Transport orientated development and commercialization of underground space in China: trends in Shanghai, Tianjin and Shenzhen

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Abstract

In China, there is significant interest in underground planning projects from City Governments, metro authorities and private developers. The success of commercialized underground space, when tied to metro developments, is dependent on the programming, design, operations, financial and long-term management model of its operators. This research makes qualitative comparisons in the underground development trends across the Chinese metropolitans of Shanghai, Shenzhen and Tianjin, three geographically, historically and climatically diverse cities with extensive metro-led underground spaces. Shanghai has the most extensive and commercially driven underground developments, followed closely by Shenzhen and Tianjin. The key lessons learned are the importance of spatial quality of undergrounds in attracting and retaining pedestrians, as well as the need to correctly position underground developments in congruence to the neighborhood needs above. If correctly positioned, underground retail corridors can be thriving and lively destinations.

Keywords: Underground space planning, pedestrian connection, commercial positioning, spatial design.

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1. Introduction

Chinese underground development has been picking up momentum with developers who wish to extend development space. Driven to a large degree by a regulatory context whereby permitted development for any site is for above ground only (i.e. developers can build as much below ground as they wish), there has been a number of high profile but unsuccessful underground developments in recent years, in large part due to lack of effective planning control, lack of integrated management and coordination between government departments, as well as over simplified imitation of foreign experience [1]. Additionally, while the Chinese development scale and speed is top-ranked, integrated planning and coordinated construction have not been realized due to preference for shallow “point and line” mode of unconnected, independent and single-functioned underground space [2].

Existing integrated underground space are commonly developed in parallel of metro stations. Operating under the transit-oriented development (TOD) principle of placing active uses within 400 meters walking distance of the station, developers and government have a mutual interest to connect surrounding uses to the station through underground passages. The government benefits from increased land sales that can offset new infrastructure costs while the developers attract increased passenger footfall through direct connections to their buildings.

This research focuses on commercialized underground spaces as related to transit-oriented developments and metro stations in Chinese cities. Shanghai, Tianjin and Shenzhen were chosen for the comparative study due to the maturity of their existing metro systems, its continuous growth of metro lines and the various degree of commercialization of their underground passages. In total, 18 stations with commercialized underground space were evaluated through site visits, representing a mix of hubs, interchanges and single stations in city centers, district centers and periphery developments. The overall purpose of the study is to help planners and designers understand the existing conditions of Chinese urban undergrounds, including which combination of physical criteria and policy framework produces the most successful and vibrant underground space.

2. Results

The following results examines the impact factors for the development of the underground space in the three cities, including historical background, population density, people’s behavior and the maturity of the services industry. Shanghai, Tianjin and Shenzhen are compared according to their physical underground space development, maturity of supporting underground policies, integration between the underground commercial space and metro stations, as well as the quality of underground commercial space.

![Fig. 1. Summary of evaluation.](image)

2.1. Impact factors

Shanghai is a Tier 1 city rich in historical and cultural heritage, at once multi-cultured, open and international. Shanghai was founded in the Yuan Dynasty around A.D. 1292. In the 19th century it has turned into a prosperous harbor and continued its economic success all the way to the Second World War. During this colonial period European, American and Japanese countries set up concession districts in Shanghai which greatly attributed to the
internationalization of this city. In the last census conducted in 2012, Shanghai’s population was 24 million residents with more than 14 million registered local populations. With an area of 6,340 square kilometers, it has a residential density of 3,809 people per square kilometer\(^\dagger\). Shanghai has a high proportion of service industry at 67.8% with an average disposable income of 52,962 CNY, the highest compared to Shenzhen and Tianjin. The streets of Shanghai are walkable with shaded and pedestrian friendly blocks from the concession period. Due to a high preference for walking and many public transportation options, including bike shares, quality and convenience are highly considered when developing underground spaces.

