its building volumes and beautiful façades as part of the city’s communal memory. The only option for architect Jacques Voncke in the station regeneration was therefore to dig 20 metres down to accommodate extra HSR and mainline services. However, this infrastructural expansion was not paralleled with increased urban facilities. A visit to the station in July 2015 showed that its spatial structure was not suited to accommodating significant urban facilities apart from a few shops along the platform for passengers and a small cluster of jewellery stores, named ‘Diamond Gallery’, at the far southern end of the pedestrian tunnel. Compared with the soaring, elegant and busy main transport spaces, this southern ‘urban’ part was depressing, low-grade and quiet. Littlefield (2010: 109) comments that ‘Antwerp station is a structure with two distinct personalities, with little overlap’. This case clearly demonstrates the conflict that exists between traditional physical space and the growing demands for a station to develop an ‘urban character’ (Figure 2.30).

This conventional understanding of the station is so dominant that new stations being built from scratch are designed to be mono-transport nodes, an example being Rotterdam Central Station56. Created with the latest technologies, this new rail node boasts stunning spaces and morphologies in both interior and exterior, but functionally, passengers are the only clients invited into the building: it presents no ‘urban’ character, despite its proximity to both residential areas and the CBD (Figure 2.31).

On the other hand, there are undoubtedly European cases that successfully incorporate urban facilities at various levels in their station precincts, such as Berlin’s Hauptbahnhof (Berlin Central Station), opened in 2006, Barcelona’s Sants Station, opened in 1975, Madrid’s Atocha Station, regenerated and opened in 1992, and Madrid’s Chamartin Station, opened in 1982. In Berlin Central, about 80 retail stores of 16,000 square metres are available for customers, making the station ‘an important centre of shopping

56 Architectural drawings available online at: http://www.gooood.hk/Rotterdam-Centraal-Station.htm; and: http://www.archcollege.com/archcollege/2015/02/11008.html
and restaurants in Berlin\textsuperscript{57} (Rong, 2007: 83) (Figure 2.32). In Barcelona, a hotel occupies an enormous
tower rising above the rectangular station box (Figure 2.33). Atocha Station in Madrid accommodates a
unique mixed urban forest area of 4,000 square metres under its arches, which invites not only station
passengers but also visitors in the city to enjoy ‘one of the most refreshing spaces in arid Madrid’\textsuperscript{58}
(Shen, 2014: 18) (Figure 2.34).

The ‘urbanisation’ initiatives in European stations, compared with their Japanese counterparts, are
either much smaller in scale (for example the commercial facilities in Berlin Hauptbahnhof are far less
extensive than those of many central Japanese stations such as JR Osaka Station\textsuperscript{59}) or offer less
sophisticated functions (for example Sants and Atocha Stations). Of the stations visited by the author,
Madrid’s Chamartin Station is the only one that delivers significant efforts to shape multiple urban life
experiences through its hybrid spatial and functional structures. In a typical section, this station has
three main functional layers: a ground level for tracks and platforms; a middle level of small-scale
commercial facilities, car parking and vehicle lanes directly connecting with urban highways; and a top
level featuring a pedestrian-friendly square, well connected to the lower levels and surrounded by a
cinema, a hotel and bars (Figure 2.35).

López Astorga (1976: 43) describes Chamartin with phrases such as ‘Integration with the city’,
‘connection with the city’, ‘separation of the traffic within the complex from the city’s traffic’, ‘maximum
use of already constructed parts’ and ‘adaptation to the surrounding topography, taking advantage of
the existing different ground levels.’\textsuperscript{60}

Having no knowledge of the Spanish language, the author’s ability to research Chamartin from the
available sources was limited. Fortunately, however, Assistant Professor Fernando Jerez, of the
Architecture Faculty, University of Western Australia, originally from Madrid, agreed to be interviewed
to discuss Chamartin. As Fernando remembered, Chamartin’s urban facilities had been warmly
welcomed since it began operating in the early 1980s. The bowling club in particular was a popular
recreational destination for local residents.

Despite its urban uniqueness among many other European stations, Chamartin did not give the
impression of busy urban lives during the author’s visit in July 2015. This was particularly true of the
empty area on the top level, where an array of closed doors took the place of the expected hustle and
bustle (Figure 2.36). An urban renovation project in northern Madrid was initiated by the local

\textsuperscript{57} The original text in Chinese is: ‘柏林一个重要的购物及餐饮中心．’

\textsuperscript{58} The original text in Chinese is: ‘干燥的马德里最湿润的空间之一．’

\textsuperscript{59} The size of the commercial facilities is obviously related to the size of the clientele. Berlin has a
significantly smaller population (according to City Population (website), near 3.5 million in 2014) than
major Japanese cities such as Osaka, which has 8.9 million (2010, according to Osaka Global Website).
Moreover, the percentage of the population who are rail users in most European cities is lower than
that in Japanese metropolises.

\textsuperscript{60} The original texts in Spanish are: ‘Integración en la ciudad’; ‘Connexión con la ciudad’; ‘Separación del
tráfico de los patios, del tráfico general de la ciudad’; ‘Aprovechamiento de lo construido’; and
‘Adaptación a la topografía aprovechando los distintos niveles existentes.’
government in early 2015, named ‘Operación Chamartín’. By extending the major avenue, Paseo de la Castellana, 3.7 kilometres north, this project will renovate about 1.5 square kilometres of land above and on both sides of the existing rail tracks, with the aim of transforming a ‘depressed area of Madrid’ into ‘a new social, economic and environmental axis’, comprising a residential area (6,300 new homes), a business area (878,150 square metres of offices and 87,425 square metres of public equipment) (Figure 2.37), a technology area (180,350 square metres of technology activities and 161,250 square metres of public equipment) (DCN, Distrito Castellana Norte Madrid). As part of the proposal, Chamartín will upgrade into a major local hub to handle 72,000 passengers per hour, connecting urban rail (Cercanías Madrid) and metro services, as well as some HSR trains. The strong nodal capacity will not only form the foundation of the large-scale urban renovation but will also redefine the station itself with the promise of a prosperous future.

2.3.2 Comparison of ‘high density’ and ‘rich diversity’ in immediate station urban areas

*Japanese case study*

Physically, the most visited Japanese railway stations are tightly spatially integrated with their nearby urban areas. This integration can be observed in two aspects. First, the square between a station building and its immediate urban precincts is mostly small and compact, being normally less than 100 metres wide, while in some cases, such as JR Osaka, JR Ueno and JR Tokyo (east side), the stations and cities are seamlessly connected without squares as buffers. This arrangement allows a high level of permeability of urban lives between station and urban precincts. For instance, to the north of JR Osaka Station there is an ambition to pump continuous station flows into a hybrid urban development of 390,000 square metres over an area of 8.6 hectares, taking full advantage of its proximity to the station node (Figure 2.24 b/c; Figure 2.38).

Second, good walkability between station and city bridges the connectivity gap between the precincts. This is achieved through well-established pedestrian facilities under or above the ground surface, which support smooth walking ‘flows’. The complicated underground pedestrian system around JR Tokyo Station (Figure 2.39) and the elevated pedestrian corridors of JR Shin-Yokohama Station (Figure 2.40) are both typical examples. In the 1880s-built JR Sapporo Station, the conventional large station square is not a barrier, thanks to the extensive underground tunnel, which allows station users to walk to the city centre 1.5 kilometres away (Figure 2.28). The icy winter of Hokkaido makes this tunnel a popular seasonal space, which attracts a large number of retail outlets (Figure 2.41).

These features translate the station immediate area from a place for station users only into a node with both density and diversity, having physical and functional dimensions. Evidence of physical density is clear to see (such as the urban development volumes around JR Tokyo and JR Osaka stations as studied in Figure 7.08 of Chapter Seven). Diversity, however, is less visible. Diversity forms the focus of the discussion below.
Jacobs (1962: 161-162) defines the ‘structure’ of urban ‘diversity’ as a combination of ‘mixed primary uses’ and multiple supportive urban functions. The primary uses define the fundamental character of an urban area, while the supportive functions are important not only for sustaining the main uses but also for attracting people from the widest possible range of backgrounds, interests and skills.

For the urban lives around a station node, the passenger agglomeration correlates with urban richness, but the station’s ‘primary function’ is consolidated through the features of its context. Marunouchi District around JR Tokyo Station and Ueno Park around JR Ueno Station serve as examples of urban diversity shaped by various contexts.

Located between Tokyo Railway Station and the Japanese Imperial Palace, the 120-hectare Marunouchi District is considered the centre of Tokyo. In the report by the Mitsubishi Estate Group (2012), this area, with its dense office and commercial buildings, is described as ‘the gateway to Tokyo’ and ‘the leading international business center in Japan’. More than 4,200 companies have offices in this area, with an employee population of 230,000 (Figure 2.42). According to Zhou (2010), a wide range of industries is found in Marunouchi, including building, manufacture, information/telecoms, finance/insurance and real estate. Finance and insurance take the largest share, at 26.6%, helping to make this the centre of the Japanese economy and ‘a place that provides the most frequent, most convenient, and most efficient financial activities in the world’ (Zhou, 2010: 107).

In 1890, Mitsubishi bought most of Marunouchi’s land from the Meiji Government, with the idea to ‘build an office district like London’ (Mitsubishi Estate Group, 2012). This vision was strongly catalyzed in 1914 by the opening of Tokyo Railway Station on the site, connecting Marunouchi with metropolitan and regional locations. Since the mid-1960s, the Shinkansen service has further turned this area into a national network, having the advantage of efficiency, and by attracting major company headquarters from within Japan and overseas, Marunouchi gained its reputation of the ‘CBD of Japan’61 (Figure 2.43).

The redevelopment of Marunouchi began in the 1990s, ushering in a new era of enriching urban life beyond its established ‘primary function’ as a business centre, which, however, had a notable imbalance in usage between day and night. The regeneration was physically implemented by increasing the heights of 17 major towers in Marunouchi to over 140 metres (Zhou, 2010), to provide the floor space to accommodate additional programmes. These include encouraging the growth of businesses in Marunouchi (EGG Japan); introducing lifestyle and cultural facilities, such as medical, educational, entertainment, theatres and galleries, to attract non-business people, as well as attracting international organisations and events into the area (Mitsubishi Estate Group, 2012).

Today, Marunouchi has eight indoor/outdoor art precincts, one museum, one theatre, a conference and art centre, six hotels and two department stores (Figure 2.44). The diversity of the urban facilities in Marunouchi does not dilute its role as a business centre, but rather constructs a definition of a ‘CBD’ enriched by dynamic and 24-hour urban experiences. The old homogeneous CBD was successfully

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61 The original text from Mitsubishi Estate is ‘Marunouchi has served as Japan’s center of politics, economics and culture for 400 years’.
transformed into an ABC (amenity business core), with a new reputation as ‘Tokyo’s famous fashion district’ (Zhou, 2010: 109).

A different urban identity is found close to JR Ueno Station, a second major rail infrastructure hub in Tokyo, providing HSR, mainline, regional and metro connections. Ueno Park, created in 1873 along aside the station, is the city’s first (Xie, 2010: 62) and largest park (Ling, 2013: 4) (Figure 2.45).

In addition to its many ‘firsts’, the popularity of Ueno Park can be attributed to its history, the presence of seven major museums built between 1877 and 1968 (Ling, 2013: 7), memorials and other points of interest, as well as its seasonally changing landscapes. The museums hold exhibitions ranging from art to history, and exhibit a variety of architectural styles, the National Art Museum, for example, being Corbusier’s only built project in Asia. The park also contains a zoo, a library, a cultural hall, the Japan Academy and Keneiji temple (Jiang and Zhang, 2010: 75), appealing to people from of all ages and from all walks of life (Figure 2.46). In addition, tourists are drawn to the spring cherry blossoms, much celebrated even in China through Lu Xun’s writing62, the summer lotuses, the red leaves of autumn and the winter peonies (Shen). The large open space, a rarity in densely crowded Tokyo, makes the park perfect for public activities, such as walking exercise competitions (Figure 2.47).

Commercialisation has undoubtedly predominated in many areas immediately around stations, creating vibrancy and colour, for example around Shinjuku and Shibuya stations. However, as Marunouchi and Ueno demonstrate, an urban area can manifest itself in many different ways, according to the specific features of the area, and is further enriched by increased diversification of meanings from urban users. Therefore, the ‘diversity’ feature of a city comes from constantly attracting rail passengers into its urban life, termed here (see Chapter Six) the ‘stationisation of the city.’

European case study

In Europe, the physical integration between station and city is generally less well achieved than in Japan, partly because of the large squares that sit in front of the stations. Nearly every terminus or major station has a square, mostly spanning between 100 and 170 metres, which acts as a physical boundary between the station precinct from the city. This boundary concept is so strong that, even in stations without a square, such as the Gare du Nord in Paris, there is no intimate relationship between the station and the city. A busy and often jammed main road cuts Gare du Nord off from the urban life close by. At the Gare de l’Est, an even stronger statement is made by steel fences sealing off the transport node.

A lack of pedestrian-friendly facilities around many European station nodes is another reason for poor station-city integration, as passengers normally have to cross large open squares and busy roads to access urban destinations nearby. Worse, vehicle uses predominate in most station squares, such as bus

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62 Lu Xun (鲁迅) was the pen name of, Zhou Shuren (周树人, 1881-1936), a leading writer, thinker and political and literary critic. In one of his best-known memories work, 藤野先生 (Mister Fujino), he compares the cherry blossoms in Ueno Park to pink clouds.
and taxi connections, as well as car drop-offs and pick-ups. Pedestrians are often fully exposed to risks from vehicle traffic – most strikingly, in the author’s experience, when attempting to cross the bus lanes in front of the Roma Termini (Figure 2.48).

Physical disconnection has shaped many huge ‘island’ stations scooped out of the traditionally dense and small-scale urban patterns of European cities, Barcelona Sants (Figure 2.33 c/d), Madrid Atocha (Figure 2.34 a/b) and the Roma Termini (Figure 2.48 a) being typical examples. As a result, densification and diversification can scarcely emerge from the impermeable urban life flowing around the station, an opposite scenario to that observed in Japan.

On the other hand, a different station-city relationship is found around small to medium-sized stations, most of which only offer intra-urban and slow train services. These stations normally have fewer passengers and therefore require less space for parking or connection facilities. A spatial intimacy between station and city can develop much more easily here. Charlottenburg Station, in Berlin’s western suburbs is a good example. It is not a major station, but, thanks to frequent local and regional services, it can easily connect to central nodes such as the Zoologischer Garten Station, three minutes away by train, and Berlin Hauptbahnhof, about 15 minutes away. This comprehensive rail network allows passengers at this station access to other destinations both near and at some distance away. As there is no square to form a barrier, apartments, commercial facilities and an aging care apartment are clustered around the station, creating a hub for local communities (Figure 2.49).

Beyond the suburbs, smaller stations support the new CBDs in European cities, such as La Défence Station in Paris and Zuidas Station in Amsterdam, by providing commuter services. Zuidas is particularly interesting, partly because it is newer and less well known to people outside Europe. This is an emerging ‘hyper-urban centre’ (de Bruijn, 2005) in the south of Amsterdam, targeted at creating ‘a top international location with mixed business and residential usage’ (Amsterdam City Council, 2009: Foreword) on its 270 hectare coverage area (Amsterdam City Council, 2009: 11). Zuidas Station is estimated to serve 15-20,000 local resident commuters and 60,000 employees in the area. There are intercity (regional train), sprinter (local slow train) and metro services available at this four-platform station, which connect directly to major transport nodes, including the central station in Amsterdam and the main airport (Schiphol), as well as metropolitan Amsterdam and other regional destinations. Moreover, the high walkability around the station is a factor that supports high density office towers and commercial centres in the vicinity, providing ‘employ opportunities for all income classes’ (de Bruijn, 2005) (Figure 2.50).

Summary

In summary, the rail infrastructure plays different roles in Japanese and European urban lives. In Japan, stations fuse with the city, supporting daily commuting and providing services for non-rail users. The city, for its part, takes advantage of its intimate relationship with the station to develop its own character. In

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63 de Bruijn (2005) mentions that HSR services are also available at Zuidas Station, but the author found on his visit that the HSR train does not stop there.
Europe, a dichotomous station-city relationship is often observed between station termini and midway stops. The ‘portal gateway’-oriented central stations are mostly homogeneous transport nodes, often disconnected from the nearby urban lives that they are expected to serve both physically and functionally. By comparison, the medium-sized and small stations successfully weave into the urban fabric and permeable urban lives.

The cases reviewed here clearly suggest that the ‘density’ and ‘diversity’ features of the station and its immediate urban precinct are achievable through a high level of physical integration, which encourages further functional integration through the translation of users from mere rail travellers to active participants in rich urban lives around the station.

2.4.0 Can HSR be a main driving force for station-city functional integration?

As can be noted from the above analysis, the central stations with large transport resources including HSR are not very successful in developing integrated station-city relationships, while stations without HSR connections do much better. Does this mean that the HSR infrastructure is unable to generate urban life? This question is especially important for understanding HONT developments in China, which are directly powered from scratch by the HSR infrastructure.

2.4.1 Fewer users on the HSR infrastructure

Passenger ridership data on HSR networks in Japan and Europe reveals that the users of the HSR infrastructure represent a very small percentage of the overall number of rail travellers.

According to the statistics on JR Tokyo Station, which has the largest number of Shinkansen services in Japan, the average daily Shinkansen ridership in 2013 was about 93,000 (JR Central a), which is less than one fifth of the daily total of rail travellers (Ito, 2014) at this station. At JR Kyoto, data from 2012 also suggest that, on average, 5.67 times as many passengers ride normal trains as Shinkansen trains. Moreover, between 2006 and 2015, the number of Shinkansen passengers using ‘commuter passes’ was roughly one tenth of those using ‘ordinary tickets’ (JR Central b). As JR-Central’s services cover the most economically important cities in Japan, including Tokyo, Osaka and Kyoto, these statistics suggest that usage of the Shinkansen is primarily for long journeys and that comparatively little commuting is done using the Shinkansen.

Similarly, European HSR attracts far fewer users than conventional trains. For example, Barrow (2015) finds that the French TGV services carried only 7% of total passengers on the French rail network. Earlier data from Freemark (2011) indicate that the TGV trains had about 10% of the annual overall rail passengers, 100 million compared with 1 billion. It is also worth pointing out that, within the past three decades, although the ridership of long-distance journeys increased by 50%, ‘TGV has seen a fall in passenger numbers since the economic crisis’ (Barrow, 2015).

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64 According to Kyoto City Web, the daily passenger numbers on normal trains and Shinkansen were 189,400 and 33,000, respectively.
Compared with the SNCF (French Railways), which had about 50% of the European HSR market, the 22% shareowner of Deutsche Bahn (German Railways) (Freemark, 2011) had an even lower passenger percentage on their ICE network. According to Perl (2002: 27, 36), between 1991 and 1998, the ridership of ICE had grown from about 0.5% to only slightly above 2%, compared with a much sharper increase from 4.77% to near 10% for the TGV over the same period.

These data clearly imply a wide gap in user numbers between HSR and normal rail; furthermore, HSR passengers differ in the distance, frequency and purposes of their travels from most conventional rail users. It is therefore important to conduct a separate study to understand HSR itself in the rail-city relationship.

2.4.2 HSR’s role in powering urban development around a station node

The best way to study HSR’s role in urban life is to compare it with conventional rail nodes, in either parallel or sequential timeframes. Two Japanese cases and two European cases are selected for the purposes of illustration.

The JR Shin-Fuji and JR Fuji Stations present an example of parallel options. JR Shin-Fuji is a midway stop of the Tokaido Shinkansen, and a very rare case of a dedicated HSR station without conventional rail or metro connections. At the time of the author’s visit in December 2014, this station at the edge of Fuji City was very quiet, and there was no significant development to be seen, even after 25 years’ operation of Shinkansen. Car parks filled the spaces outside the station, as the lack of a local railway generated a lot of open space, an uncommon state of affairs outside a Japanese railway station. Shin-Fuji is thus a mono-transport node, boasting no urban life to attract passengers (Figure 2.51).

By contrast, JR Fuji Station, in the centre of Fuji City, has integrated the Tokaido Line, which is the old national mainline replaced by Tokaido Shinkansen, and a local Minobu line connecting with Kofu City elsewhere in the region (Figure 2.51 a). Besides the passenger lines, JR Fuji also has multiple freight lines serving factories nearby, such as Toshiba Carrier in Fuji, Nippon Paper’s Fuji factory and the factories of the Asahi Kasei Group (Figure 2.29). Compared with Shin-Fuji, which is only two kilometres away, Fuji Station has a much greater source of clients and services, from national to regional scale, as well as servicing both passengers and freight. Thus, JR Fuji is far more readily able to support an urban life agglomeration around its station node (Figure 2.52).

JR Shin-Yokohama Station is another case illustrating the transition from a Shinkansen-only station into a hub connecting HSR and local rail networks. According to Executive Yuan (2007) and Institute of Transportation, MOTC (2009), JR Shin-Yokohama was located outside Yokohama’s urban area at its opening in 1964, along with the Tokaido Shinkansen Line. There was no local rail or metro at that time to connect this station to central Yokohama, which is five kilometres away. Although a station node area development plan was proposed in 1975, no substantial project was implemented throughout the entire following decade (Figure 2.53). Only since 1985 has the metro service between Shin-Yokohama and

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65 There are bus connections between JR Shin-Fuji Station and JR Fuji Station.
Yokohama become available, highlighting opportunities for urban growth (Figure 2.54). On the one hand, there was an explosion in daily average passenger numbers, from 1,000 in 1964 to 25,000 in 2003\(^{66}\) (Executive Yuan, 2007: 37) and reaching 60,000 in 2007 (Institute of Transportation, MOTC, 2009: 20). On the other hand, the established connection with Yokohama by local metro encouraged the emergence of an urban character in Shin-Yokohama as the computer industry and hotel, cultural and sport industries developed nearby (Figure 2.55).

The case of the northern French city of Lille is a third example of co-existing HSR and conventional rail nodes. The influences of different rail infrastructures are visible in EuraLille, a commercial development strategically planned between the new TGV station of Gare de Lille Europe and conventional rail terminus Gare de Lille Flandres. As part of the ambition to rejuvenate the declining old Lille through its locational advantage in the HSR network between Paris, London and Brussels, EuraLille was proposed together with the city’s new TGV station. This is a complex urban project integrating retail and entertainment facilities, schools and apartment blocks. Its proximity to major infrastructures and the operation of HSR are intended to drive new economies of HSR. The other old station, Flandres, sitting on the opposite side of EuraLille from the new TGV lines, is the city’s old terminal and comparatively less well known. However, this station provides a much wider range of rail services. Apart from TGVs between Paris and Lille, there are also trains connecting regional destinations around Lille, such as Calais, about 90 kilometres to the west, as well as Kortrijk and Tournai in Belgium, about 25 kilometres to the north and east, respectively (Figure 2.56).

EuraLille’s unique position between an HSR dedicated station and a conventional station makes it an interesting testing site for comparing urban lives on its different ‘interfaces’. On the HSR side is the main façade of the project, with an expansive square, interesting sculpture and an imposing gateway. However, on the author’s visit, only a few passengers were wandering around with their luggage in the square, which felt like the quiet far corner of a noisy market (Figure 2.57). The Flandres side, on the other hand, was full of hustle and bustle, which was directly created by the old station across the road, as well as local bus and metro connections (Figure 2.58).

Last but not least, an extreme case comes from Segovia AVE Station, an HSR stop about half an hour north of Madrid. This quiet station, opened in 2007, sits in a barren area outside Spain’s old town of Segovia. At the time of the author’s visit in 2015, there was still nothing developed around the station apart from a bus station and a car park, overall presenting a similar image to that of JR Shin-Fuji, for identical reasons (Figure 2.59).

2.4.3 Summary

These comparisons of HSR and conventional railways provide the answer to the question posed above, namely that HSR does not directly strongly support urban growth around its station nodes. It does not

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\(^{66}\) According to Figure 2.54, the station’s daily average passenger in 2003 is around 50,000. The author suspects the data of Executive Yuan (2007) is from calculating one way (departure or arrival) passenger only.
have as clear an ‘urban’ character as conventional rail, including regional, local and metro infrastructures. Certainly, at least in Japan and Europe, conventional rail is largely designed and planned to serve urban demands, unlike HSR, which almost exclusively represents long distance travel. This difference distinguishes the two types of rail infrastructure: frequent, repetitive and short journeys on conventional railways; infrequent, occasional and long journeys on HSR. This means HSR normally does not have the commuting characteristic based on large numbers of users, which is fundamental to establishing a constant ‘conversation’ with urban life and shaping an ‘interface’ between rail and city. Instead, HSR’s ‘airport’-like usage pattern distributes its passengers from all around a city and even beyond, seriously challenging the idea of user translation between the station and its immediate urban areas as a key principle for the overall success of station and city.

We need to understand the rail-city relationship in the context of a hierarchical structure of the rail system, covering full geographical and capacity scales, from HSR, mainline, regional line, local line to metropolitan line. HSR should not be considered separately from this system. It must be acknowledged that, at a large metropolitan scale, HSR is an important infrastructure to power urban growth, such as Marunouchi’s upgrade into ‘Japan’s CBD’ through the operation of Shinkansen, and Lille’s rejuvenation thanks to new blood from TGV. However, in terms of urban growth around a station node, which is a typical scenario in HONT development, the direct stimulating effect of HSR is weak, at least in Japan and Europe. This is why the rail infrastructure should be systematically mapped, as has been shown in the case of Shin-Yokohama. HSR’s efficiency advantage attracts regional, local and metropolitan rail connections, which in turn will potentially power local growth, thanks to their capacity advantage. This is a lesson that Chinese HSR practices could well learn.

2.5.0 Conclusion

This chapter argues that ‘high density’ and ‘rich diversity’ are shaping the fundamental nature of urban development and urban lives around railway station nodes, including HSR nodes. This is theorised through interpreting a high level of physical and functional integration between the two precincts. The density and diversity features are well illustrated by successful and unsuccessful cases from Japan and Europe, which reveal that station-city integration allows a permeable interface that supports the smooth flows of urban lives, eventually translating the quantitative and qualitative features of rail passengers into the density and diversity features of urban developments and life experiences.

The study of Japanese and European cases also reveals that the fusion between station and city is only achievable where there is a large and comparatively fixed population travelling repetitively and frequently between the two precincts. This means that urban rail commuting based on the local or regional networks has the capacity to support a successful rail-city relationship. This mechanism is applicable to both central termini stations integrating HSR and mainline trains and suburban midway stops providing local services only. This understanding is reinforced by the comparison between HSR and conventional rail nodes, which reveals that the HSR infrastructure would support station node urban growth only if local and regional rail services are connected to the same station node. A complete
hierarchy of the rail network, covering the full range of destinations, will release the potential of HSR to power urban prosperity. This finding should be a key reference to improve understanding of Chinese HONT practice.

This chapter also suggests that the established HONT planning theories and ‘new town’ practice pattern in China do not actively support the theorised ‘high density’ and ‘rich diversity’ features of a new urban development around the HSR node. Is it possible to claim that the station-city mechanism described above is directly applicable to Chinese HONT practice? The author accepts that it does (see further discussion in Part Three). Here, however, it is important to clarify again the three major differences between Chinese HSR and its counterparts in Japan and Europe.

First, development of the Chinese HSR infrastructure coincides with the nation’s ‘soaring rate of growth of urbanisation’ (Wang and Lin, 2011: 17). Therefore, the construction of the HSR infrastructure meets the demands of the spatial expansion and functional modification of Chinese cities, and at a high level the HSR is expected to ‘guide’ urban growth by encouraging new industries and economies. To compare, in both Japan and Europe, their major HSR networks were built some time after their period of most intensive urbanisation, meaning that HSR had a less intimate involvement in (re-)shaping the urban spaces and functions in these two regions.

Second, as an entirely new infrastructure, Chinese HSR has been developed deliberately independent of the conventional rail network, so as to facilitate new urbanisation. As a result, most new HSR station nodes are planned or located on the fringes of cities or even outside them. This principle is visible in both central hub stations (‘hub’ signifies that multiple HSR lines are integrated into one station), such as Shanghai Hongqiao, Nanjing South and Guangzhou South, as well as most midway stops, including Wuxi East, Suzhou North and Changzhou North. The strategic location sets up a unique context in which to shape an unprecedented station-city relationship in China. In Japan and Europe, nodes were by and large shared with traditional central or inner-city stations, such as JR Tokyo, JR Ueno, Antwerp Central and Amsterdam Central. New HSR stations are also mostly found within city boundaries, for example JR Kyoto, Berlin Hauptbahnhof and Rotterdam Central. Around only few remote stations outside cities was no clear evidence found to suggest that a large-scale urban growth plan was in place.

Third, China does not have a complete range of railway lines at different scales, as the focus has been on long distance journeys, largely as the expense of regional, local and metropolitan scale rail infrastructures in most cities (see Chapter Three for detailed discussion). This means that, in most cases, HSR stations will not have strong support from a local rail network (see Chapter Five for details). This is another feature that is distinct from the mostly well-established rail networks in Japan and Europe.

These differences indicate that further understandings about how to achieve ‘high density’ and ‘rich diversity’ in Chinese HONTs may be attained by studying the unique contexts of established rail-city relationships in China.

67 The original text in Chinese is: ‘城市化率加速上升的过程中.’
The next section considers this study in its chronological and geographical dimensions, in order to lay a solid foundation for HONT studies in Part Three.
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PART TWO:

REVIEW
Chapter Three

Chronological Section: Historical review of the relationship between rail and urban life in China

3.1.0 Introduction

Before further discussing the relationship between an HSR (high-speed-rail) infrastructure and urban development, it is important to present a background of knowledge regarding the established rail-city relationship in Chinese cities, which is the main purpose of this part. The review is carried out in a dichotomous approach involving both historical and contemporary contexts to present a ‘historical section’ and a ‘geographical section’ of the rail-city relationship in China.

This chapter examines the history of rail infrastructure in Chinese urban life during the past one and a quarter centuries. Through this study, the author will answer two inter-connected questions. How did rail infrastructure enable urban development and growth, especially in Chinese cities? Since the first track was laid on Chinese territory, what type of rail-city relationship has been developed?

Since 1829, when Stephenson’s first steam engine operated successfully on railway tracks in England, the advantages of a rail infrastructure, including capacity, speed, price and stability, were soon recognised. The conventionally established transport systems, such as canals and roads, lost the competition with railways in several industrialised nations in which rapid rail network expansions occurred (Wang et al., 2001; Kellett, 1969) beginning in the mid-1800s. By further extending railways to colonial and less-developed countries, the rail infrastructure had an unprecedented impact on the change of the world’s production and consumption patterns, which is most obvious through its influences on the growth of urban industries and developments.

Based on present knowledge, it can be stated that the influence of railways on urban growth has mostly been effective on two scales. The first is the state/regional scale, which matches the geographical coverage of the rail network system. Long-distance railway transportation has had substantial impacts on shaping cities in this network, especially in the early stages of urban development. Summarising Rostow (1971) and Fogel (1964), Ou and Yao (2008: 2) argues that the growth of American rail networks between the 1830s and 1860s has extensively supported the nation’s economic growth and development, which is a typical example of rail’s positive impact on igniting economies. New towns that emerged along the Union Pacific Railroad across the American west are excellent examples of this impact, such as Cheyenne and Laramie in Wyoming and Reno, Nevada (Wang, 2005 a).

The influence of railways can also be widely observed on the local and metropolitan scale. In this case, the primary travel pattern includes daily commutes of short distances, which effectively stimulated urban growth near station nodes. This phenomenon was most evident in conventional cities. Through
the introduction of rail infrastructures, changes in the rhythms of daily life and expansions of the urban footprint have been widely observed. As the major urban transport means, rails have been actively involved in urban life. London, Manchester, Birmingham and Liverpool are cases that serve as examples for this phenomenon (Kellett, 1969). The above occidental experiences are generally similar to understanding the rail-city relationship on the global level, especially through the mechanism of introducing new urban industries/economies as well as facilitating urban population agglomeration and urban expansion; however, the same mechanism did not generate identical urban outcomes in China, which is largely attributed to the unique historical and political contexts.

The rail-city relationship history in China is investigated in this chapter on the basis of two aspects. First, a comparison study between the western and Chinese experiences is discussed by reviewing the literature. By summarising experiences from America and Europe, the author aims to shape the principal understandings of the mechanism that facilitates urban changes that result from railways on various scales, which supports a further investigation of a more detailed history of the rail-city relationship in China from a comparative perspective to the occidental experiences. Second, a case study based on one city, Hangzhou, is presented to illustrate the rail-city relationships shaped by various political/economical contexts throughout this city’s entire rail history. In conclusion, the potential future relationship between HSR and cities is analysed, based on the synthesised knowledge, in order to illuminate further studies.

3.2.0 A preliminary study of the rail-city relationship based on American and European studies

The preceding rail-city relationships developed in early days of railways in America and Europe are studied to facilitate research on two scales. The first is the larger national scale, which refers to cities that emerged in the American west. Through operation at long-distances ‘the railroads provided the principal stimulus for the concentration of productive factors and capital’ (Dal Co, 1980: 185). The smaller metropolitan scale involves studying the European towns in the late 1800s and early 1900s to identify rail’s importance in urban population and developmental growth.

3.2.1 Study and analysis of rail-city relationships in the American west

In 1869, the Union Pacific Railroad joined the eastern and western coastlines of America for the first time. Within the next two decades, additional rail lines were constructed, such as the Northern Pacific, Santa Fe, Southern Pacific and Great Northern Lines, which created a rail network of an overall 72,000 miles in length to the western side of the Mississippi River (Wang et al., 2001: 71) (Figure 3.01).

Reps (1979: 25) explains that the demand for providing transportation connections between both sides of the continent was the result of ‘the rapid settlement of California after 1848’; however, as Wang (2005 a: 65) has pointed out, the emerging rail network performed ‘a very special and exceptionally
important role towards the urbanisation of the entire American west within a half century’s time. Wang et al. (2001: 70) observe that the coming of rail ‘greatly increased the population density in the infertile western territories of America, powering their developments from barren lands into a highly urbanised region’. According to Wang (2005 a), the ratio of urbanisation in the western states rose from 10.8% in 1840 to 51.2% in 1920, which substantially restructured the original mining-oriented and geographically imbalanced town distribution (Wang, 1992) (Figure 3.02).

Regarding the process for triggering urban growth, Wang (2005 a: 66-69) further states that rail infrastructures had two types of effects on western cities: ‘indirect’ and ‘direct’. The former refers to a formula in which new industries arrive due to railways, which consequently generate and promote local economy growth. Eventually, immigrants were attracted by the opportunities and relocated to these areas, and urban development was possible through the large number of new settlers.

A good example of this growth pattern is Abilene, ‘the first of the Kansas ‘cow towns’’ which was sparked by rail as described by Reps (1979: 550). Texas cattle (longhorn) farming had long been established prior to the railway tracks when droving was the only way for cattlemen to reach their markets with cattle, including a four-year mustering and droving in order to arrive at the market and transportation centre of Ohio. This huge transport demand was well met by the Union Pacific Railroad routing to Kansas. In 1861, the McCoy Company transformed a ‘sleepy hamlet’ (page 548) of Abilene along the tracks into ‘a busy, raucous, prosperous and vice-ridden’ (page 548) centre of cattle transport almost ‘overnight’ (page 548). In 1871, there were around 1,000 settlers in Abilene with considerably expanded urban facilities. In addition to the early Drover’s Cottage, which was the anchoring building in the town, the school, hotel, bank and church were built (Figure 3.03). Furthermore, Abilene’s success pattern was rapidly growing along the rail line with a cluster of new towns specialising in cattle transportation was emerging, such as Ellsworth, Wichita (Figure 3.04) and Dodge City (Figure 3.05).

On the other hand, the ‘direct’ influence Wang (2005 a) mentions refers to a significant number of new towns that were directly ‘created’ by rail. This was a result of the government’s ‘land grant’ policy to the railway companies, who were authorised to sell lands along the tracks to subsidise their investments (Reps, 1979: 25). Wang (1992: 38) comments that consequently, land was ‘a strong medium for rail to drive the urbanisation of the [American] west’. For the major rail companies, such as the Central Pacific and the Union Pacific, ‘sales of town lots were regarded as a profitable activity by these roads’ (Reps, 1979: 525), and new settlements through land sales was a second factor in new town growth. Accordingly, ‘as each of these lines pushed westward, new towns sprang up at the temporary terminal

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68 The original text in Chinese is: ‘十分特殊和非常重要的作用．’
69 The original text in Chinese is: ‘极大地提高了美国贫瘠的西部地区的人口密度，促使其由一个荒芜之地发展成为一个高度城市化的区域．’
70 This urbanisation rate is close to China’s rate within an identical 60 years, which increased from 10.6% (57.65 million urban population; 541.67 million total population) in 1949 to about 50% (669.78 million urban population; 1.34 billion total population) in 2010 (NBSC).
71 The original text in Chinese is: ‘铁路推动西部城市化进程的有力媒介．’
points. Some of these communities enjoyed only brief existence, other managed to survive as hamlets or villages, while a few grew to substantial size’ (Reps, 1979: 526).

It should be noted that, apart from the positive effect of the growth of new towns, railways also have negative impacts on the established/proposed towns outside their hinterland. As Reps (1979: 547) observes, ‘it was the railroads that brought prosperity to existing communities or if the lines bypassed established settlements, left them ruined’. The positive/negative potential effects from the rail infrastructure led to competition in track routing between towns, such as in Denver and Cheyenne with the Union Pacific Railroad as well as Seattle and Tacoma with the Northern Pacific Railroad and the Great Northern Railroad (Wang, 1992: 39-41).

In addition to the mid/small size towns discussed, major urban centres, such as Chicago, also benefitted from rail connections with large development opportunities. According to Wang et al. (2001), as the portal between the east Atlantic region and the western grassland area of America, Chicago had 16 rail lines in place by 1880 (seven lines to the east, six lines to the west and three lines to the south), winning itself the title of ‘the largest rail centre of the world’ at that time (page 73). Consequently, Chicago witnessed booming industrial growth, such as woodworking, meat processing and real estate investments, during the middle to late 1880s. The urban population soared from over 4,000 in 1840 to near 1.1 million in 1890 (Figures 3.06 and 3.07).

With the rapid growth of car ownership and the aviation industry after the Second World War, rail gradually lost its importance in the transport system in America and primarily focused its role on freight services; however, as can be observed on the basis of the historical information, rail’s contribution to developing America’s western frontier and its cities is indelible.

3.2.2 Study and analysis of the rail-city relationship in Europe

In Europe, rail construction boomed in the UK soon after Stephenson’s successful prototype engine, the Rocket, in 1829. By 1870, Britain had rail tracks of an overall length of 15,537 miles after about four decades of development. Zhang (1991: 62) states that ‘there was hardly anywhere in the United Kingdom far from rail lines, and the rail network was a national scale system of transportation’72 (Figure 3.08).

Railways were eventually accepted by continental Europe, which initiated a new era through transport reform. In Germany, for example, after an early period of doubt and hesitation towards revolutionary rail transport (Ma, 1991: 93-95), a new investment template was created to promote rail infrastructure development. This template featured ‘dual investments from private firms and provincial-level

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72 The original text in Chinese is: ‘联合王国很少再有远离铁路交通线的地方，铁路网真正成为囊括全国的交通运输体系.’
governments which were both managed by governmental overall planning73 (Yuan, 2008: 81). The German investment pattern differed from the earlier established private investment pattern in Britain and was able to facilitate the rapid expansion of Germany’s rail network, which led all other rail networks of European states of that period. For example, data from Ma (1991: 97) shows that Germany and France had roughly equivalent lengths of rail tracks in 1840, while in ten years, the German rail mileage reached 6,044 kilometres, about twice that in France, which was 3,083 kilometres. By 1920, the German network further grew to 35,850 miles, which was one and half times the UK’s total length of tracks at that time (Xie, 2007: 116) (Figure 3.09; also see Figure 2.22 of Chapter Two).

A direct effect that rail brought to Europe was to further accelerate the Industrial Revolution in the second half of the 19th century. As Zhang (1991: 63) has concluded, the huge freight demand of the early cotton textile industry around Manchester was a major reason behind the birth of a rail infrastructure. In turn, the infrastructure increased freight rail capacity, which stimulated growth in related industries, such as iron and coal mining (Xu, 2009: 110-111). Likewise, the rail operation in Germany stimulated heavy industries, including steel, coal and mechanical manufacturing (Yuan, 2008: 81), which transformed the character of the German economy from agriculture to manufacturing74.

Wang (1999 b) summarises the influences of the Industrial Revolution in Europe between the late 1800s and the early 1900s. First, due to the development of technology, Europe experienced a rapid growth of its population in the 19th century from 192 million in 1800 to 423 million in 1900. Its percentage of the global population grew from 21% to 25%, respectively.

Second, major European cities experienced significant urbanisation processes through successfully upgrading their industries, which rebalanced the population ratio between urban and rural residents (Figures 3.10 and 3.11). Data by Guo and Song (1994: 90) suggests that the urban population in Britain exceeded the rural population for the first time in 1851, accounting to 54% and 46% of urban and rural respectively. In about a half century’s time, the percentage of urban dwellers further rose to 79%. Xu (2012: 45) identifies another sharp increase in the German urban population, of which the percentage soared in 40 years from 37.3% in 1871 to 61.5% in 1910.

73 The original text in Chinese is: ‘政府规划下的私营股份公司投资以及各邦政府直接投资的双管齐下的局面.’
74 As supplementary to the Chinese studies, the author has also studied European literature as knowledge source for the railway development history in Europe. For example, Schwartz et al. (2011) have an in-depth examination of the rail infrastructure development in Britain and France during 1850 and 1914, as well as its impacts on rural economy/population in both states. Marti-Henneberg (2013) has a thorough study of the European railway network since its early birth of 1840, which includes further references to researches of individual European states of France, Italy, Germany, UK, Portugal and Spain. In addition, Michell (2000) exercises an in-depth comparison of rail development in France and Germany in a century’s period between 1815 and 1914, as well as its impacts of national economies and militaries in both countries.
Third, the restructured economy from agriculture to industry brought forth changes in the urban employment and consumption structures. Increased demands for services such as ‘food, clothes, housing, water, power, public health, transport [and] education’ (Wang, 1999b: 97) motivated the growth of urban service industries, which attracted large immigrant populations from rural villages.

Finally, with the development of the urban economy, income gaps widened within the urban population, which restructured the society into classes, such as the labour, or proletarian class, the middle, or bourgeois class, and the upper class, comprising aristocrats, bankers and industrialists. This social classification had substantial influences on future city developments.

In comparison to the American experience in which new towns were developed by the rail tracks, in Europe, the early rail infrastructure had partial, internal and limited influences over cities that had been long established. Kellett (1969: 290) illustrates this difference through figures, which is probably not the most rigorous comparison but is straightforward, that show that the rail-related facilities occupied about 5.4% of total land in 1900 central London compared with 12.76% in Kansas, which was a typical node city in the rail network of western America, during the same period.

During the early days of trains in European cities, they presented a paradoxical character to urban dwellers. On one hand, rail facilities had a strong ‘industrial’ image, which was dirty, chaotic and noisy. On the other hand, travelling on trains was comfortable, swift and punctual, which presented another image of high-quality experiences (Figure 3.12).

The railway’s paradoxical character made the location of a railway station in the city highly debatable. A common viewpoint was that a train station in a central location would be risky and pricy in return for a few minutes saved on travel time (Nilsen, 2003: 34 summarised from Bassompière-Sewrin, 1854: 831); however, this understanding ignored the railway station’s potential for integrating urban facilities through its accessibility advantage, such as the ‘post office, large hotels, banks and department stores’ (Nilsen, 2003: 27). This unparalleled privilege motivated fierce land competitions between railway companies, which invested significant efforts to locate a station in the heart of a city. This phenomenon was most obvious in London and was described by Kellett (1979: 289) as ‘land hunger’ between the privately-funded rail investors (Figure 3.13).

Prosperous urban life that developed around station nodes brought increased values and soaring prices for central lands, which drove the land uses transformed into commercial and business uses for higher profit returns (Figure 3.14). The original residents and industries (mostly the large-scale factories) in the

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75 According to Wang (1999: 97), between the mid-1800s and early 1900s, the output of agriculture of major European states had decreased by 50%-60% of the GDP prior to the Industrial Revolution period. In 1909, agriculture contributed to about 35% of the GDP in France, and by 1913, it was 23% and 45% of the German and Italian GDPs, respectively.

76 The original text in Chinese is: ‘食物、衣服、房屋、水电、公共卫生、交通、教育’.
central location were motivated to move towards fringe areas where land prices were lower (Figure 3.15).

These relocated industries and residents, on the other hand, were mostly found along the rail lines. For the industries, specifically the heavy industries, ‘the railway lines provided valuable links between suppliers and markets’ (Kellett, 1969: 346). Therefore, once an urban line was in operation, ‘industrial users, storage and constructional businesses and the like’ would occupy lands on both sides of the line. For the middle-class/bourgeois families originally from the city centre, moving to the suburbs had the benefits of fresh air and open spaces as well as the convenience of travelling to the city centre through rail services. With the support of urban rail lines, European cities in the late 1800s and early 1900s were able to expand into suburbs along track routes (Figure 3.16). For example, the Parishes of Islington and Hackney in London, an ideal train ride distance of seven to eight miles away from the Bank of England, were home to about 40,000 clerks working in central London during the late Victorian era (Kellett, 1969: 373) (Figure 3.17).

Furthermore, as mentioned, the industrial revolution shaped various social classes in European cities. Through rail operation, the gaps between classes were ‘indirectly’ widened (Kellett, 1969: 339). As railway companies were reluctant to provide low ticket prices, commuting on trains was beyond the affordability of most of the working class, and the higher income classes were the major targeted market of railway operators. As a result, the appealing and new rail-supported suburbs were growing due to the migration of wealthy families, while the working class was squeezing into the fringe areas of the central district, creating serious urban slum issues. Leigh describes them as ‘twilight zones’, which included ‘shoddy and cheap housing with defective sanitation and cramped space’ (Kellet, 1969: 339). Kellett (1969) further claims that ‘the railways played an indirect role in concentrating population in these areas and in determining their locations’ (page 339).

### 3.2.3 Summary

In short, rail ‘created’ cities in the American west, while it ‘transformed’ cities in Europe. Compared with the clustered and simple structure of the towns along the rail lines of the American west, the European cities were inclined to become internally sophisticated after rail operations. This difference shows the influences of large regional networks and local metropolitan networks on urban growth. The former concentrated on freight transportation, while the latter focused on passengers; however, regarding the mechanism that shapes the rail-city relationship, there are two common observations that can be deduced from American and European studies. First, a constant, repetitive contact between rail services and urban operation is an important condition of integration. In both scenarios of the cattle transportation in western frontier towns of the US and the commuting clerks in central European cities, the rail users were involved in urban life on a long-term basis with certain frequencies, which allowed for a constant ‘contacting’ interface that catalysed urban areas with a strong ‘rail’ character. This
repetition, generally considered the ‘commuting’ pattern in modern urban life, laid a solid foundation for rail infrastructure to play a role in daily life.

Second, the occidental studies also indicate the importance of a rail node’s location, which is critical in creating direct interactions with a city. For instance, in the Abilene case, the drover’s home close to the station defined a core facility of the transportation industry, which further characterised the heart of all urban activities. The core of rail life and the centre of urban life were perfectly overlapped. In London, the proximity advantages to a rail infrastructure were used to develop businesses from manufactory/storage industries to CBD offices, which in turn enriched the meanings of lives close to a station node.

Based the discussion presented, Chinese rail-city history will be analysed. The summarised mechanisms will be discussed in the Chinese context to understand the rail’s role in the urban life of Chinese cities.

### 3.3.0 The rail-city relationship of China

On the basis of the research conducted by Yang (1997), Jin and Xu (1981), Li (1994) and ACCMRC (1999), China has a rail history of over 130 years dating back to the 1880s and can be chronologically categorised into three stages. The first stage is between the late imperial era of the 1880s to 1949, which includes the establishment of the People’s Republic, when a fluctuating development of the national rail network (mainly distributed in the eastern half of Chinese territories) occurred. The 1950s mark the beginning of the second stage, and ends in the 1970s, in which heavy industrial developments occurred in a communist red age. Freight transportation was highlighted in rail infrastructure development to facilitate Chinese industrialisation with an imbalanced passenger transportation record. The third stage covers the 1980s to the present in which rail development was powered by a soaring national economy in both freight and passenger transportation.

The wide range of political and economic contexts of the three stages has shaped a variety of rail-city relationships in China, which are discussed and analysed in the next sections.

#### 3.3.1 Stage One: Early 1880s-late 1940s

Like many other nations, such as Germany between 1820s and 1840s (Ma, 1991: 95-96), beginning in the 1870s, the Imperial Court of Qing had for over a decade fiercely debated whether to allow railroad developments in China (Yang, 1997: 13-17). This debate concluded by the introduction of the first railway, Tangxu line (Tangshan-Xugezhuang)\(^\text{77}\) in 1881. In 1889, the imperial government announced its support of rail development (Yang, 1997: 23).

