

Global Environment Facility 6
CHINA SUSTAINABLE CITIES
INTEGRATED APPROACH PILOT PROJECT

**TECHNICAL SUMMARY
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**SHENZHEN
SUMMARY REPORT**



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GEF-6 CHINA SUSTAINABLE CITIES INTEGRATED APPROACH PILOT PROJECT

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SUMMARY REPORT

GEF-6 CHINA SUSTAINABLE CITIES INTEGRATED APPROACH PILOT PROJECT

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Preface

The Sustainable Cities Integrated Approach Pilot was a worldwide program established by the multinational Global Environment Facility in its sixth funding round (GEF-6). As implemented in China, it was aimed at helping Chinese cities use the principles of transit-oriented development (TOD) to achieve sustainable land use policies and transit plans at the levels of city, transit corridor, and transit station. The five-year China project (GEF-6 China TOD) ran from December 2017 to March 2023. It was managed by the World Bank and implemented by China's Ministry of Housing and Urban-Rural Development (MoHURD) and seven representative large cities: Beijing, Tianjin, Shijiazhuang, Ningbo, Nanchang, Guiyang, and Shenzhen.

The Shenzhen GEF-6 Project Management Office (PMO) was managed by the Shenzhen Development and Reform Commission. The planning and design of the Shenzhen project was undertaken by several consulting technical organizations.* This report summarizes and evaluates the technical outputs of the project.

* The Shenzhen Branch of the China Academy of Urban Planning and Design was responsible for the formulation and implementation of the city-level TOD strategy as well as project management support. The Shenzhen Urban Transport Planning Center was responsible for the planning, construction, and management research of the Bainikeng neighborhood.



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Abstract

Transit-oriented development (TOD) is a sustainable urban development model centered around public transportation. During the Shenzhen's implementation of the GEF-6 China TOD project (January 2018 to March 2023), it incorporated the TOD model into the long-term urban development strategy of the city and of its current and prospective rail transit stations. The report summarizes the model of comprehensive improvement and sustainable development driven by TOD and also discusses methods to stimulate public participation in the TOD process. At the city level, the project aimed to integrate Shenzhen's existing urban and transportation plans and policies with advanced TOD experiences from both domestic and international sources. At the station level, the weakly developed Bainikeng area was selected as a TOD station area pilot. Implementing TOD strategies transformed Bainikeng into a high-value area. Condensing the distinctive experiences of TOD development in Shenzhen, the report provides valuable guidelines and references for future rail transit development in the city and in other cities of similar scale worldwide.



SHENZHEN

Part 1: TOD Strategy at the City Level

Shenzhen is a prefecture-level city in the southern part of Guangdong Province. It is situated on the eastern bank of the Pearl River estuary, bordering Hong Kong Special Administrative Region (SAR) to the south and the cities of Dongguan and Huizhou to the north (figure 1). Shenzhen is recognized in China as a national economic center and an innovative city. Its establishment as a Special Economic Zone in the 1980s transformed Shenzhen from a small fishing village into a modern and youthful megacity with a population of more than 17 million. The city spans more than 100 kilometers east to west, 60 kilometers north to south, and encompasses approximately 2,000 square kilometers. Since 2004, it has built 16 operational subway lines with more than 380 stations at the end of 2022. For the past 20 years, Shenzhen has used concepts of transit-oriented development (TOD) as part of its “railway + property” development model.

Figure 1: Shenzhen City Boundaries



Source: Shenzhen Urban Transport Planning Center, *Shenzhen Urban TOD Strategic Preparatory Report*, 2020.

1. Project Background

With the support of the Global Environment Facility grant, the Shenzhen project ran from January 2018 to March 2023. It aimed to promote an up-to-date TOD model for urban sustainable development centered around public transportation. The project included the formulation and implementation of TOD strategies at the city level as well as at the station level. At the city level, the project integrated the ongoing urban and transportation planning and policies of Shenzhen with advanced TOD experiences from domestic and international sources. It identified macrolevel issues and devise plans for the improvement of TOD in the city. At the station level, the Bainikeng neighborhood was selected as a station area pilot to demonstrate how TOD could elevate the value of urban spaces. The project also explored measures and implementation paths for public participation in TOD.

Rail Development and Early TOD in Shenzhen

Shenzhen was one of the earliest cities in China to use the TOD concept. Since opening its first urban rail transit line in December 2004, Shenzhen has constructed 16 lines, with a total operating distance of more than 564.8 kilometers and a line density of 0.26 kilometers/square kilometer. In 2021, the network transported 2.17 billion passengers, and the rail system's share of public transportation ridership reached 60 percent, a new record. Over the past 20 years, Shenzhen has adhered to the concept of "building a city through the construction of a subway." Its development process has evolved from a focus on rail transit stations to a more holistic, integrated vision embodied in the "railway + property" model, which has achieved good results.

During Phase One (1998–2005) of rail transit construction, the focus was on building the Luohu and Huanggang Port interconnection hubs to enhance connectivity with Hong Kong SAR. This was combined with land development and commercial arrangements to drive the development of surrounding areas and the comprehensive development of underground spaces.

Phase Two (2005–11) initiated overbuild, using the land above the subway stations to build 22,000 units of affordable housing and numerous public service facilities. During Phases Three (2011–20) and Four (2021–present), the focus was on promoting the integrated development of stations and cities based on the TOD concept and better integrating the functions of urban spaces and hubs (major stations connecting to external traffic). The "railway + property" model also generated innovations in rail transit investment and financing, including a model for land valuation as a capital contribution, which balanced the gap between rail transit construction and operation. At the same time, Shenzhen has carried out many policy and technical innovations. The Shenzhen Urban Planning Standards and Guidelines incorporate TOD control and guidance requirements such as station modification coefficients, mixed land use, public facilities, integrated transportation connections, and parking.

TOD Status at Project Initiation

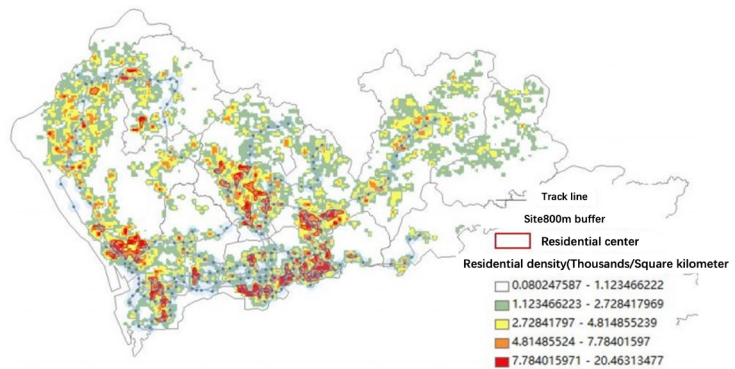
Shenzhen's rail transit system has been a contributor to the city's relatively good supply of housing and jobs. By the beginning of the GEF-6 China TOD project, however, the city still needed to overcome various challenges if it was to lead further urban TOD. Compared with regional benchmark cities such as Tokyo, Singapore, and Hong Kong SAR, Shenzhen still had some gaps in harnessing the role of TOD in urban development, implementing TOD development models, and providing supportive policy frameworks. Therefore, the GEF-6 China TOD project in Shenzhen made a systematic diagnosis of the problems and obstacles in TOD development to support the formulation of a more effective TOD process.