Tianjin is a Tier 2 historical city with a rich cultural background, but unlike Shanghai, developed conservatively and cautiously due to its relationship and distance to the capital. Tianjin was founded in the Ming dynasty around the A.D. 1404, and its proximity to Beijing greatly attracted western countries during The Opium War. In 1860, Tianjin was designated as a trading port with many countries setting up concession districts. With the Open and Reform initiative in 1984 the economy began to develop rapidly, including setting up the Tianjin Economic and Technological Development Area (TEDA). In the last census, Tianjin’s population was projected at 10.6 million residents with 2.9 million registered local population. With an area of 11,920 square kilometers, it has a residential density of 1,272 people per square kilometer. Tianjin’s service industry is 52% of its overall economy with a disposable income of 34,010 CNY, the lowest compared to Shenzhen and Shanghai. According to interviews with Tianjin residents, metro commutes are not the most popular form of transportation. This is attributed to the higher cost of metro tickets compared to other forms of public transportation, general walkable neighborhoods (especially in the the city center), and the inconvenience of old metro stations. For Line 1, which was constructed from a shallow canal in 1976, the lack of depth meant no direct access to the opposite platform for single stations in key parts of the city. In extreme cases passengers must exit the station hall completely and buy new tickets if they want to change directions, or else override to the next interchange station before reversing directions.

Shenzhen is a Tier 1 city and the first in China to open up to international trade as a Special Economic Zone in 1980. Prior to development Shenzhen used to be a scattering of rural villages. The open commerce attracted immigrants from all over China and developed rapidly in the past 30 years. According to the Financial Times, Shenzhen has become the Silicon Valley of China and to technology and financial companies such as DJI, Tencent, ZTE, Pingan Insurance and China Merchants Bank [3]. In the last census conducted in 2012, Shenzhen’s population was at 10.6 million residents with 2.9 million registered local population. With an area of 1,992 square kilometers, it has a residential density of 5,201 people per square kilometer. Shenzhen has a relatively high proportion of service industry at 58.8%, with an average disposable income of 44,633 CNY. Unlike other Tier 1 cities Shenzhen’s relative youth allowed the government to experiment with restructuring the city to reflect the market-centric growth, such as inviting foreign design firms such as SOM and SWA for shale the district masterplans [4]. However, the new avenues and wide blocks often lack pedestrian linkages and street scale conducive to street life. With ground activities restricted in Shenzhen, developers pushed to develop underground given the relative lack of restrictions [5]. Due to influence from Hong Kong MTR Corporation (MTRC), which is known for its self-sustaining and profitable ‘Rail plus Property’ model, the Shenzhen underground links are also focused around transportation and commercial connectivity [6]. The main elements of the model promotes maximization of traffic and land use so that each station acts as a hub of cohesive commercial and residential activities [7]. Additionally, the year round warm and humid climate of Shenzhen naturally encourages pedestrians to seek the air-conditioned and activity-filled underground corridors.

2.2. Physical underground space development

Overall Shanghai has the most progressive and extensive underground development, followed by Shenzhen and Tianjin. In Shanghai, shallow layers of between 15 to 40 meters of the underground space has been almost fully developed. By 2013, the area of Shanghai’s underground space reached almost 60 million square meters, including the 450,000 sqm headquarter under construction at the Shanghai Expo enterprise district and the 2.6 million sqm in

\(^\dagger\) China Census 2012
the Hongqiao Business District. At present Shanghai is preparing deeper underground space of 40-100 meters to accommodate infrastructure and transportation needs [8].

Tianjin’s limited underground space is concentrated mostly in the city center in shallow layers. In order to reduce cost in 1970, the Tianjin government utilized old canals for metro tunnels, which at the shallowest is less than 5 meters below the road surface. With the expansion of the underground railway network and planning of new towns such as Binhai, the underground space has developed into a more systematic network. In Binhai’s Yujiaapon district, there are approximately 4 million sqm of connected underground commercial space beneath 30 buildings in the new Financial District. Shenzhen’s underground development is characterized by extensive developments in the city centers, district centers and transportation hubs. By 2014, the underground space development is approximately 22 million sqm. By 2016, the city is building a 1000-meter-long underground shopping mall in the Huaqiang North station with a total area of 40,000 sqm.

