Global Environment Facility 6
CHINA SUSTAINABLE CITIES
INTEGRATED APPROACH PILOT PROJECT

TECHNICAL SUMMARY SERIES

MINISTRY OF HOUSING AND URBAN-RURAL DEVELOPMENT

National Platform for TOD Information Management

gef global environment facility
INVESTING IN OUR PLANET

WORLD BANK GROUP

北京交通大學
BEIJING JIAOTONG UNIVERSITY

THE NATIONAL PLATFORM for TOD Information Management

Publications by the Project

Executive Summary

Technical Summary Series

The National Platform for TOD Information Management
Beijing
Tianjin
Shijiazhuang
Ningbo
Nanchang
Guiyang
Shenzhen

Special Topics in TOD

Urban Regeneration
Public Participation
Urban Rail Financing

THE NATIONAL PLATFORM for TOD Information Management

GEF-6 CHINA SUSTAINABLE CITIES INTEGRATED APPROACH PILOT PROJECT

1818 H Street NW
Washington, DC 20433
Telephone: 202-473-1000
Internet: www.worldbank.org

Contents

Illustrations

Figures

Tables

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 landuse 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.

As initially built by the World Bank and managed by MoHURD, the National Platform for TOD Information Management is the main outcome of the GEF- 6 China TOD project at the national level.

This report is prepared by the team from Beijing Jiaotong University, it summarizes and evaluates the technical outputs of the project.

SHENZHEN

Abstract

This report provides an overview of the objectives, design principles, and major features of the National Platform for TOD Information Management. The platform was a product of the 2018-2023 Global Environment Facility 6 - China Sustainable Cities Integrated Approach Pilot Project, managed by the World Bank and implemented by China's Ministry of Housing and Urban-Rural Development (MoHURD). The project advanced the application of transit-oriented development (TOD) in seven major cities and involved the development of a digital information management system applicable at both the national and local levels.

The national TOD platform is a website integrating a variety of application systems, data resources, and internet resources with a unified user interface that can access both local and national data and analytical tools. The platform's three-level (rail station, rail corridor, city) evaluation system matches the analytical structure of the TOD project in each pilot city. Its evaluation system enables multidimensional assessment and analysis of the relationship between urban rail development and urban space—the relationship that is at the heart of the TOD concept. The report also shows how the platform's resources can shed light on the prospects for TOD in cities by examining selected characteristics of three of the TOD pilot cities: Beijing, Shijiazhuang, and Shenzhen.


TIANJIN

Introduction

In the 1960s, urban planners in the United States began to focus on the role of transportation in socially sustainable urban development. Over time, the concept of TOD emerged to become an important urban planning concept internationally. TOD is aimed at promoting sustainable development by constructing high-density, mixed-use buildings around multimodal public transportation hubs, thereby reducing dependence on private cars and improving the quality of life for urban residents.

Through the Global Environment Facility 6 - China Sustainable Cities Integrated Approach Pilot (GEF- 6 China TOD) Project, China embarked on a systematic, five-year effort to introduce TOD best practices to seven large, representative cities nationwide (Beijing, Tianjin, Shijiazhuang, Nanchang, Guiyang, Shenzhen, and Ningbo). The GEF- 6 China TOD project was approved by the World Bank's Executive Board on July 27, 2017, and officially came into effect on December 13, 2017. The project was managed by the World Bank and implemented by China's MoHURD.

To further knowledge sharing among the participating cities, the World Bank, in collaboration with MoHURD, designed and built the basic structure for a National Platform for TOD Information Management (hereafter, the national TOD platform). Launched in 2022, the platform is a website integrating a variety of application systems, data resources, and internet resources into an information management system with a unified user interface. It was designed to help urban planners and policymakers monitor and evaluate the progress of TOD in the pilot cities (and ultimately nationwide), identify differences, and learn from relevant experiences to better promote local TOD development.

The target users of the national TOD platform include government departments at the central and local levels, transportation and planning agencies and professionals, public transit companies, developers, and the general public. The platform should meet the research needs of these users, providing unified access to what are now scattered guidelines, toolkits, case studies, and other resources. And it offers powerful tools for TOD participants to learn and interact locally and nationally. Platform users will be able to evaluate their existing environment, analyze various scenarios, monitor the impacts of projects, and share experiences with other cities and collaborate with them on common challenges.