2. TOD Diagnosis

Although Shenzhen's rail transit system accounts for 60 percent of the city's public transportation share, high-density areas on the periphery of Shenzhen need more service. The population and job coverage within 800 meters of rail transit stations is 44 percent—good compared with other cities of similar scale in China but significantly lower than the coverage levels in Hong Kong SAR (67 percent) and London (54 percent). The integration and coordination between rail transit and other modes of transportation, such as buses and pedestrian networks, need to be strengthened. Green commuting (slow modes including walking and bicycling) faces bottlenecks, including wasteful competition between rail transit and surface buses, and a continued dominance of private cars over urban rail.

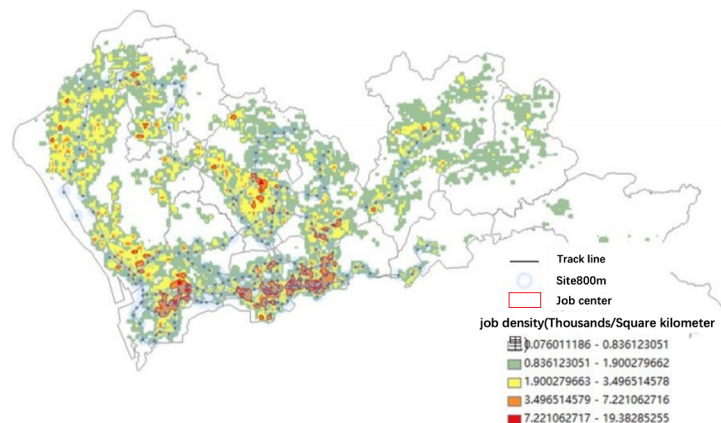
Moreover, due to geographical constraints, besides weak rail transit coverage, Shenzhen's road network is complex, resulting in longer commuting times (figures 2 and 3). The coverage of rail transit for residential and employment centers is primarily concentrated in the southern regions, such as Nanshan, Futian, and Luohu and is weaker in the northwest and northeast areas.

Figure 2: Rail Transit Coverage for Residential Centers



Source: Shenzhen Urban Transport Planning Center 2023.

Figure 3: Rail Transit Coverage for Employment Centers



Source: Shenzhen Urban Transport Planning Center 2023.

Misalignment of Rail Transit and Urban Development

Most of Shenzhen's growth has occurred outside the range of rail transit stations. For example, from 2010 to 2018, the increment of buildings within 800 meters of stations accounted for only 32 percent of the total increment. At the same time, rail transit coverage in key peripheral industrial zones has been only around 30 percent, which is less than 50 percent of the coverage within the original special economic zone. The coverage of public housing within 500 meters of transit stations radius has been less than 25 percent, and most public housing is outside the vicinity of rail transit stations. Some rail transit stations need more public spaces and public facilities, and there is room for improvement in integrating rail transit stations with residents' daily living spaces.

With the increasing separation between work and residential areas, Shenzhen has many areas with high density, low mix of land use, and low competitiveness of public transportation. During evening peak hours, Shenzhen's rail transit stations have an average of 3.9 million jobs accessible within 45 minutes by bus, which is significantly lower than in cities like Beijing (8 million), Shanghai (6.4 million), and Guangzhou (5.7 million).¹

Bottlenecks in the Development of the "Railway + Property" Model

In the four decades following the introduction of the national "reform and opening up" policy in 1978, the urbanization of Shenzhen proceeded rapidly.² By now, it has transitioned from expansion to a period of stock development. For example, as of the end of 2021, Shenzhen Metro Group has obtained comprehensive development rights for 20 land parcels covering an area of approximately 200 hectares, with a property scale exceeding 8 million square meters.³ The preliminary estimated development income of these 20 land parcels is around CNY 250 billion.

However, the supply of reserved state-owned land and other undeveloped land is decreasing, land acquisition costs have increased, and under the constraints of limited land resources, obtaining financing and land for rail transit construction has become more difficult and costly. As the supply of available land in Shenzhen becomes increasingly scarce, the construction and operation of rail transit must be approached through more sustainable and diverse business channels.

Currently, 77 percent of urban renewal projects in Shenzhen are located within 800 meters of Phase Four rail transit adjustment stations. But it is difficult to support rail transit construction through value recovery. The increase in land value brought about by rail transit construction has mostly been captured by social capital, including urban renewal projects.

Furthermore, to implement the central government's requirements for stabilizing land prices, housing prices, and market expectations, the Shenzhen municipal government has imposed certain restrictions on land development income.⁴ This has increased the impact of market fluctuations on the "railway + property" model.

1 According to data on public transportation accessibility at the digital map service Amap.

2 Reform and Opening-Up is a policy proposed in 1978 by the second generation of Chinese Communist Party leadership, led by Deng Xiaoping. It involves internal reforms and external openness. The establishment in 1979–80 of Special Economic Zones (SEZs) in Shenzhen and three other southeastern cities to allow more market-oriented policies stimulated spectacular economic growth, especially in Shenzhen, providing enormous support for China's urbanization and modernization. The SEZ in Shenzhen initially covered four districts—Luohu, Futian, Yantian, and Nanshan. Other cities were added in the 1980s and thereafter. The SEZ in Shenzhen was enlarged in 2010 to cover the entire city.

3 Shenzhen Metro Group is a large, state-owned enterprise directly supervised by the State-owned Assets Supervision and Administration Commission of the Shenzhen Municipal People's Government.

4 According to *Land Administration Law of the People's Republic of China*, urban land in Chinese cities is owned by the state.