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\(^{77}\) The purpose of this line was to transport mined coal from Tangshan to Xugezhuang where the canal was connected for further shipment to then emerging industrial centres.
In the following years, waves of rail construction occurred in the north-eastern, northern, and south-eastern territories in China (Figure 3.18)\textsuperscript{78}. According to Yin (2005: 336), by 1911, which was the end of the Chinese imperial era, there was an overall track length of 9,292 kilometres across Chinese land\textsuperscript{79}. As Jin and Xu (1981: 224) have found, this network was geographically fragmented and unevenly distributed. Most of the tracks were laid in the north-eastern and northern parts of China (Figure 3.19). South of the Yangtze River, only a small area of the Yangtze Delta region was covered by rail, which was between three of the major cities: Shanghai, Nanjing and Hangzhou. Further south in the Pearl River Delta, another small network was developed near Guangzhou, and there was only one line in the remote south-western territory linking Yunnan Province and Vietnam.

In comparison with the major industrialised nations, such as Britain’s 35,165 kilometre rail network covering the entire territory in 1900 and the 311,152 kilometre network throughout the US, which was then half of the world’s total track length (Jin and Xu, 1981: 6-7), China’s railways in the early 20th century were insignificant. This geographically imbalanced network was not expanded nationwide until the 1990s.

Moreover, this limited rail network was fragmented by individual lines that were technically not compatible with one another. As an effective way to expand their political and economic interests in China, the major industrial nations\textsuperscript{80} were actively demanding railroad rights for construction and operation through loans and wars with the imperial government. Although there were also governmental investments used to build new lines, the regime’s overall weak performance and constant compromises with the western powers were disappointing and sparked resistance from the citizens. Consequently, several local railway companies began emerging through spontaneous fundraising. In this context, the right to build and operate a railroad often involved fierce competitions between different parties, including overseas powers, the imperial government and local people (Yang, 1997; Jin and Xu, 1981; Li, 1994).

As the royal authority was unable to manage the rail projects funded by various western investors, these lines were built based on standards and codes from different origins, and they also operated in different rail systems (Xiong and An, 2012: 102). The rail lines were built with various gauges, and ‘even the fees for passenger and freight services were mainly charged with or calculated according to their own currencies’\textsuperscript{81} (Li, 2006 b: 49-50). In addition, the government-owned rail lines were poorly managed.

\textsuperscript{78} There is no official or academic definition of Chinese territories; the concept varies chronologically and geographically. Figure 3.18 shows a synthesis of author of current understanding.

\textsuperscript{79} The data from Jin and Xu (1981: 224) shows 9,100 kilometres of a Chinese rail network by 1911. The author decided to use Yin’s (2005) figure as it is a more up-to-date research.

\textsuperscript{80} As Yin (2005; 337-338) has summarised, the industrialised nations involved in China’s rail infrastructure are from Britain, France, Russia, America, Germany, Japan, Belgium and Portugal.

\textsuperscript{81} The original text in Chinese is: ‘甚至所收取的客貨運輸費貨幣也以其本國貨幣為主，或按其本國貨幣結算．’
(Xiong and An, 2012: 50). Thus, a ‘chaotic rail operation system in modern China’ was shaped. The incompatible lines created huge barriers for interchanges and transfers for both passenger and freight transports.

Within the 38 years after the collapse of the imperial government in 1911, China experienced wars between prefectural warlords, against the Japanese invasion and between the Communist and the Nationalist powers. Only limited development of rail networks was recorded. By 1949, despite the total track length increase to about 21,000 kilometres, ‘only 11,000 kilometres were operational’ (CREPR, 2007: 31), which was not much different from the 9,292 kilometres at the end of the Qing Dynasty.

Based on the discussions of Jiang and Xu (2000) and Li (1996), the rail’s influence on Chinese cities prior to 1949 can be summarised into two types of cities. The first type includes new cities that developed independently, which were widely found in north eastern and northern China in which rail networks were comparatively dense. The second type is comprised of conventional cities in which changes in urban developments were observed after a rail network was introduced. These types of cities were mostly located in the northern and eastern parts of China. The following paragraphs include a separate detailed discussion of these two types of cities separately.

Most cities of the first type had ample with resources. Natural resources were among the major reasons for building a new rail line, which can be verified by the tracks in north eastern China that were used to export rich timber and mining resources as well as agricultural products through new reclamation lands (Yu, 2008: 125). Some of the lines in northern China were centred around the rich coal mining resources near Tangshan. These lines provided tremendous opportunities for new towns, typically in the sparsely populated north eastern region. Major cities in this area, such as Harbin, Qiqihar, Mudanjiang, Manchuria and Dalian, were emerging along the Middle-East Railway in the early 1900s. In the more densely populated northern China, the rail infrastructure overtook the original canal system and shaped a series of new urban centres along its route, such as Shijiazhuang, Zhengzhou, Langfang and Xinxian along the Jinghan Line (Beijing-Wuhan) and Qingdao on the Jiaoji Line (Jiaozhou-Jinan).

Compared with the traditionally established political core structure of Chinese cities, the new rail towns had a substantially different urban function. Through research on the spatial structure of rail that influenced urban cases in northern China, Wang and Xiong (2006) assert that the population and street market of new towns expanded either near manufacture/mining industries around the railway station or around station node areas. ‘Rail tracks cutting through [central] streets were the most obvious spatial structure feature of new towns of this type’ (page 157).

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82 The original text in Chinese is: ‘近代中国铁路运营制度的混乱.’
83 The original text in Chinese is: ‘铁路分割街市成为此类新兴市镇内部空间结构的显著特征.’
Harbin is a typical example of a growing city with rail operations that was once a cold and remote fishing village near the Songhua River (Cheng, 2008: 5) (Figure 3.20). Taking advantage of joining the Middle East Railroad routing east-west and the Southern Manchuria Branch Railroad routing north-south, Tsarist Russia, which obtained most of the rail rights in north eastern China, decided to designate Harbin as the major ‘rail affiliated land of the Middle Eastern Railroad’\textsuperscript{84} as well as ‘the headquarters of their invasion activities’\textsuperscript{85} (Zhang, 2011: 23) in north eastern China.

According to Cheng (2008: 5), Russia seized 98.32 square kilometres of lands around Harbin, which was developed in parallel with the Middle East Railroad. By 1899, urban roads and facilities has developed around the station area. Zhang (2011: 23) explains that in the Xiangfang (香坊) area, which is the area initially developed by Russians close to the old station, ‘over thirty streets as well as buildings for banks, churches, trading companies, a residence of the army general, housing, clubs and schools were constructed’.\textsuperscript{86} New urban industries were also emerging, which were comprised ‘mainly of the building industry and was supplemented by machinery and timber industries as well as non-agricultural industries, including commerce, finance, culture, education and railway construction’.\textsuperscript{87} Along with the operation of the Middle Eastern Railroad since 1899, Harbin’s centre gradually moved to the new railway station and relevant rail facilities in the northern area closer to river, and experienced continuous expansion. Eight districts were planned by the Russians\textsuperscript{88} with further developments of ‘new areas with administration centres, commercial centres, barracks and residential housing in the districts, which structured the early spatial morphology of Harbin’\textsuperscript{89} (Cheng, 2008: 5) (Figure 3.21).

The rail infrastructure allowed Russians to develop Harbin into an industrial manufacturing centre and a base for processing various products through exporting their investment capitals. Zhang’s (2011: 25) statistical data suggests that by 1903, there were over 100 Russian invested manufacturers in Harbin, including heavy industries such as mining and shipbuilding and agricultural processing industries such as wheat flour, oil extraction, wine making, sugar and cigarettes. Trading was also promoted by rail. The Russian companies ‘controlled the import and export trades in Harbin by buying and exporting Chinese

\textsuperscript{84} The original text in Chinese is: ‘中东铁路附属地.’ According to the 1896 signed \textit{Sino-Russian Joint Eastern Provincial Railway Charter Contract}, Russia was allowed to develop and operate the ‘affiliated lands’ of the railway.

\textsuperscript{85} The original text in Chinese is: ‘从事各项侵略活动的大本营’.

\textsuperscript{86} The original text in Chinese is: ‘三十多条街道和银行、教堂、洋行、将军府、俱乐部、学校等大量建筑物.’

\textsuperscript{87} The original text in Chinese is: ‘以建筑业为主，机械、木材工业为辅，商业、金融、文化、教育与铁路建设综合起步的非农业产业.’

\textsuperscript{88} According to Zhang (2011: 23), the eight districts include 老哈尔滨 (old Harbin, which is Xiangfang), 新市街 (Xinshijie, or literally new street markets), 埠头区 (Butouqu, or literally quay area), 马家沟 (Majiaogou, or literally Ma family’s trench), 兵团村 (Bintuancun, or literally army’s village), 卫戍医院村 (Weishu Yiyuan Cun, or literally garrison hospital village), 桥头村 (Qiaotoucun, or literally bridgehead village).

\textsuperscript{89} The original text in Chinese is: ‘并在此区域内建设了行政中心，商业中心，兵营区，居民区等新城区，由此构成了哈尔滨城市早期的空间形态.’
agricultural, forestry and farming products and silk and cotton fabricates as well as dumping industrial products from Russia\(^9\) (Zhang, 2011: 25). After losing the war against Japan in 1905 on Chinese territory, Russia was forced to open Harbin as an international commercial port the same year. Further investments came from Japan and Europe and consequently expanded the growth of Harbin’s industries and economy.

In addition to urban and industrial developments, an even more substantial change caused by rail was the population growth in Harbin. Because the Middle Eastern Railroad connected to the Jingfeng Line (Beijing-Shenyang Line) in Shenyang, immigrants from inland China were able to migrate to new towns along the rail line, especially in developing Harbin, where cheap labour was needed in large numbers. In addition, Russians, the Japanese and Europeans migrated to Harbin during this period. As Cheng (2008: 5) finds, the metropolitan population in Harbin was 68,549 in 1912, of which Russians comprised 63.7%. By 1920, according to Zhang (2011: 31), there were over 300,000 residents in Harbin, and over 11,000 were from Japan. Compared with other Chinese cities in that era, Harbin’s high level of internationalisation was rare (Figure 3.22).

Apart from Harbin, Shijiazhuang, which is located at the intersection of the Jinghan Line (Beijing-Wuhan, opened in 1902) and the Zhengtai Line (Shijiazhuang-Taiyuan, opened in 1907) (refer to Figure 3.19 for locations), is a case with fewer industrialisation features, which resulted in a different urban industry. According to Li (2006 a: 119-123), Shijiazhuang, which was a village of 94 households in 1863, was transformed by rail into a combination of a ‘transport hub, freight distribution centre and military strategic centre’\(^9\) (Figures 3.23 and 3.24), and its hinterland stretched across the middle-south areas of the Hebei and Shanxi Provinces. The booming transit transportation and trading industry in Shijiazhuang also attracted immigrants in significant numbers.

In comparison with Harbin, Shijiazhuang did not experience large-scale manufacturing industry developments but instead was a relatively mono-functional centre of trading businesses. In fact, this is not an exceptional case. As China did not have any significant industrialisation prior to large-scale rail development, this new infrastructure could not instigate a Chinese version of the Industrial Revolution that had occurred in Europe. Instead, along the rail lines created through Chinese capital investment, most towns eventually only gained a regional trading importance (Figure 3.25). In addition to Shijiazhuang, Zhengzhou and Bengbu in the northern Chinese network were also emerging centres of trade (Jiang and Xu, 2000: 57).

For long established traditional cities, the arrival of rail also brought new changes. Jiang and Xu (2000: 59) state that the rail made cities ‘even more prosperous, and they flourished beyond their original

\(^9\) The original text in Chinese is: ‘收购、出口中国的农林牧副产品和丝棉织品，倾销俄国的工业产品，控制了哈尔滨的进出口贸易．’

\(^9\) The original text in Chinese is: ‘交通运输枢纽、商品货物集散中心和军事战略要地．’
[success]; their footprint sizes were rapidly expanding, and urban functions were further transformed.\textsuperscript{92} Major cities in the eastern and middle regions of China, such as Nanjing, Wuhan, Hangzhou and Suzhou, are good examples of this\textsuperscript{93}.

Unlike the straightforward influence of rail in developing new towns, the established cities experienced a comparatively indirect influence of rail. The main reason for this was the strong and rigid political ‘core’ inherited from imperial values and templates, which demanded closure and protection through walls. Commercial life, which is non-productive, had long been understood ‘negative’ in Chinese dynasties in contrast to the respected agriculture, which is productive and ‘positive’. Therefore, trading market areas were restricted in a ‘Cheng’, as discussed in Chapter Two. In the conventional understanding, the commercial vibrancy (and sometimes some industries) generated by the rail connection was not equivalent to the importance of the ceremonial political core. As a result, several railway stations were located in enclaves outside of traditional urban areas. Consequently, the early influence of rail in many cases occurred outside of the city walls. This is clearly demonstrated in cities such as Nanjing and Wuchang, which will be discussed in more detail.

As one of the seven ‘traditional capital cities’ in Chinese history, Nanjing formerly served eight feudal dynasties and kingdoms\textsuperscript{94} and was also established as the capital of the National Republic of China following the collapse of the Qing imperial dynasty. This city has a particularly strong influence on the territories south of the Yangtze River, which indicates strong political importance in Chinese urban hierarchy.

Nanjing was connected by a rail network in 1908 through the Huning Line (Shanghai-Nanjing Line). By 1912, the Jinpu Line (Tianjin-Pukou Line) further improved Nanjing’s rail connectivity to the cities in northern China. The railway station, which was different from the central locations such as Harbin and Shijiazhuang, was in Xiaguan, a quay of the Yangtze River nine kilometres away from Nanjing’s city centre (today’s Nanjing West Station) (refer to Figure 3.19 for locations at the national scale). There was another station, Pukou, which was located to the north of the bank of Yangtze that connected to the Xiaguan via ferry services. As Xu (2013: 25) reports, the rail connection made the Xiaguan area ‘an

\textsuperscript{92} The original text in Chinese is: ‘使它们在原有基础上更加繁荣兴盛起来, 城市规模急速扩大, 城市功能性质进一步转变.’

\textsuperscript{93} Shanghai is an exceptional case between ‘new cities’ powered by rail infrastructure and ‘traditionally established cities’ and is therefore not discussed below. This city was initially developed following the Opium War (1840-1842), taking its geographical advantage of Yangtze River’s estuary. Therefore, Shanghai gained its early trading and industrial importance by support from both river and sea shipments. The rail infrastructure further stimulated Shanghai’s growth with its central location of the network and caused the city to occupy the highest level in the urban hierarchy of the Lower Yangtze Delta region.

\textsuperscript{94} The six dynasties include the Wu Kingdom (222-280 AD) of the Three Kingdom period (220-280 AD); Eastern Jin Dynasty (317-420 AD); four consecutive dynasties during the Southern Dynasties period (420-589 AD): Song (420-479 AD), Qi (479-502 AD), Liang (502-557 AD) and Chen (557-589 AD); as well as the Southern Tang Kingdom (937-975 AD). Meanwhile, Nanjing briefly served as the national capital during the early Ming Dynasty (1368-1644 AD).
emerging hub of Nanjing’s water and land transportation; many related businesses, such as customs
clearances, interchange transport and freight transport were rooted here and were experiencing
growing prosperity. In addition, new facilities, including telegraph and post, as well as an agglomeration
of passenger and freight services all stimulated the development of the Xiaguan area95 (Figures 3.27
and 3.28).

By 1937, Xiaguan had become one of three major commercial areas in Nanjing (Li, 2012 b: 225);
however, ‘as it was located outside of the city walls and far from reach, many people regarded it as an
enclave [of Nanjing] at that time96 (Xu, 2013: 27).

The historical Wuchang was established due to its military importance and was located in the middle
reach of Yangtze (refer to Figure 3.19 for location, also see Figures 3.29, 3.30 and 3.31). This city had
therefore adopted a similar attitude towards new rail infrastructure. The Jinghan Line (Beijing-Wuhan
Line) began operation in 1906 and connected Beijing directly to Wuchang, but the station was in Hankou,
which was an international port opened in 186197 that was located on the other side of the Yangtze
opposite to Wuchang. As a consequence of the rail connection, Hankou was ‘stimulated with booming
commerce and trading, which sharply improved its position in the national economic hierarchy of
modern China’98 (Wang, 2006: 61) (Figures 3.32 and 3.33). On the contrary, the original centre of
Wuchang which had both politics and military influences did not have a direct rail connection until the
Yuehan Line (Guangzhou-Wuhan Line) was constructed about 30 years later in 1937. Unfortunately, due
to the wars that occurred immediately afterwards, there was not enough time for Wuchang to develop
a recognisable station-city relationship.

Both Xiaguan of Nanjing and Hankou of Wuchang had established port economies prior to the arrival of
rail, and they were located at significant distances from the ‘orthodox’ centres that were political and
military cities. Selecting these enclaves for rail connections advanced the further development of local
economies. They were physically detached from the city’s core area, which exposed the rigid planning
notion of ‘separating politics from commercial’. In the established cities, rail was clearly not successful in
redefining the urban life of the urban population.

Nevertheless, there was a slim chance in Nanjing for transformation resulting from the introduction of a
metropolitan rail line, called the Ningsheng Line, between Xiaguan and Wanshougong, a central precinct

95 The original text in Chinese is: ‘一跃成为南京的水陆交通枢纽,许多关联行业如报关业、转运业、
运输业等,亦开始落地生根,蓬勃发展,加上电报局、邮政局的先后设置,以及大量客运、货运流的
形成和集聚,极大地促进了下关地区的发展。’

96 The original text in Chinese is: ‘因位于城墙以外,偏居一隅,与传统的南京城市间隔相当距离,当时的人
似乎多将其视作飞地。’

97 Opening Hankou was part of the Tianjin Treaties, which were agreements between the Imperial Qing
Government and Britain, France, Russia and America after losing the Second Opium War in 1858.

98 The original text in Chinese is: ‘促进了商业贸易的繁荣,大大提升了江口在近代中国经济格局中的
地位。’
of Nanjing (Figure 3.27). This line was invested in and operated by local government. Construction began in 1907, and it was opened in 1909 (Li, 1994: 134). This metropolitan line was also a unique case in the early years of Chinese rail history when the purpose of every line was long-distance transportation\(^99\). The Ningsheng Line is probably the only case that can be used to study urban rail in the early history of Chinese rail development to identify the Chinese rail-city relationship on the metropolitan scale.

According to Li (2012 b: 40), prior to the China-Japan war, Nanjing’s metropolitan line operated ‘thirty services per day; on average, there was one train running towards the north and south, respectively, every hour. Every service had about five to six hundred passengers with luggage over tens of carrying poles’.\(^{100}\) Li (2012 b: 40) further concludes that the Ningsheng Line played an important role in Nanjing’s urban transport during its early years.

Significant urban growth was observed along the metropolitan line, which was the major development area of Nanjing prior to the war. As local businesses were mostly found near Xiaguan and on both sides of the Yangtze River (Xu, 2013: 230), the inexpensive train fares allowed a large professional and working population to commute between the main city and Xiaguan (Li, 2012 b: 220-221). This line became particularly important with the sharp rise of Nanjing’s population beginning in 1928, comprising a growth of over a half million in seven years and over one million by 1935 (Li, 2012 b: 220-221). Steady travel between the city centre and Xiaguan triggered large developments near the rail line with an agglomeration of ‘several governmental agencies and new types of houses’\(^{101}\) (Xu, 2013: 230) (Figures 3.34 and 3.35).

Unexpectedly, the Ningsheng Line’s attraction to urban residents soon faded with the increasing urban bus services that began in the 1930s. Through a comparison study, Li (2012 b: 70) has found that the bus exceeded rail services in frequency and number of urban stops and had a better flexibility to meet the demands of passengers. On the contrary, the trains had a widely known reputation of being shaking, noisy and smoky. The train’s operational speed was actually slower than buses due to frequent braking between stations with short distance intervals. The number of train passengers began to decrease, eventually making urban train operations difficult to continue. After 1949, this sole case of urban rail in China was terminated and demolished, announcing the failure of an early effort to introduce rail infrastructure into the core areas of Chinese conventional cities.

By comparing the Nanjing case with the successful urban rail networks, services developed in the Victorian cities, such as London, three major urban factors that led to different results can be identified:

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\(^{99}\) According to the author’s research, there was another dedicated urban rail case built in 1913 in 双城 (Shuangcheng) County, Jilin Province. This was a six kilometre track operated by horse power and did not have a strong influence (Li, 1994: 189)

\(^{100}\) The original text in Chinese is: ‘每日已行三十次，平均每小时有南北客车各一次。每次可载客五六百人，货物数十担。’

\(^{101}\) The original text in Chinese is: ‘大量政府机关、新式住宅。’
population density, travel quality and line routing (Figure 3.36). First, despite London’s population having reached over 3.5 million in 1901 (British History Online), which was over four times Nanjing’s 0.9 million in 1934 (Li, 2012b: 201), there was a reversed population density distribution along both sides of the urban tracks between London and Nanjing. According to Kellett (1969: 378), the average residential density of London’s outer suburbs with rail operations in 1901 was about 5.9 people per acre, which is equivalent to about 1,479 people per square kilometre. Data from Li (2012b: 216) suggests that in 1934, Nanjing’s average population density was 2,213 per square kilometre across the entire metropolitan area, which is in addition to the potentially even higher figure of the central area where trains were operated. It can clearly be assumed that the greater residential density in Nanjing had negative impacts on early steam engines, which were even amplified among the urban residents, most of whom were also the passengers.

Second, the early private rail companies in London charged expensive train fares to target the middle class to acquire profit, and this improved passengers’ comfort by designating classes between the cars. This approach, although widely criticised for effectively denying rail access to the working class, had an undeniable side effect of characterising train travel as being part of a high quality of life. The affordable public train services in Nanjing failed to build ‘quality’, which contributed to their failure in competition with bus transportation.

Third, in the line routing planning, Nanjing’s only urban rail connected two urban centres of eleven kilometres (Li, 2012b: 40) with a short average station interval of 1.6 kilometres102, which technically caused trains to struggle between starts and stops and to be easily replaceable by urban buses. In London, the urban lines connected a city’s core areas and suburbs in all directions. The swift travel to and from the suburbs made trains ‘technically efficient’ (Kellett, 1969: 373) between dense and sparse dwellings, which allowed trains to survive several other competitions.

In summary, in the first historical stage, there are distinct two features of Chinese rail networks compared with Europe and America. First, it was a highly fragmented network that covered only portions of the entire territory with a much shorter overall length of tracks. Second, the trains’ primary function was long-distance and intercity transport, which led to only slight developments in urban railways. This created a two-fold issue. On one hand, the Chinese cities had been originally established with compact spatial structures, and there was very little urban growth in the suburbs in China prior to 1949, meaning that the scope of the potential urban rail was restricted to the metropolitan area. On the other hand, technical competition from other types of vehicle transport further exposed the weaknesses of the early trains in an urban environment, which made trains vulnerable to failure.

102 This is calculated by author through synthesising the total length (Li, 2012b: 40) and station number (Li, 2012b: 55-56) information.
In terms of the rail-city relationship, rail’s impacts on stimulating the development of new towns along its routes were direct and obvious, which is nearly identical to the experiences of new towns in the American west. This is also true for conventional cities in which rail was related to new developments that were mostly outside of the city walls and that did not affect the established urban cores. It is therefore possible to assert that early railways had similar mechanisms in stimulating the growth of new towns and old towns in general; however, it must be recognised that the level of industrialisation has a noteworthy influence on the potential urban industries that were a result of rail, such as in the difference between Harbin and Shijiazhuang. On the metropolitan scale, the failure of urban rail indicates that a large population of potential daily rail passengers were unfortunately lost at the very early stage of rail history. Without a constant ‘interface’ between rail and urban operations, the rail infrastructure was unable to become a fundamental element in Chinese urban life even in later years.

3.3.2 Stage Two: Early 1950s-late 1970s

After the birth of the People’s Republic, the new Communist government faced a huge challenge in industrialising the agriculturally established nation at a rapid pace and to catch up with the industrialised nations within a short period. Through discreet considerations, in 1952, the first five-year plan draft\(^{103}\) declared that the industrial development should focus on heavy industries and should be supplemented by light industries. Huang (2005: 23) points out that this draft indicated that ‘decisions had been made to strategically prioritise the heavy industry developments, and a common understanding had been achieved within the Chinese Communist Party (CCP)\(^{104}\).

On the other hand, the fragmented and fragile rail network survived, and after decades of wars, it was awaiting repairs and extensions to meet the upcoming demands of industrialisation. Particularly for the wide and vast western territories of China, there were very few rail tracks laid until 1949, which ‘were far from suiting the needs of the national economic development and strategic plans’\(^{105}\) (ACCMRC, 1999: 39) (Figure 3.37).

In 1964, based on China’s status in the global network of politics and the military, the Central Committee of CCP decided to develop the remote western provinces to strategically prepare for potential wars on the coastal and northern frontiers. The most valuable and important industries and manufacturers, including steel, electronics, vehicles, aeroplanes and nuclear manufacturers, were moved or rebuilt in the less developed western provinces, such as Yunnan, Guizhou and Sichuan (Figure 3.38). The new locations were expected to benefit from being close to rich mining resources and also to protect the industrial entities through the deep valleys and high mountains. In later years, this decision

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\(^{103}\) 一九五四年至一九五七年计划輪稿 (The Planning Profile (draft) between 1953 and 1957) and its affiliated ‘总说明’ (General Information), authored by the Central Financial and Economic Committee of CCP (中共中央财政经济委员会) (Fang and Jin, 2001: 422).

\(^{104}\) The original text in Chinese is: ‘优先发展重工业的战略已基本确定,并在中共内部达成共识.’

\(^{105}\) The original text in Chinese is: ‘很不适应国民经济的发展和国家战略部署的需要.’
was widely known as the ‘three frontiers battle’ of south-western China\(^\text{106}\) (西南 “三线” 大会战, Sun, 2010: 17-18).

The western rail network was part of the ‘three frontiers’ battle’, which was mainly comprised of the Chengkun Line (Chengdu-Kunming) of 1,090 kilometres, the Chuanqian Line (Chongqing-Guiyang) of 423 kilometres and the Guikun Line (Guiyang-Kunming) of 639 kilometres. (ACCMRC, 1999: 84) (Figure 3.38). Due to the geographical complexities, rough terrains and the rapidly changing weather in the deep jungles, the new rail lines faced serious challenges in both design and construction and were later renowned as a ‘miracle of railway building history’\(^\text{107}\) (ACCMRC, 1999: 89-90).

Following the operation of new lines between the 1960s and 1970s, clusters of new industrial centres began to emerge along the routes, and traditional cities in the new rail network also experienced industrialisation developments (Sun, 2010: 19-22). Nevertheless, in contrast to the early urban effects of rail, this period included increased ‘productions’ through rail operations, while the ‘consumptions’ were widely ignored. In other words, the rail infrastructure focused on freight rather than passenger services during the red industrialisation era.

A typical ‘production-oriented’ case in south western China is the city of Panzhihua, a steel manufacturing centre in the deep valleys of Sichuan that developed along the Chengkun Line (Figure 3.39). Liu and Que (2010: 58-59) have categorised Panzhihua’s growth into three stages. The period from 1964-1965 is the first stage when this vanadium-titanium magnetite ore rich area in the Jinsha River gorge was conceptualised by Mao and was listed as one of the focal projects in the ‘three frontiers’. A plan was drafted for the new centre ‘to occupy about 300 square kilometres of land, and it proposed a population of 120 thousand, of which 51 thousand would be employees’\(^\text{108}\) (page 58).

The second stage covers nearly a decade between 1965 and 1974 when tens of thousands of builders were sent to Panzhihua for massive construction works. It should be emphasised that this development did not represent urban character (page 59). To maximise industrial outputs from limited available investments, a policy of ‘production first, life second’ was applied, meaning that investments for life related facilities, such as housing and retail, were minimised to the basic level, which is why Panzhihua was much more a centre of manufacturers than a ‘city’ in its early years. According to the record, the

\(^{106}\) Due to the deterioration of relations with the Soviet Union beginning in the late 1950s, China was under strong political and military pressure from the Soviets in the north and Americans in the east during the 1960s and 1970s. To protect the newly born heavy industry manufacturers from potential wars, the central committee of CCP and Mao decided to divide Chinese territories into first, second and third frontiers according to strategic locations from east and north to south and west (Figure 3.38). According to Liu and Que (2010: 58), the ‘third frontier constructions’ refer to the construction campaign between 1964 and 1980 in 13 provinces of central and western China, focusing on the basic industry, the defense industry and the transport infrastructure. War readiness was the guideline of this campaign.

\(^{107}\) The original text in Chinese is: ‘筑路史上的奇迹．’

\(^{108}\) The original text in Chinese is: ‘约 300 平方公里，人口规模 12 万人，其中职工 5.1 万人．’
‘non-production’ investment between 1965 and 1970 was only 9.61% of the total budget (page 59). The development of Panzhihua exceeded the initial estimations, and the planning was amended between 1970 and 1973, increasing the population up to a half million (Bao, 2000: 86). In the third stage between 1974 and 1980, which will be discussed in the next section, the prioritised industrial developments required increased urban growth. New municipal facilities and public projects were proposed and built beginning in 1978 (Figure 3.40). In the total investment record between 1978 and 1985, the ‘non-production’ percentage rose to 41.24% (page 59) (Figures 3.41, 3.42 and 3.43).

The history of Panzhihua clearly illustrates the imbalanced ‘production’ and ‘consumption’ relationship in the new towns that emerged during the red industrialisation. The former was overwhelming, and the latter was minimised to survival standards. In this context, the rail infrastructure was understood as a ‘production’ resource instead of serving ‘consumption’. So, what relationship was shaped between rails and cities in this period? It is especially interesting to investigate possible growth around station nodes in a planned economy system compared with the ‘spontaneous’ economic and industrial developments in early station node areas. From this perspective, another feature of the new industrial dwelling, ‘communal living’, should be discussed.

Chapter Two has discussed the communal living pattern conceptualised by early Soviet planning theories. This concept was further developed in Chinese communist/socialist practices into a self-sustained ‘worker’s village’ (工人新村) template. In this template, residencies are proposed and supporting facilities, such as dining halls, hospitals, schools and shops, are planned as supplementary entities near production precincts.

In a production-oriented planning template, a ‘city’ with a centralised urban population was never possible. As Bao (2005: 11) describes, during the early years of Panzhihua, industries were often described as simple and rough ‘worker’s villages’, and ‘some factories were surrounded by residential areas, while some were indented with residential lands’ (Bao, 2000: 86). The population was physically developed as an affiliated component to the production activities.

This self-sustained living pattern led to minimised demands for rail services for both daily and occasional travels. The rail facilities were therefore geographically located far from industrial dwellings. In Panzhihua, although there were tracks that were laid in several factory areas, the station for passengers is 14 kilometres away from the city even today.

Industrialisation in traditional cities had a similar mechanism as it did in new towns, as their new industrial centres were mostly located outside of an established urban area. In these remote, self-sustaining new industrial areas, rail served production purposes only. Generally, there was no substantial involvement of rail in the ‘urban life’ of these new areas.

109 The original text in Chinese is: ‘有的工厂被居住区包围，有的工厂与居住用地犬牙交错.’
In the central area of conventional cities, the influences of rail also began to disappear. The ‘dual residence registration’ policy that had taken effect in the 1950s was the main reason; it was an attempt to separate rural and urban residents by banning relocation between the territories. Please refer to Section 1.6.0 of Chapter One for details of this policy. Hangzhou, an excellent example that demonstrate the rail-city relationship of the conventional cities in the second stage, is included in the case study of this chapter in the next section.

3.3.3 Stage Three: Early 1980s-2000s

Due to the chaotic decade of the Culture Revolution between 1966 and 1976, China launched a series of new policies in the early 1980s to initiate political and economic reforms. Soon, the national economy was taking off, and substantial growth in both heavy and light industries was observed. The changing structure of the Chinese economy generated increasing demands for labour resources, which motivated a large rural population to move into cities. The new era of Chinese urbanisation had begun.

Through the recovery from the ideological movement’s damage, the rail development in China began to progress, and both freight and passenger services began in the 1980s. The rail’s overall length of tracks and capacity were growing rapidly (Figure 3.44), but they were still far from meeting the soaring freight and passenger transport demands of the national economy that were rising even faster. According to ACCMRC (1999: 256), in 1992, China’s GDP achieved 13% of growth, of which the industrial outputs contributed 27.5%; however, the increase of rail infrastructure development was only 3%. The freight demands were significantly exceeding the capacity of train services, and cargos across China were stuck on long-term waiting lists. The rail infrastructure became a ‘bottleneck that restricted the development of the national economy’ (ACCMRC, 1999: 256). This shortage lasted for a long period. Even in 2005, the rail infrastructure could only provide 35% of the demanded freight capacity (CREPR, 2007: 32).

On the other hand, the number of passengers also exceeded the actual rail capacity. The never-before experienced number of village labourers resulted in waves of immigrants travelling between rural and urban China, especially during the Spring Festival periods. According to the statistics of the ACCMRC (1999: 256), the passenger trains were seriously overloaded during the early 1990s: ‘most trains were overloaded by 50%-70%, and some were even more than 100% overloaded.’ The difficulty in purchasing tickets for the train was a widely criticised phenomenon of the rail services during this period.

Compared with the underdeveloped rail infrastructure, road and aviation transports experienced much faster developments. During nearly three decades between 1978 and 2005, the length of roads achieved a growth of 1.17 times, and the length of aviation routes increased by 12.42 times compared with only

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110 The original text in Chinese is: ‘成为制约国民经济发展的‘瓶颈’.’
111 The original text in Chinese is: ‘一般超员 50%-70%，高的达 100%以上.’
0.4 of the track length growth. Within the same period, the overall combined performance of transportation increased by six times, of which the road passenger/freight transportations were 10 times and 15 times, respectively. The aviation passenger/freight custom grew by 59 times and 47 times, respectively, and rail achieved a much lower increase of 0.36 times and 1.44 times of passenger/freight transportations, respectively (CREPR, 2007: 32).

In cities, old rail infrastructures were massively expanded, and new projects were undertaken to increase rail capacity. The stations and squares, although mostly defined as portals to cities, were occupied by passengers waiting for tickets, peddlers chasing their customers, thieves and pickpockets seeking opportunities and homeless people begging for coins. This chaotic and unsafe environment makes most station precincts urban destinations that people hesitate to visit unless they plan to board the train. The next chapter presents a detailed discussion on this topic.

On the other hand, rail infrastructure development did not match most of the urban expansions. Apart from metro networks developed in very few central cities, such as Beijing, Shanghai and Guangzhou, most Chinese cities had neither metro nor urban rail infrastructures to support their growth. Roadways were the only option for transport in most situations.

In general, despite the growth of urban populations, rail was gradually fading from urban life. For both commuting and long-distance travel, vehicles and highways were preferred by most travellers due to their comfort, flexibility and quality advantages. Once vehicular travel was affordable, most people would not consider visiting the dirty stations or squeezing onto trains.

3.3.4 Summary

Through further studying the rail-city relationships in China, it may be found that the understanding of the rail-city relationship mechanism that was summarised based on American and European cases is applicable in Chinese cases but with slightly different outcomes.

First, the rail infrastructure has a clear orienting effect in shaping the early industries of a new urban settlement. The cities of the American west, the north eastern and the northern parts of China during early years of rail connections and the red industrialisation period of China are excellent examples of this effect. These cases also verify the assertions made by Rostow (1971) regarding rail’s important role in the early development of urban economies. Furthermore, the study also shows that freight transport is a key factor for rail to be successful. This phenomenon is comparatively less obvious within established cities, such as Europe and China, although a certain level of urban sophistication can be widely observed.
Second, the integration of a railway and a city is built upon successful user translations. The European study indicates that a station’s inner/central location in a city generally attracted constant station users from nearby urban areas, a process which integrated stations into daily life activities. This pattern was challenged by Chinese stations, which were located away from the centre of urban life and dedicated to long-distance travel services. Even in later years when early edge location stations were surrounded by expanding urban fabrics, there was still no evidence of a good integration between the station and the city. Therefore, using the locational advantage to create a successful station-city relationship is a serious challenge for Chinese railway stations to consider.

Finally, as a phenomenon, the author observes that different rail funding models, namely the profit oriented developer investment model and non-profit oriented state investment model, appear to have different impacts in shaping the rail-city relationship. The former is well evidenced by the early American and European rail developments. In the American West, the widely known land grant schemes have encouraged private rail investments through introducing immigrants and industries to the emerging towns along the routes of the early lines (Reps, 1979). In London, new tracks were laid by privately owned rail companies targeting at the growing middle class to move into new suburbs which were established through land assembly by the rail developers (Kellett, 1969). In both scenarios, rail was employed as the central infrastructure to gain profits through supporting freight and passenger flows. This commercialised operation focusing on day-to-day rail customers was eventually translated into integrated relationship between rail and urban living.

In comparison, the Chinese rail infrastructure developed after 1949 has been invested in and operated solely by the national/local governments and their related agencies. In this mode, the rail infrastructure normally fits into the larger, national scale of strategies especially in a planned economic system. The everyday urban life, if not part of the strategy, is not targeted by the rail development and operation. This is typically presented by the Panzhihua case discussed above, where rail was employed to facilitate the national industrialisation ambition, with however no interest to serve purposes beyond it. Such a non-commercialised model does not recognise/accommodate user demands and experiences, which isolates the rail from urban lives.

From the above observations, the author tends to agree that the funding models of rail infrastructure have impacts in shaping the rail-city relationship with different levels of quality. However, the author also understands that a thorough research to disclose the mechanism between rail

112 According to Li (1994: 154), the imperial Qing government owned 4955.9 kilometres of railway by 1912, accounting for 49.83% of the total track length in then China; the rest was comprised by the Chinese developer owned rail of 6.78%, local authority owned rail of 0.39%, and the rail owned by foreign investors (including the western governments) of 43%. This fragmented rail ownership changed slightly during the National Government period after 1912 with mostly unsuccessful efforts to nationalise the trunk lines (Li, 1994: 156-195). Since the Communists’ military success in China in 1949, the rail infrastructure was quickly nationalised and integrated into the centralised governmental system (ACCMRC, 1999: 25-27).
investment/operation models and their impacts on rail-city relationship involves data and methodologies far beyond the scopes of architectural/urban design studies. Collaboration with economists will be necessary to support a future enquiry into this topic, which is therefore not further investigated in this thesis.

3.4.0 Case study of Hangzhou

Hangzhou City is used as an example to observe the rail-city relationships that developed in three stages within a consistent history of one city. The mechanisms, which have been summarised in previous sections, involved in the casting influence of rail infrastructure on urban development are also tested and verified in this case study.

The selection of Hangzhou as a case study was mostly due to this city’s continuity of rail development through the previously categorised three historical stages as well as the typicality of the established rail-city relationship in other Chinese cities. Being one of the ‘seven ancient capital cities’ in Chinese history, Hangzhou had been established for over 800 years before the rail was introduced in early 1900s; however, different from her counterparts Nanjing and Wuchang, the rail tracks penetrated the walls, which had strong political and military importance in the imperial age, and substantial changes in urban life were observed in later years. During the red industrialisation period, Hangzhou was not listed as one of the major ‘three frontiers’ bases, but there was still ‘production’ developments proposed that were located far from the conventional urban boundaries, which presents a case to be discussed in greater detail than the above summary. Within the most recent urbanisation period, data of both urban and rail growth was collected by the author to illustrate the disconnection between urban expansion and the rail extension in Hangzhou during the past decades.

3.4.1 The Late Imperial and Early Industrialisation Period (1900s-1930s)

Historically, imperial Hangzhou has a prestigious position within the urban hierarchical system in the Lower Yangtze Delta Region, and developed various scales of trading life in- and outside of its city walls. The coming of the railways in the early 1900s, however, reshaped the urban system and the city’s identity, bringing a never before experienced prosperity to urban life.

Profile of Late Imperial Hangzhou

Sitting at the southern end of the Grand Canal and estuary of the Qiantang River, Hangzhou has been long established as the trading centre of the Lower Yangtze Delta Region, based on the water transportation network prior to industrialisation. Taking advantage of the canal’s role as the spine of north-south commodity trading in China, Hangzhou functioned as a trading hub. This trading system extended further west into the Jiangxi and Anhui provinces through the Qiantang River and its branches,
which further consolidated Hangzhou’s dominant position among other cities since the period of the Southern Song Dynasty (AD 1127-1279), when this town was established as the imperial capital. Periods of prosperities have been recorded during near 800 years till late the Qing Dynasty (AD 1636-1912).

Over time, the walled up area of Hangzhou (城郭, phonetically ‘Chengguo’) has most been retained and the area of city has remained relatively constant. As by the Hangzhou Municipal Government in 1937, this is a traditional city with a long history; all of the buildings were built following ancient orders through dynasties, and variations in architecture were rarely challenged. There was however one area in Chengguo that distinguished Qing’s Hangzhou from previous dynasties, also known as ‘Qiying’ (旗营, or literally the Manchu Barracks). To symbolise the Manchus’ occupation of this important town, especially as a regional military centre, the Qiying was sited along the eastern edge of the West Lake, a place of natural beauty and cultural significance that the city had been long proud of. The Qiying’s 3-mile perimetre enclosure blocked direct contact with the lake from the town, and eventually shaped an urban life disconnected from the precious landscape (Wang, 1999 a: 108-109). In-town commercial life was organised by the central axis street or, the ‘imperial spine’ during the Southern Song. It was noticeable that the other major two markets were outside of the Chengguo: one in Gongchenqiao (wharf on the Canal) and the other in Zhakou (wharf on Qiantang River). This means the life inside and outside of the circumvallation was at different scales, the former focusing on local life while the latter represented the city’s status in national and regional trading.

The Insertion of Three Rail Lines

In 1907, Hangzhou’s first rail service, a 16 kilometre local line named ‘Jiangshu’, was put into use after one year’s construction. As a part of the proposed ‘Huhang’ (Shanghai-Hangzhou) rail, this line connected both the wharfs of Gongchenqiao and Zhakou, which presented a clear attempt at improving the connections between the two water transportation systems of the Grand Canal and Qiantang River. This was a scale that did not involve the inner city life, which explains why the trains ran on a curve around the perimeter, and all of the five stations were placed outside of the city wall.

The Jiangshu Rail was partly connected with the Huhang Rail after two years’ operation, and Hangzhou was for the first time linked with Shanghai by a 186 kilometre length of tracks in 1909 (Yu, 2005: 91). This line was soon populated, but the stations outside of the city walls made trains less accessible, especially when the curfew system was still executed during the late Qing Period. Despite concerns about city defence, the decision was later made to build a new station inside the ‘Chengguo’ for direct connections. In 1910, parts of the walls were pulled down and for the first time, the rail penetrated into the town to serve a new inner town station, Chengzhan (城站, meaning ‘the station in town’) (Figure 3.47).
The third rail line, initially named the ‘Hangjiang’ Railway linking Hangzhou and Yushan County in Jiangxi Province, has operated since 1933. In 1934, it was renamed ‘Zhegan’ Rail with plans for further extension to Nanchang City, the capital of Jiangxi Province, and eventually Zhuzhou of Hunan Province, winding its way for 1,008 kilometres (Yu, 2005: 97). The extension was finished in 1937, stretching Hangzhou’s accessibility further into the agriculturally productive inner-land provinces of Jiangxi and Hunan (Figures 3.48 and 3.49).

The Re-interpreted Urban Life of Hangzhou

By creating passages through the walls, the inner town of Hangzhou was connected into a new hierarchy networked by railways, which was centred upon Shanghai. The increasing use of rail infrastructure (Ma, 2008: 10-11) eventually superceded the traditionally dominating water transportation that had been historically established around Hangzhou, as widely documented (Ding, 2005; Su, 2011). Shanghai, powered by the rail lines linking Hangzhou and Nanjing and with the geographical advantage of the Yangtze River’s estuary, experienced a dramatic industrialisation and expansion, and soon consolidated its leading role within the urban system of the Lower Yangtze Delta region.

Three urban changes were observed after the railways were built among Hangzhou’s circumvallation, as discussed in the following paragraphs.

First, the direct contact of Shanghai with Hangzhou through the railway re-identified these two cities through increased competition and collaboration. As Shanghai became the industrialised centre of the Lower Yangtze Delta Region, Hangzhou was tightly integrated with this city by rail infrastructure (Figure 3.50), and gradually Hangzhou became the hinterland of Shanghai’s economy (Tang, 2009: 62). In fact, Shanghai nearly dominated the entire import and export trading businesses of Hangzhou (Han, 1951). Under the shadow of Shanghai, Hangzhou could hardly expect a return to the role of the ‘nationally important town of craft industries and enterprises’ during the imperial era, as described by Fu (1985). By losing its long-established identities, Hangzhou City was in search of new methods to rebuild itself.

The rail brought this opportunity after the 1911 Revolution against the imperial monarchy. In Hangzhou, the new republican government took over power from the Manchus, and demolished the symbolic Qiying (Figure 3.51). Direct contact between lake and city was recreated. Based on the natural and cultural landscape resources from the West Lake, land released from the Qiying provided an opportunity to shape a new industry: tourism. This land was developed fully oriented towards the needs of tourists, of which the emerging middle class in Shanghai made up the majority (Wang, 1999 a: 117). With 3-5 hours’ travel on the Huhang Rail, the Shanghai white-collar workers were able to spend their weekends on the West Lake, which then earned the name of ‘Shanghai’s backyard.’ The Zhegan Rail Company further amplified Hangzhou’s importance in the new tourism industry by extending further west, into the freshly opened up mountains and rivers along its tracks. Through the rail network, Hangzhou City
successfully reshaped itself not only as a destination, but also a regional hub of the tourism industry, which has been lasting up to today (Figure 3.52).

Secondly, by passing through remote villages, the rail infrastructure powered Hangzhou’s urban population growth in the 1930s. According to Ding (2009 a: 80), the Zhegan Line penetrates the drainage areas of the Puyang River and Lanjiang River (both are branches of Qiantang River), with an estimated population of about 3.3 million during the 1920s/30s. Running on the Zhegan Rail, mountain topographies were never barriers, and images of the historically water-connected and rarely accessible cities such as Shanghai and Hangzhou were no longer mysteries. The rail access triggered the mobilisation of labour. Ding (2009 b: 139) estimates that 7 million passengers travelled on the Zhegan Rail (Hangzhou-Yushan fragment) between 1930 and 1937, about one million annually, which was one third of the population along this rail. On the other hand, Hangzhou witnessed a fast population increase during the 1920s/30s. Ding (2007: 248) reveals that between December of 1928 and July of 1930, a rise of about 42,000 urban dwellers was recorded, of which near 95% was from immigration (Figure 3.53).

Thirdly, the activated flow of passengers restructured Hangzhou’s urban space. As the rail lines were serving as the artery of long-distance transportation, the historically dispersed inter-city traffics around the circular gates was condensed around the station area, gradually transforming it into a new market space. As recorded by Yao (2011: 24-25), there were hotels, restaurants (various flavours), and photo galleries clustering around the station. The flourishing market around the station area enriched the traditional single-core commercial layout of the city’s inner area; and with the other emerging market on the Qijing’s site, which was another benefit from the rail passengers, Hangzhou restructured its commercial layout into five urban markets (Chen, 2008: 35), each with a specific orientation and group of clients.

Summary

To summarise, 1930s Hangzhou enjoyed a level of prosperity not experienced since the imperial age. This was mostly triggered by the addition of a rail infrastructure, which brought new industries, enriched the constitution of the population and created a dynamic commercial economy. Compared with the summarised mechanism that shapes a rail-city relationship, the experience in Hangzhou can be also understood in terms of regional and local dimensions.

On a large scale, Hangzhou’s case verifies rail’s importance in shaping new urban industries in established cities; however, different from the trading centres that emerged in a straightforward manner in Nanjing and Wuchang, the rail had a two-fold influence in Hangzhou: it indirectly destroyed the conventional urban craft industry and replaced it with a tourism industry. Both old and new industries were strongly impacted by a rail network on a regional scale. On one hand, the rising centre
of Shanghai replaced Hangzhou through its advantage of having a rail network to dominate industrial developments and utilised the developments for its own hinterland. On the other hand, the rail lines also allowed Hangzhou to expand its hinterland into the remote western territories with new resources. Through the train operations, the rail network was able to fabricate a new hierarchical framework of a village-city-central city structure of the economy.

On the metropolitan scale, on the other hand, Hangzhou exhibited further differences to Nanjing and Wuchang. This is not only due to the fact that Hangzhou’s rail tracks had penetrated the solid city walls to present its importance in the urban centres but also because this station successfully translated its central location advantages into prosperous urban developments around the station node. Although Hangzhou’s rail was not characterised by ‘urban’ services as Nanjing was, the frequent weekend tourists from Shanghai created a comparatively steady and continuous stream of passengers. It was even more important that the historically compact urban footprint of Hangzhou made the railway station highly accessible from several major urban destinations, such as the two-kilometre radius (thirty-minute walk distance) covering nearly half of the city’s footprint area, including the famous West Lake. This geographical intimacy made the station highly convenient for rail passengers to and from Hangzhou. Furthermore, the over 150 kilometre distance between Shanghai and Hangzhou made trains unchallengeable by vehicles due to the technology of early 1900s, which is another advantage for Hangzhou compared with Nanjing.

In general, this is a rare case among Chinese cities in which the rail commute was not established to shape a highly integrated rail-city relationship. The long-term stable passenger flow and good local connections provided opportunities for developing a constant ‘conversation’ between the station and the city in Hangzhou, which formed an interface to allow the station to be a part of urban life. Eventually, a new urban identity was reshaped in Hangzhou that was partly based on rail operations.

3.4.2 The Communist Industrialisation Period (1950s-1970s)

Within the Communist Industrialisation period, the national strategies for fast modernisation and socialisation dictated both rail and urban developments, and is typically represented in the policy of heavy industry development prioritisation and the ‘Hukou’ (urban-rural dual household registration policy) system between rural and urban dwellers. As a result, however, history witnessed a process whereby rail was disconnected from urban life.