The national TOD platform also aims to allow the results of TOD city surveys to be entered into the national TOD platform, which can then monitor and evaluate while providing standards and resources. The national platform is thus a two-tier system, operating at both the national and city levels. For example, at the national level, the platform can conduct testing and provide feedback on relevant indicators from city-level TOD platforms. The national coverage of city TOD information allows for understanding the localization of TOD development in different cities. By drawing on experiences from cities, the national platform facilitates dissemination of advanced experiences during construction.

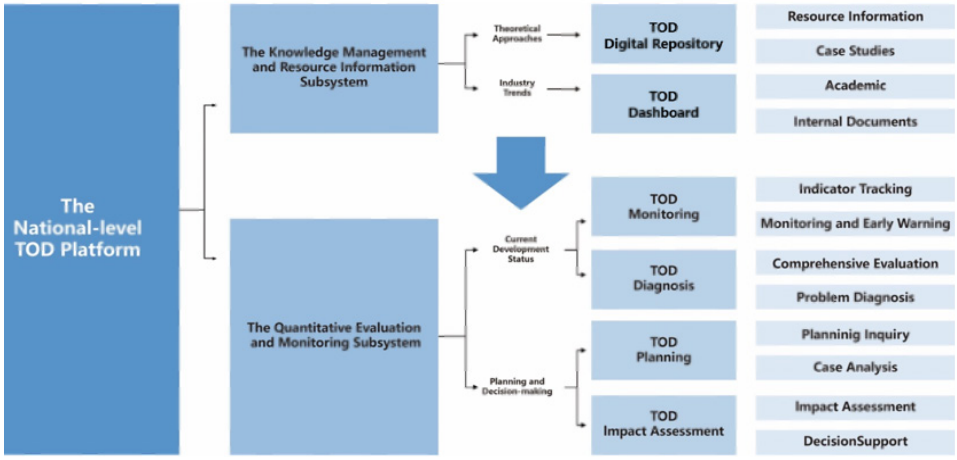
Part 1 of this report introduces the objectives, design principles, and major features of the national TOD platform. Part 2 describes the indicator and data systems underlying the operation of the platform. Finally, part 3 discusses the use of the platform in three of the TOD pilot cities: Beijing, Shijiazhuang, and Shenzhen.

BEIJING

Part 1: The Structure and Design of the National TOD Platform

The national TOD platform is an industry-specific (so-called vertical) portal website. It integrates various application systems, data resources, and internet resources onto a single information management platform and provides them to users through a unified user interface. The architecture of the platform consists of two primary subsystems: (1) Knowledge Management and Resource Information and (2) Quantitative Evaluation and Monitoring (figure 1). The subsystems in turn are supported by six modules (table 1).

Figure 1: Overall Functional Diagram of the National TOD Platform



Source: China Academy of Urban Planning and Design, *Technical Report at the End of 2021.*

1. The Knowledge Management and Resource Information Subsystem

The platform provides diversified information services to city administrators, professionals, and the general public engaged in TOD-related industries. Services in this subsystem are delivered through two modules: a Digital Repository and a Dashboard.

The Repository contains domestic and international TOD information including industry news, conferences, exhibitions, recruitment, and bidding. Professional-level information includes policy coverage, regulations, planning cases, and academic research.

The Dashboard conveys the status of TOD activities in China's cities. The information services of the platform primarily focus on noncommercial consulting and retrieval, including TOD-related research, practice information, and tools for management and analysis. Information sharing allows for the exchange of experiences between cities and within the industry.

2. The Quantitative Evaluation and Monitoring Subsystem

Quantitative evaluation and monitoring are the core operational functions of the TOD platform. This subsystem consists of four modules: Monitoring, Diagnosis, Planning, and Impact Assessment. These modules provide a scientific and rational basis for guiding the decision-making for TOD construction.

Table 1: Modules of the National TOD Platform

Module	Description
Digital Repository	A repository of domestic and international policies, regulations, and industry standards related to TOD. Technical guidelines, manuals, toolkits, research reports. Academic papers, monographs, relevant website links, etc.
Dashboard	Information on policy making, project practices, and the seven GEF- 6 China TOD project cities. Information on TOD-related research and practices in the cities
Monitoring	Monitor the short-term or long-term effects of TOD-related projects implemented in various cities; showcase the achievements
Diagnosis	Assessment and diagnosis of the current level of TOD development in various cities and showcasing of achievements
Planning	Case reports of TOD-related projects both domestically and internationally; presentation of TOD strategic research and practical achievements in seven GEF- 6 China TOD project cities
Impact Assessment	Local cities conduct impact assessments of their respective urban projects under the TOD evaluation system's standard framework provided by the national platform; results are showcased