3. TOD Vision Setting

Shenzhen's pattern of urban development through rail transit over the past 20 years ranks among the most successful in the country. Now, in the midst of problems with the continuation of past development strategies, the five-year GEF-6 China TOD project to implement best practice in TOD has opened up the possibility of a new economic, social, and environmental mission for Shenzhen and other cities in China. The lessons of the GEF-6 China TOD project show that intensive and efficient spatial growth tied to the strategic development of public transportation can fulfill the new mission under the pressures of population growth and constrained land resources. In the formulation of the new TOD vision, it is essential to fully consider Shenzhen's urban characteristics, incorporate input from stakeholders, align with the new urban, spatial, and transportation strategies of Shenzhen, and ultimately benchmark against the new vision and strategy of advanced sustainable cities worldwide.

Shenzhen's TOD Experience and New Necessity

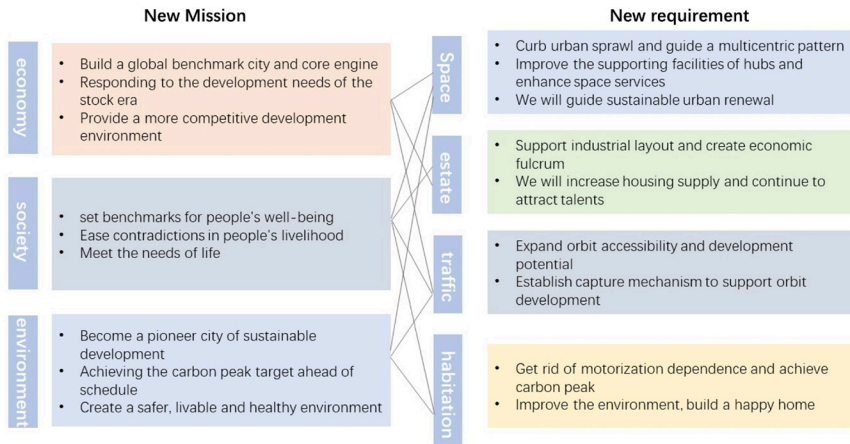
Shenzhen was among the first cities in China to practice TOD at the strategic level of urban development. The scale, speed, and effectiveness of its program ranks it among the best in the country. Over the past two decades, Shenzhen has continued to explore TOD in its rail transit planning and construction practices. The *Shenzhen Urban Master Plan (2010–2020)* prioritized a city development strategy oriented toward public transportation. In 2012, the *Shenzhen Transportation White Paper* proposed a transportation development model in which land development would be designed to prioritize and accommodate public transportation.

Today's rail network is centered around the urban core areas represented by Futian, Luohu, and Qianhai and connects the peripheral centers with the core areas through six radial lines. In the new era of development, rail transit and road transportation serve as the spatial backbone. Shenzhen must strengthen the supportive role of public transportation, especially rail transit, in the rational development of new spaces.

Shenzhen would be most effective if it applied its economic, social, and environmental mission in four areas of action: spatial, industrial, transportation, and livability (figure 4).

- *Spatial*: Shenzhen guides development through smarter and more efficient spatial structures while maintaining a land use pattern conducive to the development of public transportation, thereby activating the city's development potential.
- *Industrial*: The city increases its economic competitiveness by improving the market-based allocation of production factors and strengthening its support for talent development.
- *Transportation*: Shenzhen improves transportation services and achieves greater financial sustainability.
- *Livability*: Shenzhen promotes green and low-carbon transportation, achieves early carbon emissions peaking, and creates a safer, healthier, and more attractive living environment.

Figure 4: Analysis of TOD Necessity under Shenzhen’s New Development Mission



Source: Shenzhen Urban Transport Planning Center 2023.

Development of Shenzhen’s TOD Vision

TOD supports high-quality, resilient, and sustainable development. Thus, as a high-density megacity with constrained land resources, Shenzhen faces new national strategies and urban development situations for which comprehensive city-level TOD is ideally suited. The project’s technical team has helped Shenzhen gain a clearer understanding of the problems it faces in the urbanization process and the vital role TOD plays in creating social, economic, and environmental benefits.

Based on the analysis of key issues to be addressed in the new phase of TOD and incorporating stakeholder opinions, the technical team has formulated a shared vision for Shenzhen’s new phase of TOD:

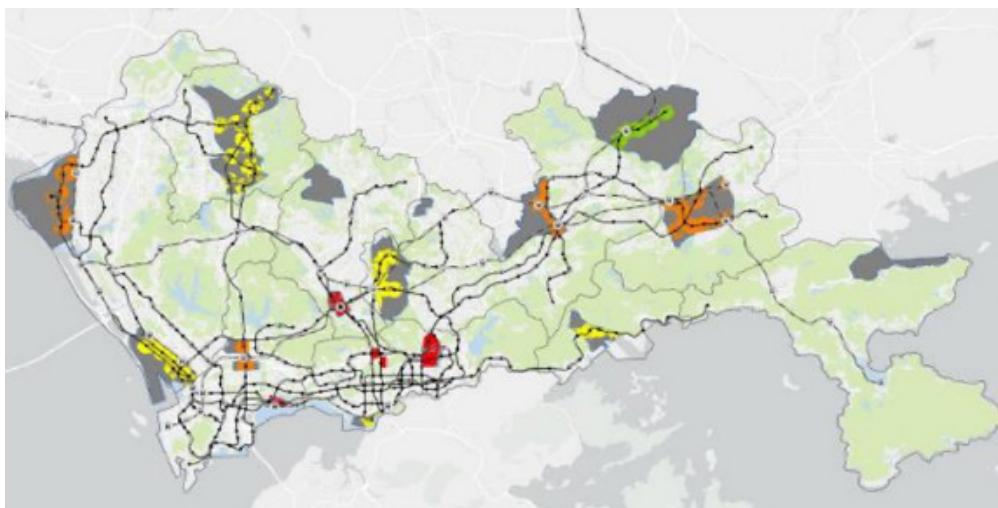
- Continue building Shenzhen as a demonstration zone for socialism with Chinese characteristics.
- Implement the Guangdong-Hong Kong-Macao Greater Bay Area national strategy, centered around the people’s aspirations for a better life.
- Establish a model of a rail transit city that is accessible to all, regionally connected, and sustainable throughout the entire life cycle.

Achieving this vision will contribute to Shenzhen becoming a globally recognized benchmark city in terms of competitiveness, innovation, and influence while achieving early carbon emissions peaking.

4. TOD Implementation Plan

Shenzhen’s rail facilities have formed a clear and beneficial structure supporting an industrial spatial layout. However, the total demand for cross-city travel, and especially by rail, is rapidly increasing. Currently, more than half of the key development areas in Shenzhen are located outside the original four districts of the Special Economic Zone and in noncentral regions, where a public transportation mode that supports “new growth poles” has not yet been established (figure 5).

Figure 5: Rail Transit Coverage of Recent Key Development Areas



Source: Shenzhen Urban Transport Planning Center 2023.