*Hangzhou’s Dilemma between ‘Consumption’ and ‘Production’*

The national emphasis upon the heavy industries put Hangzhou, with its established reputation of tourism, into a dilemma between ‘consumption’ and ‘production’. Although the city’s first planning scheme drafted in 1953 valued its established importance of culture and landscape (An, 2011), it was
Unfortunately hardly executed in the following years. Since the launch of Great Leap Forward initiated in 1958, the Chinese cities were exclusively involved in the national fever of industrialisation that ‘overwhelms everything’ (Meisner, 1999). In 1959, Hangzhou drafted the second planning proposal with its urban character redefined as ‘hybrid industrial city based on heavy industries’ \(^{113}\) (Bian, 2008).

In fact, Hangzhou did not see a booming urban transformation into an industrial centre during the years that followed. The new cluster of factories was built on remote agricultural lands far from the centre, typically as the Iron and Steel Factory of Hangzhou (ISFH). Within the planned economy system, this factory was later developed into a self-sustaining industrial town that provides ‘cradle to tomb’ services for its ‘cadres and workers’. In comparison, the conventional town area of Hangzhou was branded as ‘non-production’, and was unavoidably led into decline during the three decades since 1950s. To secure the limited resource for developing heavy industry, the percentage of state investment in central Hangzhou dropped significantly from about 50% in middle 1950s to slightly over 20% in 1960s/70s (Hangzhou Revolution Committee, 1981: 7). No doubt the city was struggling to provide basic life support in the 1970s, and won it the famous folk saying, ‘beautiful West Lake, ragged town.’

**Unbalanced Rail Development and Isolated Urban Life**

Within 1950s/70s, the rail infrastructure saw an imbalanced growth in freight and passenger transportations, making unequal choices between ‘production’ and ‘consumption.’ The target of industrialisation powered sharp increase of freight transportation on tracks. In compare, the rail passenger number experienced fluctuations in 1960s and had a slower growth afterwards (ACCMRC, 1999: 373), which is mainly a consequence of restrains in ‘consumption’ and rural population movements.

In Hangzhou, the only new rail line built during this period was the freight line connecting the ISFH to the national rail network, to support the steel manufactures. Since Hangzhou developed a very different urban life in the ISFH from the centre area, the following discussion will interpret their relationships with rail separately.

Given the poor social documentation during the decade of the Cultural Revolution (1966-1976), [Simplified Hangzhou Traffic Map](Figure 3.54) published in 1971 is analysed in this study to describe the relationship between the rail and civic life. This map clearly shows the bus routes serving metropolitan and regional destinations. Considering Hangzhou's urban transportation of that age, when there was no metro-line, few taxis, and nearly zero private vehicles, the bus route map recorded the movements of urban life. Through summarising this map, we find that urban transportation was structured by a number of bus hubs, namely Wulinmen (武林门), Hubin (湖滨), Nanxingqiao (南星桥), and so forth.

\(^{113}\) The original text in Chinese is: ‘以重工业为基础的综合性工业城市．’
Genshanmen (艮山门), Gongrenlu (工人路), and Gongchenqiao (拱宸桥). These hubs networked on both metropolitan and regional scales. The rail station, however, was not among the named hubs (Figure 3.55). It was connected only with in-town destinations, which means that regional passengers had to access the station via any of these bus hubs. If we do a closer study of the number of bus lines connected, the station was served by only three in-town lines, compared with Wulinmen, a hub next door to the coach station, which was served by 7 lines of which 2 were regional.

This map clearly indicates that: a) the rail station was connected mostly with urban dwellers, and; b) villagers from nearby rural Hangzhou were the major visitors in this town, as indicated by the number of bus lines connecting coach/rail stations. As rail was serving as the main transportation for long-distance travels, the weak connection between rail station and urban transportation hierarchy tells that 1950s/70s Hangzhou was not closely integrated with the rest of China, on either an inter-city or regional scale.

Away from the traditionally established urban footprint area, Hangzhou’s ‘productive’ industrial developments is about 12 kilometres north of central area, namely ‘Iron and Steel Factory of Hangzhou’ (ISFH), sited in the middle of rice paddy fields. This was typically an ‘industrial island floating on the agricultural lands’. As a typical example of state-owned large size industry within the planned economic framework, a Shenghuoqu (生活区, literally ‘the living area for employees’) was built near the factory site to accommodate its staff (Figure 3.56). Instead of a satellite town, this is a self-sustained ‘living workshop’ incorporating various life supporting facilities, such as massive row apartment housing, hospital, schools, and shops. During the 1980s, the Shenghuoqu grew to a size of about 9,746 residents (Zhang, 1985: 670) (Figure 3.57). As described above, a rail line was constructed in the late 1950s to link the ISFH into the regional rail network. This line was then used exclusively for freight services. As there was only one direct road link between this industrial dwelling town and the city centre, with one bus route that normally took about 40 minute-1 hour to access the edge of the city, there was however never a plan to provide passenger service on the established rail.

Summary

In general, rail developed a very different connectivity of freight and passenger transportations for this period as a result of the national strategies and policies. Rail played an important role in developing national heavy industries, but the connectivity between rail and urban life was declining or even missing compared with its heydays in early 1900s.

To compare, the ISFH area and the conventional area of Hangzhou were labelled as ‘production’ and ‘consumption’, respectively, and therefore witnessed different rail integrations. In the industrial centre, there were strong developmental supports from the rail network, which were restricted by freight trains. Compared with the city of Abilene of the American west, the rail’s role in establishing a major industry
through freight services was identical; however, within the rigid planning economy system and the ideological slogan of ‘production first, life second’, the ‘production’ train was never used for ‘consumption’. Without passengers, rail could not play a role in urban life. This is why the railway station of Abilene remained in the centre of city, but in ISFH, the trains were never visible for local residents.

In the conventional urban area, the compression of ‘consumption’ led to a significant decline of established urban industries, typically the tourism industry. Moreover, the threshold of the ‘dual residence registration system’ banned many travel flows between rural and urban China. There was rarely a rail-city ‘interface’ maintained between the Chengzhan station and its immediate urban areas. Although the station remained in its central location during the red industrial era due to little urban expansion, it unfortunately faded out from daily urban life in Hangzhou.

3.4.3 The Recent Urbanisation Period (1980s-2000s)

The fast and large scale urbanisation within the recent three decades re-powered developments in transportation. The rail, with a constant focus at the national scale operation, was not successful in keeping its connectivity with the rapid physical urban expansion. Eventually rail developed a marginal role in the urban life which was overwhelmed by roads and vehicles.

**Hangzhou’s Fast and Large Scale Urbanisation**

Since 1980s, Hangzhou reshaped its identity through three urban planning amendments in 1983, 1999 and 2007, achieving a balance between ‘consumption’ and ‘production’. The tourism industry was rebuilt with respect to the city’s rich culture and landscape resources, and targeted at national and international tourists. The re-oriented and growing urban ambitions triggered fast and massive urban expansion, as well as population inflation of Hangzhou during the recent three decades.

There were two municipal boundary expansions in Hangzhou between the 1980s and 2000s. Beyond the inherited municipal area of 430 square kilometres in 1970s, the first expansion in 1981 extended south across the Qiantang River for an extra 253 square kilometres to accommodate new industrial developments. In 2001, a second expansion merged two districts from north-east and south-west, making Hangzhou occupying 3,068 square kilometres and ‘the second largest city next to Shanghai within the Lower Yangtze Delta Region’ (ECHURDC, 2002: 23).

In parallel, the urban footprint rose sharply during the same period. Starting from 102 square kilometres in 1981 (Hangzhou Revolution Committee, 1981), an increase of about 80% increase was recorded within the two decades that followed. In the next ten years, however, soaring developments further doubled the size of urban footprint, standing at 413 square kilometres in 2010 (Hangzhou Statistics Bureau, 2012), 31.8 times of the ‘Chengguo’ size from imperial Hangzhou (Figure 3.58).
Hangzhou's population growth saw a similar record with the urban expansion which is not only a statistical increase, but geographical re-distribution. The entire population had a rise of over four times within the three decades starting from 1980, reported at 4.35 million in 2010 (Hangzhou Statistics Bureau, 2012). Meanwhile, the central area lost about 30% population between 1990 and 2000, with peripheral areas densified 3 times by new dwellers in the same period (Feng and Zhou, 2002: 62).

Despite the rapid expansion, Hangzhou did not see the dispersing of its centre. The central area, which largely overlaps with the imperial Chengguo, remained a strong core integrating the major public urban lives, such as political, commercial, cultural, and financial centres (Luo, 2005: 11-12). The recently developed fringe areas were struggling to establish contact with the conventional centre.

By putting together the above information, we find expanded urbanity, a robust central core, an increasing population and growing fringes. It is a safe prediction that the traffic demands between the newly developed peripheral areas and the conventional city centre will exhibit constant growth. How much, then, does the rail system channel these demands?

**The Competition between Rail and Road Infrastructures**

The rail lines around Hangzhou were improved since the 1980s principally in three ways: Existing single track rail lines connecting Hangzhou to major domestic destinations were upgraded to double tracks; new lines cutting through the town were built to release traffic pressure on old lines, including a second rail bridge on the Qiantang River; and a passenger line, named Xuanhang Rail was constructed, linking Hangzhou to Xuancheng in Anhui Province about 230 kilometres away (Figure 3.59).

To accommodate the growing number of passengers, the old station, Chengzhan, was rebuilt in late 1990s on its old site. The previous Nara style building was replaced by an 18 storey high-rise complex, integrating commercial, hotel and administration functions (Figure 3.60). Another station, ‘Hangzhou East’ was built in 1992, sitting on the new rail link penetrating the east part of the city. As a complementary station, it serves the passenger trains that passing Hangzhou, while the Chengzhan was targeted at termination services.

In principle, we have seen new tracks and stations developed between 1980 and 2000, targeting at improving Hangzhou’s connection with the rest of China, and enhancing the rail’s capacities on transportation. Nevertheless, if we overlap the rail map on top of the vastly expanded municipal boundary and urban footprint of Hangzhou, it is disappointing that the tracks are not supporting the city’s geographical growth. The railway has been focusing on linking national destinations while local/regional coverage was not within its scope. This is verified by the transportation performance statistics in Hangzhou, both for freight and passenger services. The percentage of passengers travelled
on rails dropped over half during the three decades, while the percentage of freight remarkably shrank over 90% (Figure 3.61).

In compare, we have witnessed constant growth in road users in the past 30 years. The percentage of vehicle passengers rose nearly 1.5 times since 1980, close to 90% in 2010; while the freight traffic doubled respectively (Figure 3.61). This is even true by reading the increase of road length, four times between 1990 and 2010 (synthesising Wang, 2005 b: 34 and Hangzhou Statistics Bureau, 2012); and sorting vehicle registrations, increasing near fifty times for the same period (synthesising Wang, 2005 b: 54 and Zhong et al., 2013). It is safe to conclude that the vehicles have channelled most of the growing demands for transportation that rail has failed to meet.

**Summary**

Compared with the Communist industrialisation period, the economic reforms since the 1980s have triggered a dramatic rise in urban mobility demands; however, the rail infrastructure’s under-development, falling far behind the transportation demands as well as the strong competition from other modes of transport, such as vehicles, made it difficult for rail to provide strong support to new urban industries as before. The over-crowded passenger trains outlined a negative perception of rail for being low-quality and unsafe. Rail travel was losing its advocates even though trains were still full because of their cheap fares.

Furthermore, the less accessible stations in the city caused rail to play a small role in daily life. With the rapidly expanding urban footprint and population re-distribution, the conventional central station was increasingly difficult to reach. In Hangzhou, the reported average peak time vehicle speed on major metropolitan roads decreased from about 26 km/h in 2006 (Yang and Lin, 2006) to about 15 km/h in 2013 (Hu, 2013). The half-hour vehicle accessibility radius to train stations is about 5 kilometres when a reasonable parking time was considered. Near the two currently operating stations, this radius covers about 110 square kilometres of the urban footprint, which is about 25% of Hangzhou’s total urban footprint and roughly 3% of the city’s vast municipal area (Figure 3.62). For bus users, the half-hour travel radius is similar, as buses share most roads with vehicles. Due to the higher dwelling density in the conventional centre, the population percentage covered by the above radius is probably higher than 25%, but this will decline in the long-term along with the de-centralised population distribution trend.

Although the station did not move from its location in the early 1900s, the disconnected rail development due to urban expansion has caused stations to be located further from most of the population. Few integrated developments between stations and cities are likely to occur, which affects the theorised ‘integration’ between both precincts. The next chapter further explores the rail-city relationship of today’s Chinese cities using additional case studies.
3.5.0 Conclusion

In 2010, the Huhang HSR was in operation and connected Shanghai and Hangzhou at 350km/h, announcing the arrival of a ‘New HSR Era’ in Hangzhou (Figure 3.63). The Hangzhou East Station, built in 1992 as a complementary option to the Chengzhan Station, was upgraded to a giant terminal hub, standing among the largest of its scale in China and housing six HSR lines (including one reserved maglev line) that connect most major domestic destinations. The new station was designed to serve 200,000 passengers daily. Near this terminal, a new town development at the predicted ‘HSR Economy’ is proposed, covering an area of 9.3 square kilometres and accommodating 200,000 residents. This new town is centred around the HSR station physically and economically and requires invention of a new urban life that is fully integrated with the railway infrastructure.

Thus, based on the studies presented in this chapter, what information can be summarised to benefit today’s HONT (high-speed-rail oriented new town) practices? First, rail infrastructure has had a proven catalytic effect in shaping urban industries, especially during the early days of its connections. According to observations of case-studies in western America and China before the 1980s, this effect is essentially catalysed by integral services of both freight and passenger trains operating on large network scales. The Chinese HSR, on the contrary, has been planned to be dedicated to passenger transportation, which generates uncertainty regarding the creation of new industries as a consequence of HONT. Although the Chinese HSR network was planned to focus on economic and industrial development priorities (Wang and Ding, 2011: 50) as well as today’s globalisation and virtual economies, which are unprecedented in human history, the HSR’s potential to directly create new urban industries without freight functions remains to be determined (this approach is not very successful in Japan and Europe, as discussed in Chapter Two). Based on historical experiences, it is possibly worthwhile to test the light freight logistics, which demand high delivery efficiencies through an established HSR infrastructure. Research in this field is currently insufficient, but the author hypothesises that expanded HSR clients would benefit by not only healthier industries but also by the richness of future HONT urban life.

Moreover, the Chinese rail-city history research also reveals that the locational advantage of most inner-city stations did not naturally lead to a high level of integration between stations and cities. This is generally a consequence of a lack of continuous station use based on the commuting population, which is an important ‘medium’ to fabricate the station into the urban pattern immediate to its node areas. The early Chengzhan Station of Hangzhou, on the other hand, presents a rare case in which its central location was transformed into a location of successful urban growth without commuter trains between the suburbs and the centre. This indicates that beyond the continuous and long-term passenger stream, the accessibility of a railway station to its users is another condition required to achieve integration with a city. The compact urban footprint size of the traditional Hangzhou and the penetration of the city wall made the early station highly accessible to a large local/visiting population compared with the enclave
stations in Nanjing and Wuchang. Unfortunately, this convenience did not survive today’s urban expansion and transport competition. Trains are much less important in today’s urban life in Hangzhou.

In the HONT scenario, as most HSR nodes are proposed in the geographical centres of their new towns, the lessons learned from conventional inner city stations are highly valuable. The HSR network has been proposed for long-distance travel, and according to experiences in Japan and Europe, this operation does not directly advance urban growth around the station nodes, which seriously challenges the development concept of HONT; however, the case of Hangzhou’s early Chengzhan Station suggests a possibility. Given good accessibility and a functional urban layout, a railway station that is primarily based on long-distance travel could still translate its locational importance into development success. This is achieved through the same mechanism: inviting station users into a rich urban life around the station node and using the station as the major transport for urban users.

Certainly, prior to discussing how to apply this pattern in a HONT, it is necessary to further establish an understanding of urban development and life experiences shaped around today’s inner-city railway stations in China. The next chapter investigates this topic based on surveys and data collection conducted by the author.
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Chapter Four

Geographical Section: A comparative urban life study of inner-city railway stations and their nodal precincts in China

4.1.0 Introduction

In today’s Chinese cities, people normally have negative impressions of the conventional railway stations and their nodal areas. Most station visitors consider them to be chaotic, dirty, crowded and even unsafe. Guo (2011) reports that visitors of the Zhengzhou Railway Station have complained about eight major problems: soliciting, begging, illegal transport services, un-licensed coaches, un-licensed taxies, parking infringements, sale of counterfeit items and criminal gangs. Li (2012: 53) summarises the urban experiences of Hangzhou Railway Station precinct as ‘un-paralleled urban development from neighbouring areas, which suffers from heavy but chaotic traffic, terrible environmental quality, few green lands or rest installations, as well as comparatively low quality commercial facilities’114.

This negative station image prevents itself from the potential of developing comprehensive lives beyond a transport node. For most urban residents, travelling on a train is the only reason to visit a station.

On the other hand, China has witnessed ‘a growing era of fast developments’115 (Wang and Ding, 2011: 49) in its national rail infrastructure since the first issue of 中長期铁路网规划 (Middle to Long Term Railway Network Planning) by the State Government in 2004. This development was particularly highlighted by the Chinese high-speed-rail (HSR) network expansion. In a comparative study of HSR construction projects between China and three precedent countries, Japan, France and Germany, Lin et al. (2010) report that China has created around 14,500 km new HSR tracks in the ten years since the first HSR line was built and opened. In the same period, however, the three other countries have extended only about 680 km of their networks.

This rapid Chinese railway development further challenges the relationship between stations and their immediate urban areas, especially as ‘HSR lines and stations are generally located on the edge of urban footprints … [which] pushes forward the suburbanisation of Chinese cities’116 (Yu et al., 2012: 1041).

The above-mentioned negative experiences associated with living near a station will undoubtedly be an

114 The original text in Chinese is: ‘与周边区域的不协调发展，交通混乱拥挤，环境质量恶劣，周边缺乏绿地与休憩设施，商贸服务设施水平较成熟商业中心也偏低。’
115 The original text in Chinese is: ‘快速建设的时代。’
116 The original text in Chinese is: ‘高铁的站点选择和线路走向通常位于城市边缘地带，...推动了中国城市的郊区化进程。’
obstacle for new stations intending to integrate and reinvent urban lives. It is therefore important to research and understand the mechanisms that shape the relationship between station and city, especially the permeability of urban lives in between. This permeability allows stations to foster a more sophisticated urban life and serve as more than a homogeneous infrastructure node. In fact, the character of station hubs can help define urban lives. Through this permeability, future stations will have the potential to promote a higher quality of life around their node areas.

Therefore, inner-city stations are targeted in this paper to examine the established station–city relationship. The author visited a total of 30 inner-city railway stations in 24 Chinese cities in early 2014 to support this study (Table 4.01).

<table>
<thead>
<tr>
<th>City (name in Chinese)</th>
<th>Station</th>
<th>Accessibility</th>
<th>Location to City</th>
<th>Train Services Provided</th>
<th>Operation</th>
<th>Station Development</th>
<th>S.ID on Either Station Side</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beijing (北京)</td>
<td>Beijing</td>
<td>One Side</td>
<td>Inside</td>
<td>NR (Normal Rail)</td>
<td>Operation</td>
<td>C</td>
<td>I/D</td>
</tr>
<tr>
<td></td>
<td>Beijing South</td>
<td>Two Sides</td>
<td>Inside</td>
<td>NR (HSR)</td>
<td>Operation</td>
<td>Exp</td>
<td>II/I</td>
</tr>
<tr>
<td></td>
<td>Beijing North</td>
<td>One Side</td>
<td>Inside</td>
<td>NR</td>
<td>Operation</td>
<td>Exp</td>
<td>II/I</td>
</tr>
<tr>
<td>Tianjin (天津)</td>
<td>Tianjin</td>
<td>Two Sides</td>
<td>Inside</td>
<td>NR (HSR)</td>
<td>Operation</td>
<td>Ext</td>
<td>I/I</td>
</tr>
<tr>
<td>Xi'an (西安)</td>
<td>Xi'an</td>
<td>One Side</td>
<td>Inside</td>
<td>NR</td>
<td>Operation</td>
<td>C</td>
<td>I/D</td>
</tr>
<tr>
<td>Zhengzhou (郑州)</td>
<td>Zhengzhou</td>
<td>Two Sides</td>
<td>Inside</td>
<td>NR (HSR)</td>
<td>Operation</td>
<td>Ext</td>
<td>I/I</td>
</tr>
<tr>
<td>Wuhan (武汉)</td>
<td>Hankou</td>
<td>One Side</td>
<td>Inside</td>
<td>NR (HSR)</td>
<td>Operation</td>
<td>Ext</td>
<td>I/D</td>
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<tr>
<td>Guangzhou (广州)</td>
<td>Guangzhou</td>
<td>One Side</td>
<td>Inside</td>
<td>NR</td>
<td>Operation</td>
<td>Ext</td>
<td>II/D</td>
</tr>
<tr>
<td></td>
<td>Guangzhou East</td>
<td>One Side</td>
<td>Inside</td>
<td>NR</td>
<td>Operation</td>
<td>Ext</td>
<td>II/D</td>
</tr>
<tr>
<td>Nanjing (南京)</td>
<td>Nanjing</td>
<td>Two Sides</td>
<td>Inside</td>
<td>NR (HSR)</td>
<td>Operation</td>
<td>Ext</td>
<td>I/I</td>
</tr>
<tr>
<td>Zhenjiang (镇江)</td>
<td>Zhenjiang</td>
<td>Two Sides</td>
<td>Inside</td>
<td>NR (HSR)</td>
<td>Operation</td>
<td>Ext</td>
<td>I/I</td>
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<tr>
<td>Changzhou (常zhou)</td>
<td>Changzhou</td>
<td>Two Sides</td>
<td>Inside</td>
<td>NR (HSR)</td>
<td>Operation</td>
<td>Ext</td>
<td>I/I</td>
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<tr>
<td>Wuxi (武)</td>
<td>Wuxi</td>
<td>Two Sides</td>
<td>Inside</td>
<td>NR (HSR)</td>
<td>Operation</td>
<td>Ext</td>
<td>I/I</td>
</tr>
<tr>
<td>Suzhou (苏)</td>
<td>Suzhou</td>
<td>Two Sides</td>
<td>Inside</td>
<td>NR (HSR)</td>
<td>Operation</td>
<td>Exp</td>
<td>II/I</td>
</tr>
<tr>
<td>Kunshan (昆山)</td>
<td>Kunshan</td>
<td>Two Sides</td>
<td>Margin</td>
<td>NR</td>
<td>Operation</td>
<td>Ext</td>
<td>I/I</td>
</tr>
<tr>
<td>Shanghai (上海)</td>
<td>Shanghai</td>
<td>Two Sides</td>
<td>Inside</td>
<td>NR (HSR)</td>
<td>Operation</td>
<td>Ext</td>
<td>I/I</td>
</tr>
<tr>
<td></td>
<td>Shanghai South</td>
<td>Two Sides</td>
<td>Inside</td>
<td>NR</td>
<td>Operation</td>
<td>Exp</td>
<td>II/I</td>
</tr>
<tr>
<td></td>
<td>Songjiang</td>
<td>One Side</td>
<td>Edge</td>
<td>NR</td>
<td>Operation</td>
<td>C</td>
<td>I/D</td>
</tr>
<tr>
<td></td>
<td>Fengjing</td>
<td>One Side</td>
<td>Edge</td>
<td>/</td>
<td>Closed</td>
<td>C</td>
<td>D/D</td>
</tr>
<tr>
<td>Jiashan (嘉)</td>
<td>Jiashan</td>
<td>One Side</td>
<td>Margin</td>
<td>NR</td>
<td>Operation</td>
<td>C</td>
<td>I/D</td>
</tr>
<tr>
<td>Jiaxing (嘉兴)</td>
<td>Jiaxing</td>
<td>One Side</td>
<td>NR</td>
<td>Operation</td>
<td>C</td>
<td>I/D</td>
<td></td>
</tr>
<tr>
<td>Haining (海宁)</td>
<td>Haining</td>
<td>One Side</td>
<td>Margin</td>
<td>NR</td>
<td>Operation</td>
<td>C</td>
<td>I/D</td>
</tr>
<tr>
<td>Hangzhou ( Hangzhou)</td>
<td>Hangzhou</td>
<td>One Side</td>
<td>Edge</td>
<td>/</td>
<td>Closed</td>
<td>C</td>
<td>D/D</td>
</tr>
<tr>
<td></td>
<td></td>
<td>One Side</td>
<td>Remote</td>
<td>NR (HSR Ready)</td>
<td>Operation</td>
<td>R</td>
<td>R/D</td>
</tr>
<tr>
<td>Zhoush (郑州)</td>
<td>Zhoush</td>
<td>One Side</td>
<td>Remote</td>
<td>NR (HSR Ready)</td>
<td>Operation</td>
<td>R</td>
<td>R/D</td>
</tr>
<tr>
<td>Yiwu (义乌)</td>
<td>Yiwu</td>
<td>One Side</td>
<td>Remote</td>
<td>NR (HSR Ready)</td>
<td>Operation</td>
<td>R</td>
<td>R/D</td>
</tr>
<tr>
<td>Quzhou (衢州)</td>
<td>Quzhou</td>
<td>One Side</td>
<td>Remote</td>
<td>NR (HSR Ready)</td>
<td>Operation</td>
<td>R</td>
<td>R/D</td>
</tr>
<tr>
<td>Shangrao (上饶)</td>
<td>Shangrao</td>
<td>One Side</td>
<td>Remote</td>
<td>NR (HSR Ready)</td>
<td>Operation</td>
<td>R</td>
<td>R/D</td>
</tr>
<tr>
<td>Shaoguixing (秀)</td>
<td>Shaoguixing</td>
<td>One Side</td>
<td>Edge</td>
<td>NR</td>
<td>Operation</td>
<td>C</td>
<td>I/D</td>
</tr>
<tr>
<td>Ningbo (宁波)</td>
<td>Ningbo East</td>
<td>Two Sides</td>
<td>Inside</td>
<td>NR (HSR Ready)</td>
<td>Operation</td>
<td>Exp</td>
<td>II/I</td>
</tr>
</tbody>
</table>

Table 4.01. Summary of visited inner-city stations, January-February, 2014.
This chapter begins with a theoretical analysis of the physical scope of research. Three station cases with their node areas, Xi’an, Beijing South and Shanghai South Stations, are selected from the visited samples for closer study. In conclusion, the author analyses and summarises observed problems to inform future practices of new towns around remote HSR stations.

4.2.0 Scenario

Alessia (2005: 6) observes that in early European railway stations ‘the station building ... was a sort of limit or boundary between the space of the railway and the traditional urban fabric’. In the past, the building envelope of a station set boundaries for station activities, which means the interactive relationship between station and city is mostly defined by the physical station building. Along with the operation of rail services, urban living, especially around station nodes, has been substantially reshaped by the rail infrastructure. The ‘station life’ experience has expanded beyond the building façades into the fabric of urban context. In the following paragraphs, this area is described as Station and Influenced Development Area (SIDA) for further analysis.

SIDA is also visible around today’s inner-city railway stations in Chinese cities. Using Zhengzhou Railway Station as an example, the station plaza is heavily occupied by passengers and vehicles connecting to the station. Moreover, this hustle and bustle is extended into nearby roads, affecting the population and demonstrating strong impacts of the rail infrastructure on urban living (Figure 4.01).

4.2.1 SIDA in Theoretical Scenario

First of all, a theoretical definition should be identified for SIDA. It is essential to understand that SIDA covers an area extending from a station node into nearby urban precincts, with fabricated urban activities that are influenced by rail infrastructure. Zhang (2002) and Cao et al. (2007) combine this extended station and node precincts into a ring structure, comprised by a ‘core area’ and ‘peripheral area’, which are functionally connected. In fact, the integration between a station and its nodal area is woven by seamlessly connected urban lives, or the permeability of urban lives. This integration is supported by urban traffic running through the combined areas, which defines a legible scope of SIDA.

From this perspective, SIDA is heavily influenced by urban traffic or ‘flow’. The available ‘flow’ options around today’s Chinese inner-city railway stations are normally limited to walking or the use of vehicles. Walking is advantageous because it supports the integration of urban life between a station and its node areas. Ghel (2010) supports this idea, noting that pedestrians smooth the contact interface between humans and the urban environment, making urban lives more inviting. Vehicular flows are faster and
more isolated and thus not well integrated for stretch activities between stations and urban areas.

The above analysis allows us to hypothesize on SIDA’s permeability according to its observed ‘flows’. It is also feasible to configure SIDA size based on walkable distances, ranging about 500–1,000 m away from the station. This hypothesis will be further verified in the case studies.

There are three main features distinguish a SIDA from a high-speed-rail oriented new town (HONT).

**Location**: SIDA applies to inner-city station and its surrounding urban areas, including conventional and redeveloped stations in recent years. HONT refers to station and its related new town development located on peripheral or remote areas to the urban footprint, which are mostly recently built (Figure 4.02 as the case of Wuxi, and Figure 4.03 showing the changing relationship between Hangzhou’s Chengzhan Station and the urban footprint).

**Function**: Physically, SIDA is part of the built urban fabric, defining a ‘gateway’ area into the city. It works collaboratively with other parts of the city to deliver a full range of urban functions. To compare, HONT is mostly planned as a self-sustained ‘satellite town’ due to its distance to the city.

**Scale**: According to the visited cases, most SIDAs extend between 500-1000m away from the station, and merge into urban context with blur boundaries. On the contrary, HONTs are planned on much expanded areas with clear edges.

It should be noted that a large number of conventional stations have been upgraded/redeveloped during the recent rail infrastructure development process. This has substantially reshaped the relevant SIDAs, which are categorised and studied separately in scenarios one/two as below.

### 4.2.2 Scenario One: SIDAs of Conventional Stations

Chinese railway history dates back to the late imperial time of the mid-1800s, when most stations were sited on the edge of/remote to cities. With the sprawl of the urban footprint in the years that followed, most conventional stations were transformed into inner-city locations or even metropolitan centres.

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117 The ‘users’ of an HSR station and of a conventional railway station from the same city are identical in most scenarios, therefore not included here as a feature to distinguish a HONT and a SIDA. This is because both a peripheral location HSR station and a central location conventional railway station are operated by the same governmental agency, and both provide long distance services only. If a city has both HSR and conventional rail terminals, most passengers would use the station as appearing on their tickets of services. In this regard, locational difference to the established urban centre is a more important factor to shape various urbanities around station nodes. This phenomenon is different from a westernised urban scenario such as the cases studied in Fuji and Lille in Chapter Two, where HSR and conventional rail serve passengers with differentiated travelling distances and purposes (urban commuting or long distance travel).
However, the early edge location has shaped most stations, which are accessible from the ‘urban’ side only, while the other side is isolated. This substantially imbalanced accessibility led to developments that vary sharply from one side to the other. The ‘urban’ side has the advantage of connections and therefore provides opportunities for large-scale developments to present a ‘gateway’ image. The ‘non-urban’ side, physically disconnected from the station and eventually dead-ending in urban roads, does not attract equal development interest and in some cases, has become a home to slums.

To summarise, we may observe one type of SIDA along the ‘urban’ side of a conventional inner-city station, featuring adaptive developments oriented at station operations. On the ‘non-urban’ side, there are spontaneous developments disconnected from station activities, thus not applicable to the SIDA definition as above (Figure 4.04).

4.2.3 Scenario Two: SIDAs of Re-Developed Stations

Along with recent improvements to the Chinese rail infrastructure, many conventional stations have been upgraded/re-developed to meet the increased rail demands. Three approaches to regeneration can be summarised from the observed cases:

‘Extension’: the conventional one-sidedly accessible station buildings were extended across the tracks to activate development on the ‘non-urban’ side. The isolated side is connected by modern urban transports, and in most cases, the redeveloped side expands far beyond its old footprint into neighbouring urban areas (Figure 4.05).

‘Expansion’: old stations were demolished and rebuilt on the same location but with a much increased size and scale. In this case, the expanded stations’ footprints cut into established urban areas around both sides of the old station nodes (Figure 4.06).

‘Relocation’: old stations were demolished and moved away from inner-city environments to eliminate the negative impacts that rail tracks cutting through a city (Wu and Jiang, 2005). Thus, new stations are mostly relocated on the edges or even in remote areas away from cities (Figure 4.07).

Each of the above-mentioned station redevelopments results in a substantial reshaping of the established SIDA. In the extension/expansion mode, highly infrastructured new station development cuts into old urban fabrics, and the relationship between rail infrastructure and urban living experiences new challenges. This is summarised as Type II SIDA in the following discussions.

Developments around new stations relocated in urban peripheral areas are similar to the urbanisation around HSR stations. Proposals are often made for new towns of significant size around station sites, mostly oriented as self-sustaining satellite towns. This is beyond SIDA as a functional fragment in an
urban context, therefore will not be further discussed.

4.2.4 Summary of SIDA Types I–II

The focus below is on SIDA Types I/II, both of which feature inner-city locations and, developing conversations with the immediate urban areas. However, different station–city relationships are observed in these two SIDA Types. In Type I, the conventional stations are comparatively monofunctional and rely heavily on facilities from immediate urban areas to support daily operations. In Type II, however, stations are well designed to integrate supporting facilities, for example, various transport connections.

4.3.0 Literature review

Theoretically, SIDA is not well defined by Chinese research. Pan (2010) compares railway station node areas from a qualitative perspective but provides no clear scope and boundary to define SIDA. Ying et al. (1999) and Min et al. (2009) discuss station node area developments through respective case studies of Hangzhou and Hankou Stations. However, vague understandings of the definition of ‘station node area’ lead to vast differences in the size of the affected urban areas despite the similar sizes of the stations: the former encompasses 23.51 hectares while the latter affects a 324-hectare area, nearly 14 times larger.

The author’s study also shows current station-city relationship research in China is not even between conventional stations and redeveloped stations. The former is less covered while the latter is widely documented. Therefore, the following paragraphs set up separate discussions of conventional and redeveloped stations, responding to SIDA Type I and II scenarios.

4.3.1 SIDA Type I theories: conventional stations and their node precincts

Current research on conventional stations presents a fragmented knowledge framework. There is a strong trend focusing on the design of the railway station and its plaza, and discussing the complexity of integrating local transport connections within the limited station/plaza spaces. Literatures that look at the urban developments around conventional station nodes are limited in both theoretical and case studies.

To be precise, in the design practice of conventional inner-city railway stations, it is widely understood that the long split of station and plaza should be changed. A high level of integration between both will improve efficiency in station operation. For example, Li (2001) emphasises the importance of ‘zero-distance connection’ in station design through analysing the projects of Nanjing Station and the second station of Shanghai (today’s Shanghai South). Cheng (2002) takes the case of redeveloped Hangzhou
Station to criticise the conventional ‘understanding and practice which split the station building, plaza, and tracks field’\(^{118}\) (page 10). Cheng suggests the integration of rail infrastructure and urban facilities should reduce passenger’s walking distance and achieve higher efficiencies for station.

Similarly, a ‘connection’ oriented functionalism dominates the thinking pertaining to plaza design. Wu (1989) summarises four functions of station plazas for small cities and towns: ‘passenger assembly and distribution, spaces for outdoor waiting and activities, vehicular access and parking, and providing public service facilities’\(^{119}\) (page 22). Wang et al. (2003) further investigate four modes for vehicular access and parking on a railway plaza concerning effective passenger connections. This attention of plaza circulations is also reflected in the study of Beidaihe Station by Wang and Men (2013).

Among the voices of functional plaza designing, there are a few efforts to understand the ‘place-making’ demands in station plaza. In the urban design of station and node areas in Yuping County of Guangxi Zhuang Autonomous Region, Deng and Li (2008) insist they suggest the station plaza should be identified through shaping its ‘recognition, accessibility, and diversity’\(^{120}\) (page 10).

In relation to the urban scale that extends from station/plaza precincts, research is very much limited within general discussions which ‘mostly regard the station node area as a spot [in the urban context] to analyse its development and transforming in the regional scale’\(^{121}\) (Cao et al., 2007: 1267). The relationship between railway station and urban area is studied by Wu (2000), Chen and Wang (2009), as well as Gu and Su (2012). However, these researches appear to focus on two ‘poles’, either the station as a very narrow scope, or the city as a broad context. The transition area (SIDA) between both is rarely touched.

The only studies of SIDA-equivalent urban area are found from cases in Guangzhou. Zhang (2002) describes the influenced urban area of Guangzhou Railway Station based on a ring structure defined as ‘core hub area’ and ‘peripheral hub area’. There are analyses delivered on transportation, public urban space, and space morphology delivered. For example, Cao et al. (2007) conclude that the influenced urban areas of Guangzhou Station and Guangzhou East Station are 380 hectares and 119 hectares accordingly, based on studying the land-use diagram of nodal areas around station. The station influence in urban development is tested through functional analysis of individual lands. Both of these studies deliver in-depth thinking of urban developments around conventional railway stations in today’s China. However, the former focuses on the metro’s impact on station node development and fails to provide a panoramic perspective for a comprehensive understanding; while the latter is restrained in data analysis.

\(^{118}\) The original text in Chinese is: ‘把站房、广场、站场割裂开来的认识与做法．’

\(^{119}\) The original text in Chinese is: ‘集散旅客、为旅客提供室外候车和活动场所、各种车辆运行和停放以及提供公共服务设施．’

\(^{120}\) The original text in Chinese is: ‘可识别性、可达性与多样性．’

\(^{121}\) The original text in Chinese is: ‘总体上还是将火车站地区作为点状形态分析其在区域中的发展与变化．’
of land-use, there is no further investigation below the surface for the mechanism that shapes the phenomenon.

4.3.2 SIDA TYPE II Theories: redeveloped Stations and Their Node Precincts

Large scale station redevelopments in past years have attracted wide interests from academia and professionals. Research in this field appears more systematic.

First, there are new principles introduced for redeveloping the conventional railway stations, defined as ‘railway station hybrid complex’. Two levels of understanding in this ‘hybrid complex’ are found in the academic literature. On one hand, the conventional station + plaza template is redesigned into a ‘transport hub’\(^{122}\) structure (Zhu, 2009: 111). This means the new station is ‘transformed from a mono-transport facility into a comprehensive hub that integrates a range of transport modes’\(^ {123}\) (Zhu et al. 2007: 47-48). A new station experience with nearly every available transport modes, including rail, vehicle, bus and metro under one roof, is reinvented. Passengers will expect less walking and higher efficiencies in station. As Cheng et al. (2010) disclose, the European stations such as Hauptbahnhof Berlin and La Defence Paris are carefully studied to improve connectivity in the new station hubs.

On the other hand, there are voices that station redevelopment should be focused on the design of an ‘urban hybrid complex’, as an effort to integrate rail infrastructure and urban life. This means stations are re-shaped as an urban destination beyond a transportation node. Through studying hybrid station development cases of Kyoto and Kowloon Stations, Wang and Lu (2006) point out the potential of achieving ‘urban functions’ in a station building. Similar thinking is legible from Li (2009), Zhu et al. (2011), and Zhang et al. (2011). Practically, however, there are pessimistic opinions developed through observing the implementation of the ‘urban hybrid complex’ idea. Shen (2009) concludes that Chinese stations are far away from integrating urban living compared with precedent cases typically as Kyoto Station. Hao and Ma (2011) attempt to explain this phenomenon through investigating the specific features of Chinese station. Two problems are summarised in this study: imbalance of efficient land-use and large volume of passenger flows; as well as split systems of rail and urban management.

Secondly, through redeveloping stations, new thinking pertaining to node precinct development is triggered. Ye (2010) suggests that efforts should be invested into ‘guiding urban function development and promoting regional vigour and prosperity, taking the advantage of the agglomeration effect from station hub’\(^ {124}\) (page 8). This trend of new station node precinct understanding is further reflected through the works of Yu (2009) as well as Gu and Su (2012). The former discloses the target of realising a

\(^{122}\) The original text in Chinese is: ‘交通枢钮化．’

\(^{123}\) The original text in Chinese is: ‘单一的对外交通集散点发展成为多运输方式高度集聚的交通综合体．’

\(^{124}\) The original text in Chinese is: ‘利用交通枢纽的集聚效应，引导城市功能发展，促进地区活力与繁荣．’
‘growth pole’ for regional economies through increased land values and agglomerated commercial facilities, utilising the development of the station hub as the driving force. The latter, on the other hand, discusses how to physically articulate the station and urban fabric. This is achieved through incorporating multi functions in a station hub, which allows urban space extending into station building, so as to ‘redefine... the spirit of public urban spaces’¹²⁵ (page 102). This thinking is echoed by Min and Huang (2009) in the project of Hankou Station redevelopment. By proposing an urban area of 3.2 square kilometres centred by the redeveloped station, Min and Huang aim at ‘a legible urban structure that integrates commercial services, business services, hotel services, entertainment facilities and residential functions’¹²⁶ (page 78).

4.3.3 Summary of Literature Review

In the design theories of station and plaza, there are significant differences between conventional and redeveloped stations. However, the functional philosophy of maximising connection efficiency is clearly inherited. This is also visible through the following case studies. The substantial change that re-defines a station is the transformation from a ‘transport complex’ to an ‘urban complex’, or the ‘urbanisation’ of station. Unfortunately, research also shows this transformation is not successful in today’s station design practice. This is also studied through the cases below.

From the perspective of ‘stationisation of city’, we may conclude that research on the integration of station and city is missing. Redeveloped stations are better studied, but mostly focus on large scale ‘catalyst’ influence of station in urban developments. Nevertheless, no detailed solution is studied/suggested to make this influence happen, especially in the context of long established isolation between conventional station and its immediate urban area. The author also expects to bridge this gap through case studies in the following paragraphs.

4.4.0 Case studies

In this section, SIDA Types I and II are further studied through selected station cases: Xi’an Station (Type I), Beijing South and Shanghai South Stations (Type II), respectively. Observed flows will be traced from inside a station to its node areas, to facilitate the analysis of SIDA permeability.

4.4.1 SIDA TYPE I: The Railway Station and Plaza Study

Initially built in 1936, today’s Xi’an Railway Station building was rebuilt on the same site between 1984 and 1990, with a total of about 28,000 square meters of floor area (Yang et al., 2013). According to Peng’s statistics (2013), this station served 29.94 million passengers in 2012, gaining a reputation as ‘one

¹²⁵ The original text in Chinese is: ‘重新定义...城市公共空间的精神面貌.’
¹²⁶ The original text in Chinese is: ‘集商业服务、商务服务、旅馆服务、娱乐配套和居住等功能为一体的清晰的城市结构.’
of the ten most important stations in China\textsuperscript{127} (Wang and Li, 2012: 43).

As a typical conventional railway station, Xi’an Station is sited near the outside of city walls built during the Imperial Ming (late 1300s to mid-1600s). Because the boundary of Xi’an’s urban footprint has expanded far beyond the old walls, today’s location of Xi’an Station has transformed from marginal to central in the metropolitan area (Huang, 2008; Figure 4.08).

Figure 4.09 shows a building plan diagram of Xi’an Station. A cluster of waiting lounges serving departure passengers comprises the main internal spaces. This waiting-oriented layout, strongly featuring stationary activities, represents one of the fundamental principles in Chinese railway station design. Most of the lounges are mono-functional, with little or even no commercial facilities available (Zhou, 1990). This means that waiting is possibly the only activity available for most departing passengers.

In addition, ticket controls from the station plaza to the platform create a string of barriers, allowing departing passengers to move in only one direction (and vice versa for arriving passengers). The inflexible station flows, along with the waiting spaces that function like reservoirs to hold station users, defines the station as a non-permeable precinct for nearby urban residents.

The plaza, a large urban open square in front of the station building, has a size of 120 m north-south by 410 m east-west. It accommodates all the local connection services for the station. According to Peng (2013), the eastern end of the plaza is occupied by tourism bus parking, the western half is for taxi queues and coach services connecting to regional destinations can be found on the south-western corner. Bus riders find service on the southern round about across the plaza.

In general, as Xi’an Station is not connected into the metropolitan metro network\textsuperscript{128}, the station’s local connection services are mostly provided by vehicular transports squeezing within and around the plaza area. For pedestrian passengers, the plaza is huge and requires walking a long distance to access the station building. We may therefore find highly mixed ‘flows’ of people and vehicles on the plaza surface. These flows vary in scale, direction and speed. Despite its significant size, the plaza must achieve a sensitive balance between different flows. This results in a complicated layout of fenced lanes that direct traffic arriving/leaving the plaza, forcing all surface movements into one-dimensional activities.

As a whole, the station plaza is fully dedicated to local connections with rail services, creating another homogeneously functioning urban space beyond the station building. Ironically, there are two sunken spaces in the middle of the plaza providing dining facilities for passengers. However, as Peng (2013: 128) suggests, these sunken spaces should be transformed as they ‘seriously split the plaza into fragments and create winding passenger flows; these detoured passing flows lead to increased walking distances

\textsuperscript{127} The original text in Chinese is: ‘我国十大特等客运站之一.’

\textsuperscript{128} At the time of the author’s visit, there was no metro service available in Xi’an Station.
and serious crossings.\textsuperscript{129}

The functionally un-inviting plaza discourages use by other urban users from nearby urban areas and inhibits the potential to develop comprehensive urban lifestyles, presenting itself as a huge, busy urban area without desirable amenities (Figure 4.10).

4.4.2 SIDA TYPE I: The Station Node Precinct Developments

Extending studies into the station node’s urban fabric, we may find two different ‘flows’ shaped along two directions: perpendicular (north-south) and parallel (east-west) to the rail tracks. Urban developments along these two paths are influenced accordingly, generating urban lives with unequal qualities (Figure 4.11).

First, in the north-south direction, local connections are dominated by vehicular traffic. This is the prime direction linking the railway station to most metropolitan destinations. Vehicles are heavily used for travel here as no metro infrastructure is available. Walking between the station precinct and nearby areas in this direction is mostly done by passengers travelling between the station and its facilities in the urban area; for example, the bus/coach station and commercial buildings on the southern edge of the plaza. Beyond this scope, passengers normally travel with vehicles to/from metropolitan destinations.

The two blocks next to the southern edge of the plaza function fully oriented to the station’s demands. The western block is occupied by a coach station, and the eastern one features a hotel, restaurant and retail shops. Both blocks lie within a 150-m radius away from the station building, and, as observed, they are heavily visited by people heading to/from the station.

Beyond these two ‘station dedicated’ blocks, influences from the station are still visible, but they gradually fade as distance increases. An example of this is the shrinking size of commercial facilities that serve station passengers, from block-scale high-rise complex buildings near the station to street-edge ground-level shops farther away. This influence extends about 450 m away from the station.

Secondly, in the east-west direction, there is an artery road linking to regional destinations in Xi’an. Vehicles travel faster on this 60-m-wide road, which creates not only a barrier for road crossers but also a pedestrian corridor along the road for station users travelling shorter distances in this direction. In fact, pedestrian flows stretch much further in this direction than in the north-south direction.

The urban development here also corresponds to the pedestrian flow. The un-crossable road pushes pedestrian traffic exclusively to one side, and therefore development happens only within a linear space.

\textsuperscript{129} The original text in Chinese is: ‘对广场起到了严重的分割作用，使得乘客流线不够畅通，经过的客流需绕道而行，走行距离远且交叉严重.’
between the road and rail tracks, extending about 1 km east-west on both sides of the station. Urban blocks in the east-west direction are courtyard structures and generally 50 m deep; only half of the depth of those blocks along the other direction.

Within the linear developments, there is a mixture of urban functions rooted deeply in the rail’s infrastructure, including rail facilities such as apartments (for rail employees), electrical services and logistic warehouses. In addition, passengers can find food and beverages, accommodation (hotels) and grocery stores along this road. Architecturally, the street edge is partly occupied by shops with similar widths and is decorated by billboards that range widely in colour and style. The buildings are mostly 2–3 stories high, and none are higher than 6 stories. Generally, urban images and experiences are comprised of a cluster of widely varied buildings for different people who are closely involved in station living with activities related to the station.

To summarize, along the two directions that extend from Xi’an Railway Station, we may find urban development and lives that were shaped by the different qualities of permeability, as discussed above and further explored below (Figure 4.12):

Development scale: Large-scale developments occupying an entire city block present a grand image along the north-south direction, where strong ‘planning wills’ are evident. On the eastern-western direction, the much-smaller developments indicate a kind of ‘spontaneous growth’.

Function/user: Developments along the north-south direction are comparatively homogeneously defined. Retail shops and hotels are the most common facilities apart from transport, and they are fully targeted to station passengers. Along the east-west direction, urban blocks are used for residential buildings, retail shops and industries serving the station and its infrastructure. In this scenario, users are still closely related to the station but come from varied backgrounds with diverse purposes in urban life.

Influence radius: Station-related developments along the east-west direction stretch much further than those along the north-south direction. This is a response to the different pedestrian flows along the directions, as analysed above.

4.4.3 SIDA Type II: The Railway Station and Plaza Study

According to Li (2009) and Li (2010), today’s Beijing South Station can be traced back to the Majiapu Station, which was built in 1897. After much reconstruction and expansion, the station was named Beijing South in 1988 and primarily served ‘low speed trains operated at medium-short distances’¹³⁰ (Li, 2009: 8).

¹³⁰ The original text in Chinese is: ‘主要以慢车和中短途运输列车为主．’
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As one of the key infrastructures of the 2008 Beijing Olympic Games, the old station was vastly expanded in 2006 from an insignificant station into ‘one of the largest railway terminal buildings in Asia’\textsuperscript{131} (Wang et al., 2008: 38) (Figures 4.06 and 4.13).