Source: China Urban Planning and Design Research Institute, *Research Background and Tasks of the Project.*

The four modules for evaluation and monitoring, described briefly below, are divided across the two major phases of TOD: (1) current development status, which involves the modules for Monitoring and for Diagnosis; and (2) planning and decision-making, which involves the modules for Planning and for Impact Assessment. They provide authoritative quantitative support for TOD diagnosis and evaluation. The modules deploy three-dimensional geospatial information for the quantitative visualization and analysis of indicators (the criteria by which TOD activities are evaluated). They compare multiple indicators horizontally and vertically at the city, corridor, and station levels, presenting the results through richly detailed charts and three-dimensional models. The subsystem also includes auxiliary decision-making and public participation as extension systems.

Monitoring Module

TOD monitoring is a dynamic monitoring module aimed at the process and effect of project implementation. It can monitor the development and construction of TOD in key regions and cities across the country and monitor the development of generalized TOD elements in each city except for rail transit.

Diagnosis Module

TOD diagnosis is a module for current status evaluation and problem diagnosis at city, corridor and station levels. Based on the TOD index system developed under this project, this module conducts a comprehensive evaluation of the TOD status of countries and cities, and visually displays the evaluation results through horizontal and vertical multi-dimensional analysis and dissection.

Planning Module

The TOD planning module enables spatial quantitative analysis and showcases domestic and international TOD strategies, planning, and construction schemes. This feature supports peer-to-peer learning and the sharing of experiences among cities and practitioners.

Impact Assessment Module

The TOD impact assessment module is also based on the TOD index system, which simulates and compares the effects of various planning schemes before and after implementation. This module evaluates the impact of the implementation and performance of relevant policy measures and forms a feedback and adjustment mechanism for management policies. At the corridor and station level, indicators can be visualized and compared to show the development trend after project implementation and the gap with the target indicators.

3. Platform Design

The platform was aimed at achieving specific goals, and specific principles were used to guide its design.

Design Goals

The design process set goals for the following four areas: functionality, deployment, collaboration, and applications development.

Functionality

The platform focuses on the needs of both national regulation and local governance. The design takes into account the different functional requirements of the national government and localities, allowing for flexible customization and deployment at both levels. It ensures interconnectivity between national and local nodes and enables data exchange and accessibility between the nodes and existing systems of different departments.

Deployment

The design supports separate public and private cloud deployments and a hybrid deployment combining the two.

Collaboration

The platform is designed to industry standards and uses an open software system to ensure system flexibility and compatibility.

Applications Development

To meet the needs of national TOD regulation, the platform employs a service-oriented design to provide data services and functional services in an integrated and callable manner. The development of business systems is customized by invoking service interfaces through widgets.

Design Principles

The TOD platform is a website in which the availability of services varies according to user access rights. At the highest level of access, its services include cases, data query, comparison, monitoring, and diagnosis. It can provide visual display and customized services according to city needs. The platform was designed according to the following principles: adhere to industry standards; be scalable; operate cost-effectively; be reliable, secure, and manageable; and be adaptable to new technologies.

Standardization

The platform employs internationally standardized and open technologies for data and service specifications in the planning and transportation industries. These standards cover data construction, system design, operation management, and information services. This approach facilitates integration across subsystems and end users.

Scalability

The system design incorporates a flexible structure that meets existing business requirements while providing support for system expansion.

Cost-Effectiveness

The design maximizes the exploitation of investments by reducing ownership costs and waste. It does so by optimizing the efficiency of user investments in terms such as utilization, management, and energy. Thus, within a given budget, it delivers a cost-effective and advanced platform.

Reliability

The national platform must have high reliability and strong fault-tolerance capabilities. To ensure uninterrupted, 24/7 operation, it must maintain a certain level of redundancy. Even during the initial stages of system construction, system availability and reliability issues were given special attention to prevent interruptions in services.

Security

To prevent threats such as network security breaches and data loss or theft, the platform strictly adheres to national regulations and requirements regarding information security. Measures include firewalls, secure servers, backup and restoration systems for the platform and for business data, and disaster recovery systems are implemented at various levels of operation, maintenance, and management.

Manageability

Once the platform is completed, thorough documentation will support the management and maintenance of the entire system.

Adaptability to Technological Advancement

The platform employs advanced equipment that is easy to expand and upgrade with future technologies. The design of the system is intended to account for technological advancement as well as the portability and upgradability of future technologies.