Optimization of the Rail Network, Bus System Improvement, and Promotion of Green Travel

There is still room for improvement in Shenzhen's transportation structure. The technical team proposed addressing the current issues of the rail transit network from three aspects: optimizing the transportation structure, improving the bus system, and advocating for green travel.

The Transportation Structure

The team recommended reorganizing rail transit routes on the periphery of the core areas that do not have direct connections and promoting differentiated development of fast lines (for express trains, with fewer stops) and slow lines (lines serving many more stops) by allocating the stops and distances of each line appropriately.

Improve the quality of the last-mile service, optimizing rail transit connections and facilities, and providing convenient amenities around rail stations to improve the quality of secondary transportation systems and expand door-to-door accessibility. For example, consider canceling bus routes with poor passenger flow that overlap with rail lines for more than five stops. On the basis of passenger surveys and road conditions, plan flexible and convenient shuttle bus routes that connect rail stations with residential and employment centers, catering to the needs of citizens and promoting efficient multimodal transportation.

The Bus System

To improve the bus system, the team proposed a comprehensive approach that would include pedestrian and bicycle travel and the rail transit system. Comprehensive transfer facilities should be established at core nodes to guide the flow of people and facilitate transfers between different modes of transportation. A well-developed bicycle network system should be constructed around stations, reducing intersections with urban expressways and main roads, and ensuring continuity of bicycle lanes. Combine above-ground and underground spaces in stations, and set up entrances/exits in a manner that guides pedestrian flow and expands the scope of walking connections.

Green Travel

The concept of green transportation implies boosting green transit—integrating rail transit, buses, nonmotorized vehicles, and walking—and restricting the use of private cars. The latter involves a suite of actions that collectively reduce the convenience of travel by automobile. The awareness of green travel should be promoted among citizens, the core competitiveness of the rail transit system should be enhanced, and a healthier lifestyle should be encouraged (figure 6).

Figure 6: Examples of Green Travel in Shenzhen—Bus, E-Bikes, and Bicycle Lane



Source: Beijing Jiaotong University, 2023.

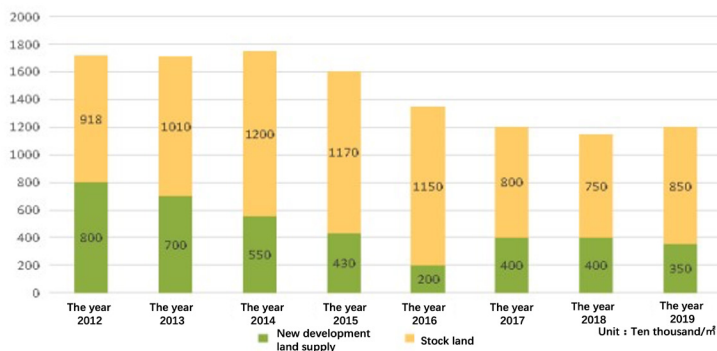
TOD-Driven Stock Land Consolidation

Shenzhen has high development density and limited land available for further development. In 1986, the development land area (or stock land—that is, land with buildings) in Shenzhen was about 74 square kilometers. After 30 years of development, Shenzhen’s stock land supply exceeded the supply of newly added construction land, making it the first city in the country to enter the stage of stock development primarily focused on urban renewal. By 2019, the construction land area had reached approximately 1,070 square kilometers, an increase of about 14.5 times, with construction land accounting for more than 50 percent of the city’s total land area. The *Shenzhen Master Plan for Land and Space (2020–2035)* states that Shenzhen is the first megacity in the country to face land constraints and the first to transition from incremental expansion to stock optimization in spatial development.

Shenzhen’s 2020–2035 master plan promotes the redevelopment and revitalizing of underused stock land through urban renewal and land consolidation (figure 7). The plan strengthens the comprehensive development of above-ground and underground spaces and transforms the scope of resource utilization from two-dimensional plane space to more efficient three-dimensional space.

Figure 7: Shenzhen’s Construction Land Supply

In units of 10,000 square meters



Source: Shenzhen Urban Transport Planning Center 2023

TOD fits well into the phase of stock development. The technical team drew on the experience of organic development at Tokyo's Oimachi Station to explore the models of stock land consolidation and urban renewal that could be applied to Shenzhen. The team classified land parcels into five development categories: (1) retained, (2) to be consolidated, (3) demolition and reconstruction, (4) comprehensive improvement, and (5) mixed development.

Efforts in the tourism area of Xia Sha are an example of category 5 (mixed development). There, the team aims to transform the stock developed during the area's brief experience into more expansive facilities for leisure and experiential tourism and lifestyle. The plan, driven by the development of rail transit Line 9, integrates urban-rural tourism and business development resources (figure 8). It involves partial reconstruction while preserving some of the original urban texture. Simultaneously, the retained areas will undergo spatial reorganization and improvement. A comprehensive development of new and old areas is intended to organically integrate different areas will be achieved. The approach in Xia Sha, which goes beyond industrial upgrading to urban spatial reconstruction, will help establish mechanisms for urban renewal and design control elsewhere.

Figure 8: Urban Renewal Driven by Rail Transit in the Xia Sha Area



Source: Beijing Jiaotong University, 2023.

Integration of Rail Infrastructure and Vertical Development

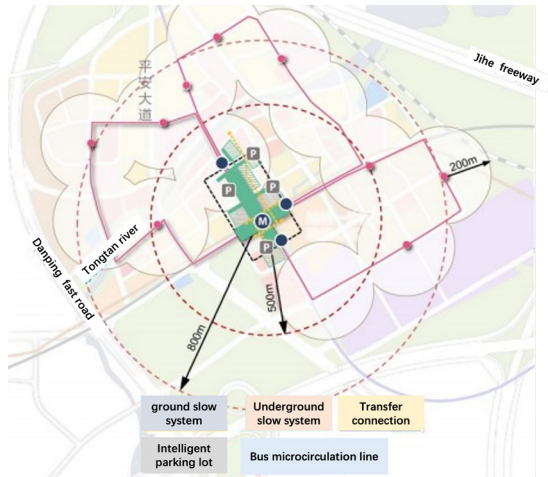
The construction of rail transit stations in Shenzhen has focused on the two-dimensional plane and floor-area ratios, which does not support intensive land use or complex spatial development. The technical team developed planning strategies to guide the vertical development at stations, enrich the vertical functions, and establish a pedestrian system incorporating underground, ground-level, and aerial levels.

The vertical development of rail transit focuses on underground space development centered around transit stations to achieve integration of the station, the surrounding open space, and city. The overall organization of the planning area should provide citizens with a convenient and efficient rail transit transfer experience.