The station has 13 platforms and 24 track lines, with a total floor area of around 250,000 square meters (Wang et al., 2009). According to Arup (2010), the station is predicted to serve 105 million passengers annually in 2030, or about 286,500 daily, peaking at 33,300 per hour. Compared to Xi’an Station, Beijing South’s much larger station size accommodates a significantly increased number of passengers.

The design of the station’s flow further distinguishes Beijing South from Xi’an. Conventional two-dimensional station connections, which heavily rely on plazas, were re-structured into three dimensions, following a ‘zero distance connection’ principle. The available range of station transports, such as HSR, normal rail, metro, taxi, bus and vehicles, are housed under one roof with vertical connections to maximize the station’s operational efficiency.

According to Wang et al. (2009), Beijing South Station has five stories, two of which are above ground. The elevated departure lounge is served by a roadway in front of its entrances. Departing passengers descend from gates inside the lounge to the platforms, which are on ground level. The next level down serves arriving passengers and has a double-deck parking garage. There are two metro services on the next two levels (Figure 4.14).

Beyond the complicated departure/arrival flows, Beijing South shares a design philosophy with Xi’an Station. First, rail passengers are guided according to a ‘one-way’ principle with many controls for both departing and arriving passengers. This means that the station does not accommodate people who are not train passengers. Second, the main spaces, such as the waiting lounge, are mostly mono-functional. There may be a few grocery stalls in the lounge, but they are mostly on the edge and in the corners, and they only serve passengers. Unfortunately, the much-improved connections of Beijing South do not bring more urban users into station life.

4.4.4 SIDA TYPE II: Developments of Station Node Areas

Again, we start from ‘flows’ to investigate the urban areas around Beijing South Station. According to Wang et al. (2008: 41), the station’s internal road system\textsuperscript{132} ‘is connected with the metropolitan skeleton road network on multi directions at multi levels’\textsuperscript{133}. There are two metro lines, number 4 and 14, which further transform the station into an urban transport network.

In terms of the usage percentage of the above transports, Gao et al. (2010) discovers that 46% of station

\textsuperscript{131} The original text in Chinese is: ‘亚洲最大的铁路枢纽站房之一．’

\textsuperscript{132} Includes roadways on elevated, ground and underground levels for all vehicles serving the station.

\textsuperscript{133} The original text in Chinese is: ‘多层面，多方向与市区骨干路网顺畅衔接．’
visitors travel by metro, 13% are bus riders, 26% use taxi services, 14% travel by other vehicles and 1%
use an unknown method. Zhou (2013) presents another study that claims that the metro serves 67% of
station visitors, buses serve 14%, taxis serve 13% and other vehicles serve 6%. Despite the variations
between the researches, both conclude that few passengers walk between the city and the station. This
indicates that Beijing South Station operates at a much-expanded regional scale; the layout heavily relies
on urban transport and considers pedestrians to be of little importance.

In addition to decreasing the number of pedestrians, the station is physically isolated from its urban
context. For instance, as the plaza is no longer needed to accommodate station connections, two empty
but well-landscaped open squares were built on either side of Beijing South Station. Also, the large-scale
artery roads that travel around the station building form a barrier to pedestrians.

This isolation strongly negatively influences urban developments around the station node. In 2006, along
with the station’s expansion proposal, the local government planned the ambitious ‘Beijing South Station
Economical Circle’ (北京南站经济圈). Taking advantage of station passengers, this plan aimed to
develop a new commercial environment that ‘highlights the business identity, such as offices and
logistics’134 (Fu, 2008: B4). However, this proposal, as can be observed, was only implemented to a very
limited extent.

Li (2010: 208) studied the impact of Beijing South Station on nearby areas, finding that ‘the area
development…is generally very slow…the station is physically detached from nearby areas’135. Hou et al.
(2012) performed a more in-depth review of the station node’s development. They found that within a
500-metre radius from station building, there are very few facilities that serve station passengers, and
the walkability of the area is poor (Figure 4.15).

It is arguable that the un-successful development around Beijing South Station is a consequence of the
pre-existing dense urban residential areas surrounding the station area, a constraint which does not
release land opportunities. In fact, similar problems are found in many other visited stations visited by
the author, such as the northern side of Tianjin Station, the western side of Zhengzhou Station, and the
eastern side of Changzhou Station. This widely witnessed problem also indicates the fact that there is a
long established gap between station and urban fabric. There is no permeability between both.

Nevertheless, can we conclude that the dense residential area is the only reason that prevents station
life from ‘flowing’ into urban fabric? If there is no such established ‘barrier’, can we expect dynamic and
unique urban life developed around station nodes? This question is answered by case study of Shanghai
South Station, another SIDA Type II example.

134 The original text in Chinese is: ‘突出商务概念，如商务办公、物流商业’
135 The original text in Chinese is: ‘从整体上看南站周边区域发展较为缓慢……南站整体上与周边区域
还呈现出一种形态上的脱离状态.’
Shanghai South Station was expanded on the old site of Meilong Station of Shanghai-Hangzhou Line in 2006, and is now the main transport hub of southern Shanghai. According to Gu et al. (2006), the station occupies about 60 hectares of land. The main building has a 50,000 square metre floor area, designed in a circular shape. Similar to Beijing South Station, a range of transport modes are highly integrated in the station building, for both metro and vehicle riders. There are a number of vertical cores designed to provide convenient links for interchanges across all levels. There are two sunken plazas on the northern and southern sides of the station to serve passengers and visitors, 11.98 hectares and 11.01 hectares respectively.

On the master plan, Shanghai South Station sits within an urban block boundaried by artery roads and elevated freeways, sized about 700m x 800m. Apart from the residential area in the southern block, the rest of block is occupied by various categories of infrastructure, such as plazas, coach station, and bus station. In addition, as part of the station node development proposal, 84 hectares of lands next to the north and east of the station block has been reserved by the government for about 3.45 million square metres future development (Wang and Lu, 2006). (Figure 4.16)

This development is named 'Shanghai South Station Business District' (上海南站商务区) which, unfortunately, did not receive optimistic responses from the very beginning. Wang and Lu (2006) point out the proposed land plots are 600-1,000 metres away from the station building, beyond the widely accepted walking distance of 500 metres. And even more difficult is crossing of the 60 metre wide barrier of Liuzhou Road between station and the development site. Without enough pedestrian accessibility advantage from station building, the proposed business district is facing a serious challenge constraining the integration of station resources. He (2010) has made an on-site investigation of the walkability around station precinct, and reveals that the surrounding artery roads substantially cut pedestrian connections between station and the proposed urban area, and concludes that ‘the target of triggering station node area development through Shanghai South Station still sits on paper’136 (page 71).

Apart from the researchers, the real-estate industry also shows very limited confidence in the commercial viability of developments around station. According to Zeng and Gao (2013), ‘since the first land auction of the business district went unsold in 2009, the commercial potentials around Shanghai South Station have been widely questioned’137 (page A13). In 2013, after the first land of the business district was sold in the second auction, a local developer expressed a surprising point during an interview about the commercial future of the sold land, that ‘if this land is programmed to serve passengers of Shanghai South Station, it will face a dim future; while if future business plan is oriented at...

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136 The original text in Chinese is: ‘通过上海南站来带动周边区域的发展目标似乎仍停留在纸上.’
137 The original text in Chinese is: ‘自 2009 年该商务区首批商办地块流拍后，上海南站周边的商业潜力已饱受质疑.’
local residents and industries, opportunities can be expected.\footnote{The original text in Chinese is: ‘如果该地块定位为上海南站的旅客服务，那么其前路渺茫，但如果是为周边产业人口服务则很有希望.’} (page A13).

4.4.5 Summary of SIDA Types I/II

With respect to station/plaza design, SIDA Types I and II present substantially different configurations for a station’s flow and connections. However, this does not convert a station from a rail infrastructure into a destination for daily urban life. The poor permeability of urban life into station means that passengers are the only clients invited into a station’s precinct.

On the other hand, SIDA Types I and II perform differently with regard to the influence of the station on the city. Influences of the station on the urban area are found around SIDA Type I, although the quality of these influences varies along different directions. For SIDA Type II, the station is closed off despite increased physical size and operational capacity.

4.5.0 Conclusion

This research has determined that a high permeability of urban life between a railway station and its immediate urban area is important for achieving integration of both precincts. This integration helps stations transform from neutral transport nodes into diverse urban destinations while allowing the development of a close relationship between the station and the city’s identity.

This paper also reveals that pedestrian ‘flows’ are fundamental for establishing sufficient permeability, which means that the physical scope of a SIDA is based on the distance passengers are willing to walk. However, this distance varies in different contexts, as observed in the case of Xi’an Station.

The increased capacity of Chinese HSR infrastructure means that the population of an expanded geographical area may become rail clients in future. Stations must rely more on motorised urban transports to support their operations.

However, this does not mean that the walking ‘flows’ in and around an HSR station should be of little importance. Beyond SIDA scenarios of the inner-city stations, HSR infrastructure looks at powering developments of a whole new town, which is built on full integration between station and city. This integration, as learned from above, is shaped by permeability through pedestrians. It is therefore important to challenge current templates of station and its node area planning and design, and reinvent new relationship between station and city (Figure 4.17).
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PART THREE:

INVESTIGATION
Chapter Five

Density Challenge: Studies on HONT flow and development

5.1.0 Introduction

The inner-city railway station study in the previous chapter revealed the low-quality integration of urban life between stations and cities in SIDA Type I and Type II scenarios. The ‘city’s gateway’ understanding of the stations can partly explain this disconnection. Comparatively, an HSR (high-speed-rail) station, which is strongly expected to function as the development core for new urban growth in a HONT (high-speed-rail oriented new town), is further challenged to find a practical way to physically integrate its urban areas around the node precinct.

Previous studies also indicate that the physical connections between a station and its nearby urban area are based on urban traffic flows. These flows – especially flows with combined capacity and efficiency advantages, such as pedestrian and public transport – allow the intensive passengers of a railway station to be translated into the dense lives of urban areas around the station node, and consequently trigger developments with increased densities.

As most HSR stations sit external to, or on the edge of established urban footprints, there are huge transport demands to link the rail infrastructure node with its main city and other regional destinations. As a result, it is observed that most HSR stations are connected with multiple local transport services. Urban traffic flows around the station node area of the HONT are expected to have a lot of potential. Taking advantage of the transport resources, it is reasonable to hypothesise that improved integration between station and city will happen in a HONT scenario, which supports increased development density. The Marunouchi area of Tokyo (He, 2013) and redevelopment of northern Osaka Station area (Hu, 2014) are both good precedent examples to demonstrate this trend.

In practice, however, many HONT planning schemes show that the expected high density features supported by transport resource agglomeration is not clear. In fact, most new towns are planned with lower densities than existing city centres in China or established rail infrastructure powered developments in Japan. A typical example is the Hongqiao Central Business District (CBD) of Shanghai, a HONT of the HSR terminal of Hongqiao Hybrid Transport Hub, which intensively incorporates HSR, conventional rail, an airport terminal, coach, metro, buses, taxis, and cars under one roof. The CBD’s Core Area (Phase One) development covers about 143 ha of land, with a proposed total floor area 1.697 million square metres (SUPDRI et al.: 13). These figures lead to an AFAR\(^{139}\) calculation of about 1.2. To

\(^{139}\) AFAR refers to ‘average floor area ratio’ of building bulks in a defined land area, which is a parameter widely applied in Chinese statutory planning practices. The author understands that the AFAR figure narrowly represents the density of developed physical building volumes, which has limitations with regard to describing the true density of urban lives and activities (due to occupation variations). However, most HONTs were still in the planning or construction phases during the writing of this paper, and there was no urban life to experience. Additionally, in the Chinese ‘top-down’ statutory planning
compare, the AFAR of Jing’an District, a 762 ha area of central Shanghai, is 2.1 (Ding and Li, 2012; also see Figure 5.01). In Japan, the 120 ha Marunouchi area powered by Tokyo Station has an AFAR of 5.9 (He, 2013); and the recent 8.6 ha northern Osaka Station presents an AFAR of 4.5 (calculation based on Hu, 2014; also see Figure 5.02).

In fact, Hongqiao CBD is not the only HONT example of lower density urban development planning. Of the studied cases, such as the HONTs of Wuxi, Guangzhou, and Changsha cities, lower density is a common phenomenon in the planning schemes. The AFAR of a core area is generally less than 2.0, and in most cases, the AFAR figure of an entire new town is struggling to reach 1.0. Achieving an increased AFAR is clearly an obstacle in most HONT practices.

This chapter investigates the reasons behind the gap of theorised higher density and practiced lower density in HONT development, focusing on obstacles preventing HONT schemes from achieving higher development densities.

It is here argued that high densities developed from urban diversity define the nature of HONT living, which is achieved through tight physical integration between stations and urban areas. This integration translates the bio-diversity and intensive number of station users into the richness of lives and the density of developments in HONT areas. Within this pattern, the transport between the station and its immediate urban areas is a key factor that allows physical integration to happen. Imbalanced HONT transport planning between the regional/metropolitan scale and local scale is one of the main factors preventing efficient urban developments.

Theoretical studies are discussed below to understand the station-city relationship built by traffic flows in a HONT scenario, and different development densities supported by flows with various efficiency performances. The Chinese HONT planning theories are then studied, which allows the author to summarise a theoretical HONT Flow-Density Model (Model One). This is followed by further analysis of selected HONT cases from Shanghai, Hangzhou, and Wuxi cities. The structure, content, and layout features of HONT transport planning are decoded through this study and summarised by a second Flow-Density Model to demonstrate density development potentials through transport planning.

Based on a zoning development diagram from the above model (Model Two), further analysis is implemented by studying the development densities of each planning scheme, which is summarised by a third Flow-Density Model (Model Three). In conclusion, the author compares three models from theory to practice studies to discuss the disconnection between station and city, which results from the observed lower HONT density. Suggestions are also provided to guide future HONT practices that encourage increased density proposals.

system, there is no description of ‘urban life’ in any planning document. The AFAR figure is so far a close parameter from published data that is capable of indicating the ‘potential’ of shaping densities of urban living.

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5.2.0 Theoretical analysis

The theoretical analysis starts by understanding the station-city relationship shaped by urban transport, namely the different ‘comprehensive efficiencies’ of transports that support different urban development densities. This mechanism is then further discussed with Chinese HONT theories, in combined contexts of HSR infrastructure and polycentric urban network, to draft the first Flow-Density Model (Model One).

2.1 Approach of development densification around HSR station nodes

Bertolini suggests a ‘node-place model’ (1999: 202) to theorise the potential of developing ‘places’ around transport node areas (Figure 5.03). This model argues that an equilibrium between ‘node’ and ‘place’ could be achieved in the long term. This understanding sets up a fundamental principle that an actively operated rail node has positive influences on the urban developments of its node precinct. However, this model is not detailed in defining the scope of urban area under station influences or about the actual mechanisms between both.

Pol (2002: 26) has suggested a ‘Development Zone’ diagram based on Schütz (1998) for urban developments around an HSR station node area, providing a measurement of station influence in both space and time dimensions (Figure 5.04, Table 5.01). This diagram sets the station as the central point of the development pattern and develops a ‘ring-zone’ structure according to travelling times. The ‘primary development zone’, which has a ‘very high’ urban density, is defined by a radius of 5–10 minutes ‘on foot or by a transport mode such as a people mover’; the ‘secondary development zone’, which has ‘high’ density, is defined by a radius of 10–15 minutes ‘via a complementary transport mode’; and the ‘tertiary development zone’, which has a density that varies ‘depending on the specific situation’, is defined by a radius of over 15 minutes ‘via complementary transport modes’\(^{140}\).

<table>
<thead>
<tr>
<th>Accessibility to and from the HST-station</th>
<th>OG1: Primary development zone</th>
<th>OG2: Secondary development zone</th>
<th>OG3: Tertiary development zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>direct 5-10 minutes on foot or by a transport mode such as a people mover</td>
<td>indirect &lt;15 minutes, via complementary transport modes (incl. travel and change time)</td>
<td>indirect &gt;15 minutes, via complementary transport modes (incl. travel and change time)</td>
<td></td>
</tr>
<tr>
<td>Location potential</td>
<td>location for high-grade (inter)national functions</td>
<td>secondary location for high-grade functions. Specialised functions related to specific location (cluster)</td>
<td>variety of functions depending on specific location factors</td>
</tr>
<tr>
<td>Building density</td>
<td>very high</td>
<td>high</td>
<td>depending on specific situation</td>
</tr>
<tr>
<td>Development dynamism</td>
<td>very high</td>
<td>high</td>
<td>modest</td>
</tr>
</tbody>
</table>

Table 5.01. The ‘Development Zone’ model (Source: Pol, 2002: 26)

\(^{140}\) Pol also described the relevant urban functions of the above development zones, which will be detailed in the next chapter.
The combined understanding of space and time provides a qualitative measurement to define the relationship between station and city. It is even important that it suggests an urban development density change according to the space-time relationship between station and city, despite its very brief description.

The station-city development relationship from the above model was supported by additional studies. For instance, Trip (2007: 74) argues that the transport connections from station to city (and vice versa) dictate the physical integration between station and city. In other words, the available transport modes—pedestrian, vehicle, metro, etc.—around the station node set the conditions that translate into users between station and city. In this theory, however, the local transport connection from the station is ambiguously described and does not include studies about the efficiencies of different transport modes, which could lead to very different densities in development policies.

According to Guan and Cui (2003: 39), ‘the transport system shapes land use pattern’, even if, within the same travelling time, different modes of transports support urban developments at different densities. Pont and Haupt (2010: 230-231) has compared coverage areas of cars and public transports (buses and trams) on a half-hour travelling time basis and tested the maximum possible building volumes supported by the three transport means. They found that trams and buses support over four and twelve times the volume, respectively, of cars (Figure 5.05).

Newman and Kenworthy (2016) have further interpreted the relationship between a transport system and the urban density, by categorising three types of urban fabrics shaped by walking, transit, and automobile in contemporary global cities. Through discussing the different travelling time of the three transports in relation to a city’s spatial structure, and its impacts on land use patterns, this research suggests that different population densities can be observed from the three urban fabrics: less than 35 people per ha in predominantly automobile cities; 35-100 people per ha in predominantly transit cities; and over 100 people per ha in predominantly walking cities.

Chinese studies also endorse the strong support given to development density by public transport, especially from the metro. Zhang et al. (2010) suggest that current metro network planning in Nanjing will allow an overall FAR figure improvement beyond 4.0 within the conventional urban area. Qu et al. (2010) recommend three possible FAR values for metropolitan Tianjin planning based on the metro network proposals. The highest values indicate FARs for commercial development up to 8.6 and residential development as 2.0. Xu and Huang (2010: 100) also find in Suzhou, by implementing the ‘public transport priority’ policy, that an increase of average land plot FAR from 2.5 up to about 5.5 can be possibly achieved.

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141 The original text in Chinese is: ‘交通系统塑造了土地使用模式’.
142 FAR stands for ‘floor area ratio’, referring to a parameter of the total built floor areas of a built project divided by the area size of the land plot occupied. This is also a widely used figure in Chinese statutory planning practices.
In the HONT practice, however, it is worthwhile to point out that its transport operation differs slightly from general urban transports as discussed above. The main reason is that the HSR station’s operation generates a significant amount of traffic flows distributed unevenly in a polarised pattern across the HONT area. Meanwhile, this station-oriented traffic mostly passes through the urban HONT instead of targeting it as destinations. These flows are comparatively weak to support HONT developments while consuming a significant proportion of its transport resource, for instance, land resources for arterial urban roads.

Despite the difference in a HONT transport pattern, findings from conventional urban transport research still present substantial values for HONT practice. In the HONT development context, the ‘efficiency’ of transportation is assessed through three dimensions: travelling time, transport capacity, and land resources demanded by transport. To clearly demonstrate the efficiency of the four modes of transports – pedestrian, metro, buses, and cars – that are currently available in HSR nodes, the author created a combined concept of ‘comprehensive efficiency’. This concept is defined as the travelling time of a transport mode given the same amount of passengers and urban road (land) resources.

This paragraph tests the ‘comprehensive efficiencies’ of main connection transports in an HSR node using calculations based on 1,000 passengers\(^{143}\) from a train arrival (Figure 5.06). In a theoretical pattern in which these passengers travel to an urban destination in the same transport, using one 3.2 metre wide lane\(^{144}\), the queues of pedestrians (forming four lines) are about 375 metres on a road surface, while the queue of cars (forming one line) is about 9,100 metres. Although walking speed is only one-fifth of driving speed in an urban context, a pedestrian has a comprehensive efficiency that is approximately four to five times that of a car within an accessible scope. If this calculation is applied to bus and metro, we may find even higher comprehensive efficiency (in ideal circumstances, with equivalent land use, a bus is five times more efficient and the metro 12 times more efficient than a pedestrian). However, considering the infrequency of bus services and the wait time to buy metro tickets\(^{145}\), the comprehensive efficiencies of both public transports are, in reality, lower than the calculation.

There are other over-estimation errors that must be reconciled against actual HSR station operations, such as passengers’ pedestrian speed in station and average vehicular speed on a busy urban road\(^{146}\). It

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\(^{143}\) According to Ou et al. (2014: 3), a Chinese HSR train normally allows 494–1,299 passengers. The author uses 1,000 for calculation.

\(^{144}\) Calculation is based on the Chinese urban transport parameters summarised by Guan and Cui (2013: 41). These include ‘width of single lane, capacity [of single lane], transport speed, dynamic land occupation per transport unit’ (the original text in Chinese is ‘单通道宽度, 容量, 运送速度, 单位动态占地面积’).

\(^{145}\) The frequency of bus service from an HSR station is greatly affected by road traffic conditions; therefore, buses have an unstable comprehensive efficiency. For metro services, passengers spend significant amounts of time – easily up to 15 minutes in locations like Shanghai Hongqiao – queuing for tickets, especially when a large group of passengers arrives on a train.

\(^{146}\) The author adopts the passenger pedestrian speed as 4.5 km/h, based on a synthesis of studies by Hu and Xie (2009) and Li et al. (2011). The average urban vehicular speed is adopted at 20–25 km/h, which is slightly higher than the concluded 15–20 km/h in metropolitan Shanghai by Wang et al. (2005).
is, however, not difficult to conclude that pedestrian and public transports are ‘flows’ with clear efficiency advantages that match the efficiencies/capacities of an HSR service. On the other hand, vehicle flows, especially those of cars, do not present satisfactory efficiency for HSR connections. As result, different relationships between station and city can be developed by the transport means discussed, shaping different supports for urban development.

5.2.2 ‘Development Zone’ diagram in Chinese HONT practice

In planning practice, the ‘Development Zone’ diagram substantially influences the creation of Chinese HONT schemes, which are further developed into a ‘ring structure development zone’. Han et al. (2010: 32) have recommended three development rings for urban edge location HONTs, with zoned developments on three radiuses extending away from a station: a five-minute pedestrian, a 10–15 minute pedestrian, and a 10–15 minute using other transports (Figure 5.07). In a case study by Shanghai and Jiaxing HONTs, Zheng and Zhang (2011: 35) introduce a physical distance dimension to define development rings. In Shanghai, three development rings were suggested, with radiiuses of one kilometre, five kilometres, and beyond (Figure 5.08).

Further observation finds that public transports with high efficiency features are less common in Chinese HSR stations than in European and Japanese stations. Li and Zhang (2014 a: 307) have surveyed 23 stations along the Beijing-Shanghai HSR line to determine available connection transports (Figure 5.09, Table 5.02). As shown in the figure, over half of the stations do not have metro services available from their main cities. This is even true for many mid-way stations in small- and medium-sized cities, where people are highly reliant on vehicles to connect to their local destinations. As most stations are located on the edges of or external to established urban footprints, arterial roads with six to eight lanes are widely used around HSR station nodes.
Table 5.02. Summary of stations and their connection services of Beijing-Shanghai HSR Line
(Source: Li and Zhang, 2014: 307, translated by the author)

<table>
<thead>
<tr>
<th>Province</th>
<th>City</th>
<th>Station</th>
<th>Distance to City Centre (KM)</th>
<th>Rail Connection (other than Beijing-Shanghai Line)</th>
<th>Urban Connection</th>
<th>Metro</th>
<th>Bus</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Beijing</td>
<td>Beijing South</td>
<td>5.4</td>
<td>Beijing-Tianjin Inter-city Beijing-Shanghai Line Beijing-Guangzhou Line Beijing Metro Line 4 Beijing Metro Line 14 (in construction) Beijing Metro Airport Line (in planning)</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hebei</td>
<td>Langfang</td>
<td>Langfang</td>
<td>3.3</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>Urban Bus Line 6, 10</td>
</tr>
<tr>
<td>Tianjin</td>
<td>Tianjin West</td>
<td>13</td>
<td>Tianjin-Qinhuangdao Passenger Line Beijing-Tianjin Inter-city Tianjin-Huangguo Line Beijing-Shanghai Line Tianjin Metro Line 1 Tianjin Metro Line 3 Tianjin Metro Line 4 (in planning) Tianjin Metro Line 6 (in planning) Tianjin Metro Line Z1 (in planning)</td>
<td>N/A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hebei</td>
<td>Guangzhou</td>
<td>Guangzhou East</td>
<td>7</td>
<td>/</td>
<td>/</td>
<td></td>
<td>Urban Bus Line 31, 16, 402</td>
</tr>
<tr>
<td>Shandong</td>
<td>Dezhou</td>
<td>Dezhou West</td>
<td>16</td>
<td>Qingdao-Taishan Passenger Line</td>
<td>/</td>
<td>Bus Line 106, 107, 112</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Jinan</td>
<td>Jinan East</td>
<td>9.7</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>Bus Line K156, K157, K38, K109, K167, 19, Airport Line 1, Airport Line 2</td>
</tr>
<tr>
<td></td>
<td>Tai'an</td>
<td>Tai'an</td>
<td>6.5</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>Bus Line K17, K18, K37</td>
</tr>
<tr>
<td></td>
<td>Qufu</td>
<td>Qufu East</td>
<td>7.5</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>Bus Line K01, Jinan BRT</td>
</tr>
<tr>
<td>Zaozhuang</td>
<td>Zaozhuang East</td>
<td>7.9</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>Bus Line K06, K107, Tangshan Inter-city Bus K109</td>
</tr>
<tr>
<td>Jiangsu</td>
<td>Xuzhou</td>
<td>Xuzhou East</td>
<td>7.1</td>
<td>Xuzhou-Luoyang Line Xuzhou-Luoyang Passenger Line Xuzhou-Suqian-Huaian-Yangzhou Inter-city Line Xuzhou-Shanghai Line Xuzhou Metro Line 1 (in construction) Xuzhou Metro Line 3 (in construction)</td>
<td>Xuzhou Metro Line 1 (in construction)</td>
<td></td>
<td>Xuzhou Metro Line 3, 10, 26, 32, 72, 80, 112</td>
</tr>
<tr>
<td>Anhui</td>
<td>Suzhou</td>
<td>Suzhou East</td>
<td>24</td>
<td>Suzhou-Huabei-Shanghai Inter-city HSR</td>
<td>/</td>
<td>Bus Line 29</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bengbu</td>
<td>Bengbu South</td>
<td>4.3</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>Bus Line 122, 128</td>
</tr>
<tr>
<td></td>
<td>Chuzhou</td>
<td>Chuzhou</td>
<td>14.5</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>Bus Line K107/K108</td>
</tr>
<tr>
<td></td>
<td>Zhenjiang</td>
<td>Zhenjiang South</td>
<td>4</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>Bus Line 19, 84, 119, 129, 181, 190, 191, 192</td>
</tr>
<tr>
<td></td>
<td>Yangzhou</td>
<td>Yangzhou North</td>
<td>9.2</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>Bus Line 29</td>
</tr>
<tr>
<td></td>
<td>Suzhou</td>
<td>Suzhou East</td>
<td>15</td>
<td>Nanjing-Zhuhai-Fuzhou Inter-city Suzhou Metro Line 2 Suzhou Metro Line 7 (in planning)</td>
<td>/</td>
<td>/</td>
<td>N/A</td>
</tr>
<tr>
<td>Shanghai</td>
<td>Shanghai</td>
<td>Shanghai North</td>
<td>16</td>
<td>Shanghai-Nanjing Inter-city Shanghai-Hangzhou Inter-city Shanghai-Zhuhai Inter-city Shanghai Metro Line 2 Shanghai Metro Line 10 Shanghai Metro Line 17 (in planning) Shanghai Metro Line 8 (in planning)</td>
<td>Shanghai Metro Line 2 Shanghai Metro Line 10 Shanghai Metro Line 17 (in planning)</td>
<td></td>
<td>N/A</td>
</tr>
</tbody>
</table>

According to the ‘comprehensive efficiency’ study, due to the dominant use of vehicles in most HSR station connections, the prospect for HONT integration between station and city is not optimistic.
To synthesise, we can predict limited physical integrations in HONT between station and city based on the station flow analysis. For those stations connected with metro services, there can be possible station-city integration areas within small walkable ranges around metro stops; while as a whole and for most of other HONT parts, the low efficiency of vehicles from and to HSR stations will be difficult to support expected high density developments.

5.2.3 HONT ‘flows’ in a polycentric urban network

The above discussion narrowly considers transports oriented at the HSR station only. In the planning practice, however, a HONT is widely planned as a node of a ‘polycentric structure’147 (Guan and Cui, 2003) urban network fabricated around main city (Figure 5.10). Therefore, traffic flows oriented at urban HONT148 from other nodes within this network should also be considered in HONT planning. Comparatively, the station-oriented flows penetrate through the HONT area and occupy substantial transport resources but normally do not bring direct urban activities. The urban HONT-oriented flows bring in urban users and driving forces of urban developments.

There is no in-depth research on how HONT development is influenced by flows from nodes in the polycentric urban structure network. However, as provisionally observed from most planning schemes, the urban HONT oriented flows travel much longer than the flows between station and HONT, which means longer time and less efficiency in most cases. The urban development density directly supported by flows from regional nodes is therefore comparatively lower. Additionally, when overlapping the ‘Development Zone’ diagram with the polycentric urban system, it is highly possible that urban HONT-oriented flows will mostly target the HONT area beyond 15 minutes travel from HSR station and therefore focus on supporting marginal area developments in a HONT layout.

From above, flows at three scales can occur in a HONT. They are flows between HSR station and urban HONT; HSR station and nodes of regional urban network; and urban HONT and nodes of regional urban network. These flows present different potentials in shaping development densities across ‘ring zones’ around the HSR node. Model I shows this trend learned from theoretical studies (Figure 5.11).

How, then, does the planning practice balance these flows in HONT? And how does this relate to the observed lower development density? Three case studies are employed below to present a higher resolution study of HONT planning.

5.3.0 ‘Flow’ study: transport planning of HONT

The three cases studied below are selected from 15 HONTs that the author visited across China between 2013 and 2015 (Figure 5.12). To fully disclose the relationship between urban traffic flow and urban development in HONT planning practices, three conditions are set out here for the case selection:

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147 The original text in Chinese is ‘多中心模式’.
148 According to studied HONT planning schemes, these flows are mainly comprised of vehicular and metro (where available) transports.
First, the selected HSR station should be located on the edge or external to established urban footprints; and between the cases, there should be a variety of distances between HONT and its main city, to allow a ‘locational effect’ comparison.

Secondly, cases are chosen with variations of planned sizes, to demonstrate the influences of physical HONT scale towards flows and developments.

Thirdly, the connection transport modes from each HSR station are weighed to be equal between different cases; the author deliberately chose metro as a key local infrastructure from limited case options, to allow a development density potential exploration in the study.

Based on the above criteria, the author focused on the Lower Yangtze Delta region, where both urbanisation and HSR infrastructure are developed ahead of most other Chinese territories. In this region, three HONT cases planned around their HSR infrastructures from Shanghai, Hangzhou, and Wuxi cities are selected (Figure 5.13). They are Shanghai Hongqiao Central Business District (Hongqiao CBD) along the HSR terminal of Hongqiao Hybrid Transport Hub (Hongqiao Hub); Hangzhou Eastern New Town around Hangzhou East Station; and Wuxi Xidong New Town Business District around Wuxi East Station. The three stations from above represent infrastructure nodes at different scales: Hongqiao is a highly intensive transport building that incorporates HSR, airport, and local connections; Hangzhou East Station shows an example of large scale hub integrating multi HSR lines; and Wuxi East is a mid-way stop on the Beijing-Shanghai HSR line and therefore, a comparatively smaller scale HSR infrastructure.

Theoretically, the significant differences between the HSR infrastructures relate to transport resources at different scales, which should power HONT developments at equally different scales/densities. The following studies, however, disclose that this hypothesis is not true.

Before conducting a detailed analysis, some brief background profiles about the cities, stations, and HONTs are necessary for those not familiar with China.

5.3.1 Background

5.3.1.1 Cities

**Shanghai**: One of the urban agglomeration centres in China, which serves as the economical/financial centre of China. This is a core city of the Lower Yangtze Delta Region. According to statistics of China News Service (2015), Shanghai’s ‘comprehensive strength’ (综合实力) ranks number one among Chinese cities. As announced by the Shanghai Statistics Bureau (2015), in 2014, the city’s GDP reached about 2,356 billion RMB, with a residential population of about 24.26 million by the end of 2014. According to the Shanghai Statistics Bureau (2014), in 2013, Municipal Shanghai covered 8,359 square

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149 The original names of stations and HONTs in Chinese are: ‘上海虹桥综合交通枢纽, 上海虹桥商务区 , 铁路杭州东站枢纽, 杭州城东新城, 铁路无锡东站, and 无锡锡东新城（商务区）’. 

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kilometre land, of which the built-up footprint was about 998.75 square kilometres by 2011 (Ministry of Housing and Urban-Rural Development, P.R. China, 2012).

**Hangzhou:** The capital city of Zhejiang Province, and one of the central cities of the Lower Yangtze Delta Region. According to Hangzhou Bureau of Statistics (2015a), Hangzhou has a municipal land area of 16,596 square kilometres, of which the built-up coverage was 452.62 square kilometres by 2012 (Ministry of Housing and Urban-Rural Development, P.R. China, 2012). By the end of 2014, Hangzhou had a residential population of about 8.89 million, and the city’s GDP in 2014 was about 920 billion RMB (Hangzhou Bureau of Statistics, 2015b).

**Wuxi:** One of the industrial centres in Jiangsu Province. Wuxi Chronicles Office (2015) states that the city has a municipal coverage of about 4,627 square kilometres, with a built-up area within 315.9 square kilometres (Ministry of Housing and Urban-Rural Development, P.R. China, 2012). By 2014, Wuxi’s residential population was about 6.5 million (Wuxi Chronicles Office, 2015). According to the same source, in 2014, the GDP of Wuxi was about 821 billion RMB.

5.3.1.2 HSR Stations

**Shanghai Hongqiao Hybrid Transport Hub:** Sits on the western edge of metropolitan Shanghai. Today’s Hongqiao hub is upgraded from the earlier Hongqiao Airport into a comprehensive node housing nearly all of the available national-scale operated passenger transport infrastructures, including airport, HSR, conventional rail, and maglev train (reserved). Meanwhile, metro, coach, bus, taxis, and cars are also integrated in Hongqiao to connect regional and metropolitan destinations in Shanghai. This one-kilometre long building is ‘the largest size [terminal building], integrating rail, road and air [infrastructures] of Chinese transport history’\(^{150}\) (Cao et al., 2010: 20), with a capacity to serve 1.1 million passengers daily (daily rail passengers: 220k).

The highly intensive but mono-functional transport node occupies 1,075 ha land area (including the station square on rail side of 19 ha, according to Google Earth). The HSR terminal, which is the western half, spans over 450 metres above the track yard. Outside the HSR terminal, there is a station square on the western side, with a depth of about 150 metres.

**Hangzhou East Station:** Sits to the eastern edge of metropolitan Hangzhou, and was upgraded from a pre-existing minor mid-way station into ‘one of the nine major [rail] terminals in China’\(^{151}\) (Li and Jin, 2010: 98). Although there is no airport service integrated, Hangzhou East has a similar size to the HSR terminal in Hongqiao, with 15 platforms and 30 lines (and extra 2 platforms and 3 lines reserved for future maglev trains from Hongqiao). This station is also connected with metro, coach, bus, taxi, and cars to serve passengers from regional and metropolitan Hangzhou areas. About 85 ha of land is covered by the terminal (the rail track yard and building occupy 58 ha land, and both station squares on eastern

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\(^{150}\) The original text in Chinese is ‘交通史上最大规模集‘轨、路、空’三位一体的交通枢纽...实现发送旅客 110 万人次/ 日’.

\(^{151}\) The original text in Chinese is ‘全国九大枢纽站之一’.

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and western sides sit on a total 27 ha land). The terminal building spans about 500 metres east-west, and the total edge-edge distance including both squares is about 750 metres (daily rail passenger: 200k).

**Wuxi East Station**: Is a mid-way stop of Beijing-Shanghai HSR Line; therefore, it has the least extensive size compared with the other two cases. The station also sits on a smaller site of 20 ha, but its squares on both sides are larger than the squares of the other two stations, with a total size of 55 ha. This is partly because Wuxi East Station does not provide a vertical connection between the train platform and local transports, as in Shanghai and Hangzhou. The squares are used to facilitate coach, bus, taxi, and car parking, which expand in a horizontal dimension (daily rail passenger: 30k).

**HSR Station Distance to City**: Of the three cases, Shanghai Hongqiao and Hangzhou East are both edge locations of the urban footprints; the former is about 15 kilometres to central Shanghai, while the latter is about five kilometres away from Hangzhou’s metropolitan centre. Wuxi East sits external to the urban footprint, about 15 kilometres east to the centre of Wuxi City.

5.3.1.3 HONTs

**HONT size**: The three selected HONT cases largely vary in their sizes. Hangzhou Eastern New Town is the most compact case, with its planned boundary within 9.3 square kilometres. In Shanghai, the HONT expands up to 86 square kilometres, with a 27 square kilometre ‘main functional area’ planned immediately around the Hongqiao Hub. This includes a ‘Core Area’ of 3.7 square kilometres. In Wuxi, an even larger 120 square kilometre ‘Xidong New Town’ is planned, which is comprised of three sub-centres. The middle one with 44 square kilometre area is officially defined with an HSR ‘theme’ and is named the ‘Business District’ (Figure 5.14).

5.3.2 HONT Transport Planning

The transport planning from all of the three cases shows strong priorities on flows operated at regional/metropolitan scales which support the HSR station’s operation. This transport system also works as a skeleton infrastructure for other traffics related to the HONT areas. Therefore, the following paragraphs start with discussing flows at this scale.

5.3.2.1 Regional scale (Flows between regional/metropolitan destinations and HSR station/urban HONT)

As a city’s major infrastructure, the HSR station is obligated to connect itself with regional/metropolitan destinations through urban traffic, although its marginal location is normally not an advantage to support this operation. Figures 5.15-5.20 show the regional connections and their locational relationships to other regional destinations of the three studied HONT cases.

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152 Measured through Google Earth; Shanghai’s city centre is located on People’s Square (人民广场); Hangzhou’s city centre is located on Wulin Square (武林广场).
153 Measured through Google Earth; Wuxi’s city centre is located on Sanyang Square (三阳广场), which is the crossing point of Wuxi Metro Lines 1 and 2.
154 The original text in Chinese is ‘主体功能区’.
If compared with conventional inner-city located stations, it is interesting to find that the HSR station normally has much increased passenger capacity. Taking Hangzhou as an example, the old station in the city centre serves about 50,000 passengers per day, peaking at about 100,000 daily during Spring Festival periods. However, the HSR station of Hangzhou East is designed to serve 200,000 people daily as average, about four times the capacity of the former. In Shanghai, the HSR terminal of Hongqiao is proposed for about 215,000 daily passengers, compared with about 100,000 per day in the central station. As a mid-way stop, Wuxi East Station has almost the same passenger capacity of 30,000 daily as the central terminal of Wuxi Station. It is also worthwhile to note that the remote location of Wuxi East Station makes it potentially accessible by other regional cities for HSR services, such as Changshu City 30 kilometres away to the east.

Additionally, to compare, the conventional railway stations are much closer to the city centres: Shanghai Station is about 3 kilometres away, Hangzhou Station is 3.5 kilometres away (to today’s centre in Wulinmen), and Wuxi Station is only 1.5 kilometres away respectively. Increased passenger capacities and expanded passenger coverage areas, and further connection distances— all these factors convince one that an HSR station node demands much stronger support from local transports than the conventional stations within the city. Consequently, these local transports are also used to serve connections to the urban HONT areas with regional/metropolitan destinations.

In terms of transport modes, the regional transportations are mainly comprised of urban roads, specifically arterial roads designed for speeds of 60 kilometres per hour and beyond. Of the three selected cases, road based passenger connections include coach, bus, taxi and private cars.

Meanwhile, metro service is also available in all three studied stations. At the time of this writing, stations in Shanghai and Hangzhou both have two metro lines in operation, and Wuxi East Station has one line connected.

With a further insight observation, we may find the connected metro service in each station to have different shares of passenger percentage, which is significantly influenced by the coverage of the urban metro network in each city. Shanghai has about 14 lines in operation by 2015, with a comparatively intensive network coverage of nearly the entire metropolitan area. Upon this, planners predict the metro lines connected in Hongqiao will share 45–50% of passenger flows into the transport hub (Xu, et al., 2008: 47; Huang, 2006: 8; Ji, 2007: 35). Hangzhou has a much shorter period of metro history, with

155 According to Chen (2009: 7), the rail terminal of Hongqiao is proposed to serve 78.38 million annual passengers by 2030, equal to an average daily rail passenger number of about 215,000.
156 Data estimated by author through synthesising online information by Shanghai Local Chronicles Office [http://www.shtong.gov.cn/node2/node2245/node4476/node58291/node58460/node58474/userobjec
157 The passenger capacities of Wuxi East Station and Wuxi Station are according to Mo (2013) and Huang (2002) respectively.
158 According to the official website of Shanghai Metro [http://www.shmetro.com, visited 07 October 2015]; new lines proposed or under construction at the time of writing were excluded.
the first line opened since 2013, and the city had only two lines in operation by the end of 2015. This much less developed network explains why only 25% passengers are expected to use the metro travelling to/from Hangzhou East Station (PLT and ZUURPDI: 2011). Due to limitations on published sources, the author was not able to collect relevant metro passenger data in Wuxi. As an assumption, because Wuxi has a similar profile of its metro network as Hangzhou, it is reasonable to predict the passenger share of metro in Wuxi East Station will not be too different as to the case of Hangzhou.

On the other hand, does a higher metro passenger share percentage mean less uses of vehicles in station connection? The author analysed transport data of Hongqiao provided by Chen (2009: 8) and found that vehicle users to/from Hongqiao Hub are about 330–380 thousands per day; while in Hangzhou, about 150 thousands daily passengers are connected to the station on vehicles. This reveals that increased terminal capacity in Shanghai in fact requires even increased road capacity to support, despite its much better metro network than most other Chinese cities.

Today, most Chinese cities, apart from the major centres of Beijing, Shanghai, and Guangzhou, are still at very early starting stage to provide metro services to their urban users. Additionally, the metro networks in these cities are far from covering enough area to support a high passenger percentage for HSR operation. It is predictable that for most HSR stations, vehicles will be used as the primary connection transport for many years to come.

The flows between regional urban nodes and HONT are operated on the same infrastructure as the station flows. Their influences towards HONT development are analysed in later paragraphs.

5.3.2.2 Transport planning within urban HONT area (flows between HSR stations and urban HONTs)

The three studied cases also indicate that the transport planning within the urban HONT area is largely based on a skeleton system shaped by the regional scale transportations including arterial roads and metro. Beyond this skeleton system, travelling within the HONT scope is normally only done via normal urban roads. There is no dedicated high efficiency transport, such as a tram or metro, to serve the demands of urban HONT according to author’s observation. As a result, although there are significant size differences between the HONTs of Shanghai, Hangzhou and Wuxi, we may find they have similar layout structures of the transport system within HONT (Figure 5.21).

This regional scale, long distance-oriented local transport planning structure, and the central location of an HSR station in HONT planning, such as the cases of Hangzhou and Wuxi, are together creating a ‘polarised’ layout of a HONT’s transport planning.

Consequently, a series of features can be analysed due to the unequal transport resource distribution in the ‘polarised’ layout system. First, the highly intensified HSR infrastructure core with multiple transport modes largely expands the size of the transport node, which substantially increases the walking

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159 Shanghai Hongqiao presents a rare example of locating the transport terminal next to a HONT. According to the author’s understanding, the comprehensive requirement of airport operation is the most important reason for this.
distances inside the station. Beyond this, the interface between station and urban area is mostly cut through by arterial roads to facilitate intensive vehicle uses. Physical isolation from immediate urban areas is clearly observed around most HSR stations, making the walking connection between city and station difficult on the ground surface.

Secondly, within the polycentric urban network, the main city normally sits on one side of the HONT, which attracts most transport resources, resulting in uneven transport distributions across different sides of the rail tracks. This uneven distribution is an even serious issue in HONT cases that are remote to the city (being at the far end node of the polycentric network), such as Wuxi, where the western half of the HONT clearly has the advantage of metro stop numbers and urban road densities that the eastern half does not have.

Additionally, as the rail tracks are laid directly on the ground surface in some HONT cases, the urban area is physically split because of the middle location of HSR station. Hangzhou’s HONT is a typical sample of this, as it heavily relies on tunnels crossing rail tracks to stitch urban lives on both sides.

Figures 5.22-5.24 summarise the transport planning proposals of three studied HONTs.

5.3.2.3 HONT Flow-Density Model based on transport planning

The above analysis discloses two general features of HONT transport planning: large volume of station passengers travelling on regional/metropolitan scale, and uneven transportation resource distribution within urban HONT scope. Based on these understandings, the following section further investigates individual transport modes (flows) in the HONT planning, the scope of their HONT accessibilities, and their potential influences on urban developments.

First is the pedestrian flow around the HSR station, which is ‘oriented at commercial services/recreational entertainment’\(^\text{160}\) (He, 2010: 34) purposes\(^\text{161}\). These flows normally cover and have the potential to shape urban developments around the station node area.

This development potential, according to studied planning schemes, is however much restricted by the over-stretched station size, which, for example, spans about 560 metres in the HSR terminal of Hongqiao (including the station square on western side), and 780 metres in Hangzhou East Station (including station squares on both sides)\(^\text{162}\). This means a five-minute pedestrian distance from the middle of a station at about 3–5 kilometres per hour covers only the station node footprint. Even 10 minutes of walking only reaches the urban fragments marginally because of detours crossing the wide roads in front of each station. In Wuxi, the advantage of a smaller station is taken away by the ambitious

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160 The original text in Chinese is ‘商业服务/休闲娱乐为导向的步行流’.
161 He (2010: 38) categorises the pedestrian flows in a railway station into four types: ‘rail transport oriented; transfer oriented; commercial services oriented; and recreational entertainment oriented’ (以铁路客运为导向；以换乘为导向；以商业服务为导向；以休闲娱乐为导向).
162 Data source: Google Earth.
scale of squares, reaching a 640-metre range edge to edge. Pedestrian flows in this case also access urban areas with difficulty.

Physically, despite successful precedent projects like Kyoto Station and Berlin Hauptbahnhof that well integrate urban facilities into a station node, most of the studied Chinese cases are functionally homogeneous transport nodes. Station-related urban facilities are only found on the outside of the station building.

According to the ‘Development Zone’ diagram, pedestrian flows can potentially support ‘very high’ density developments within a 5–10 minute range area. In a Chinese HSR station scenario, this development is difficult within the station building or urban fragments on far-end of the walking radius. The station squares which are seamlessly connected to the station building are probably the only precinct to accommodate urban densification within a station node footprint.

Secondly, there is the metro system. The metro line(s) provides high efficiency links between station and urban nodes at a regional scale. Meanwhile, urban HONT areas within walkable ranges along the metro stops also benefit from metro’s ‘comprehensive efficiency’ advantage. High level of station-city integration can be expected in these limited urban HONT areas, which will potentially lead to high density developments.

Currently, Chinese metro’s operation speed is normally between 30–40 kilometres per hour; therefore, a 15-minute combined metro and pedestrian travel radius reaches about three kilometres away from HSR station, with a further 250–500 metre ring coverage around the metro station. This shapes a cluster of about three development rings along the metro route in a typical size HONT planning (about 3–5 kilometres in square), providing high potential of urban densities.

Despite its support of urban HONT development, the regional transport nature of metro means that the planning prioritises straight line to maximise the travel speed between regional/metropolitan destinations and the HSR station. As a result, the accessibilities of metro within the HONT are substantially limited, which minimises the potential developments that a metro could support. Furthermore, it is also observed that multi lines in a HONT are planned to merge into one line across the HSR station precinct, as is clearly shown in all three cases.

Finally, the interval distances of metro stops on marginal HONT areas are greatly increased compared with central areas, such as two kilometres compared with one kilometre in the Wuxi case. The increased intervals are good for higher travelling speed between the main city and HSR station, but reduce the coverage areas of metro services for urban HONT. This is another conflict example between regional scale transport and HONT scale development.

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163 According to Baidu Baike (百 度百科), Hangzhou Metro Line One has an average operational speed of 37 km/h. Li and Zhang (2014 b) suggest an average metro operational speed of 40 km/h for Chinese cities. The author adopts a range between 30-40 km/h for this chapter.