Part 2: Evaluation Indicators and Data

The functions of the Quantitative Evaluation and Monitoring Subsystem require TOD-related indicators. The project has specified the broad criteria or orientations that should guide evaluations, and it has devised more than 20 indicators to support the evaluations and monitoring by this subsystem.

A sound data system is also indispensable to platform operations. The project built a big-data resource library for TOD cities. It offers continuous access to the data resources of the seven pilot cities, and extensive access to the relevant data of other cities in China.

1. Evaluation Orientation

TOD is an essential component of urban development, and to a certain extent, TOD is synonymous with building a city. Therefore, besides emphasizing efficient transportation and intensive land development. TOD should also aim to improve the quality of urban construction, its energy and environmental sustainability, and residents' quality of life. To that end, the project team identified four fundamental principles, or orientations, for the evaluation of TOD:

- *Efficiency*: TOD should leverage rail transit to enhance the travel efficiency of urban residents and reduce commuting time.
- *Intensity*: TOD around rail stations should exhibit appropriate land development intensity and population density supporting a mix of residential and commercial uses.
- *Quality*: TOD should focus on enhancing various aspects of quality, including the quality of transportation services, the accessibility of supporting facilities, the quality of pedestrian environments, and community quality.
- *Low-carbon*: TOD must support and enhance energy-saving technologies, balance energy consumption, reduce carbon emissions, and promote sustainability.

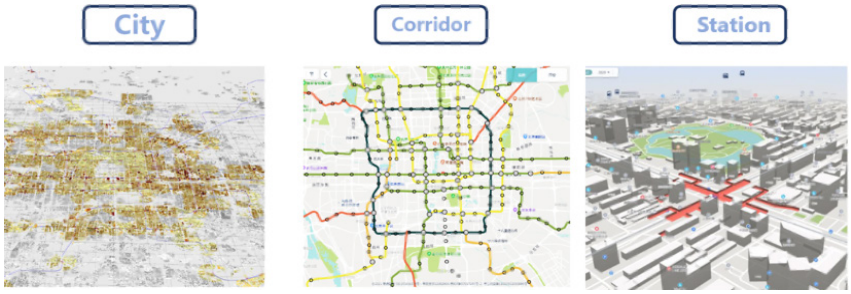
2. Indicator System Supporting Evaluation

Differentiation is one of the fundamental principles in developing the indicator system and setting evaluation standards. Differentiation is mainly reflected in four dimensions:

- First, in the scales of cities, corridors, and stations
- Second, in city scale, including population, level of economic development, and scale and maturity of the rail network
- Third, in the construction period and functional layout of cities along the rail lines at the corridor scale
- Fourth, in spatial location and functional types at the station scale

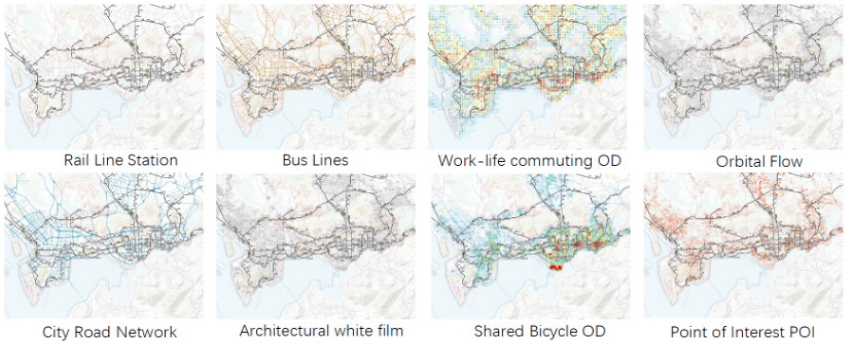
In this way, the differentiated evaluation of the same indicator in different scales (figure 2) and multiple indicators in the same scale (figure 3) can be realized.

Figure 2: Monitoring and Evaluation at Multiple Scales of City-Corridor-Station



Source: China Urban Planning and Design Research Institute, *TOD Achievement Review Meeting*.

Figure 3: Multiscale, Multidimensional Data System



Source: China Academy of Urban Planning and Design, *TOD Achievement Review Meeting*.

For consistency in the selection of indicators, they are drawn from the perspectives of rail operation, land development, functional mix, commuting services, environment, and other aspects. Differentiated indicators can reflect the systemic impact at different scales. For example, station-level indicators may include network centrality characteristics, corridor-level indicators may include passenger flow intensity characteristics, and city-level indicators may include scalability characteristics.