For example, at the Bainikeng Station, a network is formed by interconnecting the land within the core area of the hub, and the entire system is connected through underground streets (figure 9). Combined with the synergistic design of green spaces and urban public spaces, it complements the surrounding urban functions. Various transportation connections are concentrated to provide multiple options for the “last mile” of the station.

A multilevel pedestrian system that includes underground, ground-level, and aerial levels strengthens the connection between transit hubs and buildings. It will improve the efficiency of the station and expand its range into the surrounding area. At the Bainikeng station, a multilevel, accessible pedestrian network connects living, employment, entertainment, and leisure spaces through internal roads, open spaces, and second-floor corridors .

Figure 9: Composite Development of the Bainikeng Transit Hub Above and Below Ground



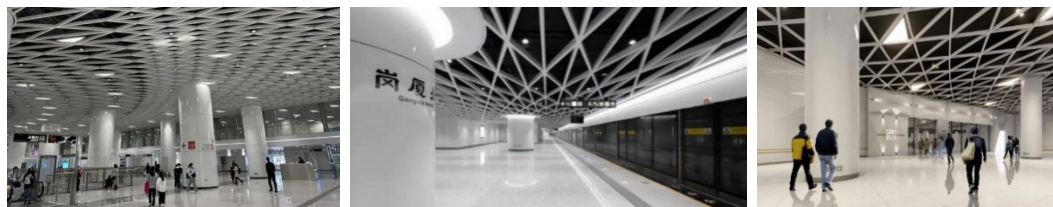
Source: Shenzhen Branch of the China Academy of Urban Planning and Design 2023.

For another example, the Gangxia North interchange (figure 10) connects four rail transit lines: Lines 2, 10, 11, and 14. The interchange has 23 entrances/exits, including seven rail transit entrances/exits. The space of the interchange is divided into five levels, three of them underground:

1. The mezzanine level includes an urban overhead corridor (at the same level as Metro Line 2).
2. The ground level includes a sunken plaza and surface buildings.
3. The first underground level includes the interchange station hall.
4. The second underground level includes the east-west platforms and track areas of Lines 11 and 14.
5. The third underground level includes the platform level of Line 10.

The interchange has a total length of about 900 meters from east to west and 620 meters from north to south, with a construction area of about 244,000 square meters. It is connected to the underground commercial development of Caitian Road and Shennan Avenue and with Gangxia Station (Line 1).

Figure 10: Interior of Gangxia North Rail Transit Hub



Source: Beijing Jiaotong University, 2023.

5. TOD Implementation Support

Complex land ownership, diverse development models, and the challenges of coordinating multiple interests hindered the continued implementation of Shenzhen’s long-standing “rail + property” model. The arrival of the GEF-6 China TOD project gave the opportunity to chart a new course for TOD in the city. Carrying out the project required a new level of collaboration among existing institutions in Shenzhen, innovations in financial support, and a greater capacity for monitoring and oversight of the contemplated expansion of complex TOD.

Institutional Support

The Shenzhen municipal government, through the Shenzhen Development and Reform Commission, established the GEF-6 China TOD Project Working Group to ensure strong coordination and comprehensive development of TOD projects.⁵ In addition, a specialized TOD team was established at the city level to formulate a working mechanism for planning coordination, land transfer, and comprehensive development. The TOD team also implemented rules for coordinating cooperation in cross-city rail transit construction and TOD development between Shenzhen, Dongguan, and Huizhou.

Financing Diversification

The main funding sources for rail transit construction in Shenzhen had been government investment, land financing, and social capital, with the first two of those as the main source and social capital as a supplementary source. However, in recent years, with the slowing of Shenzhen's economy and public revenue growth, public financing of rail transit construction had been decreasing annually, making it increasingly challenging to raise construction capital. As for land financing, it faces challenges such as urban renewal, land consolidation, and clearance of construction land. The increased number of stakeholders and rising costs make land financing more difficult.

To further diversify the channels for financing rail transit construction, the technical team promoted (1) joint investment in construction by the municipal and district governments and (2) enhancing the use of the public-private partnership (PPP) model to achieve a more standardized operational process that leverages the role of market-oriented operation by social capital.

Data Support

Establishing a system of performance monitoring and evaluation is crucial to assess the effectiveness of TOD implementation and make timely adjustments. The technical team developed the Shenzhen Public Transit-Oriented Development Information Data Online Management System, an information and data platform that is linked to the national TOD platform and other pilot cities of the GEF-6 China TOD project.

With the support of the platform, government departments can reflect on existing policies, macroscopically evaluate the current situation, adjust statutory planning accordingly, develop coordinated strategies, determine the timing and urgency of various projects, decide the direction of government funds, and formulate special policies to encourage integrated development of stations and cities and urban renewal.

Rail transit construction and operation enterprises can collaborate with developers to explore profit models, understand the government's and developers' demands, and propose management and operational models for integrated station-city development.

Developers can receive guidance and evaluation of spatial design for the development of surrounding plots, understand the demands of various departments in construction and management, and lay a foundation for successful future operations.

⁵ The Working Group was chaired by the Deputy Mayor, with members from the city's Development and Reform Commission, Justice Bureau, Finance Bureau, Urban Planning and Natural Resources Bureau, Transport Bureau, State-owned Assets Supervision and Administration Commission, Rail Transit Construction Command Headquarters Office, various district governments (management committees), and the Shenzhen Metro Group.



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Part 2: Station-Level Analysis: The Bainikeng Area

Located in the border region between Shenzhen and Dongguan, Bainikeng is a suburban area with a rail hub surrounded by four high-speed roads.⁶ It was selected by the GEF-6 China TOD project in Shenzhen as a pilot study on sustainable urban renewal-oriented TOD. It offered the opportunity to explore regional collaboration and provide an example for other areas facing TOD challenges in suburban areas. More generally, a station-level TOD project helps assess and provide feedback on TOD strategy at the city level.