164 This calculation takes one-kilometre interval of metro stops in HONT, which is the average distance as observed from most metro planning in Chinese metropolises.
Third is the urban road system. In HONT, road infrastructure can be clearly categorised into arterial road and normal roads. The former is proposed for regional/metropolitan scale links which are similar to metro, but instead of the metro system’s penetration through the main development area of the urban HONT, the arterial roads are mostly planned as rings external to the urban HONT footprint. In Shanghai and Wuxi, elevated roads are built to connect the external arterial roads with the HSR station in the middle to minimise interferences between station and HONT flows. There is no elevated road inside Hangzhou’s HONT, but similarly, the major ring roads are connected into the station precinct through wide roads which actively avoid penetrating the main development area.

Compared with the metro line, the planned arterial roads are mostly away from direct access into the main development areas of urban HONT. Apart from their lower ‘comprehensive efficiencies’, the arterial roads have a second disadvantage in relation to support for HONT growth defined by transport planning schemes.

On the other hand, the normal roads serve most transport demands within the urban HONT. This is also observed in all three cases, around the station node area (central area to HONT), where there are dense layouts of normal roads (with intervals between 100–200m). This dense road area also largely overlaps with the metro service coverage. Pedestrians can take advantage of smaller size urban blocks, which benefit from improved urban permeability. This also encourages the use of buses in this area to compensate for the lack of metro service coverage.

Comparatively, in the fringe areas of HONT, the road density drops significantly, and urban block size increases up to 300–400 metres. In this area, accessibilities are mostly provided by vehicles, including buses, taxis, and private cars.

For bus riders, walking around expanded fringe urban blocks between bus stops and destinations is unavoidable. Typically, in Wuxi, the fringe urban block grows to, or even exceeds, 300 metres per side, creating huge walking barriers and discouraging pedestrians in this area. As Chen and He (2012) find through research in Shanghai, the walking Pedestrian Route Directness (PRD) figures can increase from 1.2 in central urban areas with dense roads up to 1.7 in outskirt areas with low density roads. Jin (2010: 3) concludes that fewer pedestrians will result in ‘less preference for bus usage’\textsuperscript{165}. Consequently, it is not difficult to predict a car dominating scenario on fringe HONT roads.

To summarise, a second Flow-Density Model (Model Two) is drafted to represent development potentials based on the HONT flow planning. Figure 5.25 illustrates this model based on 36 square kilometre (6x6) and 9 square kilometre (3x3) templates, according to studied HONT examples. However, as most observed HONTs are sized close to the larger template, the 6x6 square kilometre is used below for further studies.

\textsuperscript{165} The original text in Chinese is: ‘不愿意采用公交出行’.

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5.4.0 HONT flow-density analysis

The Flow-Density Model (Model Two) indicates that HONT is zoned through transport planning with a range of development density potentials, shaped by different station-city relationships. These areas are defined here in accordance with different density potentials as ‘Central Core Area’, ‘Development Strip Area’, and ‘Peripheral Development Area’ (Figure 5.26).

The ‘Central Core Area’ is shaped by pedestrian flows within a 10-minute walking distance around HSR station, which primarily covers the station and its node precinct. According to the three cases, this area has about a 500-metre radius around the station. The ‘Development Strip Area’ has its major development support from the metro infrastructure, within 15-minute combined travelling time to/from the station. This area is therefore mainly comprised of a cluster of density rings around metro stops across urban HONT, whose radiuses range between 200 and 500 metres. Comparatively short travelling time means above-mentioned two areas have strong potential for integrating with the HSR station, compared with the third area, ‘Peripheral Development Area’, which sits in fringe HONT and has a longer travelling time to the station. This area is dominated by vehicular flows from both station and regional/metropolitan destinations.

Based on the above flow-density zoning diagram structure, the following section discusses the planning and development densities of the three selected cases.

5.4.1 The Central Core Area

In the ‘Central Core Area’, the development density refers to the new urban building projects that are triggered by HSR infrastructure, typically the public/commercial service facilities such as retail, hotels, restaurants, offices, conferences, and exhibitions. These facilities are built as ‘destinations’ of urban lives and have a different nature to the commercial facilities intended for/aimed at servicing passengers in the station precinct. Station-related urban facilities can be observed only on the outside of the station building, mostly on station squares with theoretically high densities.

However, different findings are obtained in the three studied cases, despite the fact that they have similar walking conditions in their node areas (Figure 5.27). The distances from the centre of station to the edge of the station square are respectively 325 metres in Shanghai, 375 metres in Hangzhou, and 330 metres in Wuxi.

The largest node of the three, the Hongqiao Hub at Shanghai, occupies an incomparable 1,075 ha land (about 176 ha land footprint of the HSR Terminal, according to Google Earth). Unfortunately, this ambitious node proposal does not include any urban facility development within the node precinct. On its only station square which connects the HSR terminal from western side, there is no commercial facility provided. A 120-metre wide strip of well-landscaped open space without any urban life is presented here between the station and city (Figures 5.28 and 5.29).

166 Up to a 500-metre radius, the boundary of the ‘central core area’ is further defined by main urban roads around the HSR node.
Comparatively, Hangzhou’s case made very different efforts to integrate urban functions within its station squares on both eastern and western sides. Apart from the transport facilities at lower floors, there are also retail, hotel, and office spaces proposed inside the ‘square’ projects. The total development size of both squares is up to 750,000 square metres, of which 270,000 square metres are above ground and dedicated to various urban uses. The underground size is 420,000 square metres, including retail (190,000 square metres) and connection transport facilities. Meanwhile, station pedestrians can find bridges and tunnels to cross arterial roads and access immediate urban fabrics without too much effort (Figures 5.30 and 5.31).

In Wuxi, the spaces of station square are largely occupied by local transports, mainly ascribed to its two-dimensional planning layout. The only commercial facility oriented at station users is located on the southern edge of the station square, found in a sunken open space. This commercial facility has a total size of around 20,000 square metres (Baike). On the other hand, the very well-landscaped northern square has no service facility to offer.

Because of its smaller station footprint, the 500-metre walking radius in Wuxi’s case includes seven urban development plots around station node. These plots are generally office towers, located at least 250 metres away from the centre of station, and according to author’s estimation, their total development volume amounts to about 500,000~650,000 square metres. If we only focus on Wuxi’s station\(^\text{167}\), there is hardly any visible effort to develop it into an urban destination compared with Hangzhou’s case (Figures 5.32 and 5.33).

Through the author’s survey, it was found that, unfortunately, most HSR stations and squares are not developed into spaces that accommodate high density urban activities, despite their advantages of good pedestrian access and a large number of passengers. This phenomenon can be understood as a consequence of the prevalent understanding of such sites as constituting an ‘urban gateway’\(^\text{168}\) (Jing, 2012: 112) concept for HSR stations, which should become ‘the primary space to present a city’s character and image’\(^\text{169}\) (Gu and Su, 2012: 102). This understanding has created widely observed rigid design approaches in many station squares. For instance, the HSR terminal of Hongqiao successfully integrates all local connections into the station building in a three-dimensional way to allow the square surface to be fully released. However, development opportunities still do not exist. The large scale emptiness on the square provides a perfect ceremonial space for the station building to be viewed as a dominant landmark, as part of a large urban ‘landscape through perspectives’\(^\text{170}\) (Gu and Su, 2012: 102, also see Figure 5.34) (also refer to the development of Chinese ‘new town’ template in Chapter Two of the ‘Socialist’ space structure in new towns).

\(^{167}\) The next chapter finds that station-side office towers do not present strong functional integration with the station despite their easy accessibility.

\(^{168}\) The original text in Chinese is ‘城市门户’.

\(^{169}\) The original text in Chinese is ‘成为展示城市气质形象的 “第一空间”’.

\(^{170}\) The original text in Chinese is ‘透视景观’.
This phenomenon is observable not only in Shanghai and Wuxi’s cases, but also in many other visited stations such as Tianjin South, Nanjing South, Guangzhou South, and Xi’an North. Even in the Hangzhou case, which actively occupies the square space with functional developments, the station building is still positioned as the most visually focused urban monument through symmetrical square developments on both sides of it.

Undoubtedly, there is a potentially huge urban cost to shaping this strong ceremonial space and presenting an HSR station. Tokyo Station, with a similar passenger capacity as the HSR terminal of Hongqiao\(^{171}\), shows the full potential value of immediate station-side urban spaces. Along its eastern side (the Yaesu side), the narrow 60 metre gap between station and arterial road (Google Earth) is intensively occupied by high-rise office blocks, hotels, and shopping destinations, with a total development size estimated around 800,000 square metres\(^{172}\). To compare, the Shanghai equivalent generously gave up all development opportunities within an even larger gap area between station and city.

It is also important to point out that the station building-oriented ceremonial space is further extended into urban HONT area through a planning axis from the station into both sides of the city. Empty and open space is the main instrument to shape an even larger scale ‘single point perspective’. It is also observed that the planned urban axis is widely proposed as a ‘pedestrian street’ in many schemes, such as the HONTs of Hangzhou and Wuxi. In Hangzhou, the building heights are controlled along the axis to further emphasise the station building’s domination by axial planning of symmetrical perspectivity.

To summarise, the Chinese HSR station buildings are expanding more than their Japanese equivalents, including about 500 metres spanning in the stations of Shanghai and Hangzhou cases, compared with 200 metres of Tokyo Station and 100 metres of Osaka Station (Figure 5.02). Large spanning size is a significant barrier for pedestrians to access urban facilities/destinations in the vicinity of the station node. An even wider gap is the planning desire to make physical statements through station building in visual contexts. It is urgent to reorient planning priorities from an emphasis in the station design upon authoritarian visual spectacle to instead a practical awareness that powers urban lives within the station node.

5.4.2 Development Strip Area

The ‘Development Strip Area’ refers to the development area mainly supported by combined metro and pedestrian flows within the urban HONT scope. This area is within a 15-minute travelling radius from the HSR station. According to the ‘Development Zone’ diagram, a strong potential for ‘high density’ developments can be expected.

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\(^{171}\) Daily passenger capacity of Tokyo Station is about 1 million.

\(^{172}\) This estimation is synthesised upon information from the official website of Mitsubishi Estate, the official website of Marunouchi, and Google Earth.
As this area is shaped through a cluster of ring developments around metro stops, it presents a ‘strip’ morphology as a whole. Meanwhile, the metro infrastructure also dictates the size of this strip, which, however, does not relate to the size of HONT. For example, the size of Wuxi’s Xidong New Town Business District is about four-and-a-half times the size of Hangzhou’s HONT, but the ‘Development Strip Areas’ from both are similar in size, 280 ha and 360 ha respectively. This is because the planned metro resources in both cases are identical (Figure 5.35).

However, when attributed to large variations in other factors like proximity to the main city, layouts of metro infrastructure, and pedestrian system planning, significant differences are found in planned development densities in the three schemes.

In Hangzhou, the ‘Development Strip Area’ is structured by three stops used by metro lines 1 and 4 (excluding the metro stop in HSR node), stretching diagonally across the HONT. In planning, the developments are physically structured by a string of ‘urban hybrid complex’ projects with individual FARs between three and six. The 500-metre pedestrian radiuses of all metro stations overlap with each other thanks to the dense station intervals which are less than one kilometre long. This results in a continuous densification of developments.

Additionally, a pedestrian street along the central axis extending from the HSR station east square also agglomerates retail developments along its route. The building heights are controlled by planning within 24–32 metres on both sides of the street, to highlight the HSR station building in a perspective urban scape. The project FAR figures along the axis therefore drop down to 2.5–3.

According to the 15-minute combined travel time from station principle, we can draw a ‘Development Strip Area’ in Hangzhou HONT of about 280 ha around three metro stops, with circa 5.83 million square metres of total developments floor areas. The responding AFAR figure is 2.1 (Figures 5.36 and 5.37).

In fact, as Hangzhou’s HONT has the smallest size compared with the other two, there is a strong pressure to maximise the development potential in practice. The proposed FAR figures across the whole new town are quite identical. If only the FAR figures are considered, there is not a clear boundary to distinguish the theoretically higher density ‘Development Strip Area’ from other peripheral areas.

Wuxi’s HONT has a similar metro layout to Hangzhou, comprised of lines number 2 and 4 (Line 4 was in the proposal stage at the time of writing), and it mainly covers the middle and south-western part of the HONT footprint. The furthest metro station in the Wuxi case is about 3.5 kilometres away from its HSR station, which is roughly beyond a 15-minute combined travel time in actual operations. According to the planning scheme, the HONT has a ‘CBD planning’ which excludes the far-end metro stop. The author therefore chooses three metro stops close to HSR infrastructure to frame the ‘Development Strip Area’.

It is also worth noting the special planning approach in Wuxi: an underground ring road system dedicated to vehicle flows, covering an area of 40 ha immediate to the HSR station. This ring road

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173 Source of data: Hangzhou Eastern New Town Planning Scheme, including FAR figures of individual land plots.
system is proposed to ‘guide [vehicle] traffic flows underground...to release conflicts between pedestrian and vehicles on the ground surface, as well as to improve environmental qualities of urban blocks’ (Planning Exhibition Centre, Xidong New Town Business District). This ring road system has a total length of 3.1 kilometres, with connections to the urban road network, as well as underground parking areas of individual office buildings in this area.

According to the author’s data, Wuxi’s ‘Development Strip Area’ has about 200 ha size (excluding HSR station node), with a total development of 3 million square metres. The AFAR figure here is about 1.5 (Figures 5.38-5.40).

The ‘Development Strip Area’ has a slightly different structure in Shanghai’s HONT, due to influences from its mega-size transport infrastructure.

Although Shanghai has a much better developed urban metro network than Hangzhou and Wuxi, the ‘Development Strip Area’ of Hongqiao CBD does not receive strong urban growth support from the metro operation. On the one hand, Hongqiao Hub’s huge size squeezes the HONT to one side of its footprint, and an urban strip is developed in parallel with the HSR rail tracks. As the metro lines that are currently in operation are perpendicular to the rail tracks, the overlapping between metro and urban footprints is minimised. On the other hand, the huge passenger capacity of Hongqiao Hub demands dedicated metro services. The two available metro stops are planned for the transport hub only, one for the HSR terminal and the other for the air terminal. As the hub building has a footprint greatly exceeds the 10-minute walking distance of about 500 metres, these metro stops can hardly support urban developments beyond them. The low coverage of metro service makes the author slightly change the policy here to define the ‘Development Strip Area’ in Shanghai’s case.

According to the 15-minute travel time from the station principle, as well as the planning scheme of Hongqiao CBD, the ‘Development Strip Area’ of Shanghai’s case occupies about 370 ha land, which is part of the proposed ‘Core Area’ of planning (excluding the one square kilometre size ‘Exhibition Complex of China Expo’). From an accessibility perspective, there are two components in this area (Figures 5.41-5.43).

The first part is officially defined as the ‘Core Area (Phase One)’ area, with a 140 ha footprint. This is geographically the closest area to the HSR infrastructure of the HONT. Walking from the station, the entire Phase One area is accessible within about 15 minutes maximum. The second part is constituted by the ‘northern and southern areas’ sitting on both ends of ‘Phase One’, which are about 220 ha. These

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174 The original text in Chinese is ‘通过将交通流导入地下，...缓解地面的人车矛盾，改善街区环境’.
175 The ‘industrial layout map’ by the authority of Wuxi’s HONT was referenced to decide the boundary of its ‘development strip area’. Additionally, this 200 ha size is verified by introductions by Wuxi HSR Station Business Area Administrative Committee (2010).
176 According to the same sources as above, the total development volume in the core area is 3.6 million square metres; after deducting 500,000–650,000 square metres of station node area, there are roughly three million square metre floor areas in the ‘development strip area’.
177 Fourteen lines are in operation in Shanghai as of 2015, compared with three lines in Hangzhou and one line in Wuxi.
areas are proposed for subsequent developments beyond ‘Phase One’, which are currently not connected but planned with metro services. If the proposed line is opened, the second part will have combined metro and pedestrian access from the HSR terminal within 15 minutes.

According to the planning scheme, the above ‘core area’ has 3.73 million square metre of proposed developments\(^{178}\) (Shanghai Hongqiao Central Business District Administrative Committee), with an overall AFAR figure of about 1.0. If only the ‘Phase One’ area is focused on, it has a proposed total built area of 1.7 million square metres, equivalent to an AFAR of a slightly higher 1.2.

To summarise, the above cases disclose two features of HONT’s ‘Development Strip Area’. First, its physical size is very limited compared to the entire HONT footprint. In Hangzhou’s case, the ‘Development Strip Area’ takes about 30% of the total HONT footprint; in Shanghai, it takes only 14% (calculation based on the ‘main functional area’ size; 4% if calculated with the entire Hongqiao CBD); and in Wuxi case, it takes the smallest amount, 5% only. These percentages indicate that the direct development influence brought by metro infrastructure is not significant in terms of its coverage.

Secondly, although the ‘Development Strip Area’ represents the highest physical density of urban developments in HONT, the achieved AFAR figures are not higher than most established urban centres. The HONT of Hangzhou has the highest AFAR of 2.1 in its ‘Development Strip Area’ compared with the other two, which is similar to Shanghai’s Jing’an District as a typical case of a conventional central area in a Chinese city. The much-increased transport resources in HONT are not translated into increased density figures. If Chinese HONTs are compared to established urban developments around Japanese HSR infrastructure, we may find that the Marunouchi area of Tokyo Station has an impressive AFAR of 5.9 (He, 2013), nearly three times more than the highest studied case by authors in China.

To further clarify this development density gap, one clear fact is that Chinese HONTs are generally weakly supported by their local metro infrastructure. There are generally less metro resources available in a HONT compared with a developed ‘rail-oriented’ pattern like Marunouchi. Meanwhile, the metro’s priority in regional/metropolitan scale destinations also restricts its support in urban HONT.

Further, we may find that ‘Development Strip Areas’, which are theoretically supported by metro flows, are in practice also under strong influences by vehicular flows from regional/metropolitan destinations, creating another barrier for achieving higher development density.

The Hongqiao CBD, which presents the lowest AFAR figure case of its ‘Development Strip Area’, is a good example to demonstrate this problem. Case research reveals that the metro has a limited supply of resources to support the HSR terminal’s operation in Hongqiao, and it will therefore be further challenged after the CBD core’s opening (Zhou, 2013: 118) expected in late 2015/early 2016. Wang (2015: 3-5) has studied Hongqiao Hub’s performance since its opening. Through detailed passenger data

\(^{178}\) According to Shanghai Hongqiao Central Business District, a brochure by the Shanghai Hongqiao Central Business District Administrative Committee, the total development volume above ground is five million square metres, including 1.27 million square metres of the ‘Exhibition Complex of China Expo’. Therefore, the remaining floor area is 3.73 million square metres.
analysis and comparison, Wang found that the percentage of the terminal’s internal Shanghai travellers
grew much faster than its external Shanghai passengers, reaching 80% and 68%, respectively. Current
metro services that connect the terminal experience large traffic pressures before the terminal even
reaches its full capacity and before the HONT is ready to open to the public.

The fragile metro system indicates that current metro resources focus on supporting the transport hub
only, which will barely meet extra demands when the CBD core attracts more ‘flows’ through the same
infrastructure. This also leads to the high probability that future traffic in and out of the CBD core will
mostly rely on vehicles, which constitute an inefficient mode of transport, as noted above.

On the other hand, the transport assessment in Hongqiao’s planning document (SUPDRI et al., 2010)
finds the urban road system around the terminal/HONT to be vulnerable to saturated traffic congestions.
A policy is consequently suggested stating that ‘to secure the operation of the terminal’s transportation
and the reliability of its connections, the [HONT core] area’s development volume should be strictly
controlled’\(^{179}\) (SUPDRI et al., 2010: 25). There are two important clues to be found in this statement.
First, the Hongqiao CBD’s core area may attract large vehicular flows from the main city and other
regional destinations, which would create competition with traffic flows linking to the station. High
pressures on urban roads are predictable. Second, the terminal is the priority in this traffic competition,
meaning that development potential should be low to balance flows on the road.

Wuxi has much smaller HSR stations, with expected daily station passengers of 30,000, about 15%  and 3%
of its peers in Hangzhou and Shanghai respectively. However through the HONT planning, this station
will see comparable development volume in its ‘Development Strip Areas’, reaching about 70% of the
other two. It is highly doubtful if the much less HSR resource is enough to support this development
ambition. On the other hand, there are significant developments supported by flows from regional
nodes, which reveals Wuxi HONT to have a much stronger characteristic of being a node in the
polycentric structure network.

The very limited published resource limits the author’s access to detailed data concerning Wuxi HONT
transport planning. However, through Wuxi’s emerging metro network and small service coverage
across the urban area, it is reasonable to predict that most regional flows will consist of vehicular traffic.
This is verified by the underground ring road system in the core area of HONT to accommodate
increased car uses. This also explains Li Chong-wu’s (2011: 8) suggestion of a ‘medium’ density for HONT
development in Wuxi, to avoid the potential negative impact by high volume vehicular traffic attracted
by HONT developments.

Compared with Shanghai and Wuxi, the case from Hangzhou has two outstanding features in its metro
planning. The first is the highest metro coverage of ‘Development Strip Area’ of the entire HONT area,
which is achieved without investing in more metro line infrastructures. This clearly shows the advantage
of a smaller footprint in HONT planning.

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\(^{179}\) The original text in Chinese is ‘为保证枢纽本体交通系统的运行及地区对外交通联系的可靠性，
应严格控制地区开发总量’.
Secondly, Hangzhou HONT is the only case that allows metro lines to penetrate the entire town area by the time of this writing. Currently, in Shanghai and Wuxi, metro services terminate within the HONT scope. The metro penetration in Hangzhou benefits from the HONT’s closeness to the centre location within the polycentric network, therefore inviting metro flows from multiple directions.

On the other hand, there are also clear weaknesses in the metro infrastructure in Hangzhou’s HONT. These include lower metro service coverage if compared with the conventional centre of the Hangzhou (Wulin Square area, 30% vs. 68% if calculated with a 500-metre radius around metro stops). It is clear that the HONT developments have less support from metro network than the conventional centres.

Less usage of metro infrastructure is the other weakness if compared with Shanghai. According traffic evaluation report by PLT and ZUURPDI (2011: 22), the passenger share of metro services to/from Hangzhou East station is predicted at 25%, half of Shanghai’s 50%. The lower metro usage also implies high vehicular usage in the planning of Hangzhou’s HONT. As the road traffic assessment from the same report (page 42), the intersections on arterial roads accessing the HONT are highly vulnerable to traffic jams. This also gives strong reason to control the density planning in Hangzhou’s HONT, on the same principle as with Shanghai.

Although there are high FAR figures of individual plots/projects observed in all of the ‘Development Strip Areas’ among three studied cases ranging between 4 and 7, generally speaking, there is no strong feature of high density planning in the planning approaches.

The ‘Development Strip Area’ is theoretically defined through the high efficiencies of metro flows, while in planning practice, the strong influences of vehicular flows are widely observed in this area. Meanwhile, both the HSR station and urban HONT are operated at flows from the regional/metropolitan scale, which creates serious competition upon limited transportation resources. Development density is unfortunately a sacrifice to secure the HSR infrastructure.

5.4.3 Peripheral Development Area

The ‘Peripheral Development Area’ refers to the fringe HONT areas beyond the above-specified areas, which are mostly accessible after exceeding 15 minutes from the station. This is also a ‘metro service imperfect area’ (Okumori and Xu, 2012: 27), with limited bus and pedestrian accessibilities. Private vehicles are encouraged to use this area.

According to the ‘Development Zone’ diagram, the influences from HSR infrastructures are weakened in this area, with increased influence exerted by the immediate urban context, which is indicated by the flows from regional urban nodes in the HONT scenario. Combined influences from both the HSR station and regional urban nodes can be theorised within the HONT’s peripherals. The domination of vehicle uses in the ‘Peripheral Development Area’ means the size of HONT and the locational relationship

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180 Source: Hangzhou Institute of Urban Planning and Design, 杭州市城市规划设计研究院.
181 The original text in Chinese is ‘轨道交通系统不完善的区域’.
between HONT and its main city are both important factors for the efficiency of vehicle flows, with further influences on the density potential of a peripheral HONT (Figure 5.44).

The HONT in Hangzhou has the smallest size of ‘Peripheral Development Area’, occupying about 580 ha land\(^\text{182}\). The furthest point in this area is about a distance of 2.2 kilometres on a straight line from the station in middle, which is accessible by about 3 kilometres of urban roads. Although the urban road traffic in HONT changes according to train operation and working hours, by driving an estimated average speed of 15–20 km/h, the fringe area of Hangzhou’s HONT is accessible at about 20 min away from the station.

If zooming out to a wider urban context, Hangzhou’s HSR station is about five kilometres away from the city centre. This means part of the HONT’s ‘Peripheral Development Area’ are at nearly an equal distance to the city centre and HONT centre. Meanwhile, as the HONT is enclosed by four arterial roads on its edge, driving to the city centre might be quicker than to the HONT centre. This fact allows significant support from regional/metropolitan scale to the developments in the fringe area, which does not relate to HSR interests. In total, the ‘Peripheral Development Area’ of Hangzhou HONT has about 7.9 million square metres floor area\(^\text{183}\), with an AFAR figure about 1.36, reaching the highest among the three studied cases (Figures 5.45 and 5.46).

Both Wuxi and Shanghai have very different examples of ‘Peripheral Development Area’ to Hangzhou. Their distances to the main city are longer, about three times that of Hangzhou; and they are larger, with both HONTs planned with multi-centre structures along with their HSR themed developments.

The ‘Peripheral Development Area’ in Wuxi HONT has about 4,160 ha coverage (construct-able urban land 3,500 ha\(^\text{184}\)). The distance between its furthest point and the HSR station is about twice of that in Hangzhou’s case. In terms of transport mode, there is one metro stop in this marginal area with comparatively limited service coverage. The majority area is connected by cars with the rest of HONT and other urban nodes at the regional/metropolitan scale. However, given the longer distance between HONT and main city than at Hangzhou, the development support from regional nodes is hardly comparable. According to this author’s estimation, the total built area in the ‘Peripheral Development Area’ of Wuxi HONT is planned between 15.05 and 20.30 million square metres\(^\text{185}\). It has a much lower AFAR figure here of between 0.4 and 0.5 (Figures 5.47 and 5.48).

\(^{182}\) This area figure is calculated upon the boundary drawn by the author.

\(^{183}\) According to the statutory planning document of Hangzhou East New Town, the total floor area development in Hangzhou East New Town is proposed to be 14 million square metres. After deducting the building volumes of ‘central core area’ (0.27 million square metres) and ‘development strip area’ (5.83 million square metres), the remaining size is about 7.9 million square metres.

\(^{184}\) Source of data: the exhibited information from the Planning Exhibition Center, Xidong New Town Business District, visited September 2015. The build-able land across the HONT of Wuxi is 35 square kilometres, of which residential land occupies 7.9 square kilometres, public facilities occupy 3.6 square kilometre area, and industrial land is 1.4 square kilometres.

\(^{185}\) There is no published data on total building floor area in Wuxi’s HONT planning scheme; this figure is by the author’s estimation based on residential, public facilities and industrial land usage as planned. The building floor area of each usage is calculated through the following formula: ‘(Floor Area)\(=\)(FAR) X
In Shanghai, the HONT has an even more complicated planning structure. The transport terminal and its immediate urban areas form a separate entity that develops independently from other ‘centres’ in the Hongqiao CBD. Freeways and metro lines that do not access the station area are also planned to connect the other centres in the HONT with nodes in Shanghai’s urban network, which leads to very limited HSR influence beyond the 26 square kilometre ‘main [HSR] functional area’s scope. According to statistics, the remaining centres of Shanghai’s HONT are estimated to have 30.27 million square metre developments. Based on their 60 square kilometre total area, the AFAR here is only about 0.5—the HONT is thus far from being a ‘high density’ proposal (Figures 5.49 and 5.50).

In general, planning schemes in the ‘Peripheral Development Area’ show much stronger influences for their developments from urban nodes at the regional/metropolitan scale. It is also true that vehicular flows are prevailing in this area; therefore, the distance between HONT and the main city becomes another important factor to shape different efficiencies of vehicular flows across the three HONT cases. Eventually, different supports from the main city towards developments in peripheral HONTs are observed.

5.4.4 Summary

Compared with the flow-density model from theoretical studies, the planning practice shows a very different approach in density development and distribution in a HONT, which is summarised by the Flow-Density Model III (Figure 5.51). First, the theorised 15-minute travel radius from HSR station, regardless which connection transport is used, has a very limited physical coverage compared with the ambitious HONT footprint sizes which are normally over 10s of square kilometres. In another word, the theoretically high density potential area in a HONT is not comparable to its proposed area.

Secondly, it is also observed that the HONT development substantially relies on vehicular flows from regional/metropolitan nodes. This vehicle-centred urban development template has been applied to

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FAR Figure Estimation: According to land sale data of Wuxi’s HONT by Xidong New Town Business District (a: 31) and Xidong New Town Business District (b: 31), the residential land FAR mostly range between 1.0 and 2.0, with rare cases up to 2.5. Considering comparatively lower density in the peripheral area, the residential FAR is estimated at 1.5–2.0. The FARs of public facility lands are significantly lower in peripheral than central areas, because from the same source, typically, a vehicular industry (retail) land planned with FAR of 1.5, and a cultural/creative usage land has a FAR of 1.0. Therefore, the author takes an estimation FAR value of public facility land between 1.5 and 2.0, and industrial land between 1.0 and 1.5.

Land Area Data: According to the total land for residential and public facilities, take 1150ha (790ha+360ha) and deduct the core area of 240ha. The result is 910ha, equivalent to 1,365ha–1820ha floor areas, and based on the total industrial land of 140ha, we can estimate a total industrial development volume between 140ha and 210ha.

Total Building Floor Area Estimation: The building floor area of peripheral Wuxi’s HONT ranges between 1505ha (1365+140) and 2030ha (1820+210). The total development volume within the 44 square kilometres boundary is between 1,865ha and 2,390ha.

186 According to Lin and Ci (2012: 97), the total office building floor area is planned to be 15 million square metres in Hongqiao CBD. The total residential floor area is 19 million square metres. Therefore, the total development volume in Hongqiao is not less than 34 million square metres, and by deducting the 3.73 million in central core area, the peripheral area will have about 30.27 million square metres.
many other conventional ‘new town’ planning practices widely emerging along with Chinese urbanisation during past decades. However, by comparing the transport planning in HONT and the conventional practices, it is clear that the HONT is further challenged by extra flows oriented at the HSR station, which means the potential for developing a high density urbanity in HONT is even less than for a conventional new town. Consequently, the HSR station becomes a negative factor in achieving urban densification. This is ironically opposite to the theoretical hypothesis that HSR infrastructure is able to trigger high density developments by attracting increased urban transport resources.

The above argument is also evidential from Chinese researchers. In a discussion of development density around Chinese HSR infrastructure node, Pan et al. (2010: 129) suggest that the limited road transport resources around stations are a result of ‘applying a medium level figure to the [urban] area’s development density, which should neither over [calculated] to affect traffic, nor less [estimated] to harm local developments’. Ye (2010: 9) has studied traffic pressure through high density developments in HONT with the conclusion that ‘higher density of land use generates increased traffic demands … [which] is a substantial negative influence towards the [HSR] terminal and urban development’.

5.5.0 Conclusion

In this chapter, it has been demonstrated that current Chinese HONT planning fails to translate its highly intensive transport resource into a support of dense development. On the contrary, a competition of transport resource is developed between the operation of station and city. As a result, not only is densification potential weakened, but the urban life between station and HONT is separated. The expected physical integration does not exist in the studied planning schemes.

From the perspective of ‘flow’ studies, there is a wide gap between theory and practice. In theory, station flows are read as the main resource to power HONT development, while in practice, flows from regional/metropolitan scales are preferred to shape HONT urbanity. Flows from two different sources are creating sharply different station-city relationships. Station flows integrate HSR infrastructure with its immediate urban areas to form a highly incorporative and supportive development pattern for HONT. The regional node flows, however, lead to separated and restricted operations in both station and city, with the development potentials sacrificed in HONT.

Nevertheless, in the polycentric structure urban network context of Chinese urbanisation, conversations between HONT and other regional nodes in the urban network are unavoidable. The regional nodes (including the parent city) are widely understood as given resources to support new town development. This seriously challenges future HONT practices. For example, how can the HSR infrastructure features be shaped in HONT planning? How can direct support from station flows be encouraged for urban developments in HONT? Most importantly, how can the relationship between flows connecting station and regional nodes be balanced?

The following conclusions derive from the preceding theoretical and case-study research.
First, a dispersed layout of HSR infrastructure nodes might be a better option for many cities to consider, against the current planning pursuing of giant, highly incorporative, and landmark-oriented single terminal approach. This case study indicates that an over-sized HSR node faces increased obstacles with regard to merging itself with neighbouring urban spaces, while the ‘polycentric’ urban HSR layout of smaller stations fabricated by well-developed metro/regional rail systems will possibly be a better way to actively power urban lives and developments.

Secondly, the land of station node precinct areas should be more focused to maximise their development potential, especially to translate their locational advantage into values of urban living, instead of presenting the land as green, open, but ultimately undefined emptiness. The three-dimensional layout of local connections inside station buildings presents the opportunity to redefine the city’s gateway with practical functions that seamlessly connect to both station and urban living.

Thirdly, the scale of HONT needs to match its development potential. This case study also revealed that the density development potential heavily relies on support from high efficiency flows, typically as metro infrastructure. Therefore, the physical scope of densification is dictated by the layout of transport with efficiency features. The less/not developed metro infrastructure nowadays in most HONTs indicates that only a limited area in a HONT presents densification potentials. Therefore, HONT planning practices should be based on a more practical framework to propose available transport resources with high ‘comprehensive efficiency’ features. On the one hand, the scale and connectivity of HONT should be reconsidered to reduce land wastage by low density developments. On the other hand, a new transport system dedicated to HONT demands and with a ‘comprehensive efficiency’ feature should be developed to facilitate a wider coverage of densification developments.

Fourthly, the distance between HONT and regional urban nodes, especially the main city, has substantial influence on flow efficiency. It is normally a comprehensive decision to locate an HSR station, but the advantage of closeness to the main city and subsequent benefits are not ignorable. Both Shanghai’s and Wuxi’s cases show examples of a remote location which allows metro access from one side of the HONT only. This unbalanced layout creates congestion both in and out of HONT/station. On the other hand, Hangzhou has metro access from both sides, which increases the potential of metro resources without investing more lines.

Finally and most importantly, there should be a clear target to transfer the regional flow driving development to a mixed template of both regional and local flows. This means that flows between urban HONT and the HSR station should be encouraged to shape new urban growths. The planning of a node of the regional urban network should also encourage less inter-node transports and more localised transports to achieve a balance between living and working in the urban node (Sun and Pan, 2008: 22).

It is true that this target will be achieved only with a functional/land-use pattern in HONT that articulates the urban HONT and HSR infrastructure on a daily operation basis. The next chapter will further theorise the requirements for functional integration between urban HONT and HSR stations in planning practices.
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Chapter Six

Diversity Challenge: Studies of HONT functions and programs

6.1.0 Introduction

This chapter further investigates the integration between the HSR (high-speed-rail) station node and its immediate urban area, or HONT (high-speed-oriented new town), from an urban function perspective.

The theory underlying this thesis is that the diversification of urban living shapes one of the fundamental HONT features that attract rail infrastructure users. From the previous chapter, we learned that the physical transport connection between an HSR station and its urban HONT in current planning schemes is weak. Can we expect urban diversification to happen in the context of this physical station-city relationship? Is it possible that a ‘reasonable’ urban function or land use planning scheme will encourage changes in the traffic patterns of the HONTs and shape a successful evolution of diversification between passenger station and urban living?

Unfortunately, current HONT development does not support an optimistic view of the future. As widely reported in the media, the HONTs are not attractive to potential residents, and worries about ‘ghost towns’ and ‘wilderness’ are emerging (Bao et al., 2014; Li et al., 2014; Fu, 2014). Shi et al. (2014: 3) further point out that HONT development entails a series of problems, such as the underdevelopment of urban industry, the homogenisation of urban functions and over-reliance on real estate during urban development.

The author interprets these problems as a result of functional disconnection between station and city, as observed from the cases studied. This disconnection leads to modularised zoning and template planning approaches in HONT practices. Consequently, not only can the vernacular features be scarcely identified in planning schemes but also the uniqueness of HONT living resulting from the HSR infrastructure is often missing.

Successful urban development is undoubtedly a sophisticated process that integrates multiple factors, demanding complicated mechanisms and long periods of time. It is a catalysed result of social, economic and political efforts. This chapter takes a narrow perspective of planning and design to discuss the functional relationship between station and city within available HONT schemes.

The planned/designed functions of the city are realised and implemented through their ‘users’. Theoretically, the level of functional integration between station and city can be assessed through studying the ‘users’ of both precincts. In the following study, the ‘users’ of both HSR station and relevant urban HONT are employed as the means of conducting a qualitative analysis.

It is worth pointing out that the Chinese statutory urban planning system focuses on the classification of land usage, such as commercial, residential and utility uses. There is not normally a clear description of
potential users in a planned project. This means that a given planning function will attract different users. For example, land defined as ‘commercial’ could be developed with the aim of targeting tourists/visitors or local residents (as in the case of projects around Shanghai South Station in Chapter Four). It is also possible that a development project will serve different users during its life span.

Beyond the planning schemes, in order to clearly identify the potential users of the HONT developments, the author also collected data from individual projects from limited sources and visited three HONT sites in Shanghai, Hangzhou and Wuxi. It is expected that the functional flexibilities in these projects will be tested by potential user change in the future.

There follows a theoretical discussion, building an argument that the functional integration between HSR station and urban HONT is dichotomously shaped by the ‘urbanisation of the station’ and the ‘stationisation of the city’. The ‘user’ overlapping both precincts is one of the most important dimensions in assessing functional integration. This argument allows further examination of current planning and design theories in Chinese HONTs, as well as employing three HONT cases from Shanghai, Hangzhou and Wuxi to analyse the functional relationship between HSR station and urban HONT in practice in greater detail. The chapter concludes by summarising the ‘functional integration’ problems revealed in today’s HONT practices and providing preliminary suggestions for future projects of a similar nature.

6.2.0 Theoretical basis (Literature review)

Substantially, functional integration between station and city means the station provides major transport services for urban life on a daily basis; by the same token, urban lives around station nodes provide passengers for the station operations. This functional intimacy built upon physical integration between station and city allows a translation between intensive passenger activity at stations and the hustle and bustle of urban life, achieving high-efficiency living through high-density developments. Moreover, the attractions of high-quality urban life generate increased demand for use of the station. The capacity and efficiency of the rail infrastructure make the station a most important part of the urban transport system.

Thus, the functional integration between station and city should be promoted from two aspects. The first is the urbanisation of railway stations. Based on its fundamental transport functionality, the station is further challenged to integrate hybrid urban identities and further transform into a destination with strong location features to attract the maximum number of users. On the other hand, the city is also subject to stationisation, which means accepting the station as one of the major places in its everyday life. The city structures its urban life on rail as its substantial infrastructure and directly invites station users to become involved.

From the users’ perspective, the urbanisation of the station and stationisation of the city reveal a fundamental condition of maximum user overlap between both precincts. The station passengers
identify urban areas around the station node as their main destinations; and the urban users choose a rail (including metro)-based infrastructure as their major mode of transport.

In a study of SIDs around Chinese inner-city stations, the low connectivity of social spaces between the station and its immediate urban precincts has been shown to create isolation around conventional railway stations. As regards the HONT, its disadvantageous location in relation to the city, the one-off planning and building development pattern\(^{187}\), and the theorised development power from the HSR station are together creating an unprecedented urgency to realise the functional articulation between station and urban HONT in the planning process. If the station does not provide enough passengers to power urban life, or if the HONT does not accept the station as a key engine to power its operation, the survival of both will be at risk. In Bertolini’s (1999) view, the imbalance between ‘node’ and ‘place’ will lead to a weakening of both.

6.2.1.1 The urbanisation of the station

How to apply urban identities to a railway station beside its fundamental transport function is not a new challenge. On the one hand, there are many successful examples from Japan of hybrid city-station projects (Nikken Sekkei ISCD Study Team, 2013). On the other hand, transit-oriented development (TOD) studies that have emerged since the mid-1990s have discussed in depth the notion of the transport station in urban living, providing a large number of case studies (Banister, 1996; Cevaro, 1998; Curtis et al., 2009) such as the metro system in Singapore’s urban development. In general, however, misunderstanding is often generated when a hybrid station is narrowly interpreted by commercialisation, especially the retail/service facility agglomerations along corridors and in spaces where people gather.

From the ‘function’ perspective, the urbanisation effort challenges a station’s nature as a ‘neutral’ space that is defined by the transport infrastructure. This ‘airport’-like experience comes mainly from spaces that are oriented towards high efficiency of transit movements. In normal urban spaces, such as open squares, parks, houses, restaurants and schools, the ‘place’ experience is shaped by activities or communications and characterised as places where people ‘stay’, rather than pass through. The movement-focused activity of a transport building does not usually allow an experience of ‘staying’, and thus does not generate ‘memories’ or impressions of a space for its users.

From this point of view, adding retail/service facilities in a movement channel serves the movement itself, which does not substantially redefine the function of a station; hence, the neutral understanding of a transport space is not changed. This understanding shows that the activity patterns of ‘move’ and ‘stay’, which are flow and destination of activity, in a station should be questioned before defining urban meanings. How to increase the percentage of ‘stays’ among the dominant ‘moves’ is a key factor for urbanising a station. An increased ‘stay’ pattern results when there are more station users (not only

\(^{187}\) Jacobs (1962) has suggested that buildings through a long period are an important dimension to define urban diversity. This is however difficult to achieve in most ‘new town’ practices in China, due to prevailing ‘one-off planning and building development’ pattern.
passengers) and the life of the station becomes richer. By successfully integrating ‘stay’ and ‘move’ activities in a station, a transport node will become inviting to users and even a destination of urban living.

According to current HSR experiences, especially those learned from the Shinkansen over its half century of history, a homogeneous HSR infrastructure node does not sufficiently power the urban development of its immediate areas. The Shin-Fuji Station and Shin-Yokohama Station studied in Chapter Two are both good examples of this. It is only through a comprehensive integration of transport infrastructures, which brings diversified users from various geographical areas into the station, that the functional homogeneity of an HSR station may be possibly changed. Diversified users help an HSR station to build connections with local urban lives and eventually promote urban developments.

The development of a functionally hybrid HSR station is not limited by adding commercial facilities. It is true that intense pedestrian flows in a station create a strong attraction for retail facilities. Both Tokyo Station and Shibuya Station are typical examples of stations that experience dynamic urban life powered by retail agglomeration. The life of a station can be redefined by increased ‘user’ diversification. For instance, the winning submission of Melbourne’s Flinders Street Station design competition delivers a sophisticated station experience, which includes urban venues such as an amphitheatre and a museum (Figure 6.01). Atocha Station in Madrid is another example that functionally integrates station and city through inviting visitors to its urban forest, without orienting development towards exclusively commercial facilities. This potential richness of station life also encourages innovation in design.

A functionally hybrid station is customised through two aspects. First, the publicity generated by passenger flows requires that the urban identity of a station should meet the demands of a large population (e.g. commercial retail/services) or alternatively provide spaces and venues that encourage urban users to further create new lives (e.g. an open square or forum). Second, local people who have no intention of taking a train journey should also be encouraged to use the station and thereby create an increased percentage of ‘stays’. This allows stations to also develop local unique identities customised by their local users and distinguished from other stations in the rail network.

6.2.1.2 The stationisation of the city

Comparatively, the ‘stationisation’ of the city is an even bigger challenge, with a wider geographical coverage.

Urban lives around HSR station nodes theoretically feature a high level of vitality and diversity, similar to the development around urban transport nodes such as metro stations. Lai (2005: 51) suggests the development of urban areas ‘around a metro stop will create a vibrant new urban life node’. Through synthesising multiple urban functions, ‘intensified urban activities [and] increased urban vibrancy’ occur. Similarly, Bertolini and Spit (1998: 39), writing of a European HSR station node, observe that, ‘as a

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188 The original text in Chinese is: “使车站地域成为一个富有活力的新型城市生活节点”.
189 The original text in Chinese is: “增加了城市活动的强度，...使城市活力得到提高”.

result of a complex of factors, the transportation node is thus becoming a magnet for more than transport-linked activities. Offices and shops are in all development plans, but sport, recreational and cultural facilities, exhibition and convention centres, hotels, government buildings, housing and - to a lesser extent - light industry may also be present.’ Economic centres that are important on a European scale and operate round the clock can be expected around an HSR infrastructure.

On the other hand, the HSR is essentially a large national-scale operation, which brings passengers from far more mixed geographical areas than a metropolitan or regional transport hub is able to. The difference of rail users also brings significant changes of scale for economic or social activities around the station node area.

For instance, Pol (2002: 17-20) investigates the potential of shaping the economies of new urban networks through agglomerating European cities within the HSR infrastructure. Zhang (2009) has conducted an intensive study of urban industry and population changes in cities along the Shinkansen network throughout Japan, concluding that the Shinkansen has reshaped the urban system around its network and the agglomeration effect from major metropolises such as Tokyo and Osaka has been reinforced. Bertolini and Spit (1998: 37-38) agree that the HSR infrastructure changes the relationship between cities. The conventional location-based ‘centre-hinterland’ relationship between cities is redefined by the HSR infrastructure into a much-flattened complementary and competition-based relationship, which will potentially develop into a ‘synergy between urban development and the development of transport networks’ (Priemus, 2007: 15).

Compared with HSR-related developments in Europe and Japan, the Chinese HONT is unique in that the HSR has a direct influence on the development of the new town, which in most cases is built from scratch. The remoteness of most HSR stations from their main cities shapes another feature of HONTs, distinguishing them from their European and Japanese counterparts by their different relationships with established urban life. These features provide opportunities for Chinese HONTs to develop stronger HSR characters than the HSR-related developments in Europe and Japan.

A fully HSR-scale oriented urban design means the HONT should draw urban users from highly mixed geographical and cultural backgrounds. This diversity extends beyond users of the HSR infrastructure to local and regional residents. Thus, the HONT’s sophisticated urban life is shaped by both HSR users and local residents, the former identifying a HONT’s specific importance in the HSR network and the latter imbuing a HONT’s life with local identities. This mixed experience of HONT life can be expected to distinguish the new town from other nodes of the HSR network and the regional urban network. This approach is especially important given the ‘neutral’ nature of the HONT as simply a transport node.

As a result, by connecting multiple transport modes from national to local operations, a HONT benefits from the great diversity of users. Therefore, the ‘stationisation’ of a HONT means the new town should be prepared to attract users from a much more widespread population and thereby contribute to the diversification of urban life. This diversification should not be an arbitrary outcome of the ‘superficial’ (Bertolini and Spit, 1998: 39) mixing of people. Customisation in planning/design practice should
consider the unique geographical, cultural and historical backgrounds of potential users, giving maximum priority to a HONT’s dual identities derived from the HSR network and the regional urban network.

6.2.2 Functional integration reinterpreted by Chinese theory

Functional integration between station and new town is also emphasised in Chinese HONT planning theory. However, unlike the Western approach, which aims to shape an identifiable ‘place’ around a station node, Chinese theory focuses on HONT development through industries with an infrastructural advantage. This is further discussed below from both station and city perspectives, as of sections 6.2.2.1 and 6.2.2.2 respectively.

6.2.2.1 Balance between node and place in Chinese HSR stations

With regard to a railway station’s functionality, Chinese theorists widely accept the split between the ‘transport function’, focusing on infrastructure operation, and the ‘commercial function’, dedicated to passenger services (Zhang et al., 1998: 37; Shen, 2009: 8). Interestingly, researchers have different views on how to balance this functional dichotomy.

In conventional thinking, ‘transport’ overrides ‘commercialisation’ in a station’s functional mapping. As Shen (2009: 8) suggests, ‘although commercial functions have importance in a station hub’s design, they are subordinate to the transport node, of which transport is the focus’.190 Liu (2009: 24) has a similar viewpoint: ‘in the design of Chinese [railway] station buildings, there should be enough spaces for [passengers] waiting and moving to the platforms. Circulation flows and the organisation of space should take passenger transport as their core [function], and commercial services do no more than [superficially] enrich the function of transporting passengers’.191 Jia (2013: 77) adds that the commercial resources in a station should ‘target arriving and departing passengers, and [hence] aim to offer food and beverages, retail outlets and particular types of advertising to meet the needs of passengers on their journeys’.192

Beyond a simple comparison between transport and commercialisation within a station, there is potential for interactions between HSR stations and their immediate node areas. Li and Zhang (2011), Yan and Yu (2010), Gao et al. (2010) and Wang et al. (2010) all bring forward the idea that an HSR station should achieve hybrid functions. In addition to its transport function, it should further integrate urban functions such as shopping, finance, food and beverages, entertainment and even residential provision. This helps to transform a current ‘transport complex’ into a future ‘urban complex’. Ju and Wang (2012: 8) suggest a typology for defining Chinese HSR stations, namely an ‘urban node type’ and a

190 The original text in Chinese is: “尽管商业功能在枢纽站的设计中占重要地位，但仍应属于交通枢组的从属功能。重点仍是交通功能”.
191 The original text in Chinese is: “在我国的客站站房设计中, 要保证足够的候车空间和进站作业面积。交通流线与空间组织都以客运功能为核心, 商业服务仅为丰富客运的外用”.
192 The original text in Chinese is: “以车站乘降旅客为主要目标群体，开发餐饮、零售、广告等旅游业态商业，满足旅客在车站乘降环节的消费需求”.