2.3. Maturity of supporting underground policies and regulations

Chinese underground regulation is complex due to separation of duties within different departments, with planning, civil, defense, housing management and construction management departments taking part in oversight. There is existing policy framework for each city, such as the “Land Approval Regulations on Shanghai Underground Space Development and Housing Property Registration”, “Regulations on Shenzhen Underground Space Development”, “Planning and Management Regulations of Tianjin Underground Space” in 2006, 2008 and 2009 respectively. These documents detail regulations on underground space planning, implementation, acquiring of development rights, and legal responsibility, etc. However, there are general loopholes pertaining to underground development and usage, such as informally allowing private entities to develop the underground space without the above ground rights. Also, the pace of development outstrips existing guiding legislation. Tianjin has prepared the Tianjin Master Planning of Underground Space (2009-2020), but this fell short due to incomplete planning framework, absence of clear preparation method, and inability for the underground space planning to meet the regulatory framework of the surface level [9]. This was ultimately adjusted in the revised Utilization of Underground Space Planning in Tianjin Central City (2011-2020), which clarified all shallow and middle layer underground space must construct nodes around subway stations and done so to encourage integrated development.

2.4. Integration between underground commercial space and metro

There is an increasing awareness of integrated developments especially associated with TODs and metro connections. Out of all three cities, Shanghai has the most collaboration between metro and commercial developers. In Shaanxi South station, the Hong Kong-based developer for the upscale IAPM mixed-use development and Shanghai Metro managed to integrate a new interchange station beneath a luxury shopping mall. The metro vents have been integrated as part of the mall’s elevated green park while the metro exits are integrated directly into the mall basement and ground levels. This is perhaps the most successful example of public and private collaboration. The interface between the station hall to IAPM basement has the same high-quality décor as IAPM’s interior, with costs shared by the city and developer where property lines overlapped.

Fig. 2 Shanghai Shaanxi South station integration with IAPM.
Shenzhen, due to its influence from MTRC’s integrated development model, also has well connected and active underground corridors. The majority of the city’s main shopping centers such as Mix City, KK Mall, Yitian Plaza, Link City and Coco Park are developed collaboratively with metro authorities. There are comprehensive underground networks that connect metro exits to several destinations at once, and also connections between commercial destinations that bypass the station hall. The best example is the Futian-Shopping Park-Convention Center-Gangxia metro station link, where the 663 meter-long and 27,000 sqm underground Link City shopping corridor threads 3 metro lines, 4 stations and one high-speed railway station together via seamless connection. Tianjin has seamless connections but far fewer in comparison and usually located in the outlying new districts. Metro exits are contained within the edges of the above ground roads, with simple and direct connections to the surrounding buildings. In the case of Xiaoubaillou station, the metro exits simply onto a sidewalk despite a well-visited mall with basement access only 25 meters away. Since the mall came after the metro exits were planned, both authorities did not see the need to revise the underground connections.

2.5. Quality of underground commercial space

Shanghai once again has the most attractive underground space largely due to the willingness of private developers to collaborate with the development of metro stations. The overall high quality of the underground attracts pedestrians, for instance Jing’an Temple station, where underground corridors connect to 5 large shopping malls including Reel and Kerry Center. As shown in the photos, the spaces are wide, well-lit and layered to ensure multiple connections to different store basement levels, station hall and above ground exits. Each metro corridor matches the decor of the adjoining commercial establishments so as to give a consistent, high-level and visually appealing underground commercial space.

Shenzhen is also ranked highly in the overall quality of underground space and is dominated by linear underground space that connects to nearby office and business areas. There is strong focus on pedestrian linkages and shopping demands, which corresponds to the high daily ridership of over 2 million passengers. Mix City in Shenzhen’s Grand

![Fig. 3. Shenzhen Futian underground network](image)
Theater station is an example of quality underground commercial space, where riders are directed to Mix City through well-marked, well-lit and concession-filled corridors to the bustling basement level mall. There is a publically inviting sunken plaza to further draw pedestrians to and from the street level to the underground.