1. Overview of the Bainikeng Area

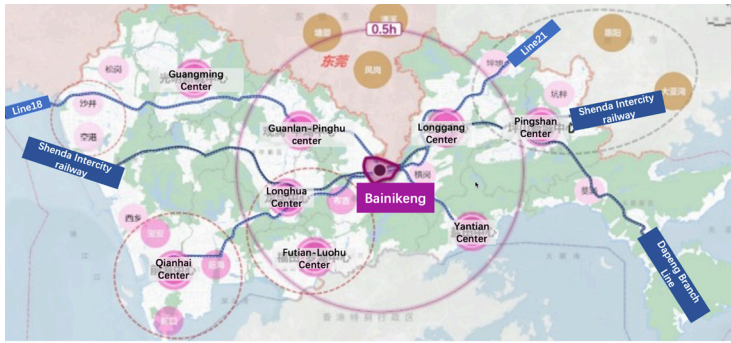
The Bainikeng community (figure 11) sits astride the Dongshen River in the Longgang District, along the southern part of Pinghu Street, 10 kilometers from the city center. It is adjacent to the Xinmu and Liangan Tian communities in the northwest, and on the south shares boundaries with Nanwan Street, Henggang Street, and Dongguan City. The area is conveniently connected to multiple highways (Yanpai Expressway, Jihe Expressway, Shuiguan Expressway, and Danping Expressway) and rail lines (Line 18, Line 21, and the Shenzhen-Dayawan Intercity Railway). The community covers a total area of about 8 square kilometers and is relatively underdeveloped due to its location on the outskirts of the core urban area.

The research scope was divided into three rings: region, station area, and hub area (figure 12), with each ring at roughly 1,000, 500, and 200 meters, respectively, from the Bainikeng Station:

- The regional level encompasses the area enclosed by the Jihe Expressway, Yanpai Expressway, Shuiguan Expressway, and Danping Expressway, a total of approximately 368 hectares.
- The station area level includes the area enclosed by Heluan Road, Shuilong Road, Danyi Road, and Ping'an Avenue, a total of approximately 94 hectares.
- The hub area consists of the area enclosed by Dingtoubu Road, Hengdongling Road, Quwolong Road, Xiangfa Road, Huanbaidong Road, and Tangbian Road, a total of approximately 21 hectares.

⁶ Dongguan, a prefecture-level city in the southern part of Guangdong Province, borders Shenzhen to the south. The Dongguan-Shenzhen commuting corridor is an important transportation route for cross-city commuting in the Greater Bay Area.

Figure 11: Highway and Rail Connections in the Bainikeng Area



Source: Shenzhen Branch of the China Academy of Urban Planning and Design 2023.

Figure 12: Three Research Zones for Bainikeng Station-Level Project



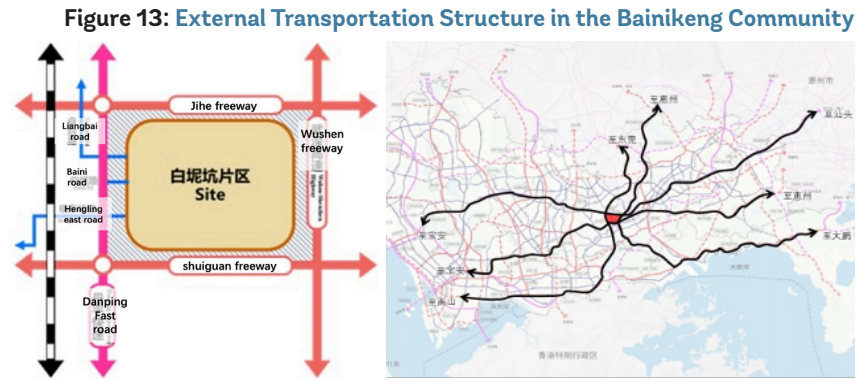
Source: Shenzhen Branch of the China Academy of Urban Planning and Design 2023.

2. Development Status in the Area

The Bainikeng area is located in the second ring of Shenzhen, on the periphery of the urban core area with a mix of urban and rural land. The surrounding external highway network is well developed, but entering and exiting the area requires using Danping Expressway, which leads to traffic congestion and low reliability during peak hours. The buildings in the area are aging, low-rise, and of poor quality. Sprawling trading and logistics districts leave too-little room for residences and service facilities.

Road Transport Difficulties

Currently, there are only three roads that connect to the auxiliary road of the Danping Expressway within the internal road network, Hengdongling Road, Baiping Road, and Liangbai Road. When traffic is congested on Danping Expressway or these three access roads, it significantly degrades the usability and reliability of the road network in Bainikeng and reduces its reliability (figure 13).



The road infrastructure in Bainikeng requires significant upgrading. It has poor overall connectivity and numerous irregular intersections, resulting in disorderly traffic operations. The roads are generally too narrow even for motorized traffic, let alone for slow modes. The only arterial road in the area is Hengling East Road. Since the opening of the Haijixing Industrial Park in 2011, a great deal of traffic has relied on village roads. The resulting movement of freight vehicles through residential, school, and service facility areas is inefficient makes life less healthy and more difficult there (figure 14).

Figure 14: Traffic Mixing Situation in Bainikeng



Source: China Academy of Urban Planning and Design, 6-Month Progress Report, 2021.

Integration of Urban and Rural Development, Inefficient Spatial Development

Urban and rural development coexists in Bainikeng. The overall spatial quality is poor: low-end factories and urban villages are scattered throughout, suffering from significant mutual interference and poor environmental quality (figure 15). Building density is low, and the buildings themselves, mainly one to three stories, are old and of relatively low quality.

Figure 15: Layout of Buildings in Bainikeng



Source: China Academy of Urban Planning and Design, 6-Month Progress Report, 2021.

Lack of Living Service Facilities

Facilities to meet the internal service needs of the area are insufficient. Residential land accounts for only 12 percent of developed land, and the related living and public service centers are mainly concentrated along the Dongshen River and around Bainikeng Park. Industrial land occupies 56 percent of developed land and is distributed around the residential areas, while logistics and storage land are mainly concentrated in the southeast of the area. Industrial and storage land tends to sprawl, with inadequate space for each enterprise, exacerbating the situation of industries surrounding the village.

Currently there are 190 enterprises within the community, distributed in four industrial agglomeration areas and a large-scale agricultural product logistics park.⁷ However, many industrial spaces encroach on the community's development space, resulting in significant negative impacts on environmental quality and safety. The conflicts between the village and enterprises were a key target of the station-level plan.

3. TOD Planning Strategy

Three planning packages were developed for the upgrading of the Bainikeng area using TOD principles: (1) rail, road, and slow mode transportation improvements, (2) high-density land development around Bainikeng Station, and (3) three concentric living circles centered on Bainikeng Station, with enhanced public service facilities in each circle keyed to variations in the area's demographics.