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‘transport node type’. The former is a hub complex with regional transport and commercialisation, while the latter essentially provides interchange services within the node area. Zhu et al. (2011) express the view that ‘the clients of a station should not be restricted to passengers buying tickets, departing or arriving. Other people around the station should also be drawn into and involved in station [life], which promotes consumption [in the station] and increases its popularity.’

The conventional dichotomy of ‘transport’ and ‘commercialisation’ in a railway station is drawn from the simple behaviour pattern of passengers, which reveals a lack of knowledge about potential clients of a station. This is also a major reason for the disconnection between station life and urban life. According to the station ‘urbanisation’ principles discussed above, the transformation of an HSR node from a ‘transport complex’ into an ‘urban complex’ demands an understanding of client shifting, which helps the station to re-orient itself towards a different population in the city. However, the missing part in the theoretical approach of the ‘urban complex’ is the building of a legible urban ‘place’ identity. Current researchers often stop short of discussing the challenge of organising flow circulation in a station due to increased numbers of users. For example, Ye (2010: 10) emphasises that the key problem in HSR station design is the conflict between the gathering together and the fast evacuation of large numbers of users, as a result of combining a transport terminal and urban functions.

From the ‘user’ perspective, the functionality of a station is the focus of much theoretical argument, but few efforts are made to understand how to attract station users to trigger a transformation into functional diversity. In the absence of sufficient research, most HSR stations today are still dedicated to long-distance rail travellers only.

6.2.2.2 Functional zoning diagram in Chinese HONTs

The functional planning of a HONT starts from the economic character of the HSR network. In the scenario of Chinese urbanisation, the HSR network strategy prioritises economic/population coverage rather than purely geographical linkages. According to Wang and Ding (2011: 50), by 2015, ‘the one-hour commuting radius from the HSR stations will cover 40.9% of the nation’s territory, 84.5% of the entire population and 90.6% of the total economy.’ This demonstrates the integration of national economic and population strategies in HSR infrastructure planning. For HONT planning and design, the challenge is increasingly how to balance the economic growth target with the provision of high-quality and dynamic urban life.

Shi et al. (2014) has considered the proposed urban industries and functions of 19 HONTs across China, defining the outcome as a ‘combined transport hub and base for trading and logistics, business recreational area, new industrial base, creative intellectual base, tourism centre and ecological living

193 The original text in Chinese is: “服务对象也不再局限于买票进站或出站的旅客，也能吸引周边普通的人群参与到其中，既能刺激消费，又提高了区域人气”.
194 The original text in Chinese is: “其小时范围内服务的国土面积、人口和经济总量的比重可分别占到全国的40.9%、84.5%和90.6%”.

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Each HONT normally targets more than one industry or function (Table 6.01). For example, Suzhou (苏州), one of the cities with the most thriving economies in China, developed its HONT along the lines of a ‘creative intellectual base’ and ‘tourism centre’. Chuzhou (滁州), a comparatively little-known city in Anhui Province, presented an ambitious plan for a HONT that would represent a ‘combined transport hub and base for trading and logistics’, a ‘new industrial base’ and a ‘creative intellectual base’.

Table 6.01. Summary of urban industries proposed for 19 HONTs in China (Source: Shi et al., 2014, original texts in Chinese as quoted, translated by author).

<table>
<thead>
<tr>
<th>Industries 功能定位</th>
<th>Measures 举措</th>
<th>Examples 典型站点</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complex Transportation Hub/ Base for Trade and Logistics 综合交通枢纽商贸物流基地</td>
<td>Combining the advantage of integrated infrastructure systems of urban rail, long-distance coach, HSR, and highway, to develop large trading and logistic base targeting at regional scale services.</td>
<td>Songjiang South; Chuzhou; Yuyao; Harbin West 松江南、湖州、余城、哈尔滨</td>
</tr>
<tr>
<td>Business Recreational Area 商务休闲区</td>
<td>An area integrating HSR station as its core, with locational, rental and land value advantages, to develop residential, recreation, shopping, exhibition, entertainment and food functions. By mostly orienting at HSR preference population and combining commercial demands from local communities, there are opportunities to shape a [future] CBD.</td>
<td>Dezhou East; Hangzhou East; Xuzhou East; WuXi East 德州东、杭州东、徐州东、无锡东</td>
</tr>
<tr>
<td>Base for New Industries 新兴产业基地</td>
<td>Shaping a fast speed transport route and a high-end logistic route, with consideration of local population structure. A combined development of HSR node with technological and industrial parks, providing hybrid services, residential, office, and trading functions, to trigger the growth of a new industry base.</td>
<td>Chuzhou; Dezhou; WuXi East 濮州、德州、无锡东</td>
</tr>
<tr>
<td>Base for Creative and Intellectual Industries 创智产业基地</td>
<td>Combine local intellectual resources such as university campuses, cultural and creative industry park, as well as film base, to further develop an intelligence intensive HONT. By absorbing human and technology resources from hinterlands, and flows of talented people as well as information, [HONT] will have a future of creative and intellectual industries. New dwelling and work spaces are required to accommodate the intellectual industry and its employees, providing creative and aesthetical environments. [This includes] building new SOHO projects that integrate modern commercial and living activities, [customised for] the life of elite and talented people.</td>
<td>Tianjin West; Songjiang; Changsha; Suzhou; Chuzhou 天津西、松江、长沙、苏州、慈州</td>
</tr>
<tr>
<td>Centre for Tourism Industry 旅游集散中心</td>
<td>Taking the tourism resources and HSR portal advantages to create new gathering centres for tourism industries around HSR node, with benefits of powering regional tourism through its radiation effects. [For areas with] rich natural and historical resources, this will encourage growth of relevant activities such as recreational holidays, hub of tourism transport, conference and exhibition, information and media centre, tourism organisation and services, as well as tourism reception.</td>
<td>Chuzhou; ShaoShan; Suzhou; Hangzhou East; Changsha; Wuhan 慈州、韶山、苏州、杭州东、长沙、武汉</td>
</tr>
<tr>
<td>Ecological Dwelling Areas 生态宜居区</td>
<td>Attractive new eco-residential area for local communities, with benefits from low cost on transportation and dwelling, as well as high quality eco-environment. Utilizing abundant resources, lower cost, better environment, and better lifestyle, to develop a new family-oriented community with ecological requirements.</td>
<td>JInNan West; Harbin West; Songjiang 晋南西、哈尔滨、松江</td>
</tr>
</tbody>
</table>

The original text in Chinese is: “综合交通枢纽商贸物流基地、商务休闲区、新兴产业基地、创新产业基地、旅游集散中心以及生态宜居区”。
Shi et al. (2014: 2) also point out that many HONT industry decisions are influenced by established contextual industries within the urban network, such as a ‘[new] development zone, university campus town, cultural creative industry park, science and technology park or combined urban functional area, etc.’ However, there is a lack of proposals for balancing individual HONT functions at the national or regional HSR network scale. The HONT industry is normally decided by local government, while little coordination occurs at the HSR scale, which creates duplicated functions among many HONTs (Shi et al. 2014: 3) and unnecessary competition, such as many ‘office CBDs’ along the HSR network. On the other hand, short-sighted duplication can also lead to a failure to develop the functional mapping of HONTs that could potentially develop into an inter-complementary economic system. In general, although economic growth is the aim of the HSR infrastructure, the practice of HONTs is far from building an operational economic body that ‘runs on the HSR tracks’.

With regard to the planning and design of HONTs, Chinese understanding is developed through synthesising multiple theories (Zheng and Du, 2007: 35). These include the ‘growth pole’ (Zhang and Xu, 2007: 37), which focuses on the urban economy and industry growth powered by ‘flows’ along major rail infrastructures; the ‘urban catalyst’ theory (Li and Zhang, 2011), which studies the driving force for urban growth generated by key infrastructural projects; and the ‘Development Zone’ diagram, targeting the functional layout and density of developments around a station node.

Western theories have been studied and redeveloped to shape Chinese HONT planning, which attempts to customise new economic and industrial relationships between station and new town. Through this planning, theoretically, the HONTs are expected to be quickly connected into the economic system powered by the HSR infrastructure and to generate local growth.

From the planning and design perspective, the ‘ring-zone’ structure developed from the ‘Development Zone’ diagram echoes the Chinese statutory planning practice of functional zoning, and has therefore been widely accepted. This diagram was further developed into a relationship pattern showing how different functional zones in a HONT are powered by the HSR infrastructure and directed towards different urban industries.

Further to the ‘Development Zoning’ diagram discussed in the previous chapter, Pol (2002: 26-27) describes the functional relationships between the ‘ring zones’ and the HSR station. The most immediate area around an HSR node (5-10 minutes pedestrian or people mover) is defined as serving ‘high-grade (inter)national functions’. A secondary zone (10-15 minutes on complementary transport) is suggested for ‘high-grade functions, specialised functions related to a specific location (cluster)’. The zone furthest distant (over 15 minutes on complementary transport) is oriented towards a ‘variety of functions depending on specific situation.’ (Refer to Figure 5.04 of Chapter Five)

The diagram shows how HSR infrastructures tend to have decreasing influence over urban functions with increasing distance from the station node. In an inner-city European station, this relationship

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**196** The original text in Chinese is: “开发区、大学城、文化创意产业园、科技园和综合性的城市功能区等”.

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transition indicates the growing importance of contextual urban settings over increased distance from the station. This is an important factor to note when translating the ‘Development Zoning’ diagram into Chinese HONT practice, where the urban context is very different from that of Europe.

Zheng and Zhang (2011: 35) translate the zoning diagram into a ring structure around the HSR station in two HONT cases from Shanghai and Jiaxing. The travelling time-based zones from the original diagram are reinterpreted according to geographical distances. The first ring, 1-2 kilometres away from the station, is proposed as the ‘business core area’; the second ring, which is between 2 and 5 kilometres away, is marked as the ‘HSR business area’; the third ring, which is 5 or more kilometres distant, is the ‘extended business area’ (Figure 6.02). As the diagram suggests, business and finance under the influence of the HSR infrastructure are the dominant industries in the two cases studied, accounting for 76.4% and 80%, respectively, in the first ring in the HONTs of Shanghai and Jiaxing. Comparatively, the outer rings are less involved in business and finance functions, where increased residential and ‘mixed use’ functions are suggested.

Han et al. (2010) present another approach to interpreting the ‘Development Zone’ diagram. In this study, an ‘HSR influenced area’ is divided into a ‘station node area’ (5 minutes’ walk from the HSR station), a ‘core area’ (10-15 minutes’ walk from the HSR station) and an ‘influence area’ (10-15 minutes’ radius by multiple transport modes from the HSR station). In land use planning, this paper suggests ‘commercial, trading and office’ functions in the ‘core area’, which relate closely to the station node. In the fringe ‘influence area’, land is designated as ‘industrial, educational, cultural and residential’; this is less influenced by the station.

Xing (2013: 25) describes the ‘ring-zone’ structure from a dichotomous perspective of passengers and residents around the station node area. The first ring is the ‘high-level business office zone’, dedicated to demands from passenger flows; the second ring provides ‘business facilities’, which covers both passengers and locals; in the third ring area, ‘various urban functions’ are provided to support local residents.

It is not possible to examine every Chinese understanding of the ‘Development Zone’ diagram, but some features of HONT functional layout are clearly identified in the above literature. First, business and office use is highly prioritised as a functional connection between station and city and thus intensively planned in the most immediate station node areas. Lin and Ma (2012) conclude that ‘the HSR node has
the effect of driving the development of office, hotel and market functions, especially the office. This explains why less land is given over to business or office use in the outer ring.

Second, HSR riders and local residents are labelled as different ‘users’ of a HONT. The former transfer the power from the HSR engine into urban developments and economic growth, and are therefore zoned around the station node. The latter do not represent a clear HSR character and hence are arranged remotely from the station.

Third, the mechanism by which the HSR physically triggers planned HONT industry is rarely discussed in the literature. Most HONT industries are presented as decisions without convincing reasons. There are certainly doubts around decision-making, and even worse are the difficulties of implementation. As the case studies show, some planned HSR industries eventually become local industries in practice.

Beyond the HSR-oriented ‘ring-zone’ structure of the functional layout, it is also important to understand the HONT as a functional node of the regional ‘polycentric structure’ urban network. Ju and Wang (2012) make efforts to illustrate this relationship (Figure 6.03). Sun and Pan (2008) also provide an important principle underlying the general practice of polycentric urban nodes, which is valuable to the specific scenario of the HONT. Having considered the arguments for single-centre (Cervero and Landis, 1991; Cervero and Wu, 1998; Schwanen, Dieleman and Dijst, 2001; Naess and Sandberg, 1996) and polycentric (Gordon and Wong, 1985; Guiliano and Small, 1993; Gordon and Richardson, 1997; Gordon et al., 1991; Deng et al., 2000; Wan et al., 2007) urban structures, Sun and Pan (2008) suggest that the polycentric structure is appropriate for the geographical expansion of Chinese cities, which have conventionally been single-core and dense. However, the balance between residing and working in a sub-centre should be considered to improve efficiency, in particular to avoid increased commuting as a result of wide geographic dispersal of employment sources in the urban network.

In a HONT context, the ‘localised balance of residence and employment’ applies not only to residents of the new town but also to people moving to and from the HSR infrastructure. This challenges the current pattern in which passengers travel between station and the main city, just as HONT users travel between the HONT and the main city, as we learned in the previous chapter. A new station-new town integration should emerge among commuters.

6.2.3 Summary of theory

Functional integration between station and new town entails the maximum overlap of both precincts and poses the challenge of creating a mixed and attractive urban life that transforms station passengers into urban users. According to this criterion, there are problems inherent in Chinese planning theories. On the one hand, the comparatively homogeneous urban industry as planned in the HONT means that

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203 The original text in Chinese is: “高铁枢纽对接办公、酒店、市场等功能确实具有开发带动作用，特别是办公功能”.

204 Through building floor area calculation of seven studied cases, Lin and Ma (2012) have identified four major urban functions of station-side development: market, hotel, office and residential; their percentages were 7.71%, 6.95%, 25.27% and 56.17%, respectively.
the future urban life has threshold for certain users, setting barriers to converting station passengers into a diverse mixture of urban life participants. This practice has a negative impact on creating a diversified urban living experience. On the other hand, dichotomous planning practice that distinguishes and separates passengers from residents shows the strong influence of conventional understandings about zoning. Combined with the mono-user passengers in the HSR station, we may find a HONT core area that is designed mostly for the HSR facility and its users. The HONT residents are located marginally away from this core area. Functionally disconnected users of station and city will bring parallel operations to both facilities, and minimise the desired effect of ‘powering urban lives with HSR infrastructure’.

Moreover, compared with European stations, which are mostly in inner-city locations, Chinese HSR infrastructure nodes are widely planned in areas without precedent urban developments. The urban contexts that define outskirt areas in the ‘Development Zone’ diagram are missing for the fringe areas of most HONTs. Therefore, a ‘neutral’ identity has been a huge concern in these planning schemes, typically represented as developments of large-scale residential lands. For example, Lin and Ma (2012: 43) comment that ‘residential is still the main function for station node area development in the HSR era’.

To compare Chinese and Western theories, functional integration between station and city is clearly a key common interest, which however has developed in different directions. Western theory employs travelling time as a mean of assessing the different degrees of station-related urban lives. In the Chinese theory, this model is reinterpreted into geographical rings, which zone urban functions and urban users according to their relationship with the station node.

On the other hand, comparing the HONT land-use template with a conventional new town planning scheme in China also reveals significant similarities. Superficially, this comparison indicates a simple ‘plug-in’ operation of the HSR infrastructure into the centre of a new town body planned in the conventional way. However, HONT planning demands a much more sophisticated catalytic process than a surgical plug-in operation. Therefore, it is not clear whether current HONT schemes represent the station-city relationship that distinguishes them from conventional new town practices. Can we expect a large proportion of user overlap between station and new town? The review of current Chinese research does not support an optimistic outlook on these issues. Below, three case studies are presented.

6.3.0 HONT case study: ‘urbanisation of stations’

HONT examples from Shanghai, Hangzhou and Wuxi are used here to analyse the functional relationship between station and city. The cases are discussed from two aspects: the ‘urbanisation’ of the station and the ‘stationisation’ of the city.

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205 The original text in Chinese is: “居住功能仍然是高铁时期铁路枢纽站区开发的主要功能”.
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6.3.1 Station composition

We start with the ‘urbanisation’ of Chinese HSR stations.

Shen (2009: 6-7) identifies a typical Chinese railway station by three components:

Station and facility building: The station and facility building forms the main part of a railway station. It houses spaces for ticket sale, waiting, and check in/claim luggage. This building works as a key pivot that connects the other two parts, namely the station square and the track field. Functionally, a station and facility building comprises luggage transfer, a ticket hall (space), bag deposit, waiting rooms and administration rooms.\(^{206}\)

Rail-track yard: The rail-track yard is installed with rail tracks, signals, platforms and cross-line facilities. This is the main area technically for passenger trains arriving and departing. This is also a distribution area for both passengers and luggage.\(^{207}\)

Station square: The station square connects the railway station with urban transport. It ties’ up both precincts through transportation and is therefore a gathering and distribution space for passengers, vehicles and luggage.\(^{208}\)

The 15 stations surveyed by the author vary considerably in the scale of their buildings and the numbers of connected rail lines (see Figure 5.12 of Chapter Five). It is however true that these stations were all built with the above three major components (Figure 6.04). In this station template, the ‘station and facility building’ and ‘station square’ are user/passenger-oriented spaces, which will therefore be further discussed in detail.

It is also necessary to introduce the widely applied pattern of investment in railway stations in China. A railway station generally receives investment from the Ministry of Rail (MOR, now restructured as China Rail) and local government, with different shares for different components. As the ‘station and facility building’ and ‘rail-track yard’ are key parts of the rail infrastructure, the MOR normally contributes over 50% of the budget. The station square(s) is often regarded as part of the local infrastructure, and its costs mostly fall to local government. For example, in the Hangzhou East Station project, the MOR was responsible for 60% of the cost of the station building and yard, the rest being covered by provincial and municipal governments. On the other hand, the squares on both sides were fully funded by the municipal government.

\(^{206}\) The original text in Chinese are: “车站设备用房”，“车站设备用房是客运站的主体，是旅客办理购票、候车及托、取行包的场所，是站前广场与站场相连接的中枢。按功能来分主要可分行包房、售票厅（处）、寄存处、候车室及其余行车办公用房等”.

\(^{207}\) The original text in Chinese are: “站场”，“站场的主要设备有线路设备、信号设备、站台、过线设备等，是进行客运技术作业的场所，是列车通过和到发的场地，也是旅客和行包的集散地点”.

\(^{208}\) The original text in Chinese are: “站前广场”，“站前广场是铁路客运车站与城市交通的衔接部，是铁路车站与城市交通联系的纽带，也是客流、车流和行包流的交汇点和集散点”.
Strong influences in architectural design can be observed in developments funded by different investors. Railway station buildings across China funded predominantly by the MOR were mostly designed according to the same template, with identical functional components. The station squares, on the other hand, were designed with much more varied understandings. Factors such as available transport connections, urban development, station location or even the indigenous residents around the station node could be significant issues leading to different design decisions. This is clearly reflected in the three case studies from Shanghai, Hangzhou and Wuxi.

6.3.2 Station buildings

Now we consider the functions of the ‘station and facility building’. The departure (waiting) and arrival spaces in a station are the most heavily used spaces in such a building.

HSR stations, according to the present survey, can be classed as either terminal stations or stopping stations. A terminal station is the destination of more than one HSR or normal line, and therefore normally has a large rail-track yard. Hangzhou East Station is a typical example of this type, with its building plan over 450 metres in depth, incorporating 15 platforms and 30 lines. A stop station is mostly a mid-way station along an HSR line, and has a significantly smaller size of building. Wuxi East Station spans only 120 metres across two platforms and six lines. (Figure 6.05)

In both types of stations, the passenger departure (waiting) spaces are vertically above or beneath the rail tracks to achieve higher efficiency of passenger movements. In a terminal station such as Hangzhou East, the departure (waiting) area spans the rail-track yard (Figure 6.06), whereas at the stop station of Wuxi East, the departure (waiting) area is under the elevated rail tracks (Figure 6.07). In both layouts, the passenger waiting spaces provide direct access to the platforms. This is substantially different from the conventional stations (such as Xi’an Station studied in Chapter Four), which locate the waiting lounges beside the track yard, linking the platforms by pedestrian bridges or tunnels. The ‘upgraded’ relationship between departure (waiting) area and platforms shows a stronger orientation towards the rail infrastructure of the new HSR nodes.

Among the departure (waiting) spaces, there is another significant difference between the HSR station’s universal open spaces and the conventional individual ‘lounge’ rooms. However, the functional ‘upgrades’ in the new station’s waiting spaces are minor. Typically in the Hangzhou East Station, the entire 60,000-square metre waiting area is dedicated to rail passengers (Figure 6.08). The ticket controls and security checks screen all other users off this space. There are retail/food facilities in four corners of this waiting space on the mezzanine floor, but their services do not extend beyond waiting passengers (Figure 6.09). This is also true in reverse, insofar as local people would not come here for everyday conveniences, purchases or leisure opportunities.

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209 Shanghai Hongqiao is a special case of combining HSR with an airport terminal and therefore having an exceptionally large building. However, if the HSR terminal is considered separately, it has a building identical in size and scale to that of other HSR terminal stations.
Compared with the stationary and homogeneous departure space, the station’s arrival area (after the ticket checkpoint) is less controlled and offers better potential intimacy with urban lives. In this movement-oriented space, commercial facilities are no longer peripheral and fragmented. They are centrally located and continuous, matching pedestrian flows. Most terminal stations, importantly, have their metro infrastructure closely connected with the underground arrival space, benefiting from hosting people with a variety of travelling purposes, compared with passengers departing for long-distance travel only. A good example of dynamic experience of this space comes from Beijing South Station, where a strong commercial environment has a particular focus on food services (Figure 6.10). It is also worth pointing out that the central location of Beijing South Station serves to connect multiple metro lines and consequently creates interchanges not related to HSR. This is probably the main reason for the thriving station life this station enjoys compared with many other marginally located terminal stations, such as Tianjin West and Nanjing South, where equivalent urban living was not observed in the arrival areas, partly owing to having fewer metro interchanges and fewer mixed station users.

Of the three cases studied, Hangzhou East and Shanghai Hongqiao have commercial lives emerging in their underground arrival and interchange spaces, but at Wuxi East, the arrival area is quiet at most times (no metro interchange currently available).

In general, Chinese HSR infrastructure strongly features in the large-scale national transport, which dictates the station design across the country with a mono-template of functionality and circulation inside station buildings. Such a homogeneous infrastructure node understanding restricts potential users and activities inside the station, which is very well represented by the life in departure waiting spaces. Although a different dynamic experience can be expected in the arrival space, it is difficult to reproduce in the context of a remote location. The ‘infrastructural node’ definition echoes the conventional understandings from the literature that ‘transport’ should override ‘commercialisation’ in a station building.

6.3.3 Station squares

Next, we extend our discussion to station squares.

The author’s survey reveals that the balance between ‘transport node’ (providing connections for the station) and ‘urban place’ (being a destination of urban living) also exists in the station square development. There are cases where either a mono-connection infrastructure or a hybrid of transport and urban living can be found. It is also interesting that the size of the station node seems not to be related to the node or place balance of a square.

The station square of Shanghai Hongqiao’s HSR terminal presents a classic mono-transport usage example. According to the survey and published data, this square is designed for metropolitan bus, regional coach and car parking services. Although it is a sophisticated ‘connection hub’ with multiple storeys underground to house various vehicles, this plaza is designed on a similar functional principle to that of conventional squares such as the one in front of Xi’an Station (Figure 6.11). This problem has
been discussed in Chapter Five. The present survey found similar squares in large terminal stations including Tianjin West and Nanjing South, as well as at mid-way stops such as Yuhang Station and Shaoxing North Station.

Comparatively, efforts to develop the station square beyond a transport node are also visible in other cases, typically at Hangzhou East Station. This station is distinguished from others by a few features. First, as a terminal upgrade from a smaller mid-way station, there are pre-existing urban developments and population related to station life. Second, despite its marginal location, Hangzhou East is not physically far from the centre of Hangzhou city (5 kilometres), compared with most other HSR stations. Influences from the main city and local people are strong in this station square design. Third, the HONT around Hangzhou’s HSR station has a much smaller land size compared with nearly all HONTs of cities that are the same size or bigger, for example Nanjing and Shanghai. How to efficiently use limited resources is a serious challenge in Hangzhou.

These features allow the design of station squares in Hangzhou East to meet demands not just from passengers but also from local residents. In its architectural design, the lower levels under the ground surface are mostly arranged for connecting services and commercial facilities oriented towards arriving rail passengers. (As Hangzhou East station integrates two metro lines, metro interchanges are highly possible in this station, as also in Beijing South Station.) Above the ground, there are urban facilities providing shopping (west side), office and hotel (east side) services, which target clients from both the station and urban areas (Figure 6.12). With further HONT developments around the station node area, it may be reasonable to predict a certain level of merging in future between urban and station lives in the square areas, supported by pedestrian bridges or tunnels.

Wuxi East Station presents a node/place balance somewhere between the examples from Shanghai and Hangzhou. Although this is a much smaller station, with fewer passengers and integrated transport resources\(^\text{210}\), it has two squares, one on each side of the station, of larger sizes to those of Hangzhou. However, as Wuxi is a less generously funded rail infrastructure node, the squares here are horizontally laid out without complex vertical layers. Most of the arrival/departure connections are arranged on the square surface, which is partly why very limited commercial facilities are proposed in the square precincts (20,000 square metres only on the southern plaza).

According to the author’s survey of December 2014, over four years of operation had not brought much business for the limited commercial facilities. There was only one restaurant open with enough clients to be counted, and most other facilities were closed or still not ready for business. It is clear that the squares in Wuxi are narrowly defined to serve passengers, who are much fewer in number compared with Shanghai and Hangzhou. A certain level of ‘commercialisation’ is observed but far from defining the station’s ‘urban’ character (Figure 6.13).

\(^{210}\) Here we refer to combined transport, namely rail and local connections, such as metro, bus and cars. In practice, the rail, metro and bus services are described in ‘line’ numbers; cars are quantified by number of parking bays.
Varied local contexts lead to a wide range of different ‘urbanisation’ approaches in the square design, as seen in the cases mentioned above. Without the studied HSR stations having had enough operational time in order for definitive conclusions to be drawn, it is still difficult to say that a proven successful example exists of achieving a satisfactory merger of station and urban life in a square. It is, however, clear that the square has greater potential and flexibility to develop an urban precinct compared with the rigid station building templates. This is especially true in most terminal stations where square surfaces have been released through utilising their underground spaces for local transport connections. Meanwhile, demand from local residents for an immediately accessible station area drives the transition of square space from neutral infrastructure to customised civic space. For example, the western square of Hangzhou East station is reportedly ‘occupied’ by local people as a daily ‘group dancing’ venue, taking advantage of its size and accessibility. This shows the huge ‘urbanisation’ potential of a station area, even if it is ‘unbuilt’ open space (Figure 6.14).

6.3.4 Summary: a strong node but a weak place

Although ‘station building’ and ‘station square’ are read as a combined entity in most circumstances, there is clearly an unequal balance of ‘node’ and ‘place’ potentials in these two components of a station. The ‘station building’ provides the core transport functions, but its rigid operational template isolates it from any potential permeability by urban lives from areas immediately round the node. Under the strong ‘transport’ understanding of a station’s function, this hard and functionally homogeneous HSR core curbs the ‘urbanisation’ potential of the entire station node, despite possible transitions of the ‘station plaza’ into a shared urban space.

Further, if there are efforts to design an HSR station building with hybrid urban functions, does this mean that ‘urbanisation of the station’ has been achieved? The author argues that a station’s functional diversification is part of the ‘urbanisation’ target, but of itself this is not enough to attain urbanisation. One example comes from Hangzhou Railway Station (Chengzhan Station), the conventional inner-city station of Hangzhou, not designed as an HSR infrastructure. This is one of only two cases known to the author in China (the other is Kunming Station) that try to incorporate urban functions into the station building. Because of limited land in the central area, this 1990s-designed infrastructure node has hotel, restaurant, office, rail terminal and connection services on the ground level and square. Contrary to expectations, this attempt at functional incorporation was not very successful. On the one hand, the station node is cut off from the urban fabric by complex arterial roads, and has a reputation for heavy traffic as well as a chaotic environment (Figure 6.15). People are reluctant to go to this station every day (Zhu, 2011). On the other hand, the building’s internal circulation design separates station passengers from users of other functional parts, which acts as a barrier to transforming ‘travellers’ into ‘stayers’ inside the same building.

The case of Hangzhou Station further reveals that the ‘urbanisation of the station’ goes beyond simply transforming a station building (and its plaza area). The whole station node and its immediate urban area should be considered together. New station life must attract clients from both the station and the
urban area to support its development to the full. This understanding is especially important for the many HSR practices that are not well connected with their nearby urban fabric (as seen in Chapter Five).

6.4.0 HONT case study: ‘stationisation’ of the city

Before we consider a city’s ‘stationisation’ further, we need to distinguish observed urban facilities used by station passengers from those for combined station and urban clients. In the previous discussion about Xi’an Station, we note the presence of large commercial developments in front of the station area, which attract a large volume of station users. Is such a phenomenon an example of the ‘stationisation of the city’?

From the passenger’s point of view, the commercial facilities around the station node provide complementary services that are mostly not available in the station building, such as short stay accommodation and some retail outlets. However, by expanding the observation boundary, we may discover that the station node area is not a travel destination for most passengers and that it lacks a commuting pattern featuring ‘regular repetition on a daily basis’ (see the Shinkansen analysis in Chapter Two). However, from the city’s perspective, passenger-oriented service facilities apply ‘commercialisation’ but not ‘diversification’ to urban living. Transforming passengers into urban users means that the travellers are attracted by urban industry and urban lives around the station node, which is their destination for travel purposes. This scenario is well interpreted by the Marunouchi, and Ueno Park cases in Tokyo and the Grand Front Osaka, a new development in front of Osaka Station. By contrast, many facilities around conventional Chinese inner-city stations are substantially complementary services for passengers that are missing from the mono-functional station building. A successfully ‘stationised’ urban precinct attracts users through its own unique features, which are much beyond what a template commercial development around a station can provide (Figure 6.16).

This difference highlights the challenge for HONT development to distinguish itself from conventional station node urban living. ‘Stationised’ urban living actively defines and customises its characteristic features through combining transport and industrial advantages. By comparison, conventional station-side development passively adapts to passenger demands without asserting its own identity. This is probably why many inner-city stations present very similar node area experiences across China.

The functional planning of a HONT corresponds to the ‘ring-zone’ structure shaped by the Flow-Density Model, as discussed above (Figure 6.17). The following section continues within this framework to analyse the urban function and land uses of the ‘Development Strip Area’ around central HONT and the ‘Peripheral Development Area’ around peripheral HONT.

6.4.1 The ‘Development Strip Area’

Theoretically, the ‘Development Strip Area’ receives the strongest influences from the HSR infrastructure operation, which powers direct industries and urban living. A review of HONT planning schemes reveals that the land plots of this area are mostly filled with red colour, defined as commercial uses such as business/office, retail, restaurant or hotel. In general, these schemes indicate a common
understanding of integrating commercialised public facilities around the station node, reflecting the station’s strong public character. However, in-depth studies show that each individual scheme targets specific potential users to shape its own urban identity, producing urban lives that vary widely, as is shown by the three HONT cases from Shanghai, Hangzhou and Wuxi.

6.4.1.1 ‘Development Strip Area’ of Shanghai Hongqiao CBD

The Hongqiao CBD has an aspiration to ‘build a world-famous business district’\(^{211}\) (official website of Hongqiao CBD). Based on its key infrastructure consisting of the Hongqiao Hub and the Exhibition Complex of China Expo, this aspiration incorporates certain major functions, as described by the Shanghai Hongqiao Central Business District Administrative Committee\(^{212}\), ‘a gathering area of modern service industries and a new international trading platform, and where a number of renowned companies from both home and abroad will come to set up their headquarters. It is to make Shanghai an international commercial centre to provide high-end services for the Yangtze River Delta, the Yangtze River region, and the country at large.’

In the light of its industrial development as a HONT, Hongqiao CBD’s proposal aims particularly at securing ‘office industry’ and ‘business headquarters’.\(^{213}\) The CBD should consist of an agglomeration of service and trading businesses. In the wider context of Shanghai, the new CBD is identified as a ‘service and trading industry centre’ to challenge the other two business centres, Lujiazui, known for its financial industry, and the Shanghai Free-trade Zone, famous for its port shipment industry.

For the Core Area (Phase One) (Figure 6.18), an urban planning and design scheme has been jointly produced by the Shanghai Urban Planning and Design Research Institute (SUPDRI), SBA (based in Germany) and the East China Architectural Design & Research Institute (ECADI). This scheme, named the Regulatory Planning of Hongqiao CBD Core Area (2010), interprets the 370 ha area as a centre for ‘modern business, which forms one important component of Shanghai’s “multiple layout of CBDs”; and it will be the first low-carbon business community’.\(^{214}\)

The 140 ha Phase One area plan encompasses developments occupying 1.7 million square metres. Business offices will take 56.3% of the total volume, equivalent to about 956,000 square metres. There are also 500,000 square metres of service facilities proposed, including hotels and retail, making up about 30% of the total development volume. In addition, the Phase One plan also suggests exhibition, conference, culture and entertainment facilities to shape a ‘hybrid’ urban functional layout (SUPDRI et al., 2010: 13; also see Figures 6.19 and 6.20).

The planning parameters indicate that business offices constitute the most important land use of Phase One, shaping the most recognisable urban functions and spaces. Along the middle part of this area,

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\(^{211}\) The original text in Chinese is: “建设成为世界著名的商务区”.

\(^{212}\) See the Bibliography for details.

\(^{213}\) The original text in Chinese is: “总部经济”.

\(^{214}\) The original text in Chinese is: “现代商务功能，是上海“多中心”中央商务区的重要组成部分，将建设成为上海市第一个低碳商务社区”.

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close to the HSR terminal of Hongqiao, there are two urban blocks proposed with large-scale commercial facilities to provide retail, exhibition, conference and culture (cinema and theatre) services (Figures 6.21 and 6.22). Much diversified urban life can therefore be contained in these two blocks, unlike in the rest of the area.

Superficially, in the 140 ha Phase One of Hongqiao’s Core Area, we can provisionally identify the three features for the ‘stationisation of the city’: hybrid urban functions (office, commercial, exhibition, conference and cultural services); clear urban identification (business); and attracting rail users (within the immediate proximity of the HSR terminal). Is it possible, then, to conclude that Hongqiao CBD partly presents a good example of the ‘stationisation’ of a HONT?

It is interesting that the Marunouchi area of Tokyo is comparable with Hongqiao’s 140 ha Phase One development area, being similar in urban character (both are centres for business headquarters), rail infrastructure (HSR and Shinkansen) and land size (140/120 ha). Marunouchi is widely recognised as an urban development that is highly integrated with the rail infrastructure. Comparison between Shanghai and Tokyo therefore illustrates in greater detail the potential users in Hongqiao CBD’s planning scheme.

First, in terms of functional diversification and mixed land use, both cases are planned to suit multiple urban lives, to increase the richness of experience of urban users. However, in Shanghai’s case, the planning approach appears to be ‘mixed zoning’, which means mixing land plots with different single usages to create functional richness. And, as most blocks in central Hongqiao CBD are proposed for offices, urban diversification here is achieved through ‘plugging’ two commercial blocks into an agglomerated office area. In Tokyo, by contrast, mixed uses are applied to individual plots of urban land, allowing a much higher level of functional flexibility and customisation to happen (Table 2 and Figure 6.23).

Second, the connections with rail/metro systems are different. In Shanghai’s case, there is only one railway station/metro station planned to support the 140 ha developments. Most urban blocks are beyond the walkable 500 metres’ distance away from the HSR terminal of Hongqiao, which is thus not particularly accessible for pedestrians. In Tokyo, however, a rail framework consisting of 12 rail/metro stations is such that every land plot is within a maximum of 200 metres’ walking distance, and some were even developed as part of the underground stations, affording seamless connections (Figure 6.24).

Third, a different ratio of car bays to individual land plots, as required by the statutory planning, indicates that these two cases are relying on different modes of transport. In Shanghai, the office towers normally have a ratio of one car bay per 200-250 square metres floor area; and in the commercial blocks one car bay relates to about 270 square metres development. Projects in Marunouchi allow one bay to about 400 square metres, nearly half the allocation of Shanghai. This demonstrates that vehicles are used much more in Hongqiao and the relationship between the HONT and the HSR station is weaker (Table 6.02).

Despite having the same planning objective of urban ‘diversification’, differing approaches in Hongqiao and Marunouchi lead to different urban user outcomes. In Shanghai, the richness of user experience is encouraged within limited urban blocks and projects, and it is unlikely that the rail/metro station will be the main source of urban users. The Tokyo case, however, presents well-integrated urban and rail systems, which allow diversification in every block or project and serve as an invitation to rail users from many sources to participate in urban life at various scales.

Beyond the 140 ha area of Hongqiao, the next phase of Core Area development is proposed, namely the ‘northern and southern areas’, which together cover an area of 230 ha. The planning document (SUPDRI: 6, see bibliography for details) indicates that these are dedicated to urban functions supporting the Phase One area, focusing on research and training uses.

Residential plots are proposed within the scope of the 230 ha Phase Two, and it is expected that these will bring regular users to Hongqiao’s Core Area (Figure 6.19). This is especially important that the office blocks in the Phase One area will have a large commuting population. Meanwhile, the planning scheme shows that the ‘northern and southern areas’ have better metro service coverage than the Phase One area, which allows better connectivity between urban living and the rail/metro infrastructure.
Unfortunately, the comparative sparsity of published data prevents further investigation into this area at present. Thus, the predictions made here need to be tested by future observations.

In summary, the planning of Hongqiao CBD’s ‘Development Strip Area’ shows the clear intention to achieve a high level of functional integration between station and city. However, its approach to urban diversification is questionable. The hoped-for ‘multiple functions’ may emerge through the top-down planning mechanism, but it is more certain that these will be achieved by programmes encouraging users from many backgrounds and with various purposes. Moreover, the planning serves to perpetuate the disconnection between station and city.

6.4.1.2 ‘Development Strip Area’ of Hangzhou Eastern New Town

Apart from general features discussed above, such as closeness to the main city and a smaller footprint, Hangzhou’s HONT can be also distinguished from Hongqiao CBD in other respects. First, the rail infrastructure of the present Hangzhou East Terminal was upgraded from a mid-way station on the same site. A ‘quasi-urbanisation’, which is a mixture of medium-low quality urban facilities and a dense footprint but low-quality village-type houses lacking urban utilities, can be observed around the station node area, as a result of many years of rail operations. This historical rail context does not exist in Shanghai’s HONT (Figures 6.25 and 6.26).

Second, Hangzhou has a smaller HSR node than Shanghai’s ambitious infrastructure, which allows the station to be accessed from both sides. Consequently, Hangzhou is able to plan a HONT on both sides of the station node, compared with the single-side layout of the HONT in Shanghai.

According to the ‘Development Zone’ diagram, Hangzhou’s HONT has a proposed ‘Development Strip Area’ with multiple land uses, including commercial, business office, apartments and public facilities (Figure 6.27). The western side of the station has a stronger relationship with the main city than the eastern side, and proposed to have facilities mainly oriented at rail passengers travelling between the station and metropolitan destinations such as hotels and retail outlets. The influences of the old station are still noticeable on this side, despite new developments, which have similarities to a conventional inner-city station node pattern as seen at Xi’an Station. The eastern side of the station, on the other hand, is oriented at a different user pattern that encourages rail passengers to ‘stay’. This is partly because the eastern side of Hangzhou’s HONT has boundaries set by three highways, which physically isolate it from the surrounding area. Meanwhile, this side of the HONT has been developed upon demolishing the existing buildings and rebuilding, and has a clearer ‘HONT’ character. The following discussion focuses on the eastern side of Hangzhou’s HONT.

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215 The original residents are registered as ‘rural’ in the Chinese dual registration system, but farming is no longer their main source of income. Thanks to their proximity to the city, their villages are sought after by immigrant labourers for cheap rental accommodation, which has become the main source of income for the original residents. ‘Quasi-urbanisation’ refers to a mixed pattern of urbanised life, based on the rural registered population and land ownership.
Unlike Hongqiao CBD’s ‘business headquarters centre’ understanding, Hangzhou conceptualises its ‘Development Strip Area’ with a strong urban public life identity made up of a cluster of commercial complexes (Figure 6.28). This area focuses on retail facilities, mixed with cultural, food, gym, hotel, and office functions. On the eastern side, two major commercial complexes are planned to frame a ‘consumption’-based urban experience. The first complex, namely ‘Dadongmen’ (大东门), is structured by the pedestrian street extending from the station, facilitating continuous movement between the station and urban precincts. Water features are arrayed in the middle of the street to create a relaxing environment and attract station users. The other complex named ‘Pengbu Shuangtie’ (彭埠双铁) is directly supported by the metro infrastructure, with a wider scope of combined clients from the HSR station and the metro network (Figure 6.29). Clearly, the future clients of these two complexes will differ.

In project programming and design, however, user differentiation is not significant. Analysis of two projects from each complex reveals that the same group of clients is targeted in practice, with identical programs.

The site sitting between the station’s eastern plaza and the pedestrian street is a key development proposed for rail travellers. As reported by Peng (2014), on this site, a project entitled ‘Huarun Ode to Joy’ (华润欢乐颂) has been proposed, with ‘a total planned floor area of 230,000 square metres on two land plots, connected by pedestrian bridges’ and encompassing a ‘130,000 square metre commercial area, 30,000 square metres of offices and an 80,000 square metre area for parking with 1,800 bays’.

The same source reports this development will have a ‘large shopping mall and marketplace, cinemas and a large square for weddings. The supermarket will be designed to the highest standards’. This is evidently a high-level commercial facility of impressive size and quality. However, as a station-side commercial project, there is no clear ‘HSR’ character exploited to attract rail travellers. Local residents are much more likely to become the future clients. This assumption is corroborated by a statement by a local newspaper (Sun et al., 2013) that this project is oriented at ‘[local] family consumption’ (Figure 6.30).

The other project in the complex around the metro station is ‘Ganglong City’ (港龙城), which shows a high degree of consistency between project design and urban planning. As Wan (2015) observes, this project aims to be ‘a stylish landmark of eastern Hangzhou, and a centre of families’ lives’. Within the project, there will be a ‘shopping centre with outlets of famous brands, a market featuring the global top 500 [brands], star 4D cinemas, national franchises and digital shopping, stylish food and beverages, recreational entertainment and themed shopping for kids, as well as offices’ (Xinhua, 2014) (Figure 6.31).

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216 The original text in Chinese is: “规划总建筑面积约 23 万平方米，分为两个地块，以多个连廊连接，其中商业部分建筑面积近 13 万平方米，甲级写字楼 3 万平方米，停车场 8 万平方米，还拥有近 1800 个停车位”.

217 The original text in Chinese is: “大型商场、大卖场、电影院以及最大的婚庆广场，其中超市将按最高的标准设计”.

218 The original text in Chinese is: “面向家庭消费”.

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Both projects will offer very similar facilities and services aimed at similar clients. A significant problem is that rail passengers are widely ignored in the project programming. Only local residents are regarded as part of the urban lives around Hangzhou’s HSR station node. This phenomenon echoes the story of Shanghai South Station, discussed in Chapter Four, where the developers also redirected station-side land from passengers towards local residents.

Apart from the commercial facilities, the ‘Development Strip Area’ of Hangzhou’s HONT has a much greater number of residential projects than the other two HONT cases. These are re-dwelling apartments built by local government for original residents to move back into. As part of the urbanisation process, their original properties or lands were bought by the government and demolished to make way for the HONT development. These people moved out temporarily, with compensation from the government, and will move back to new apartments built on roughly the same site as their demolished homes. Because their land has been changed from ‘rural land’ to ‘urban land’, these people become ‘urban residents’ when they move back into the new development (Figures 6.26, 6.32 and 6.33). As a priority of the development plan, the original residents can suggest locations for their new homes; this is why Hangzhou’s HONT has a significant number of apartments in the core area, which is rare in most other cases.

Every household is allocated residences amounting to about the same size as their demolished property, which is 300 square metres on average. This means that each family will have two or three apartments (between 60 and 150 square metres each), of which they will normally occupy one and let the other(s). This allows them to continue to derive an income from tenants, as they have traditionally been able to do (but now with upgraded properties).\(^{219}\)

The residential blocks around the station node are between 200 and 300 metres of their edges, and are normally fully closed to public access, with only two or three entrances per block. Inside the residential block are homogeneous high-rise apartment buildings laid out in rows, constituting an agglomerated residential function. Although on the street edge these blocks normally have their ground and lower levels developed into retail/food stalls serving local people, this hardly amounts to substantial urban diversification. Moreover, the blocks do not have good functional ‘permeability’ with their contextual urban areas.

The commercial residential apartment projects built by developers (who purchase land from the government) in the ‘Development Strip Area’ also have a weak connection to the HSR infrastructure. For example, the sale flyer for the Visa Mansion project (新中宇维萨) boasts that it is ‘five stops to Wulinmen [on the metro] and five stops to Wanxiang Cheng [on the metro]’. However, it fails to

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\(^{219}\) The urbanisation of the rural population is undoubtedly a sophisticated problem in China. Especially for a HONT that occupies a large area of farm land, there are usually significant numbers of farmers ‘urbanised’ by losing their lands. This poses unprecedented challenges: the newly urbanised people need new skills to survive in their new environment, and a reasonable HONT population structure needs to be maintained. Urban planners must seriously consider this unique transition. However, this topic is not investigated in this chapter, which focuses narrowly on the functional relationship between station and city.
mention the new HSR station, which is one metro stop and only 800 metres away (Figure 6.34). This clearly indicates that the HSR infrastructure does not have the same attraction as established urban centres to potential property buyers in the HONT.

The relationship between the HSR infrastructure and urban residential apartments cannot be fully appraised through limited case studies, but what is clear is that residential occupiers much prefer access to the metro over the HSR. In a HONT scenario, the metro resource integrated into a HSR station indirectly becomes a strong support for residential developments. This also suggests wide acceptance of the HONT as a node of the urban network which is connected by metro lines. The larger scale network of the HSR is often ignored because of an absence of a convention of commuting on HSR lines (or conventional rail lines).

Viewed from another perspective, Hangzhou’s station-side apartments have great potential to serve future commuters on the HSR network.

Limited media reports (Lin and Lin, 2015; Gong, 2014) suggest that commuting is recently emerging on the established HSR network. There are reported examples of people living in Suzhou and working in Shanghai, and similar pattern between Tianjin and Beijing. Commuting distances normally range between 50 and 100 kilometres, connecting centres of hinterland city and central city. Property prices in different cities, employment opportunities and family issues are, according to the media reports, the main motivations for HSR commuting.

The reports also show that current HSR commuting patterns are mostly ‘from city centre to city centre’, while there is no pattern of travelling ‘from HONT to HONT’. This means longer travelling times between marginal/remote HSR stations and city centres. The apartments within the core area of Hangzhou’s HONT offer a comparatively more efficient HSR commuting opportunity. Therefore, given enough social acceptance, the ‘Development Strip Areas’ of HONTs have a much stronger potential to develop mixed urban uses beyond the current prevailing understanding of commercial and office projects. It is, however, also true that if the rigid residential block template could be converted into a more permeable structure, this core area life would become more dynamic and attractive.

In summary, Hangzhou’s HONT case shows strong influences from pre-existing residents and the life patterns of the station node area. The HONT is planned with clear identities of ‘localisation’ and ‘commercialisation’ but, in terms of future urban users, the development focus has shifted from rail passengers to local residents. With strong support from the metro infrastructure, it is reasonable to expect large commercial demands to arise from high-density living, which consequently generates busy urban life. However, the potential relationship between station and city could be tenuous, parallel or even separate. Unless HSR communities are encouraged by creative innovations, there are not many opportunities for long-distance travellers to or from the railway station to share urban life with local users who travel only short distances at the metropolitan scale.
6.4.1.3 “Development Strip Area’ of Wuxi Xidong New Town Business District

Wuxi East Station is about 15 kilometres east of the city centre, rather like Hongqiao Terminal; but, a much smaller urban footprint of Wuxi, this station sits in the middle of farms and fields where there are few original residents. This means Wuxi’s HONT has been built almost from scratch, and the station is theoretically the only direct driver of future urban developments. The functional integration between station and city will heavily influence the transfer of development resources from the station into the city.

On the other hand, being the smallest of three stations studied, Wuxi has the largest HONT ambitions, which cannot be attained from the resources of a much smaller HSR station alone. There have to be extra resources put in to drive this ambitious development.

The planning scheme shows that both sides of the station are accessible and developed, with a planned ‘business headquarters centre’ covering its 240 ha core area (Figure 6.35). Within this scope, there are 50 ha of land adjacent to the western side of the station, to be developed as the first stage of implementation, with an urban design scheme that is available to the public. By the time of the author’s visit, a significant portion of this land had been architecturally designed and even partly built. Compared with other parts of Wuxi’s HONT, this 50 ha area is much more detailed and legible; hence it is the focus of the in-depth study that follows.