Tianjin's underground spaces are generally of good quality and are physically comfortable, however commercial activity is not active except when contained in the basement level of shopping malls.

![Image](image1)

**Fig. 4.** Shenzhen Grand Theater station to Mix City interface (L), sunken plaza (C) and basement level of Mix City (R).

Most of Tianjin’s underground space is unable to attract enough pedestrians due to its overall utilitarian characteristics. This is especially evident in the old town city center, where shopping centers such as Yingkoudao station have basement connections to metros that are not particularly inviting with dark entrances and poor wayfinding. Tianjin in general has depressed commercial activities, which negatively impacts any underground commercial development. This is attributed to two reasons. First, commercial malls have taken a financial hit due to increased online shopping. Second and most importantly, commercial activities are banned by the Tianjin Transportation Management regulations, which also forbids interior decoration in connection corridors between metro station hall and commercial space. Only advertisement spaces are available to personalize the underground space.

![Image](image2)

**Fig. 5.** Tianjin's Yingkoudao station. Uninviting underground entrance and functional transition space to The Exchange Mall. However, once inside the B1 level is pleasant with restaurants and gift shops.

### 3. Discussion

In the case study of the 18 different metro stations and their connected underground passages, there are four main key themes present on what makes commercialized underground corridors successful, vibrant, safe and inviting to pedestrians. These are the importance of integrated developments, focus on spatial quality, features that promote user experience, correct positioning and neighborhood impact.

#### 3.1. Integrated design

Features of integrated design include metro and retail integration, when the metro exit and retail interface are developed in coordination. Good design features include consistent underground décor, direct connection to basement level of buildings, promotion of business development of connected properties due to improved interface,
and intuitive wayfinding for pedestrians due to proper signage and lighting. The best station examples of integrated development are Shanghai Shaanxi South station, Shenzhen Grand Theater station, Shanghai Expo station and Shanghai Jing’an Temple stations because they contain seamless connections between metro and mall where the edges of one blends into the other. In the case of Shenzhen’s Grand Theater station where two competing and similarly positioned malls are connected to the same station hall, the developer who had the more visible and well-decorated underground corridor ushered in more pedestrians.

Transportation hubs also benefit from integrated design. In Shanghai’s Hongqiao Airport, a super hub was constructed in 2006 to include an airport, metro, national rail, long distance and local bus terminals, Maglev train, as well as exhibition space, office development and entertainment center known as The Hub. All are connected through B1 underground corridor, which ties the entire hub together as well as future commercial expansions to the west.

3.2. Spatial comfort is key

Spatial design and pedestrian comfort are vital in the success of the underground. Well-designed undergrounds bring qualities of the urban green and street-filled activities down to the pedestrians. In general, underground space that are privately operated has a higher spatial quality that state-owned or city-owned enterprises. In Shenzhen’s Huaqiang station, Century Place mall leased an entire metro exit corridor to extend the mall’s upscale decor to the transit passengers. As a result, Century’s visibility and feel is significantly better than those of other rival retail corridors accessible from the station hall.

Sunken plaza is a positive spatial feature necessary to counter the boxed in feeling of being underground. These plazas should feature outward facing retail and food establishments, have plenty of public seating and is within easy connections from the inside to the sidewalk above. The best examples include The River Mall in Shanghai, Coco Park and Huangting Plaza in Shenzhen. Coco Park’s plaza regularly hosts community performances and exhibitions, and its café-lined walls are inviting and well-used. Poorly built sunken plazas will deter pedestrians, and are characterized by abundant negative space, no green features, lack of public seating, use of too much heat-absorbing materials, and lack of access points from the street level. Tianjin Station’s north hall underground plaza felt uncomfortable and potentially unsafe, and is rarely used during the day due to lack of active features. Spatial comfort should also include have abundant natural lighting with regular light wells and extended ceilings. Lastly, underground corridors should incorporate regular nodes and transition spaces to break the monotony of long passages to provide pedestrians places to rest and socialize while also acting as an indicator between programed spaces, i.e. transition from retail to dining.
3.3. User experience