Integrated Transportation Network with Convenient Accessibility

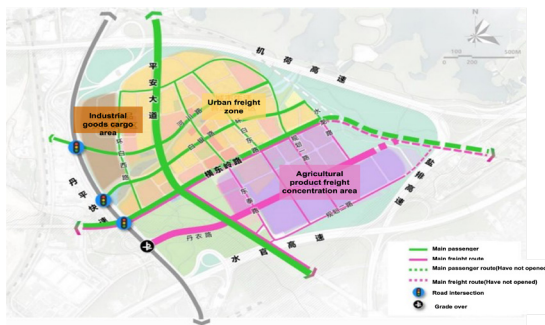
The Bainikeng area is surrounded by high-speed roads and plagued by internal road congestion, limited travel options, and inefficient and dangerous mixing of vehicles and pedestrians (figure 16). The technical team proposed improvements to overcome these problems.

⁷ The industrial areas of Nijiu Keng, Litchi Garden, Tangbian, and Hengdongling; and Haijixing International Agricultural Product Logistics Park.

The existing east-west Hengdongling Road (partially completed and operational) is a freight distribution route for Haijixing. After widening and upgrading, it will also facilitate east-west passenger and freight transportation in the Bainikeng area. The main arterial road within the area, Ping'an Avenue, will also accommodate north-south passenger and freight transportation. With this strategy, traffic pressure on Danping Expressway can be effectively relieved, and the primary passenger and freight flows within the area can connect to the city's high-speed road network via the interchange of the Danping and Jihuo expressways. This will provide convenient transportation connections from Bainikeng to administrative districts in Shenzhen, such as Luohu, Futian, Pingshan, as well as the Hong Kong SAR region. These planned elements form a good transportation foundation for residents' daily travel, leisure activities, and the exchange of agricultural products between Shenzhen and Hong Kong SAR.

Furthermore, several new metro lines, including lines 10, 14, 17, 18, and 21, as well as the Shenzhen-Dayawan Intercity Rail (figure 17), and stations have been planned around the Bainikeng area. Each station will serve its respective catchment area independently but with similar transportation. Collectively, the new stations will relieve traffic pressure at the Bainikeng Station, shorten residents' travel time, and enhance their travel experience.

Figure 16: Organization of Passenger Transportation in Bainikeng Area



Source: Shenzhen Branch of the China Academy of Urban Planning and Design 2023.

Figure 17: Existing and Proposed Rail Transit Stations in Bainikeng



Source: Shenzhen Branch of the China Academy of Urban Planning and Design 2023.

Residential areas within the Bainikeng area are mainly distributed on the north side of Hengling East Road, while industrial parks led by Haijixing predominantly occupy the south side. The technical team proposes a comprehensive corridor arrangement in which a slow traffic network with continuous connections between various road segments will be established. At the crossing of Hengling East Road and Ping'an Avenue, pedestrian facilities such as overpasses and underground passages will be constructed to facilitate pedestrian movements.

Intensive Development around the Bainikeng Hub

Bainikeng has had the spatial layout of a typical urban village. Improvements to land use efficiency face obstacles in the form of complex ownership and limited available developable land. To address these issues and enhance the overall urban quality of the Bainikeng area, the technical team proposed high-intensity development around the Bainikeng hub, including the construction of landmark buildings, to enhance the overall value of the hub and achieve a regional balance of needs. The building height will gradually decrease from the core of the hub area to ensure visual connectivity with Qiusui Peak Forest Park, and the landscape interface with the Dongshen River will be enhanced. The overall result will be a gentle, rhythmic, and well-structured urban skyline.

In the wider area surrounding the Bainikeng hub, underused land will be cleared for more concentrated development (figure 18). Mixed-use development will be promoted to foster diverse communities and create a vibrant 24-hour neighborhood. Low-density development will be implemented on the eastern side of the Dongshen River to protect the ecological resources (figure 19). This approach will balance the interests of property owners, industrial development, and environmental protection, resulting in distinct character zones with different textures and scales. In the southern area, the Haijixing Industrial Zone, the floor-area ratio will be relatively low to achieve harmony with the existing environment. Overall, the Bainikeng hub area will be redeveloped as a combination of “hub complex + office + park.” This will enhance the hub’s gateway function and the overall appearance of the Bainikeng area.

Figure 18: Planned Gradation of Development Intensity in Bainikeng



Source: Shenzhen Branch of the China Academy of Urban Planning and Design 2023.

Figure 19: Mountain and Water Resources in Bainikeng



Source: Shenzhen Branch of the China Academy of Urban Planning and Design 2023.

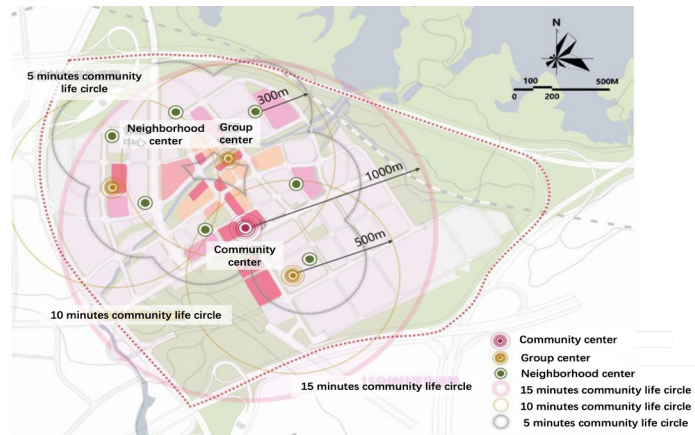
Building Community Living Circles in Three Sizes

The encircling of Bainikeng by high-speed roads has made the area a secluded island with limited external connections, and the distribution of internal service facilities has been inadequate to meet residents' daily life needs. The technical team devised a system of three types of community living circle, each based on desirable walking distances for various public service facilities. The distances account for the needs of vulnerable groups, such as the elderly and children, and working individuals.

Three community living circle sizes have been planned for Bainikeng. They are accessible within 15 minutes, 10 minutes, and 5 minutes, respectively, of various public service facilities (figure 20).

- The 15-minute living circle covers the entire Bainikeng community and serves a population of 50,000 to 100,000. It is centered around the Bainikeng transit hub and provides comprehensive services for the whole of the Bainikeng area. Community-level public service facilities such as middle schools, high schools, and comprehensive hospitals are planned.
- The 10-minute living circles have a radius of 500 meters, and each serves a population of 15,000 to 25,000. One residential living circle and two industrial living circles were identified, with public service facilities within the living circles meeting the residents' needs within a 10-minute reach. The facility layout is closely connected with the bus system and pedestrian system.
- The 5-minute living circles have a radius of 300 meters, and each serves a population of 5,000 to 12,000. Seven multifunctional neighborhood centers were identified on the basis of public green spaces, street-level commercial areas, and street squares. They are closely connected with the pedestrian system. Public service facilities such as kindergartens, cultural activity rooms, and waste transfer stations are integrated with other buildings to meet the service needs of the 5-minute living circles.