According to the Investment Guide of Xidong New Town Business District, Wuxi (Wuxi Xidong New Town Business District Administration Committee: 13), the 50 ha area is proposed to encompass ‘a total built floor area of 1.7 million square metres, with the highest building 180 metres. Business offices, commercial and combined commercial/residential projects comprise the main developments within this scope, which is the core area of Xidong New Town. The street blocks are designed according to the American small block structure, to achieve maximum speed of throughput for people and ease of access for businesses.’ 220 According to the planning document, which is attached to the Investment Guide, this area will ‘focus on developing regional headquarters and functional headquarters [of companies] and providing an appropriate amount of commercial and service apartment facilities’. 221

Compared with the Hongqiao CBD, which incorporates a similar ‘business headquarters’ centre, the core area of Xidong New Town is planned in a more homogeneous way. The urban blocks are universally infilled with office towers, presenting a strong agglomeration of single use across the land area.

In addition, according to the official website of Xidong New Town, the confirmed projects in its core area are mostly developed by local Wuxi companies, who will as well be the major end-users of these towers. A typical example is the Hongdou Oriental Fortune Plaza (红豆东方财富广场) developed by the local Hongdou Group (Figure 6.36). These ‘end-users’ are from a wide range of industries, including energy,

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220 The original text in Chinese is: “总建筑面积 170 万平方米，最高建筑 180 米，以商务办公、商业及商住为主要功能，是锡东新城的核心区域。整个街区采取美国小街区的形式，最大限度加速人气商气集聚”.

221 The original text in Chinese is: “重点发展区域总部和功能总部，并配备适度的商业和酒店式公寓”.

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technology, finance and real estate. By comparison, the office towers in Hongqiao CBD’s core area are mostly developed by experienced estate developers, including big names such as Wanda and Shui On, whose projects are wholly oriented towards a changing market. In terms of future project users, the ‘end-user’ mode tends to entail customising building design towards specific purposes, whereas the ‘marketing’ mode provides projects with adaptability and flexibility. As local businesses act as major developers in Wuxi’s HONT ‘Development Strip Area’, it is highly likely that users in this area will come mainly from the polycentric urban nodes in Wuxi. This is difficult to change because of the customisation of buildings towards local businesses. On the other hand, the flexibility of marketing-oriented developments means that some local users may become HSR users, which probably creates a better long-term balance of users.

The commercial facilities in the ‘Development Strip Area’ are sited at the farthest ends of the eastern and western sides, oriented to meet the demands of local residents. Smaller commercial facilities are planned around the HSR station node, targeting office block users rather than station passengers. For instance, the Shi’ao Centre Project (世奥中心) next to the station’s southern plaza has about 75% of its 87,000 square metre floor area developed as office and 25% commercial (Figure 6.37). In Shanghai’s case, a similarly situated project known as ‘the Hub’ has about 50% of its 380,000 square metre floor area designed as multiple commercial facilities, including hotels, retail and entertainment. The 80,000 square metre office spaces occupy only 20% of the entire development, much less significant than that in the Shi’ao Centre.

This analysis of Wuxi’s HONT ‘Development Strip Area’ indicates weak support provided by the HSR infrastructure for urban development. This being so, what resources are envisioned to drive the ambitious urban growth? As reported in Wuxi Business (Wuxi New Media, 2013), the head of the scheme in the local authority thought that ‘at present, the foremost problem challenging the new town is that available resources [for urban development] are not highly agglomerated, and suffer from a low level of support [for growth]. The current scale of [local] residential population and the industrial base do not support huge developments in the new town. [...] The solution is] to focus on regional development, further expose the agglomeration effect and increase the [new town’s] attractiveness to residents and resources from Xishan, Wuxi and nearby areas. Then a sustainable development future for the new town can be expected.’

This understanding of ‘local resource agglomeration’ to support a HONT’s development puts the HSR infrastructure, which operates on a much larger scale, in a dilemma situation in Wuxi. Moreover, it attests to the fact that the HSR infrastructure has only a weak influence on HONT developments.

The 3.1 kilometre long underground road system discussed in the previous chapter adds to the notion of ‘local resource agglomeration’, which relies on vehicles from regional urban network nodes to support...
HONT growth (refer to Figure 5.39 of Chapter Five). This is difficult for the metro, owing to its low coverage across regional Wuxi.

In general, there is a clear ‘business’ identity in the ‘Development Strip Area’ planning of Xidong New Town, which, however, lacks diversity and attraction to rail users. Thus, this serves as an example of the separation between station and city, with the former providing little development support for the latter. It is interesting that the far-away regional nodes of Wuxi’s urban network have replaced the immediate HSR station as a source of power for HONT developments. Consequently, this scenario will shape a dichotomous operational system between the HSR station and the HONT: rail passengers and urban users are defined by two scales that do not meet and do not interact with one another.

4.2 The ‘Peripheral Development Areas’

In the Flow-Density Model, the HONT areas with over 15 minutes’ travelling time to the centre are defined as ‘Peripheral Development Areas’, indicating the decreased influence of the HSR and the increased importance of local context in urban living. In terms of urban functions, the less defined peripheral areas differ widely across different HONT planning practices. In the HONT cases from Shanghai and Wuxi, the developments on the outskirts are directly mobilised by local/regional resources, rather than by the HSR. Hongqiao CBD is a typical example of this, having its 86 square kilometre area planned with multiple sub-centres, HSR-oriented developments being among them. In Wuxi, the even larger 126 square kilometre footprint is divided into three parts, of which only the middle 44 square kilometre portion takes HSR as its main theme (but not as a driver of development). Only the smallest Hangzhou HONT keeps a clear ‘single core’ structure around the HSR terminal. Its peripheral areas are distinguished from the core areas by providing community-centred urban lives (Figure 6.17).

The previous chapter’s Flow-Density Model concludes that the HSR infrastructure node has limited geographical coverage of influence in the HONT, which is mainly restricted within the scope of the ‘Development Strip Area’. It is thus difficult in the HONT peripheries to establish tight functional integration with the station. However, as part of a complete understanding of the HONT, the peripheral areas are briefly discussed below. For this purpose, the author has customised the study area in the cases of Shanghai and Wuxi, disregarding those sub-centres that are not clearly related to the HSR infrastructure. As a result, Hongqiao CBD’s peripheral area is within the 27 square kilometre ‘main functional area’ (Figure 6.18), and Wuxi’s peripheral area occupies designated 44 square kilometres (Figure 6.17). Hangzhou’s HONT has a peripheral area the same as the previous study.

Hongqiao CBD’s peripheral area (of its ‘main functional area’) is mainly in-filled by the airport infrastructure, squeezing the fragmented development lands to its eastern side. Urban roads are the only infrastructure planned to link the developments on the eastern side to the western HONT core area. (Metro lines do not have a stop in the eastern development area.)

According to the planning scheme (SUPDRI: 6), the eastern side developments are oriented towards aero-logistics, urban offices and medium to small-scale conference facilities. Thus, the urban functions
in this area are based upon anchoring airport operations, a HONT equivalent ‘Development Strip Area’ of the aero industry, but having a very weak relationship with the western side (Figure 6.38).

Compared with Shanghai’s case, Hangzhou’s HONT has a closer relationship between its peripheries and the core area, with the former developed for residential communities to achieve ‘balanced living and working’ (居职平衡). On this principle, Hangzhou has peripheral areas comprising large volumes of apartment housing and facilities including a community centre, school and hospital (Figure 6.39).

As we have seen, the residential function in the HONT has a weak general relationship with the HSR infrastructure. Therefore, the idea of ‘balanced living and working’ represents the regional character of a HONT in its urban network. Without strong influence from the HSR infrastructure, the residential projects in the peripheral HONT derive an advantage from their location to attract buyers from both the existing city centre and the HONT.

If we ignore the scale difference, Wuxi’s HONT has a similar relationship between periphery and core to that of Hangzhou, based on developing residential projects to meet the demands of working in the HONT (Figure 6.40).

However, its scale and distance from its main city means that Wuxi gains little local support either from the core area and regional urban nodes. The planning scheme envisages large residential plots of over 400 metres infilling this area, shaping highly homogeneous and agglomerated residential zones. Undoubtedly, these urban spaces lacking diversification and permeability are inimical to the development and enhancement of rich and satisfying lives in the HONT. There is little reason to expect functional integration between peripheries and station in Wuxi’s HONT.

To summarise, the three cases indicate that the relationship between the peripheral HONT and the station is further weakened by development; in fact, in a case such as Wuxi, there is almost no visible relationship between the two precincts. The HONT’s outskirts function complementarily to the ‘Development Strip Area’ under the ‘balanced living and working’ principle, but do not relate to the HSR infrastructure directly.

It should be pointed out further that the case of Wuxi exposes a unique problem of Chinese HONTs, namely how to define the urban life of the outskirts. The original ‘Development Zone’ diagram recognises that the influence of the station fades as travelling time from the station increases, and urban lives gradually transform from infrastructure-oriented into contextual urban-oriented. Given that most European stations are sited inside cities, this model clearly illustrates the station-city relationship. However, most remotely sited Chinese HONTs lack existing urban contexts to define their peripheries. In fact, many cases develop their peripheral areas into neutral and unrecognisable urban identities. This is a significant theoretical shortcoming in directly applying Western models to Chinese practice.
6.4.3 Summary

Through the perspective of ‘stationisation of the city’, the problems of HONT planning and design can be identified from the case studies.

First, today’s Chinese planning theory has widely recognised mixed use as one key principle in urban practice, but most HONT schemes translate this idea into ‘mixed zoning’ of land use. As seen from the cases of Shanghai and Hangzhou, ‘mixed zoning’ does not lead to diversification of city users, especially transforming station users into urban participants. In the peripheral areas, even this limited effect is hardly visible, urban spaces being universally infilled by large residential blocks.

Second, despite many efforts to define urban character through proposing major urban industries, the planning of HONT industries on a large HSR infrastructure scale has not happened. Duplicated urban industries are often found between neighbouring HSR stations. For example, Shanghai Hongqiao and Wuxi East, which are about 100 kilometres apart (about 30 minutes on a non-stop HSR service) are both surrounded by office towers accommodating business headquarters. In fact, this functional duplication indicates that the proposed HONT industry is supported by local resources, instead of resources on the HSR network.

Third, both the above problems suggest that future station users may only rarely be transformed into urban users. There is no observed planning or design effort to propose innovative urban functions that encourage the involvement of HSR travellers or even trigger constant and regular travel on the HSR infrastructure from HONT to HONT.

In the current only moderately successful approaches to the ‘stationisation of the city’, the station-city relationship based on user transfer in the ‘Development Zone’ becomes, in practice, a ring-structure zoning pattern of urban functions. This pattern has a morphological similarity to the original theoretical diagram, but substantially dictates land uses without a clear analysis of their user potential. In a top-down statutory planning system, the end-users’ experiences of urbanity are largely ignored. In a HONT scenario, this leads to wide neglect of a proper respect for the relationship between station and city. In the highly likely future dichotomous operations between city and station, there will be no ‘nourishment’ from the HSR infrastructure to support urban HONT growth. Compared with the conventional inner-city stations in China, we may find surprisingly similar urban functions between HONT and SIDA. And, compared with the conventional ‘new town’ practices emerging in China during the past decades, the lack of a catalytic relationship between station and city indicates the surgical implantation of a HSR infrastructure into a template ‘new town’ body, as in many HONT planning practices. Parallel operations of station and city are a regrettable outcome of HONT planning practice.

6.5.0 Conclusion

Both theoretical studies and case studies from Japan suggest that the functional integration of station and city comes from the ‘urbanisation of the station’ and the ‘stationisation of the city’. From the users’ perspective, this integration is achieved by encouraging station users to become the main users of urban
areas in the immediate vicinity of the station, while urban users mainly use the station to meet their travel needs. A high degree of overlap between users in both precincts is based on functional complementary in between. The overlapping ‘users’ can be taken as a measure of the level of integration between station and city.

Nevertheless, the case studies show a nearly opposite scenario, which categorises the station and urban users of a HONT as different future ‘clients’. In other words, station and city are designed for people with different purposes, the former dedicated to long-distance travel and the latter serving only to orient commuters to and from regional destinations, not through the station.

This finding indicates that, at least in the near future, new HSR stations will develop a relationship to their immediate urban area that is similar to the SIDA observed around conventional inner-city railway stations, shaping separate operations in between. For the HONT practice, however, this emerging tendency may bring about a crisis in urban living. On the one hand, the HSR station will find it difficult to merge into its urban context by way of separate groups of users; in turn, this isolation will cast the station in the role of an uninviting and uninteresting place that is to be avoided. This will eventually forge a form of station life like that which exists around conventional inner-city stations such as Xi’an Station.

On the other hand, most of the remotely located HONTs are in theory powered solely by the HSR infrastructure. But typically, as the Wuxi case demonstrates, planning practice rejects the HSR and turns to regional or metropolitan resources to support urban growth. A direct result of this situation is increased local commuting traffic into the HONT; moreover, it substantially removes the fundamental feature of HONT living, namely HSR.

The present analysis suggests that today’s planned HONTs are initially understood as one node of a polycentric urban network, while HSR is a significant element that triggers but does not power developments in the ‘new town’. In other words, HONT planning practice shapes a ‘new town with an HSR infrastructure’, rather than the theoretical ‘new town driven by an HSR infrastructure’.

How then to develop a highly integrated and mutually supportive station-city relationship in Chinese HONT practice? The Japanese cases cited in Chapter Two are superficially good examples to pursue. However, these well-integrated station-city relationships are based upon a complete rail system that operates on local, regional and national scales, with associated commuting patterns. For most Chinese cities, rail infrastructures at metropolitan and regional scales are just emerging, if they exist at all. It probably needs a few decades before China achieves an equivalent urban rail infrastructure density and rail-oriented patterns of travel that ‘match’ the operation of the HSR infrastructure. Meanwhile, building from scratch a HONT that operates on the scale of the whole rail infrastructure demands huge further investment.

From a practical perspective, station-city integration should be built through innovative urban land use planning and design practices in the HONT. At present there is no overall plan across the HSR network to
guide individual HONTs with complementary functions and identities that will tighten their relationship with the HSR infrastructure and make them into indispensable functional nodes.

Shi et al. (2014: 3) suggest that the current problem of ‘duplicated identical functions’ between HONT practices may lead to mutual repulsion, which will eventually weaken the role of the HSR in shaping new industries and economies. This phenomenon stems from the fact that HONT industry is supported in practice by local resources, rather than resources from the HSR network as theorised. This further reflects the negative influence of the absence of large-scale industry planning across the HSR network. If every HONT were able to clearly identify itself with respect to industries from other HONTs in a mutually supportive industrial network, a ‘city operated on HSR’ could be expected to develop. As a result, a highly interdependent relationship would be forged between the HONT and HSR, which would lay the foundations for competitive and higher-quality urban living.

It is also important to note that the relationship between the HONT and its parent city or urban network should not be neglected in a new station-city relationship. In fact, the parent city defines its HONT, with social, cultural, historical and many other features in the HSR network. Physically, the transport resources integrated by the HSR infrastructure will still be an advantage for HONT development, but they need to contribute towards HONT growth in a collaborative and balanced way with the HSR infrastructure.

The following part will further discuss these issues through an urban design strategy based on one selected HONT site.
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PART FOUR:

PROPOSAL
Chapter Seven

Illustrating the Theory: An urban design strategy for Hangzhou New Eastern Town

7.1.0 Introduction

Further to the theoretical discussions developed in the previous chapters, this chapter summarises the framework of HONT (high-speed-rail oriented new town) planning/design theories and employs a real site to illustrate this theoretical framework through a brief urban design practice. By improving the physical/spatial connectivity between HSR (high-speed-rail) infrastructure and an urban HONT area based on the current statutory planning scheme, this design investigates the potentials for achieving a well-integrated ‘rail–city’ relationship in a real project context. Through this approach, the author aims at improving the ‘density’ and ‘diversity’ features of a HONT through contributing to the successful transition of users between the rail node and its immediate urban areas.

On the other hand, however, the author’s architecture background sets limited capabilities in developing sophisticated transport engineering solutions; as well as many access barriers to data resources in China, this design is limited to diagramming the possibilities for the transportation modes, development volumes and urban functions. Detailed building and space designs are not further investigated.

The Eastern New Town (ENT) of Hangzhou, centred by the city’s new HSR hub of Hangzhou East Railway Station, is selected for this urban design site. The design benefits from the author’s involvement in the planning and design practice of the ENT between 2009 and 2012, with access to detailed data. As discussed in previous chapters, the HONT case from Hangzhou presents a comparatively higher development density and level of urban richness compared with its equivalents in the HSR network. However, this advantage is mainly contributed by the station’s proximity to the established urban centre of metropolitan Hangzhou and local communities, which do not yet benefit from being fully connect to the HSR infrastructure’s operation. The author intends to illustrate how urban life can be intensified and enriched through integrated rail–city relationships across this site, to serve as a highly valuable example for HONTs in the rest of China.

This chapter starts by summarising the theoretical framework of HONT planning/design based upon studies presented in this thesis, which is then applied to the selected HONT site for a diagrammatic urban design strategy. The design outcomes allow a conclusion through comparison with the original scheme at the end of this chapter.

7.2.0 Summary of a theoretical framework

In general, the HONT-featured style of urban life is substantially identified by its high level of mixed uses. These mixed uses are generated by various users from the operation of a full range of rail infrastructure hierarchy including HSR, normal rail and metro, who are measured through many dimensions such as
geography, culture and travelling purposes. This hybridity differentiates HONT living sharply from conventional urban life, which is shaped by long-established communities, living within a defined geographical scope.

The HONT strategy is therefore challenged by encouraging the transition of users between the station and city through developing building volumes and customising urban functions, which eventually leads to physical densification and empirical richness in the urban HONT.

The above discussion, generated from the theoretical discussions and case studies developed in the previous chapters, can be summarised into a cluster of objectives of HONT development. The overall objective of these is to achieve a high level of integration between station and city. This ‘integration’ is interpreted by translating the large number and rich background of rail users, in both quantitative and qualitative dimensions, into the development density and functional diversity of both rail node and its immediate urban precincts.

To specify, the overall objective can be further detailed through two aspects as below:

First, there should be strong physical connections between the HSR station and urban HONT. This is achieved through planning HONT transport with station connections balanced between regional centres and urban HONT.

Second, a high level of functional integration between station and city precincts should also be proposed. As discussed in Chapter Six, this integration comes from ‘urbanisation of station’ and ‘stationisation of city’.

How, then, can we achieve the above objectives in HONT planning practices? The author further asserts that practical principles as below should be considered in the implementation process.

First, in the transport planning, a HONT must be supported by a tiered transport system that connects the HSR station to its surrounding area, with particular focus on facilitating pedestrian movement near that station.

Chapter Five points out that most HONT schemes are weak in building transport connections between an HSR station and its nearby urban areas, which is partly because of the overuse of vehicles in the HONT area. This form of transport planning leads to difficulties when translating users between the station and urban precincts in the HONT. A new system should therefore be envisaged to encourage robust and strong connections between the station and urban areas to support density and diversity growth in both precincts. In addition, the overall control of vehicular uses within the HONT will benefit from the increased density of urban activities. It is especially important to rethink the usage of cars from regional destinations penetrating urban HONTs to access the station in the centre. A ‘park and ride’ strategy applied to peripheral areas of the HONT will significantly increase the overall transport efficiency of urban HONTs and potentially encourage use of public transport where available.
Second, in planning and design of the urban HONT, physical forms should be of a grain to encourage pedestrian flow.

Chapter Four discloses that the inner-city railway stations are generally isolated from their surrounding urban fabric in China, in both spatial and empirical dimensions. This phenomenon also happens around the HSR stations, as studied in Chapters Five and Six, which appears to be even worse due to expanded infrastructural scale. The case studies also show that this station-city isolation is shaped by the arterial roads around the station node, as well as the closure and overly-large size of urban blocks. New permeability strategies should therefore be envisaged through these two aspects.

Third, in the station design, it should be considered to be a component of the urban fabric, not an isolated object with a singular function.

The split investment mode of a railway station and its plazas are one of the major explanations for the current homogeneous functional layout found in many railway stations. Meanwhile, the case of Hangzhou’s Chengzhan Station further indicates that the limited Chinese efforts of integrating urban facilities in station nodes are restricted by the failure to understand the unique function of a railway station in an urban context. The urban character of a station is therefore shaped by customised urban functions in the station node responding to its specific location and contextual urban life, which aim at attracting users from both the urban area and rail network. And beyond its functional ‘urbanisation’, a station should also be physically woven into the fabric of its immediate surroundings. This means station design needs to consider increasing pedestrian facilities, reducing arterial road sizes and strengthening local transport (especially urban rail transport) systems to achieve a higher level of permeability between the station and urban inhabitants.

Fourth, by programming the urban HONT, the functional purposes of the area should be varied and attractive to human habitation and use.

These urban facilities are built upon a high level of pedestrian/urban rail accessibility to and from the station node, with their own features established to attract rail users. This constant attraction will generate greatly increased urban building volumes and enriched life experiences. Meanwhile, it should also be pointed out that the current scale of most urban blocks in HONT planning schemes is oversized, which can create barriers that constrict flows between the station and urban areas. Smaller urban blocks should be considered to promote the smooth transitions of users.

Finally, at a much larger scale of the HSR network, an inter-complementary functional planning should emerge to characterise different HONTs in this network.

This functionally inter-supplementary HONT network will encourage future commuting on the HSR network and possesses a huge potential to generate a large number of long-term users of both the HSR infrastructure and urban facilities around station nodes. This network is undoubtedly a challenge much beyond the scope of most urban design approaches, but its benefits will be clearly exposed in every HONT development.
As a result of the practical principles, an urban HONT area with developments of high density and richly diverse features is expected to emerge around HSR nodes. In other words, this area can be labelled as urban development ‘hot spot’\(^{224}\). This ‘hot spot’ phenomenon, in the HONT context, is powered by successful translations of rail and urban users. Therefore, as a result, the general HONT objective of rail-city integration is physically presented by development spaces, empirically understood by diverse functions, and substantially driven by user translations.

This approach from theory to practical outcome is diagrammed in Table 7.01. And further, it is demonstrated by the urban design strategy below.

![Diagram of Table 7.01](image.png)

**Table 7.01. Relationship between theoretical objectives, practical principles and development outcomes.**

### 7.3.0 Brief for urban design strategy

**Design Target**

This design focuses on applying the summarised theoretical framework into a real HONT site, based upon the current statutory planning scheme. It employs the principles of ‘urbanisation of station’ and ‘stationisation of city’ in a real HONT context. Through improving the physical and functional connectivity between station node and urban HONT, the author aims at envisaging intensified urban activities in and around HSR infrastructure, which further explores the potential to achieve higher levels of physical density and diversity in HONT development.

The intensification of density and diversity is presented through the comparison of an urban development ‘hot spot’ diagram, drawn from existing planning and new proposals.

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\(^{224}\) The concept of an urban development ‘hot spot’ is a combination of intensive urban activities, accommodated by large-volume urban developments and experienced through rich urban functions. The author employs this concept of a qualitative dimension to assess the outcome of urban design practice.
Design Scope

The design is performed within the boundary of Hangzhou’s ENT. The discussion is developed on two scales: a HONT scale covering a footprint of 9.3 square kilometres and a node scale of an area of about 22 hectares immediately adjacent to the HSR station. On the first scale, a newly dedicated domestic HONT transport plan is suggested, which allows for a comparison study of issues including urban transport, land use diagram and physical development density between current and new proposals. As a result, different urban development hot spot diagrams are also compared between the original and re-envisioned designs.

The second scale allows the author to further zoom into one of the hot spots with a detailed demonstration of the possibilities for urban living immediately adjacent to the HSR station node and interpreting user transitions for different purposes around the station area.

Design Contents and Deliverables

The design contents primarily echo the main practical principles (Connectivity / Permeability / Urbanisation of Station / Stationisation of City) of HONT discussed in section 7.2.0. It focuses on urban infrastructure and its relevant urban activity potentials. It does not, however, place an emphasis on designing the physical spaces and buildings. As an approach to applying academic theories, it employs diagrammatic illustrations to present design outcomes, which include:

- **HONT scale**:
  - analysis of the HSR network around Hangzhou (Figure 7.01);
  - analysis of urban industries/institutions of Hangzhou that have potential to extend into the ENT (Figure 7.02); and
  - comparisons of the original and re-envisioned ENT planning in: transport systems (Figure 7.03a–e), FAR index diagrams (Figure 7.04a–e), land-use diagrams (Figure 7.05a–b) and urban development hot spot diagrams (Figure 7.06a–b),

- **Node scale**:
  - development site comparisons between the cases of Hangzhou and Tokyo, Osaka and Amsterdam (Figure 7.07);
  - development density comparisons between the cases of Hangzhou and Tokyo, Osaka and Amsterdam (Figure 7.08);
  - comparison of original and revised planning/urban design schemes within the urban design boundary (Figure 7.09a–b);
  - master planning diagram (Figure 7.10);
  - urban functions and flows diagram (Figure 7.11);
  - urban sections through the site (Figure 7.12); and
  - development comparison between existing and new schemes (Figure 7.13).
Design Compliance

This design complies with the physical constraints set by the site’s contexts, such as building height limits when close to an airport and building footprints offset from built metro lines. At the same time, the current statutory planning codes are directly/indirectly challenged to test new theories. This includes codes of land use, FAR, ratio of building footprint coverage, ratio of green vegetation coverage and car park percentage.

References for Design

This design is developed upon the major planning and design documents of Hangzhou’s ENT, as well as the architectural design of built projects within the node-scale urban area. These documents are detailed as follows:

The ENT planning and design documents:

- Statutory Master Plan of Hangzhou Eastern New Town (《杭州市城东新城控制性详细规划》), issued by Hangzhou Institute of Urban Planning and Design (HIUPD, 杭州市城市规划设计研究院) in 2010 (a), approved by the Metropolitan Government of Hangzhou in 2010.
- Urban Design of Hangzhou Eastern New Town (《杭州市城东新城城市设计》), issued by Hangzhou Institute of Urban Planning and Design (杭州市城市规划设计研究院) in 2010 (b).
- Evaluation of Overall Traffic, Hangzhou Eastern New Town (《杭州城东新城整体交通评价》), issued in 2011 by PLT (柏麟德规划建筑有限公司) and ZUURPDI (Zhejiang University Urban-Rural Planning & Design Institute, 浙江大学城乡规划设计研究院有限公司).
- Middle Stage Assessment of Eastern New Town Planning Implementation (《城东新城规划建设中期评估》), issued in 2015 by Hangzhou Planning Bureau (杭州市规划局), Hangzhou CBD Investment Group (杭州市钱江新城投资集团) and Tongji University.

The architectural design documents include:

- The schematic, design development and documentation drawings of Hangzhou East Railway Station (including the Eastern and Western Plazas) as issued by the Central South Architectural Design Institute (中南建筑设计院有限公司) between 2009 and 2012.
- Architectural design of the relocation apartments of R21–22 land plot, Pengbu Planning Unit, issued by China United Engineering Corporation (中国联合工程公司), 2009.

7.4.0 Regional and metropolitan analysis

This section starts with a brief profile of Hangzhou city, its HSR network, urban industry and geographical location, to assist an analysis of potential urban activities in the city’s HONT area. Two contextual scales of the ENT, the HSR network and metropolitan Hangzhou, are studied here to propose...
ways of optimising the kinds of urban living possible in and around the HSR node for future developments.

Due to the author’s disciplinary limitations and access to data resources, the following analysis drawn from both the above scales is not completely inclusive to generate a fully informed HONT program decision for the case of Hangzhou. However, this limited data serves well to demonstrate a design process by applying summarised theories, which is the author’s intention in this chapter.

7.4.1 HSR network analysis around Hangzhou

At the time of developing this thesis, there are four HSR lines in operation around Hangzhou. They are Huhang Line (沪杭高铁, Shanghai-Hangzhou), Ninghang Line (宁杭高铁, Nanjing-Hangzhou), Hangyong Line (杭甬高铁, Hangzhou-Ningbo) and Hangchang Line (杭长高铁, Hangzhou-Changsha). There is also one line under construction, Hanghuang Line (杭黄高铁, Hangzhou-Huangshan) (see Figure 7.01 of the line routes). Beyond these existing and under-construction lines, a maglev train line between Shanghai and Hangzhou has been proposed to connect Hangzhou East Railway Station from Shanghai Hongqiao Terminal. This project, however, the route of which largely overlaps with the HSR line between both cities, has been inactive for the last five years without any clear future implementation. Therefore, the author does not take this line into account for further discussions.

For the purpose of understanding the potential commuting population on this HSR network around Hangzhou, it is important to assess the accepted commuting times for metropolitan China. According to Sun’s (2016) investigation among major Chinese urban centres (Beijing, Guangzhou, Shanghai, Chengdu and Hangzhou), the average daily commuting time for one way ranges between 24 and 50 minutes. Meng (2014: 26) further discloses that the residents of the western part of metropolitan Hangzhou spend an average of 48 minutes one way between home and workplace. Gao (2015: 90) studied the commuting pattern of Hangzhou’s affordable housing residents, who are more inclined to use public transport, and finds an average time of 43 minutes on the road. Based on a comparison of these examples, the author concludes that for Hangzhou’s commuters, especially those riding public transportation, 45 minutes is widely acceptable for one-way traffic.

By applying this commuting time data to the HSR infrastructure, with consideration of extra time for local connections \(^{225}\), it is possible to draw a half-hour HSR ride radius around Hangzhou East Railway Station, which includes a residential population within reasonable distances to commute to Hangzhou’s ENT. Through investigating the HSR train schedules operating in May 2016, this half-hour HSR radius can be translated into a distance of about 75 kilometres, which includes nine stations/cities: Jiaxing, Haining, Yuhang (on the Huhang Line), Huzhou, Deqing (Ninghang Line), Shangyu, Shaoxing, Xiaoshan (Hangyong Line) and Zhuji (Hangchang Line) on currently operating lines. Along the Hanghuang Line under construction, Fuyang and Tonglu are highly accessible within the 30-minute HSR radius. In total, there

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\(^{225}\) The connection at the ENT end of Hangzhou is minimised through building an efficient HONT transport system.
will be eleven stations/cities connected to Hangzhou ENT within the widely accepted 45-minute total travelling time (see Figure 7.01 of radial distances along HSR lines around Hangzhou).

According to Wikipedia, the above 11 cities have a total residential population of about 11 million (around 2010–2013) (Table 7.02), which is over three times that of metropolitan Hangzhou’s 3.3 million residential population (within the conventional area composed of Shangcheng, Xiacheng, Jianggan, Gongshu and Xihu Districts).

<table>
<thead>
<tr>
<th>HSR Line</th>
<th>City/Town</th>
<th>Residents (million)</th>
<th>Urban Registers (million)</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Huhang HSR</td>
<td>Jiaxing</td>
<td>1.2</td>
<td>0.9</td>
<td>Including metropolitan area (Nanhu and Xizhou Districts) only</td>
</tr>
<tr>
<td></td>
<td>Haining</td>
<td>0.8</td>
<td>0.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yuhang</td>
<td>1.2</td>
<td>0.9</td>
<td></td>
</tr>
<tr>
<td>Ninghang HSR</td>
<td>Huzhou</td>
<td>0.8</td>
<td>0.6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Deqing</td>
<td>0.5</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td>Hangyong HSR</td>
<td>Shangyu</td>
<td>0.8</td>
<td>0.8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shaoxing</td>
<td>1.9</td>
<td>1.4</td>
<td>Including metropolitan area (Yuecheng and Keqiao Districts) only</td>
</tr>
<tr>
<td></td>
<td>Xiaoshan</td>
<td>1.5*</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>Hangchang HSR</td>
<td>Zhuji</td>
<td>1.2</td>
<td>1.1</td>
<td></td>
</tr>
<tr>
<td>Hanghuang HSR</td>
<td>Fuyang</td>
<td>0.7</td>
<td>0.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tonglu</td>
<td>0.4</td>
<td>0.4</td>
<td></td>
</tr>
</tbody>
</table>

Total residents of above 11 cities/towns: 11 million;
Total urban registers of above 11 cities/towns: 9 million

Table 7.02. Population data of HSR commute-able cities/towns around Hangzhou East Railway Station

The 11 involved cities also have a wide range of characteristics, such as Haining’s reputation as a leather product manufacturing/trading centre, compared with Shaoxing’s historically established literary culture. In general, however, these cities are part of the province’s urban hierarchy centred on Hangzhou and receive its social, cultural and economic influences. It is reasonable to expect that the HSR’s operation will further consolidate Hangzhou’s central position in the province’s hierarchical urban structure (which has happened in Japanese cities such as Tokyo and Osaka), especially benefitting the locationally sensitive industries such as service and education.

By further expanding this HSR network scale, we may measure Hangzhou’s distance from other major urban centres by hours of HSR ride, such as 1–1.5 hours to Shanghai, 1.5–2.5 hours to Nanjing, 6–7

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226 The items enquired are: ‘杭州市’, ‘嘉兴市’, ‘湖州市’, ‘绍兴市’.
227 It is also true that the city of Hangzhou is itself a hinterland of Shanghai in many aspects, which challenges Hangzhou’s central position for second/third tier cities located between Shanghai and Hangzhou, including Jiaxing and Haining.
hours to Beijing, 6–10.5 hours to Guangzhou and 4.5–5 hours to Changsha\(^\text{228}\). These much extended
distances make it difficult to encourage constant commuting passengers, but HONT-related activities at
regional or national scales, such as conferences, exhibitions and other public/private events will also
attract HSR users. These activities with local characteristics and features will generate incoming flows
and populate urban HONTs.

Apart from passengers, rail freight is another emerging industry to boost the HSR infrastructure,
especially the huge delivery demands stemming from the blossoming online businesses. According to
Cai’s (2016) summary of reports from City Bank and Remarkety\(^\text{229}\), China’s online business accounted for
39.5% of the global share in 2015, and is estimated to take over 50% by 2018. In 2015, about 562.7
billion dollars were spent on Chinese internet shopping, ranking number one worldwide, and 1.6 times
that of America, which was second on the list. Hao et al. (2016) studied the distribution of Chinese
online businesses, and discovered that the eastern coastline cities/provinces have the highest level of
internet-based business agglomeration, namely Beijing, Tianjin, Jiangsu, Zhejiang, Fujian and Guangdong
(page 4). Among the 264 investigated cities, there are 68 cities, including Hangzhou, labelled as typical
cases of ‘high level online purchases and high level online businesses’\(^\text{230}\) (page 7).

Huge courier demands have been triggered by the fast growth of online businesses. As reported by Lin
(2015), over 14 billion parcels were delivered in China in 2014 alone, which overtook America to be the
largest such market in the world, with 40% further annual growth. Road vehicles and airplanes have
been long used as major transports of the Chinese courier industry, but the recent development of rail
infrastructure has opened another door for growth. As noted by Jin and Xu (2014) and Shen (2014), rail
freight enjoys 30–40% lower costs compared to road vehicles and only half compared to aeroplanes,
with other advantages such as being safe and on-time. The HSR network, although designed for
dedicated passenger transport, attracts strong interest for delivering small sized and light packages.

As Liu (2014) reports, China Railway introduced a preliminary HSR delivery business in 20 major cities
across China (including Beijing, Shanghai and Xi’an), targeting ‘same day arrival’ services. Figure 7.14
shows a photo in Chongqing of loading light packages to an HSR train. This service is currently operating
on a much smaller scale compared with its competitors, and still has a long way to achieve future
success. However, there is a clear trend that HSR station nodes and their immediate areas should
consider to provide facilities supporting the delivery business and its relevant industries.

7.4.2 Potential industrial analysis of Hangzhou

Within the scope of metropolitan Hangzhou, as shown in Figure 7.02, there are established industries
and services potentially benefitting from HSR connections, which are worthwhile to consider in the ENT
precinct.

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\(^{228}\) Train schedules enquired through: [http://shike.gaotie.cn](http://shike.gaotie.cn), 7 June 2016.

\(^{229}\) According to its official website ([http://www.remarkety.com/about-us](http://www.remarkety.com/about-us), visited 22 July 2016),
‘Remarkety is a Data-Driven Marketing Platform for e-commerce that uses customers’ behavior and
purchase history in order to create targeted and segmented marketing strategies’.

\(^{230}\) The original text in Chinese is: ‘高网购-高网商’.
First, Hangzhou is among the Chinese cities hosting the most developed online businesses. According to a survey by Shen (2015), Hangzhou had 470,000 ‘internet-based business bodies’\(^{231}\), which ranked number one in China of ‘website number, B2B/C2C and third party payments’\(^{232}\). In 2015, the total turnover of Hangzhou-based online businesses broke through 1,500 billion RMB, making up one eighth of the national statistics. According to research by Wang and Xu (2011: 1565), there were 142,377 Hangzhou-based retailers operating businesses on Taobao, the largest Chinese online shopping platform and equivalent of eBay.

It is worthwhile to further add that Taobao is a Hangzhou-based e-commerce website with a short history since 2003, but nearly half a billion registered users. On average, it has over 60 million daily visitors, providing over 800 million online commodities and sells 48,000 of them every minute (Taobao). According to Wikipedia\(^{233}\), in 2012, the online trading of Taobao recorded an overall turnover beyond 1,000 billion RMB, exceeding the total sum of Amazon and eBay together.

Hangzhou’s flourishing online business has powered strong demands for deliveries that consist mainly of small-sized packages. As Huo et al. (2015) report, recent years have seen an 80% annual growth of Hangzhou’s courier services. In 2014, 846 million packages were delivered to/from Hangzhou, about 2.3 million per day.

As of the ENT, the advantages of its passenger and freight transport infrastructure give it a strong potential to further boost Hangzhou’s online business development. Specifically, the development of HSR delivery services will attract business operators to set up their own storage facilities in the station node area. In addition, for online retailers of high value and large size commodities, such as luxury furniture, HSR infrastructure provides the convenience of consumer inspections before placing an order\(^{234}\). And finally, despite Taobao’s decentralised business running over the internet, the company has established a (partly) geographically centralised service to train its retailers in the skills and knowledge for operating their Taobao-based businesses, named ‘Taobao University’ (Figure 7.15). Taking advantage of Hangzhou’s site of Taobao’s headquarters, it is reasonable to expect a strong training centre in the ENT for both trainers from the company and trainees from all around the country.

Second, as the capital city of Zhejiang Province, Hangzhou has a large agglomeration of education resources. For example, of the province’s 33 universities/colleges that provide bachelor and higher degrees, near half (16) are based in Hangzhou, with the rest distributed in another seven cities.

At the same time, Hangzhou’s metropolitan government has implemented a policy to relocate a significant number of university and technical and further education (TAFE) college campuses into

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\(^{231}\) The original text in Chinese is ‘网上经营主体’.

\(^{232}\) The original text in Chinese is ‘网站数量、B2B/C2C、第三方支付等方面居全国第一’．‘B2B’ refers to ‘business to business’; ‘C2C’ refers to ‘consumer to consumer’.

\(^{233}\) The item enquired is ‘淘宝’.

\(^{234}\) The author learned this trend through researching a Taobao-based online furniture trader: Norhor Design (https://norhor.tmall.com). Their website indicates that this company founded in 2003 has been a successfully growing business. They have opened exhibition spaces in Hangzhou, Shanghai and Beijing for their clients to visit in person.
Xiasha new town (Figure 7.02), which sits east of the conventional urban area and links back with a metro line (Line Number One). Today, there are nine universities and five TAFE colleges in Xiasha. This policy is highly contestable, but from another perspective, these physically agglomerated educational resources can be easily introduced into the ENT through the metro line, providing potential HONT users of teaching staff and students.

The operation of HSR makes Hangzhou’s educational resources highly accessible by residents of the network. The ENT, with connections of both HSR and metro services, is undoubtedly the best site to make this happen. Plus, the public nature of rail services would encourage people from all age groups to participate in the training activities in ENT, given an acceptable commuting time.

Third, the established cultural facilities of provincial importance can expect increased users by making use of the advantages of rail. A typical case of this type is Zhejiang Library, serving readers from throughout the province. However, its current location on the western side of Hangzhou makes this library difficult to physically access even for users around metropolitan Hangzhou (as Figure 7.02 shows). By building a branch (or relocating) into the ENT, this library will be much more accessible to its potential readers, resulting in improved social benefits and influence.

Setting up a public library in the ENT will also strongly support the potential training facilities to share the same site.

Fourth, Hangzhou has a number of wholesale markets attracting clients from all over China, such as the famous Sijiqing (四季青) fashion market located between the old Chengzhan Station and new East Railway Station. This market, started in the late 1980s, has grown into ‘one of the largest fashion wholesale destinations in China’\(^235\), with an average daily attendance of between 70,000 and 100,000 visitors (Wikipedia, item: 四季青) (Figure 7.02). It is reasonable to assume that by extending this market’s exhibition and business facilities into the ENT, it will satisfy its future visitors with improved efficiencies. And the ENT can also expect related industries, such as fashion events, design and photographing businesses to flourish in the area.

Finally, Hangzhou has a long-established reputation of a rich cultural and artistic heritage, as well as an active art market involving multiple categories of art works. Of the city’s history of over 800 years, the huge achievement in Chinese literature and art is among the most recognised identities of Hangzhou. Well-known poets such as Bai Juyi (白居易, Tang Dynasty), Su Shi (苏轼, Song Dynasty) and calligraphy painter Huang Gongwang (黄公望, Yuan Dynasty) all have created influential works describing their experiences in Hangzhou. This strong tradition has been well inherited and is still developing even today, typically by the famous art, seal and calligraphy society of Xilingyinshe (西泠印社) and the academic institution of the China Academy of Art, both of which have established their footprints on the shore of West Lake (Figure 7.02).

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\(^{235}\) The original text in Chinese is: ‘目前已成为全国最大的服装集散地之一’.
Hangzhou’s strong literary and art tradition has established a solid foundation for the city’s art trading market. According to a report by Xia (2015), Hangzhou has assumed the ‘flagship’ of the art trading market in Southern China, with nationwide influences. In the autumn auction (in 2014), Hangzhou took the number three position of the overall turnover in China, and number one of the sold rate. Apart from the conventional calligraphies and paintings, Hangzhou’s art market also features a richness of different artworks, including seals, Tianhuang (a precious stone type for seals), calligraphic stationary and Bonsai (potted miniature natural landscapes).

It is indisputable that the HSR development provides a new opportunity for Hangzhou to expand the success of art trading. With exhibition and auction spaces close to the HSR station, Hangzhou’s artworks will have higher exposures to collectors nationwide, and the trading activities will enjoy an increased number of bidders.

7.5.0 Rethinking HONT transport and development hot spots

With contextual knowledge established by the above paragraphs, we now move to the ENT design practice. As discussed, the concept of urban development hot spots combines the density and diversity features of rail infrastructure-related urban growth. As regards the strategic design, the author employs this concept to examine the effectiveness of urban growth driven by rail operations. What, then, is the hot spot distribution in the original statutory ENT planning?

With respect to urban function, the land use planning indicates that most ‘C’ type lands (referring to commercial land with a potential to develop commercial service facilities) are agglomerated along both sides of the proposed central axis and metro station (Figure 7.05a). From the dimension of urban density, the FAR map as summarised by the author reveals that very few lands are planned with ‘very high’ physical densities (beyond 6.0 of the FAR index; see Figure 7.04a), which are around the metro station, compared with very low development density around the HSR station (less than 2.0 of the FAR index; see Figure 7.04a).

By comparing information from both diagrams, we can determine that current planning results in only one urban hot spot in the ENT, centred on the metro station. The HSR station area (also including another metro station), although theoretically the development centre of the entire ENT, is in fact far from forming any hot spot to attract urban users. As analysed in Chapter Six, this phenomenon indicates that current development in the ENT is heavily dependent on local residents, instead of resources/flows from the HSR network.

7.5.1 Transport planning optimisation

The author argues that the observed isolation between the HSR station and urban HONT is a main reason for the widely criticised development of most HSR nodes (see Chapters Five and Six). Therefore, improving the connectivity between these two precincts through optimising HONT transport planning is the first step to encouraging urban growth around the station node. It is also important to clarify that this improved connectivity does not introduce increased vehicle usage in the urban HONT area.
compared with the current scheme. On the contrary, through proposing public transport routes, the total use of vehicles in the ENT is expected to be reduced. The transport optimisation suggestions include the following features:

**Relocating car parking facilities in the HSR station to the periphery of ENT**

With the intention to improve the internal connectivity between HSR station and urban HONT, as well as to encourage increased use of public transport, the author hypothesises a ‘park and ride’ policy to be applied in the ENT area. This involves relocating most or possibly all of current parking bays\(^{236}\) (provided for private vehicles to/from the HSR station) in the HSR station node to the marginal ENT areas and providing shuttle services between peripheral parking and the central train station. By doing so, the ENT will receive benefit in many ways regarding its growth. First, there is less vehicular traffic, meaning that road resources to support local developments will be increased. Second, as the park and ride sites need to release their planned car bays to accommodate relocated parking demands from the station, there are opportunities that the increased HSR users will be introduced to these sites (which is further explained below). The mixed users will bring opportunities to change the homogeneous housing that is now dominant for urban residents of the fringes of ENT. And finally, the original parking spaces in the HSR station are now available to accommodate urban activities.

There are two criteria for nominating peripheral urban blocks to accommodate station parking:

First, these blocks should have direct and easy accesses to the major urban roads.

Second, these blocks are planned for commercial and public uses in the original planning scheme, including land-use types C2 (commercial and financial), U (urban utility), R24 (community green) and R22 (local community).

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\(^{236}\) The total number of car parking bays in the HSR station node is 3,870 (1,880 on the eastern side and 1,990 on the western side) (Figure 7.16a-b show the underground plans of the station and both plazas).
<table>
<thead>
<tr>
<th>Nominated Urban Block</th>
<th>Land Size (ha)</th>
<th>Planned Land use</th>
<th>Planned Building Footprint Ratio</th>
<th>Planned Building Height Limit (m)</th>
<th>Planned/Existing Car Bays</th>
</tr>
</thead>
<tbody>
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<tr>
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<tr>
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</tr>
<tr>
<td>W-C2-14</td>
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<td>50%</td>
<td>24 (as existing) (maximum 70m)</td>
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<tr>
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<td>Community</td>
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Table 7.03. Nominated fringe blocks with planned/built car park statistics (source: HIUPD)
The nominated land sites are shown in Table 7.03, with a total number of planned/built car parking bays of 9,658. By transferring 3,870 of these to serve the HSR infrastructure, 40% of the users originally proposed to transport with private vehicles should turn to public services, if no extra parking plots are added to these lands. Therefore, the HSR station has the stronger advantages of both distance and travelling time over public services compared with other metropolitan nodes in Hangzhou’s polycentric urban system. In this scenario, developments of the marginal areas will be motivated to customise their programs and features to attract HSR users.\(^{237}\)

**Shuttle bus/tram loops**

Based on the current urban road planning scheme, new shuttle bus/tram services will connect the nominated fringe parking areas and the HSR station in central ENT. These services will be operated in loops from both directions, to improve transport capacities.

Beyond connecting the central HSR node and fringe parking areas, the new shuttle services will also contribute to the accessibility of urban ENT. This means vehicular riders to the urban area can also choose a park and ride strategy to reduce car usage inside the new town. (See Figure 7.03c for detailed route planning of shuttle services.)

**New routes of ‘personal rapid transit’ (PRT) services**

In addition to the shuttle loops, the author also suggests a new transport system to improve connectivity between the HSR node and urban ENT. This system is operated by ‘personal rapid transit’ (PRT) vehicles, with precedent examples operating in London’s Heathrow Airport\(^{238}\) (Figure 7.17a). The new PRT route forms a loop departing from/terminating at the released underground parking area of the station’s Western Plaza, taking advantage of its direct access to the vehicle tunnel.

\(^{237}\) The author also assessed another ‘extreme’ situation in which maximumly the extra 3,870 car bays are required to be provided in the peripheral areas. This requirement will only be met through developing open spaces (i.e., underground parking structures in green land and utility land), or utilising ‘unbuilt’ spaces (i.e., the existing buildings not fully built at height allowed by planning). Further calculations indicate that to provide 3,870 bays, the nominated lands will be heavily developed, such as 2–3 underground structures or high-rise car parking buildings up to 70 metres. These proposals will be economically and environmentally unfeasible and unconvincing. Meanwhile, extra vehicles will create further traffic pressures around these sites, which need to be examined in detail through modelling by transport planning professionals. In general, the author does not support building extra car bays in the peripheral ENT area.

\(^{238}\) The author has had an interest in the PRT system since 2011, which has been developed through conducting a few researches. The PRT was conceptualised in West Virginia University in the 1970s, aiming at providing a small-size and flexible urban transport through customise-able services to increase the efficiency of urban transport and reduce car reliance (He et al., 2011: 10). According to further research by Andreasson (2011), the PRT system is ‘suitable’ to feed/distribute the passengers of a rail infrastructure node. Based on this conclusion, the author attempts to employ the PRT in a Chinese HONT context, as a prototype to build tight physical connections between the HSR station and urban HONT. This experiment, however, recognises that the Chinese HONT has a significantly different context than that of the Swedish railway stations that are the cases studied by Andreasson (2011). Therefore, the feasibility of applying a PRT system in HONT needs further verification in future through modelling transport planning cases. The author’s decision in this design practice is a qualitative guidance.
The author envisages that the PRT capsules will operate on new rails laid on existing urban roads and with automatic pilots\(^{239}\). There are two types of services available from this system. The first is a ‘mini-tram’ service through hinging multiple capsules, which operates between stops on a fixed loop at scheduled times. The second type is more like a ‘mini-taxi’, which is provided on demand (booking available through portable device apps or fixed screens in the station) and travels directly to booked destinations (Figure 7.17b–c). By combining both services, the PRT system will provide strong links both in efficiency and capacity between the HSR station and major development areas in the ENT\(^{240}\).