The success of undergrounds is not necessarily focused on just having the right mix of stores but how it makes people feel. Best undergrounds have strong wayfinding and gives pedestrians a sense of security and physical comfort. According to Singapore’s Urban Redevelopment Authority’s underground guidelines, the underground pedestrian network (UPN) should be at least 6-7 meters wide with a minimum of 4 meters of ceiling height. Shenzhen’s Link City is an example of this suggested ratio, where the 663-meter-long corridor is filled with natural lighting, water fountains, and public seating at key nodes, as well as cafes and restaurants that replicate the sidewalk experience. It also helps when the underground space matches the theme of the above ground, such as Shanghai’s Art Museum (Expo) station where the stall hall matches the red geometric museum building above. Underground corridors should avoid poorly-lit, poorly circulated spaces that gives feelings of isolation, such as the dark and much too long Hong Kong shopping street at People’s Square station. The site visits also confirmed that all retail activities are best kept at Basement level 1 or 2 (less desirable). Anything below is more suitable for utilities and Back of House uses [10]. This is evident in Shanghai’s Huasheng Street, where the near empty wedding-themed corridor on B3 is in sharp contrast to the bustling retail corridors above.

3.4. Correct positioning and neighborhood impact

Underground spaces in China are not necessarily about filling it with trendy and expensive retail storefronts, and it certainly will not attract pedestrians unless the uses are incongruence to the needs of the neighborhood above. It is also about mirroring the cozy and vibrant neighborhood streets above and getting into the right place and tapping the pedestrian flow. In order to be successful, it should contain a variety of uses to attract pedestrians throughout the day and week. Cheongmiao station in Shenzhen is mainly an office area with daytime workers. It is also a future interchange station with new retail and residential construction surrounding the station. The two underground malls attached to the metro station offer concentrated and affordable dining options for workers and residents alike. The shops also offer home accessories, fashion and small restaurants, often mixed together in one corridor with open food stalls. Although the corridors often feel cramped and chaotic, it is very popular and well used in the city due to its convenient location, air conditioning and the congestion-heavy neighborhoods above. It is successful despite not being a particularly beautiful space. Likewise in the Shenzhen North station, even though the commercial undergrounds are well-designed and well-integrated into the hub station hall, the lack of supporting neighborhood commercial developments and general lack of retail atmosphere causes the shopping centers to be underused until the neighborhood land uses change.
4. Conclusions

Chinese underground spaces are unique in its multi-functional abilities to provide humane and vibrant space for not just pedestrian connections, but also serve as a leisure and entertainment center for cities. Due to the fast growth of Chinese cities and the need to provide public infrastructure in a timely manner, the public and private collaborations have produced undergrounds that offer integrated and seamless connections between metro and the surrounding properties. This model is more prevalent in Shanghai and Shenzhen, though Tianjin is starting to experiment with integrated development on a joint MTRC project for the new Baiyunhe station. In a sense these underground networks promote urban density, and when built within the TOD model it encourages uses to be built and connected to the metro stations as much as possible within the 400-meter catchment area.

The highly commercialized form for Chinese underground are the conditions and product of the above ground developments. Due to the large size of blocks, which can be around 700 meters long in the Shenzhen city center, car-dominated wide boulevards, unfriendly sidewalks, reliance on public transportation, coupled with local factors such as extreme climate in cities, pedestrians are more inclined to view undergrounds as a convenient transit option and even destinations for social gathering. Therefore, undergrounds have incentives to be attractive. Underground spaces can be airy, well-lit with natural light wells, provide access to urban greenery through sunken plazas, promote sense of well-being through a right mix of services and sense of place, and serve as a way to bring the urban life below ground, whenever and wherever it is necessary.

As China’s second and third tier cities continue to build and expand their metro system and increased interest in public-private partnerships in funding public infrastructure, it is important to keep in mind that successful undergrounds should be positioned to suit the needs of their neighborhood and place the comfort of pedestrians as priority.

References