Figure 20: The System of Community Living Circles



Source: Shenzhen Branch of the China Academy of Urban Planning and Design 2023.



SHENZHEN

Part 3: Summary of Achievements and Prospects

Since the opening of the rail transit system in Shenzhen in 2004, the city has undergone 19 years of construction and development, with a total of 16 lines and over 380 stations covering a total operating mileage exceeding 560 kilometers. In the latter years of that period, the emergence of constraints on further development and ongoing congestion meant that Shenzhen had entered a redevelopment and renovation stage of its growth that needed to encompass environmental sustainability.

1. Key Experiences and Lessons Learned

The GEF-6 China TOD project in Shenzhen offered the opportunity for the city to assemble a community-wide collaborative group to pursue a more systematic vision of TOD for the entire city: establish a rail transit city that is accessible to all, regionally connected, and environmentally sustainable. It likewise established a robust and inclusive mechanism for public participation in the visioning and implementation.

The Shenzhen TOD project applied its formulation of its vision for the future redevelopment of the city to a specific, peripheral area, Bainikeng, that represented many of the challenges to be faced in revitalizing areas beyond the urban core.

The project participated in the local development of a TOD data management platform that would interact with a national platform and likewise with similar platforms in the other pilot cities of the GEF-6 China TOD project.

Establishing a Leadership Group with Local Characteristics to Guide Project Implementation

The Shenzhen TOD project enjoyed the organizational advantage of the unified approach taken by the Shenzhen Development and Reform Commission, the implementing body of the project. The commission coordinated with the World Bank on various project matters.

The commission invited experts in urban planning, transportation planning, public policy, investment, and the environment as an expert think tank for the project. The group provided technical guidance throughout the process and created a benchmark resource for urban sustainable development projects.

During the project, the Shenzhen Municipal Government established the GEF-6 China TOD Project Working Group, whose membership included the Development and Reform Commission. Clear responsibilities were assigned to each member unit. Operational mechanisms such as major project meetings, departmental coordination, daily group discussions, and district government coordination mechanisms were set up.

Technical teams, including from the Shenzhen Branch of the China Academy of Urban Planning and Design and the Shenzhen Urban Transportation Planning and Design Institute, were invited to conduct TOD planning work at the city and station levels and supervise the progress. The coordination of related departments formed an effective organizational model.

Establishing an Inclusive and Continuous Mechanism for Public Participation

The Shenzhen TOD project conducted extensive stakeholder consultations at the city and station levels throughout the project. A flexible and continuous public participation mechanism was established, conducting regular resident surveys, workshops, expert consultations, and collecting feedback through WeChat public accounts and the TOD data information platform. The interactions included identification of current issues, solicitations on a TOD vision for the city, establishment of development goals, and formulation of strategic and action plans. The feedback and suggestions were promptly addressed and provided to support the formulation of the TOD strategy.

The city strategy has been developed from the bottom up, taking into full consideration public demands and suggestions. The vision solicitation stage encompassed numerous stakeholder consultations, questionnaires, community surveys, government discussions, and enterprise forums to understand residents' demands for convenient travel and a favorable living environment.

Government departments were engaged in understanding the expectations for solving complex land ownership issues and integrated development between stations and cities.

Multiple consultations with environmental, social, and transportation experts were conducted to improve the project quality and analyze the environmental and social impacts of the strategy from various dimensions.

Exploring Redevelopment Mechanisms and Policies for High-Density Suburban Areas

Solutions to the constraints of limited land resources in Shenzhen were developed through a TOD demonstration project. The Bainikeng area and its rail hub were chosen to explore innovative approaches to using land resources efficiently.

The research in the Bainikeng area needed to consider the urban renewal demands of multiple development entities and coordinate the construction of an ideal urban spatial pattern. By comparing various development scenarios, development intensities were determined, and a core area for integrated development between the station and the city was defined. The GEF-6 grant helped the project design the implementation path for the TOD-guided development in Bainikeng and specify the policy support system.

Establishing a Data Management Platform to Enhance Planning and Decision-Making

The Shenzhen TOD project established a data information management platform to support the TOD strategy formulation and decision-making. A foundation for clearly defined, uniformly managed, and standardized data was created. A comprehensive, multidimensional TOD evaluation index system was constructed to cover traffic efficiency, land coordination, commuting convenience, environmental quality, and commercial vitality. The platform supports project monitoring and dynamic evaluation. It assists in decision-making, knowledge dissemination, and knowledge exchange with a related national TOD platform and platforms in other GEF-6 China TOD pilot cities. The user interface caters to government officials and technical personnel who analyze the TOD development level in Shenzhen and options for the future.

2. Continuing Optimization Directions

Priorities for the future include (1) enhancing the inclusiveness and equity embodied in the TOD approaches of the GEF-6 China TOD project and (2) learning how to flexibly apply TOD principles for land-use optimization in a greater diversity of development sites.

Exploring a More Equitable TOD Approach

The GEF-6 China TOD project advanced public transportation as the organizing force for urban sustainable development. The city now further aims to achieve equitable TOD (e-TOD). Efforts will include a focus on affordable housing: increasing its proportion of the housing stock, allocating a portion of it to areas close to subway stations, and embedding it more rigorously in the TOD planning process.

Increasing the supply of affordable housing around rail transit hubs could improve the accessibility of cost-effective housing for low-income groups, ensuring the benefits of TOD for both residents and newcomers. Particular attention will be given to the transportation, housing, and living needs of vulnerable groups. For example, regular employment training and long-term employment guidance will be provided to help the current workforce integrate into new employment environments.

Promoting Functional Restructuring Based on Site Development Characteristics

This project has helped create a solid foundation for using TOD to optimize existing land in Shenzhen. Future work can further explore land-use issues of sites with varying combinations of industries, functions, and ecological resources. The work can include upgrading industrial systems and functional restructuring of activity. For example, such work can be applied in the Bainikeng area to introduce fresh food e-commerce. Through TOD, the supply chain could be revamped to provide for the intelligent upgrading of logistics, storage, transportation, and other aspects. In the Chegongmiao area, the existing land resources will be leveraged to increase the proportion of affordable housing. TOD will drive vertical development around hubs, introduce diverse industries, activate local vitality, and promote comprehensive area upgrading.

3. Conclusion

Shenzhen is the fastest-developing city in China in terms of rail transit. As an international metropolis, its development has entered a quality improvement and increment stage. As demonstrated in this project, the problems, potential, and planning of rail transit development in Shenzhen will provide a positive reference for TOD and construction in cities of similar scale in China and other developing countries worldwide.

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