See Figure 7.03d for details of the proposed PRT routes.

Meanwhile, a potential extra PRT loop will be introduced to ‘stitch’ together urban activities across the rail tracks in the middle of the ENT, given that the performance of PRT is widely recognised. This is shown in Figure 7.03e.

7.5.2 Hot spot development re-envisioned

Improving the connectivity between station and city will provide strong support for the transition of users between them. It is especially important to state that the new transport systems have the aim of improving road efficiency and capacity with reduced use of vehicles in the urban ENT. The original planning scheme struggles to achieve higher urban development volume by putting restrictions on the over-reliance on road vehicles\(^{241}\). However, by providing further public transport and restricting car usage, the HSR station is expected to orient at future users of the urban ENT, instead of those coming from regional urban nodes via vehicular riding.

By converting urban ENT users from vehicular riders to rail riders, the constraint of limited road transport resources in HONT is no longer a reason to limit the physical urban growth, which allows further densification of ENT from the original planning scheme. As a result, it becomes possible for hot spots of urban developments to emerge around the HSR node (Figure 7.06a–b).

The following section further explores one case of the proposed hot spots to give a further detailed demonstration. It should be clarified here that the proposal to ‘reprogram’ the station plaza and its

\(^{239}\) The operational PRT systems today are generally auto-pilot, but on their own tracks (mostly elevated) and separate from urban traffic. Considering the cost and feasibility of building new structures or elevated tracks to accommodate PRT, the author suggests operating HONT PRT on existing roads mixing with vehicular traffic. This decision needs the strong technology support of auto-piloting systems, which are currently still under development. But it will bring the benefit of the maximum use of built urban infrastructures with minimum investment.

\(^{240}\) According to the data of He et al. (2011: 11), a PRT system has the potential to achieve service frequency between 5,000 and 7,200 (capsule) vehicles per hour. This theoretical frequency can be translated to a capacity of about 20,000–30,000 passengers per hour, which will be a strong link to support the transition of users between the HSR station and urban HONT. Nevertheless, the actual performance of a PRT in the HONT environment is still subject to modelling by transport planners in real urban traffic settings. A future study on this subject will be necessary to verify the PRT’s potential in HONT.

\(^{241}\) The ratio of car bays relating to developed floor area and limited road resources means the developable floor area is decided by the road capacity of cars.
nearby urban areas as below is only suggestive and predictive, based upon the contextual understanding established by the previous sections in this chapter, as well as an ‘integration’ optimised by the transport planning between the HSR station and urban HONT. The author understands that changing circumstances, such as the urban economics and demographic structure, will possibly generate different demands from the urban functions of station and urban HONT.

7.6.0 Re-fabricating station-side urban lives

The hot spot development immediate to the eastern side of the HSR station is selected for a detailed design. The reason is that it sits along the highlighted development axis in the new town, which in the original plan is the gravitational centre of future HONT living comprising a 1.5 kilometre cluster of commercial projects extending in an east-west direction.

However, this urban axial morphology template inherited from Socialist ideologies does not support a high level of integration between station and city. Therefore, the author has made an attempt to rethink this axial development approach. In this view, its direction should be adjusted from being perpendicular to the rail tracks to parallel. This change will maximise the locational advantages of urban lands adjacent to the station and encourage interactions between both precincts.

Another reason for selecting the eastern side of the station is that a mixture of land uses, including commercial and residential, is found here according to the original planning scheme. This is a rare case of a Chinese HONT presenting/featuring residential use around the central station node, which offers a unique opportunity to demonstrate a station–city integration potential based upon diversified urban functions.

7.6.1 Site selection and master planning

According to the above principles, a 22-hectare area adjacent to the eastern side of the station, including six land plots from the original plans, is selected for developing an urban design scheme. Apart from the station’s Eastern Plaza, there are six land plots in this area, including E-C2/C6/R-06, E-G11/C1-01, E-S19-01, E-G11/C2-02, E-R22-20 and E-R21-22. See Figure 7.09a for details.

Within the selected area, the station’s Eastern Plaza was fully built and opened in 2013; the original local residents who were transferred from ‘rural’ registration to ‘urban’ through the new town development are scheduled to be relocated to residential land in the south. In 2011, the apartments on this site were fully constructed and distributed to their owners (according to the author, every household on average owns an apartment with 300-square-metre floor area, or equivalent to about three apartments). At the time of this writing, the commercial lands to the north side were at a late stage of design approval or early stage of construction. Seen from the Google satellite maps as of May 2016 (which probably has a delay from the actual situations), there was no sign of construction on these lands (Figure 7.18).

Considering the various design/construction conditions across the site, two different strategies are applied in the design site. For those built projects, the existing condition is respected and feasible
suggestions are made for adjustments. For instance, the Eastern Plaza is proposed within the current built form to reprogram some of its internal spaces with the principle of ‘station urbanisation’; and the residential project is targeted at inviting station and urban users with improved spatial permeability and functional richness, but without significant rebuilding (Figure 7.09b).

For those lands not built/under construction, there will be a redesign strategy. This mainly involves the commercial lands, through which the author expects to exercise new thinking towards station–city integration. The original architectural schemes for these lands, which have been designed following the density and diversity limitations set by statutory planning, are challenged in the urban strategic design.

The urban design sets targets of high level integration and continuous demographic and urban functional flows between the station and its immediate areas. However, to implement a clear interpretation, the following paragraphs discuss the plaza, commercial lands and residential areas separately.

7.6.2 The Eastern Plaza

In the original design, the Eastern Plaza assigns its entire third subfloor and part of the second subfloor areas for car parking (serving HSR passengers). Passenger-oriented retail facilities are arranged on the first and second subfloors, and a bus hub can be found on the first subfloor. Aboveground, there are two major tower developments on both sides of the station canopy; to the south are two hotel towers (Towers A); and two office towers to the north (Towers B). Between Towers A and B there is a huge open space designed for the possibly large number of passengers gathering during peak periods (such as the huge travel demands annually before/after the Chinese New Year period). However, for the rest of the year, this is mostly an empty and neutral space (see Figure 7.16d-e for details).

Following the urbanisation of station principle, the above-discussed relocation of station car parking will release spaces on the second and third subfloors of the Eastern Plaza for urban purposes, such as small parcel storage and administrative uses of the emerging HSR courier services. Meanwhile, these spaces can also be leased as storage for the online businesses that will possibly occupy office spaces around the station.

The commercial facilities of the first and second subfloors will still serve the station’s passengers, comprised mainly of retail grocery and food stores. Some of these spaces will also be transferred for office functions to support the courier and storage businesses.

The hotel towers and office towers of the Eastern Plaza will be programmed according to their original purposes, but introduced to users directly from the HSR/metro infrastructures. The hotel guests will be mainly the ENT business visitors and HSR travellers, who take the locational advantage of being proximate to major urban transports and local living facilities (which are reached in the residential area through a new pedestrian bridge). The office towers are attractive to users of courier and online business companies, especially those that need large display spaces for their visiting customers, such as the furniture traders. Meanwhile, the large spanning spaces of the tower skirts are also possible to
accommodate art galleries, for artwork exhibitions and auctions. The convenient HSR and metro connection will encourage collectors and artists from all geographical scales to participate in art events in the station precinct.

The author also suggests two extra pedestrian bridges connecting Towers A/B to the urban ENT area across the arterial road (Figure 7.09a). The only bridge from the original scheme forms part of the east–west orientation axis, but does not provide efficient connections due to the 750-metre-long plaza north–south oriented. Increased pedestrian facilities correspond to the new principle of ‘parallel development’ to the station and will maximise the permeability between the station and its adjacent urban areas.

The empty open space between Towers A/B has huge social and commercial potential, which is, however, difficult to occupy by physical development. It is firstly a reserved space for possible large-scale passenger gatherings, as described above; and secondly, the current supporting structure of the Eastern Plaza does not support the further addition of significant floor areas above its surface, which is a feasibility issue. From another perspective, however, this open space has been used by local communities from around the station node for group dancing during mornings and evenings. It suggests that it is still possible to achieve a certain level of urban activity density in this open space (see Figure 6.14 of Chapter Six).

7.6.3 The commercial blocks

The commercial lands, which cover about seven hectares of area, are the main challenge in the urban design. The current approved architectural scheme for this area is restricted by a building height of 70 metres due to the presence of an airport in northern Hangzhou, and it has about 117,000 square metres of floor area designed aboveground, as well as 146,000 square metres of development underground. This scheme provides for a shopping mall, office and large capacity parking facilities for the ENT (see Figure 6.30 of Chapter Six).

By comparing Hangzhou’s seven-hectare area to equivalent land size developments from similar precedent cases in the Marunouchi of Tokyo Station, the Grand Front Osaka project of Osaka Station and the Zuidas area of Amsterdam, we may find two significant differences. First, the urban block size varies largely between the Chinese and overseas cases. In Hangzhou’s ENT, seven hectares are divided into two blocks but as one project, compared with eight blocks/projects in Tokyo. In Osaka, there are four connected towers over a hundred metres developed on half the size of land area. Even in the comparatively lower density case of Amsterdam, there are five individual projects on an identical size of land (Figure 7.07).

Second, different development densities can be observed from the studied cases. The author estimated the developed floor areas through data from Google Maps and Hu (2014), upon selected areas from Tokyo, Osaka and Amsterdam, with similar land sizes of seven hectares. The result is 750,000 square metres (above-ground) in Tokyo; 430,000 square metres (above/underground) in Osaka and 160,000
square metres (above-ground) in Amsterdam. If assuming a height restriction in these areas of 70
metres, then we will see 490,000 square metres (above-ground) in Tokyo, 200,000 square metres
(above/underground) in Osaka and 150,000 square metres (above-ground) in Amsterdam, which are still
substantially higher volumes of building development compared to Hangzhou’s approach of only
117,000 square metres above-ground (Figure 7.08).

Based on the above comparison study, the author has chosen to further divide the planned blocks from
the original planning to improve the permeability of urban flows in this area. By referencing the proven
block sizes in Japan and the Netherlands, the author suggests a new plan of seven urban blocks (land
plots number I–VII), with block sizes being cut down from the original 150–200 metres to less than 100
metres. The block footprints decrease from around three hectares in the original scheme to around 0.4
and 1.3 hectares. By including the planned small land to the south of the metro lines (land plot number
VIII), there are overall eight commercial plots for the development proposal (Figure 7.09a, also see Table
7.04 for details).

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Table 7.04. Comparison of planning outcome between current and new schemes (source of current
scheme: HIUPD)

Second, with regard to function (see Figure 7.11 for proposed urban functions and flows), the eight land
plots described above will provide a continuous retail environment on the ground level (and sub-level
one where necessary), providing facilities including supermarket, shopping mall, store, and restaurant to
meet the daily demands from local urban users. Above the retail level(s), three different anchoring
urban precincts are proposed across the commercial area to functionally respond to the three fragments

of the Eastern Plaza. These upper-level areas are also smoothly interconnected by an elevated pedestrian network.

Land plot numbers I–III face towards Towers B of the station plaza, which are therefore feasible for extending the courier, online business and art industries from Towers B into this area through the new pedestrian bridge. The author suggests this bridge to be trolley friendly to support the smooth flow of small goods across both sides. Further beyond, wholesale fashion traders from Sijiqing and other relevant industries such as fashion designers, photographers, advertising designers, art traders and IT services will find opportunities in this area. Hospitality facilities covering a range of affordability are also introduced into this area to accommodate business travellers.

In detail, land plot number I is proposed to house a serviced apartment complex, number II will be developed as an office complex and number III is a combination of offices and a business hotel.

In the middle part of this area, referring to land plots number IV–VII, a variety of educational facilities are developed for skill training and tertiary education. Trainees of these facilities are from metropolitan Hangzhou and cities within commutable (half an hour as based on the Hangzhou case) HSR riding distances, for purposes of professional study, continuing career training, pre-examination training (such as ‘Gaokao’, the highly competitive National Higher Education Entrance Examination in China) and tertiary education. These different programs will cover both short and long terms of study and are envisaged for full-time students who participate mainly during the day time and full-time employees who will come here after hours. Also, a segment of this area will be developed for the provincial library, which serves both local students and visiting readers traveling on the railway.

Apart from the training facilities, a small proportion of the floor areas is used for offices occupied by online traders and education administrators.

On the top floor of this area, there are two arenas proposed as a gymnasium and sport courts for students and residents in and around this area.

In detail, land plot number VI will be developed as a complex of office and educational functions; land plot numbers V–VII are proposed for training, library and sports facilities.

Land plot number VIII sitting on the southern end will serve users from the training facility, as well as local communities of the relocated apartments. This is firstly an affordable hostel for short stays of students, and secondly a training site for local rural residents who are seeking future skills to survive urban living. Meanwhile, school children from the metropolitan and HSR networks will be offered after-school classes here to develop their interests and skills. In addition, this site also provides entertainments such as cinema and karaoke, as well as living conveniences including grocery retail, food and beverage stores, as well as health services.
7.6.4 The apartment block

The 6.6-hectare residential block is the largest single urban block involved in this design. Although it has a location immediately adjacent to the station node, this highly enclosed large urban footprint offers no opening towards the station, which cuts off all possible direct access to/from the rail services. Meanwhile, there is a large number of apartments potentially available for lease, thanks to the policy of an average of three apartments being provided for every relocated family in this area. This means this residential area has significant capacity (and advantage) to accommodate future station users.

Based on the context analysis, three further aims can be interpreted from the design: to build a direct connection between the station and the residential area; improve the permeability level of this block; and provide urban service facilities to attract users.

The pedestrian bridge between Towers A of the Eastern Plaza is the first step in the design, which provides the opportunity for a station user to make the transition of becoming a local resident. This is an essential infrastructure to make it possible for HSR-based commuters to emerge. In addition, this bridge will guide the hotel guests of Towers A into local communities to experience the local cultures through new services and facilities in this area (see Figure 7.11 for details).

Second, the author suggests opening the original inner-block roads to public access, which will transform this area from a cul-de-sac into a through route for a greater flow of urban transport. In addition, this residential area is connected to the commercial area’s pedestrian network through a bridge on its northern side. The seamless walking connectivity will fully expose the amenities of the residential area, such as its central garden and a range of convenience stores for daily living, which will shape a future local life centre not only for residents but all urban users around the station node.

Third, it is suggested that the apartment buildings on the western and northern edges, with proximity to the station and commercial area, be made available for leasing purposes. Compared with the proposed hotel, service apartment and business hostel, these rentable apartments are most affordable for long-term stays or very cheap sharing-room hospitalities. HSR commuters, budget travellers and students are possible clients of these apartments. On the ground and first levels, it is possible to add new retail spaces between the high-rise rows, thanks to the non-underground parking space design (underground parking bays are mostly constructed below the community garden in the centre). The new retail edge will introduce affordable and convenient services, such as food (raw and cooked), grocery, foot/body massage, bathing, cosmetic beauty and hairdressing, to people from inside/outside of this community. Meanwhile, these retail additions will also provide a walking corridor along the edge of the residential area, connecting the pedestrian networks with its neighbouring precincts.

Table 7.05 provides a summary that analyses different approaches in the planning and design scheme of the ENT that respond to the listed practical principles in Section 7.2.0.
Table 7.05. Summary of the practical principles and responsive approaches in the planning/design proposal

7.7.0 Comparative analysis

Now we move to a qualitative analysis of the design outcome, against the overall objective set above as ‘high level integration between station and city’. As the transport planning and urban design are proposed at two different scales, they are separately discussed below, starting from the urban design of the node scale.

According to the discussion in section 7.2.0, the general objective of ‘high level rail-city integration’ is qualitatively measured by its outcome in three dimensions: high density of urban development; rich diversity of urban function; and urban translation between station and city. A comparison between the new and current schemes is developed in Table 7.05 to gauge the respective changes above in three dimensions. These changes are also diagrammatically presented by Figure 7.09a-b and Figure 7.13.
Table 7.06. Comparison of design outcome between current and new schemes (source of current scheme: Hangzhou Planning Bureau)

The comparison indicates that the new scheme includes significant changes for the following aspects:

First, an increase of the urban user mixture can be expected in the new scheme through reprogramming urban functions based upon the rail infrastructure operation (also see the envisaged functions in Figures 7.11 and 7.12; as well as flows between station and designed urban area in Figure 7.11). This exercise will trigger a shift of urban users from local residents, as targeted by the original scheme, to a population with easy access to the HSR nodes (within commute-able distances) and metro lines.

Second, the development volumes of commercial area in the new scheme (355,664 square metres) more than triples the current proposal (116,293 square metres) (also refer to the development floor area comparison in Figure 7.04a-e). This development density is close to the studied case in Tokyo, and beyond both cases from Osaka and Amsterdam (as assumed in the same condition of 70 metres building height, see Figure 7.08). It should be further pointed out that, this increased development volume is mostly generated by pedestrian traffic between the station and site, which has potentially very low dependency on the urban road infrastructure (Figure 7.11). This is a reverse scenario compared with the original proposal.

Finally, the new scheme encourages the diversification and customisation of its urban functions/activities, brought by an increased mixture of users from rail infrastructure (also see urban land-use comparison in Figure 7.05a-b). The ‘shopping centre + office’ template found from the current scheme does not respond to the rich diversity of rail users, nor does it echo the unique urban character of Hangzhou. By investigating and incorporating the cultural, industrial and historical features of the HSR

![Table 7.06. Comparison of design outcome between current and new schemes](image-url)
station’s parent city, the author is able to propose a functional balance between the established urban residents and HSR network in the central ENT area.

The above comparison enables the author to conclude that a qualitatively higher level integration between the station node and designed urban area is achieved in the new scheme (also refer to Figure 7.13). This conclusion, however, will be better supported by future research to benchmarking and quantifying the three discussed dimensions. Related disciplines such as transport engineering and planning will contribute with new methodologies to measure the level of ‘integration’.

In this urban design strategy, on the other hand, the author employs pedestrian traffic as the main flow to connect station and urban precincts, by creating new links across the arterial road and reducing urban block size. These approaches allow maximum 10 minutes (or about 500 metres) walking distance between the designed urban area and station. This high level of pedestrian accessibility without much reliance for support from vehicular access on urban roads gives the author confidence to make a qualitative judgement regarding ‘high level integration’, which is highly possible to be supported by further transport engineering formulas.

Comparatively, the PRT approach at the ENT (HONT) scale needs to be tested in relation to its potential performance in connecting the HSR station and urban HONT, although it has been theoretically supported of being effective in feeding rail infrastructure (Andreasson, 2011). By this suggestion, the author expects to encourage innovative thinking that will improve the efficiency of HONT transport planning, and find better alternatives to vehicles.

By comparing to the current planning scheme of the ENT, the new transport planning focuses on balancing the station connectivity competition between regional centres and urban HONT, the latter which is clearly ignored in the current scheme. Through introducing the ‘park and ride’ policy and PRT system to the ENT, the author expects to redistribute the limited urban road resources to meet transport demands of station users from both regional and HONT scales. Qualitatively, this resource redistribution encourages stronger links between station and further areas of urban HONT, with potential outcome of increased level of ‘station-city integration’ in these areas.

To summarise, both the transport planning at the ENT scale, and the urban design of the station node precinct scale, demonstrate different approaches to achieve strong physical connection between station and city in a HONT context. Although some of the approaches need to be quantitatively verified in future, these hypotheses will hopefully expand the boundary of current rigid HONT planning, and pave a new path towards better integration.

Beyond the Hangzhou case, the argued theory and its practical principles are also applicable to other HONTs in Chinese expanding HSR network, including the large number of HONTs around the mid-way stations, such as the eleven feeding stations around Hangzhou’s network. However, the various contextual scenarios of each HONT can lead to a range of different local solutions in achieving station-
city integrations. For example, the dedicated HONT transport can be either light rail, tram, or bus, depending on the scale of HONT and volume of users.

And in addition, a HONT practice is also challenged by customising the urban functions/industries against its counterparts in the HSR network. Compared with the traditional centre-hinterland urban hierarchies shaped by the branch and mainstream river system (Skinner, 1977), the contemporary HSR network has created a much more flattened relationship between its nodal cities, leading to much stronger ‘complementarity and competition’ (Bertolini and Spit, 1998: 37) relationship between each other. Again, this understanding urges an overall planning of urban functions/industries for the HONTs sitting in the HSR network, to encourage inter-complementary relationship instead of excessive competitions.

7.8.0 Conclusion

This chapter tries to test the argued theory through demonstrating its application in a particular HONT case. Similar to most other design theories, the theoretical principles can be approached through various ways in projects with different contextual backgrounds. Therefore, although some of the suggested approaches in the Hangzhou case are difficult to implement in other HONT sites, the theoretical principles are expected to be widely applicable.

By comparing the planning and design outcome with the original urban planning/design scheme, it is not difficult to see that the theory guides a possible way to achieve better HONT practice through increased station-city integration, although further innovations are still required to be tested in transport planning.

Against today’s widely criticised HONT practices based on duplicating established new town templates, the new theory tries to define the character of HONT living through translating the HSR infrastructure into different urban contexts. This translation aims at fully exposing the urban characteristics of each HONT defined by its geographical and cultural contexts; and, on a larger scale, to shape the richness of HONT experiences across the entire HSR network.
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Chapter Eight

Conclusion: Redefining urban living for future Chinese HONTs

8.1.0 Introduction

This thesis investigates China’s unique HONT (high-speed rail oriented new town) phenomenon, which has grown out of the country’s rapid urbanisation and ambitious HSR infrastructure development. It targets the widely observed and criticised ‘ghost town’ problems of HONTs from an architectural perspective, leading to an argument of physical urban ‘density’ and functional urban ‘diversity’ regarding the quality of HONT living. Based on in-depth knowledge of the substantial features of Chinese urbanisation and HSR development, the author aims to interpret the relationships between rail infrastructure nodes and their immediate urban areas. This focus shapes a preliminary theoretical framework for HONT planning and design through the customisation of densified and diversified urban developments and social/commercial activities around station node areas.

This research attempts to challenge the observed highly templated HONT practices and to create new theoretical understandings of and principles for improving HONT planning and design that fully recognise and comply with the unique features of Chinese HSR (high-speed rail) infrastructure. It is hoped that this thesis will trigger future interest in and investigations of the unprecedented Chinese HONT phenomenon.

This chapter presents a systematic summary of the author’s argument as set out in the thesis. The paragraphs below begin by summarising the findings of the prior chapters. This discussion is followed by a brief analysis of the theoretical impacts of this research. The research limitations are also discussed in relation to a profile of potential theoretical development. Finally, the chapter concludes by reinforcing the research statement through identifying lines of future research.

8.2.0 Research findings

The author has composed five chapters (Chapters Two through Six) to develop a systematic argument for the above research target. Each chapter focuses on specific and inter-connected research question(s). The findings of each chapter are summarised below:

Chapter Two (Research Question: How can we define future HONT living in China?) discusses the influences of rail infrastructure on urban life by defending a hypothesis that ‘high density’ and ‘diversity’ are the fundamental features of urban living around railway station nodes. This viewpoint is supported by case studies of railway stations with various scales and services selected from Japanese and European contexts. These cases also suggest that the integrated relationship between rail and city is shaped through the constant and highly repetitive translation of a large number of users between stations and urban areas over a long period of time. This pattern of station and city user translation is represented primarily by the idea of rail ‘commuting’ in contemporary cities. However, observations also reveal that
the established HSR infrastructures in Japan and Europe do not have strong ‘commuting’ characteristics in their daily operations. To parallel these observations, this chapter also reviews the ‘new town’ development pattern of historical and modern Chinese urbanisation. This review concludes that the widely applied ‘new town’ template in HONT practices does not support densified and diversified developments in urban HONTs, especially in the central areas where HSR stations are typically located.

Through this chapter, the author further develops the initial research question, as follows: How can we power HONT growth directly through the operation of HSR infrastructure, which does not have the same proven record of triggering urban commuting patterns as normal rail? Secondly, how can we challenge today’s ‘new town’ development template with customised ‘density’ and ‘diversity’ features in future HONT practice?

These questions are addressed in the following chapters. Chapter Three (Chronological Section: A historical review of Chinese relationship between rail and urban life) reviews the historically established mechanism of how rail infrastructure has powered urban growth and explores the kinds of relationships that have been shaped between rail and city both in and beyond China. By studying cases from Europe and the American West, the author theorises that rail infrastructure influences urban growth on two different scales: a regional/national scale, through which rail defines the anchoring urban industries, and a metropolitan scale, through which rail supports the expansion of the urban footprint. By juxtaposing this understanding against the developmental history of rail-city relationships in China, the author reveals that the Chinese railway has conventionally focused on long-distance travel, without a strong commuting character. Limited cases (such as Hangzhou) also indicate that, under certain conditions, the long distance-oriented rail infrastructure has significantly positive impacts on powering dynamic urban lives around station nodes.

Chapter Four (Geographical Section: A comparative urban life study of inner-city railway stations and their node precincts in China) further analyses the established rail-city relationships of inner-city railway stations across contemporary China. This chapter proposes a new concept of ‘SIDA’ with two scenarios to facilitate a comparative study of urban HSR case-studies visited by the author. The chapter reveals that current inner-city stations are mostly isolated from their immediate urban areas in spatial and functional dimensions. Therefore, a low level of station-city integration is widely observed. The author also finds that ‘traffic flows’, especially pedestrian flows, are highly effective and valuable for building integrated station-city relationships.

These three chapters develop a thorough discussion of rail-city relationships from an architectural perspective, which, in turn, lays a solid foundation to support further research in HONT planning and design. Based on these understandings, the author moves to examine station-city integration in HONT practices. This exploration is developed through the dichotomous study of urban ‘density’ and urban ‘diversity’.

Chapter Five (Density Challenge: Studies of HONT flow and development) explores the ‘density’ argument by discussing the conflict between theorised high-density development and observed low-
density practice in studied HONT cases. Based on the conceptual and case-study-based platform established in the preceding chapters, this discussion is developed through an analysis of the transport planning of HONT schemes, with a focus on studying the rail-city relationship shaped by proposed HONT ‘flows’. By further comparing three HONT examples from Shanghai, Hangzhou and Wuxi, the author finds that HONT transport planning is dominated by traffic flows between HSR nodes and regional destinations, which monopolize a significant proportion of urban HONTs’ limited transport resources without effectively facilitating urban activities or developments. As a result, weak transport connections between HSRs and urban HONTs lead to very limited support for urban HONT growth from HSR operations.

Chapter Six (Diversity Challenge: Studies of HONT function and programs) investigates the functional integration of station and city by studying the ‘user translation’ of both precincts. The author asserts that this integration relationship is represented through the ‘urbanisation of station’ and the ‘stationisation of city’, with the level of user translation between the two indicating the qualitative effectiveness of integration. Through this understanding, the author finds the three studied HONT cases to be, in general, very weak in user translation between HSR station and urban HONT areas. On the contrary, as a node within the polycentric urban network, HONT development is powered primarily by resources from regional centres. The lack of functional integration between station and urban HONTs is the reason that HSR and urban HONT operations are mostly separated. It is also true that the larger scale HSR network lacks the inter-complementary functional and industrial planning capacity to co-ordinate different HONTs; this is another reason for the disconnection between station and urban life.

The studies from the above chapters make it possible for the author to summarise a theoretical framework for HONT planning and design practices and to implement an urban design strategy by applying this theory to a real HONT site in Chapter Seven (Illustrating Theory: An urban design practice of Hangzhou New Eastern Town). The design outcome reveals that, given the highly effective connections between station nodes and urban HONTs, as well as an in-depth understanding of a city’s economic and social contexts, it is possible to identify connections between HSR networks and local industries that might trigger urban growth around station nodes with features of ‘high density’ and ‘rich diversity’ that are directly powered by the operation of rail infrastructure. This practice also proves that the theory articulated in this thesis has the potential to change future HONT practices by improving the quality of urban life.

8.3.0 Theoretical impacts

This thesis presents a qualitative and empirical study of the relationship between HSR nodes and the growth of their immediate urban areas from an architectural and urban design perspective. Unlike other HONT research studies, which are largely documented from the planning perspective and which focus on the impact of HSR on metropolitan industries and populations on an extended scale, this research focuses on the less studied HONT scale. In so doing, it offers a necessary supplement for a complete understanding of the relationship between HSR and urban growth.
The summarised theoretical framework of HONT planning and design emphasises the spatial and functional integration of the rail infrastructure and urban living. This understanding stems from a combination of knowledge about the specific features of the Chinese rail-city relationship learned by studying its past and present, as well as the mechanisms of shaping rail-city relationships learned from the experiences of Japan, Europe and America. So far, to the author’s knowledge, there is no identical research among the Chinese literature. Furthermore, compared to European studies, which primarily investigate inner-city station development modes, this author’s topic, which explores peripheral or remote urban locations, has rarely been examined in previous literature.

In general, therefore, the author is confident in stating that this thesis contributes to the extant knowledge of planning and design practice of HONT as a unique ‘new town’ phenomenon in today’s Chinese urbanisation and, possibly, a common pattern for future ‘urban’ living based on HSR infrastructure.

8.4.0 Research limitations and future development

As stated in the previous chapters, this research has limitations in terms of content and methodology due to the constraints of the author’s disciplinary boundaries, limited to the fields of architecture and urban design, and the available data resources.

In terms of content, this research emphasises the physical density and urban functions of HONT planning and design theory. However, the author understands that a complete urban design theory must cover a much wider range of urban issues, such as ecology (in a HONT scenario, this may refer to the impacts of rail infrastructure on urban, regional and rural ecological systems), sociology and anthropology (e.g., the localised urbanisation of peasants through HONT development, as well as the social impacts of domestic immigrants), and economy (e.g., the economic relationship between a HONT and its parent city, as well as the other HONTs of an HSR network; and the impacts of different rail infrastructure funding models). The summarised theoretical framework is a preliminary research outcome, which requires further, more detailed and inter-disciplinary collaborative studies.

With regard to the study methodology, some research conclusions are drawn from reference data on relevant studies or experiences, especially with regard to the discussion of urban transport capacities in a HONT. The author’s limited access to data resources and lack of disciplinary knowledge in the field of transport planning calculations precluded the development of any specific data verification of HONT transport performance. In future research, collaboration with transport planning professionals to develop more precise calculations will benefit and support the research conclusions.

Further, as the author has repeatedly advocated in this thesis, there should exist large-scale urban, industrial and functional planning to cover all HONTs in the HSR network. Such planning, which should fully consider industrial relationships at various scales, will effectively guide the growth of each HONT involved, eventually shaping a sustainable ‘HSR city’ that operates on the tracks. Research on such an
enormous scale is far beyond the author’s individual capacity; however, the situation urgently demands an immediate start on this important project.

8.5.0 Conclusion

China is not the first country to build and operate an HSR infrastructure; however, its HONT practice has no global precedent. The development of HONTs represents China’s substantial urbanisation, while also representing an opportunity to define the HSR infrastructure with an identity beyond its speed advantages and to shape a new pattern of urban living for human beings. It is undeniable that humans’ dwelling patterns have been constantly impacted and reshaped by the development of transport technologies. From the old livestock powers and river and marine shipments to the early railways of the industrial revolution, through recent automobiles and aircrafts and, finally, to today’s high-speed rail networks, historic shifts in transport modes have not only benefited their users through increased speeds and extended travel distances, but also transformed the rhythms, radii, and contents of human lives.

Through an in-depth understanding of the rail-city relationship in the HONT context, it is possible to predict that China’s future HONT planning practice may solve today’s dilemma of low-quality urban living experiences. Due to the tight integration of HONTs with the HSR infrastructure, it may be envisaged that, through the development of both multi-modal, integrated transport systems that reduce reliance on vehicles, and through an emphasis upon the development of a rich urban life, along the theory/principles set out in this thesis, through the ‘urbanisation’ of HSR stations, and the ‘stationisation’ of cities, improving economic and human flows, HONTs may, in the future, be hubs and propagators of vibrant urban life, sustaining both an improved quality of life and a resilient economic structure.
APPENDICES
## Appendix One

Collation chart of English/Chinese names of Chinese territories in the thesis, and their hierarchical relationship

<table>
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<th>Chinese Territory</th>
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<th>District/County in City</th>
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National capital city
Provincial capital city
## Appendix Two

**Collation chart of English/Chinese names of Chinese Rail lines, and their terminating cities**

<table>
<thead>
<tr>
<th>HSR Line</th>
<th>English/Chinese Names of Rail Line</th>
<th>Terminating Cities</th>
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<td>Jinghu HSR Line - 京沪高铁</td>
<td>Beijing - Shanghai</td>
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<td>Huhang HSR Line - 沪杭高铁</td>
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<td>Ninghang HSR Line - 宁杭高铁</td>
<td>Nanjing - Hangzhou</td>
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<td>Hangyong HSR Line - 杭甬高铁</td>
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<td>Hangchang HSR Line - 杭长高铁</td>
<td>Hangzhou - Changsha</td>
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<td>Hanghuang HSR Line - 杭黄高铁</td>
<td>Hangzhou - Huangshan</td>
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<td>Tangxu Line - 唐胥铁路</td>
<td>Tangshan - Xugezhuang</td>
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<td></td>
<td>Middle-East Railroad (Manchuria Branch) - 中东铁路</td>
<td>Chita (Russia) - Vladivostok (Russia) (routing Manchuria and Harbin in China)</td>
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<td>Southern Manchuria Branch (of Middle-East Railroad) - （中东铁路）南满支线</td>
<td>Harbin - Lvshun</td>
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<td>Jinghan Line - 京汉铁路</td>
<td>Beijing - Wuhan</td>
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<td>Jiaoji Line - 胶济铁路</td>
<td>Jiaozhou - Jinan</td>
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<td>Jingfeng Line - 京奉铁路</td>
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<td>Xuanhang Line - 宣杭铁路</td>
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Chinese urbanisation powered by high-speed rail: 
challenges for hyper densities and diversities

Shan He
   Bachelor of Architecture (Zhejiang University) 
   Diploma in Architecture (Cambridge University)

Volume II 
(Illustration)
PART ONE:

INTRODUCTION
Chapter One

Research Challenge: Current high-speed-rail oriented new town (HONT) practices in China

Figure 1.01. The rise of Chinese urbanisation degree with increasing national GDP between 1949 and 2009 (Source: redrawn from ‘60 Years of China’s Urbanisation: 1949-2009’, Urban China, 2009, Vol 40, pp20-21).

Figure 1.02. Mid-long term rail network planning (amended in 2008) of China (中长期铁路网规划图（2008年调整）), issued by the Ministry of Rails (Source: http://news.cngaosu.com/tupian/gsdr/2015/10/155.html, viewed 25 April 2016).
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Figure 1.06. Comparison of Hangzhou Chengzhan Station (inner-city conventional railway station, left) and Hangzhou East Station (new HSR terminal, right); the latter has much increased passenger capacity and footprint size (Source: author; based on data from Baidu Map).
Figure 1.07. Emptiness of a recently built HONT in Zhenjiang, Jiangsu Province, during morning peak hours, Feb 2014 (Source: photo by author).
Chapter Two

Research Question: How should we define future HONT living in China?

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![Diagram 2.01](image)

Figure 2.02. *The ‘node-place model’ for infrastructure node area developments, indicating a balance trend between the capacity of ‘node’ and development of ‘place’* (Source: Bertolini, 1999: 202, Figure 1)
Figure 2.03. Distribution of the 32 ‘new towns’ in the UK (Source: TCPA, 2014: 2).

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Figure 2.06. Planning proposal for Kuznetsk by Vesnin brothers, 1930, suggesting a 35,000 resident city structured by commune buildings each accommodating 1,100-2,100 people, with shared facilities (Yang, 1988: 11) (Source: Yang, 1988: 12, Figure 4).
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Figure 2.13. Tiananmen Square before (a) and after (b): originally built as one of the southern cluster gateways leading to the imperial ‘Forbidden City’, Tiananmen (literally ‘heaven peaceful gate’) was transferred into a statement of monumentalising Socialist ideology in 1950s by creating a new enormous political open space in front of it (c) (Source a: [http://hubao.an.blog.163.com/blog/static/41886843201201265245219/]; source b: [http://image.tuku.china.com/tuku.news.china.com/history//pic/2008-09-04/aa0862e9-2bb6-460e-8a97-168ff23eab64.jpg]; source c: [http://www.williamlong.info/google/upload/229_2.jpg]).
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Figure 2.16. Plan of Chang’an, Tang Dynasty, showing the two markets as enclosure spaces on both sides of the central axis, which allow the strict curfew management system to apply (Source: Wheatly, 1971: 412, Figure 21).

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Figure 2.18. Two ‘new town’ design samples in Shenyang (沈阳中近海滨水国际新城城市设计, by Teamzero, a) and Chengdu (郫县新城总体规划设计, by RSAA, b), both clearly representing the ‘monumentalising image characteristic’ feature in central areas and expansive residential blocks on fringes (Source a: http://www.teamzero.com.cn/; source b: http://rs-aa.com/).
Figure 2.19. Sales data statistics of commercial and residential lands in Hangzhou, 2015 (Source: drawn by author based upon data of TMSF).
Figure 2.20. Summary of railway stations visited in Japan (a) and Europe (b) (Image source a: https://upload.wikimedia.org/wikipedia/commons/a/ae/Shinkansen_map_201603_en.png; source b: Marti-Henneberg, 2013: 131, Figure 3).
**Figure 2.21.** Early rail infrastructures and suburban dwellings (a) of Hankyu Line (b), Osaka (Source a/b: Nikken Sekkei ISCD Study Team: 2013: 38-39).

**Figure 2.22.** Evolution of the railway network in Europe, 1840-1910 (Image source: Marti-Henneberg, 2013: 129, Figure 2a).
1872 ~

**Symbolic station building and city development**

Since 1872, the opening of the railway in Japan, main station buildings in major cities were designed in grand manner and magnificent style with ornamental verandas. The station buildings were characterized by their monumental forms and grandiose scale, reflecting the aspirations of central government and modernization.

![Symbolic station building](image)

1920~

**Department Stores at Private Railway Terminals**

Around 1920, it is said that department stores started developing the world’s first department stores attached to terminal stations called “terminal department stores.” These were a successful move in the “Great Depression” period and became the trend of the contemporary department stores.

![Department Stores at Private Railway Terminals](image)

1950~

**Emergence of “Public Station” – Proliferation of Station Buildings**

In the postwar period of recovery, Japan National Railways built station buildings containing commercial facilities, selling the “public station,” with the financial compensation of local government. This typology of building, called “station building,” became a nationwide phenomenon.

![Emergence of “Public Station” – Proliferation of Station Buildings](image)

1960~

**Expansion and development of underground malls**

As part of JNR efforts to develop station front areas, underground malls became a standard feature, incorporating shopping, leisure, and cultural spaces. This created a unique concept of railroad station-city development including underground malls.

![Expansion and development of underground malls](image)

1970~

**Active Redevelopment in front of Stations**

In the remaining existing facilities or establishing new station-building complexes, “Active Redevelopment” has expanded to include a variety of integrated activities including station building in buildings, provision of various entertainment facilities, on-site development and station-city connectivity development.

![Active Redevelopment in front of Stations](image)

1990~

**New age of “integrated station-city development”**

With upgrading of infrastructure necessary for station functions, station buildings underwent change as new stations were built. Various forms of “integrated station-city development” that integrate the station building, station interior or the station upper levels began to appear.

![New age of “integrated station-city development”](image)

**today**

![today](image)

*Figure 2.23. Six development stages of Japanese railway stations* (Source: Nikken Sekkei ISCD Study Team, 2013: 47).
Figure 2.24. Functional diagrams (a), and panorama photo across rail tracks including further urban developments from station (four buildings to the left, b) of Station-City (the new extension) of JR Osaka Station. A pedestrian bridge smoothly connects the Station-City to nearby development projects (c) (Source a: Hu, 2014: 124, Figure 16; source b/c: author).
Figure 2.25. Functional diagram (a) and photo of service guide sign (b) of JR Kyoto Station (Source a: Qian and Zhou, 2010: 105, Figure 6; source b: author).
Figure 2.26. Service guide (a) of JR Sapporo Station, and distribution of major facilities in the station-city (b) (Source a/b: http://www.jr-tower.com/page/catalog/jrt_shoppingguide/#page=3).
Figure 2.27. The originally 1914 built Tokyo Station has been ‘growing’ upwards and downwards during the past century (a). The recent opening of Gran Tokyo North and South Towers on the east side of tracks further defined the station’s urban character into a vertical dimension (b). The conventional 3 storey-old building, incorporating a hotel and gallery, is now much enriched by new office and retail facilities far above ground (Source a: diagram redrawn from Wu, 2006: 48, Figure 2; Photo 1/2 from Zhang and Li, 2011: 176, Figures 1 and 5; source b: diagram by author; Photo 3 from http://www.gotokyo.org/en/tourists/topics_event/topics/141208/topics.html, viewed 27 April 2016).
Figure 2.28. Extension of Sapporo Station underground pedestrian ways (Source: redrawn from Google Maps).

Figure 2.29. The industries served by Fuji Station (Source: http://townphoto.net/shizuoka/fuji.html, viewed 27 April 2016).
Figure 2.30. Both the façade (a) and foyer spaces (b) of Antwerp Central Station make strong ‘monumental’ statements, but its interior spaces (c) are substantially infrastructural. Station shops are laid in clusters along the platform mostly to serve passengers (d). In the quiet far end zone, there is a ‘diamond gallery’ presenting very limited ‘urban’ character of the station (e). The entire layout can be summarised by a sign board found in the station (f) (Source: photos by author).
Figure 2.31. Rotterdam Central Station sits between the city’s CBD area to the south and the Proveniersingel residential area since 19th century to the north (Westrik et al., 2009; a), with strong potential to shape its own ‘urban’ characters by functionally connecting these two precincts. Although the station design establishes a potential pedestrian link between the residential and business parts of city through its central tunnel, there is however little effort to transfer the station space from a pure infrastructure node into sophisticated urban space (b, c, d) (Source a/b/c/d: http://www.gooood.hk/Rotterdam-Centraal-Station.htm, viewed 27 April 2016).
Figure 2.32. Berlin Central Station (HBF) presents much increased functional sophistication than conventional European stations such as Antwerp Central, which can be discovered from the ‘IHR EINKAUFSBAHNHOF’ (her shopping station) board in the station (a, b). Apart from station services oriented at passengers (Service & Dienstleistung; Deutsche Bahn), we can also find retail clusters covering Gastronomie (gastronomy), Hartwaren & Mode (hardware & fashion), Presse & Buch (press & book), Gesundheit & Pflege (health & beauty), and Leibensmittel & Frische (food & fresh) themes. Although Berlin HBF has a central space of strong infrastructure character (c, d), identical to Antwerp Central, the wide range commercial facilities on multiple layers transfer the station into an urban destination on the rail network, which is a statement never made by the Belgium counterpart (Source a/b: author; c/d: von Gerkan and Hillmer, 2009: 49).
Figure 2.33. Barcelona Sants Station: giant boxes of a vertical hotel above the horizontal rail infrastructure (Source a: photos by author; source b/c/d/e: Barcelona Urban Development Bureau and Gao, 2015: 63-64, 66, Figure 1/2/6/7).
**Figure 2.34.** Atocha Station in Madrid, another large scale infrastructure node cutting into dense urban fabric (a, b, c, d), but presenting an interesting ‘urban forest’ under its conventional arches (e) (Source a: Yang, et al., 2012: 32, Figure 3; source b: Google Earth Software; source c/d/e: author).
Figure 2.35. Different functional parts of Chamartín Station (a, b), compared with a view of today (c) (Source a: López-Astorga, 1976: 44, English translation by author; source b: López-Astorga, 1976: 47; source c: Apple Maps Software).

Figure 2.36. Emptiness of the pedestrian plaza above Chamartín (Source: author).
A model that completes the transport network in the north of Madrid

*The design is for an urban environment prepared for high speed that consolidates the capacity of Chamartin station to convert it into a financial and transport pole*

*The proposed public transport can handle 72,000 passengers/hour*

*At 15 minutes from Sol by public transport*

**Figure 2.37.** Through increasing rail connections in Chamartin (a), this station is expected to power further urban regenerations in north Madrid (b) (Source a/b: Distrito Castellana Norte Madrid).
Figure 2.38. Diagrams of ‘Grand Front Osaka’, the north development connecting JR Osaka Station
(Source: Hu, 2014: 125, Figures 17, 18, English translation party by author).
Figure 2.39. The underground pedestrian network around JR Tokyo Station (Source: Okumori, 2012, Figure 2).

Figure 2.40. The elevated bridge system in front of JR Shin-Yokohama Station to provide seamless pedestrian connections across artery road (Source: Okumori, 2012: 26, Figure 5)
Figure 2.41. The underground area in Sapporo is warmed up by pedestrian flows during freezing winter (Source: http://img.m.club.pchome.net/upload/club/other/2014/2/15/pics_pwbpwb66_1392442562.JPG, viewed 28 April 2016).
Various data about Marunouchi

<table>
<thead>
<tr>
<th>Concentration of the world’s top companies</th>
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<tr>
<td>Marunouchi area</td>
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<tr>
<td>Other areas of Tokyo</td>
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<tr>
<td>New York</td>
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<td>Other</td>
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</tbody>
</table>

Companies listed on the first section of the Tokyo Stock Exchange

| Approx. 75 companies | ² |

Consolidated sales(1)

| Approx. 124 trillion yen | ² |

Number of employees

| Approx. 230,000 | ² |

Railway lines serving the area

| JR, subways | Total of 20 lines | ² |

Total number of train station users

| Approx. 2.35 million/day | ³ |

Area

| 120ha | ² |

Equivalent to 2.95 times the area of Tokyo Dome (Floor space 46,765m²)

Number of buildings

| 109 | ² |

Approx. 4,200 offices

Building floor space

| 709ha | ² |

Including the 7.7 ha under construction.

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1: Fortune Magazine (2012) *Global 500*

2: Survey by The Council for Area Development and Management of Otemachi, Marunouchi, and Yurakucho

3: OMY Community Social Responsibility Report 2011 *A Community for 1000 Years* by the Daimaru Yuyu Community SR Promotion Committee Secretariat

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**Figure 2.43. Various data about Marunouchi** (Source: Mitsubishi Estate Group, 2012: 6).
**Figure 2.44. Cultural precincts and events in Marunouchi** (Source: Mitsubishi Estate Group, 2012: 11).

**Figure 2.45. Location of Ueno Park next to JR Ueno Station down in the image, in the dense urban context of Tokyo** (Source: Apple Maps Software).
Figure 2.46. Diagram and a street board indicating major precincts in the park (a, b) (Source a: Jiang and Zhang, 2010: 76, Figure 1, English translation by author; source b: author).
Figure 2.47. Various activities attract streams of visitors even in cold winter morning (a); such as a walking competition was in progress during author’s visit (b) (Source a/b: author).
Figure 2.48. Roma Termini as a huge node in the middle of dense urban blocks, and isolated by square and artery roads without facility to improve pedestrian connectivity with nearby urban precincts (a). The ‘flatness’ of this station is typically presented by the square’s scale in the panorama photo (b) (Source a: Apple Maps Software; source b: author).
Figure 2.49. The small scale of Charlottenburg Station allows a cluster of community facilities agglomerated around it (a), such as the aged care apartment named ‘Seniorenpflege Birkholz’ shaping the station’s southern entrance (b), and many local shops across road to the north (c) (Source a: Apple Maps Software; source b/c: author).
Figure 2.50. Locational relationship of Zuidas to central Amsterdam and Schiphol Airport (a), with support from the rail network (b). The good connection transformed station immediate precincts as ‘frontier’ of developments in Zuidas, where most anchoring projects were agglomerated (c) (Source a: developed from Amsterdam City Council, 2009: 13; source b: Amsterdam City Council, 2009: 48; source c: Google Earth Software).
Figure 2.51. Location of JR Shin-Fuji Station on the Shinkansen network and its relation to JR Fuji Station (a); as well as development emptiness around JR Shin-Fuji (b, c) (Source a: developed from Google Maps, English by author; source b/c: author).

Figure 2.52. Urban space outside JR Fuji Station, a sharp contrast to JR Shin-Fuji (Source: http://townphoto.net/shizuoka/fuji.html, viewed 28 April 2016).
Figure 2.53. Location of Shin-Yokohama on Shinkansen and its relationship to Yokohama (Source: Nikken Sekkei ISCD Study Team, 2013: 79, Figure 2-62, English translation by author).
Figure 2.54. The urban growth of Shin-Yokohama between 1962 (left) and 2007 (right, a), benefitted from continuous rising of station passenger number (b) (Source a: Nikken Sekkei ISCD Study Team, 2013: 79, Figure 2-63; source b: Nikken Sekkei ISCD Study Team, 2013: 78, Figure 2-61).
Figure 2.55. The urban scape of Shin-Yokohama (a) and upcoming proposals of further rail connection into JR Shin-Yokohama Station with other regional destinations (b) (Source a: Google Earth Software; source b: street board photo by author).
Figure 2.56. The locational relationship between Gare de Lille Europe (up-left), EuraLille (middle), and Gare de Lille Flandres (below-right) (Source: Apple Maps Software).

Figure 2.57. Emptiness of EuraLille’s TGV side square and entrance (Source: author).
Figure 2.58. The other side of EuraLille was much populated, where Gare Lille Flandres is just a stroll away (Source: author).

Figure 2.59. Segovia AVE Station in the middle of undeveloped openness, connected only by vehicles (Source: author).
PART TWO:

REVIEW