At each of the three levels, the indicators cover 11 factors (table 2):

- Urban rail transit facilities
- Urban rail transit operations
- Land development
- Mixed use of land
- Connectivity
- Transportation environment
- Jobs-housing commuting
- Living costs
- Neighborhood environment
- Low-carbon energy use
- Resource management

With the indicators taking into account the different scales of station, corridor, and city, the evaluation system can fully consider the systemic benefits brought about by networking and scaling, rather than being limited to the aggregation or averaging of station-level evaluations.

3. Principles of Indicator Selection

TOD construction exists within the context of long-term urban development. Therefore, it is essential to accurately evaluate the effectiveness of completed TOD projects, summarize experiences, and provide guidance for future TOD construction. To support those goals, the project adopted the following principles in constructing the TOD evaluation indicator system:

Comprehensive

The TOD evaluation indicator system should comprehensively cover various elements involved in TOD construction and application, including land development, transportation, livability, and other relevant factors. Each of these elements should be supported by corresponding indicators.

Rational

The weights of the indicators at different levels need to be scientifically and reasonably determined. Multiple weight schemes should be provided based on different evaluation priorities. The evaluation software system should also offer flexible and adjustable weight customization functionality, allowing users to define weights according to their specific needs.

Data Driven

The selection of evaluation indicators should take into account the availability of data and fully leverage the data potential collected by the TOD monitoring system. Adopting a data-driven evaluation approach can enhance the feasibility, quantitative level, and comparability of the evaluation.

Future Oriented

TOD evaluation should fully leverage its practical guidance. It should not only assess the effectiveness of completed TOD units, identify issues, and accumulate experiences, but also use the accumulated knowledge to guide future TOD development efforts.

Table 2: Indicators for TOD Evaluations

Indicator	Station Level	Corridor Level	City Level
Urban Rail Transit Facilities	Number of entrances and exits.	Average number of entrances and exits.	Average number of entrances and exits. Number of stations. Total track mileage. Number of urban rail lines.
Urban Rail Transit Operation	Average daily passenger flow at stations.	Average daily passenger volume per line. Passenger flow intensity. Rail passenger load factor.	Average daily rail passenger volume. Passenger flow intensity. Rail passenger load factor.
Land Development	Intensity of building development Gradient of building development intensity	Intensity of building development Gradient of building development intensity	Average daily rail passenger volume. Passenger flow intensity. Rail passenger load factor.
Mixed-Use	Degree of mixed-use functionality Density of functionality	Degree of mixed-use functionality Density of functionality	Degree of mixed-use functionality. Density of functionality.
Connectivity	Number of transferable rail lines. Number of transferable bus routes. Centrality of rail network.	Number of transferable rail lines. Number of transferable bus routes.	Number of transferable rail lines. Number of transferable bus routes.
Transportation Environment	Bicycle riding speed. Road operating speed.	Bicycle riding speed. Road operating speed.	Bicycle riding speed. Road operating speed.
Jobs-Housing Commuting	Density of residential and employment population. Gradient of residential and employment density. Intensity of OD commuting coverage.	Density of residential and employment population. Gradient of residential and employment density. Intensity of OD commuting coverage.	Density of residential and employment population Gradient of residential and employment density. Overall residential and employment coverage rate. Overall commuting coverage rate. Intensity of OD commuting coverage.
Cost of Living	Residential housing price level Suitability of residential housing prices	Residential housing price level Suitability of residential housing prices	Residential housing price level. Suitability of residential housing prices.
Neighborhood Environment	Green view rate Road network density	Green view rate Road network density	Green view rate. Road network density.
Low Carbon Energy-Saving	n.a.	Per capita turnover total energy consumption. Per vehicle turnover traction energy consumption.	Per capita turnover total energy consumption. Per vehicle turnover traction energy consumption.
Resource Management	n.a.	n.a.	Resource management income. Station commercial income.

Source: Shenzhen Urban Transport Planning Center, *GENB-1 Ningbo TOD Strategic Research, Task 5*, September 2022.

4. The Data System

The national TOD platform adopts a unified framework, standards, and guidelines for the data used in the modules for diagnosis, monitoring, and impact assessment. A TOD Urban Big Data Resource Library is set up in the Knowledge Management and Resource Information subsystem. It systematically integrates or accesses data resources and outcome resources from the seven pilot cities in a planned, organized, and continuous manner. This creates a distributed data access and aggregation approach and establishes a well-defined mechanism for updating and maintaining the data. On this basis, big data analysis and mining are carried out through shared and open data application services.

Data Collection and Maintenance

The national and city data centers manage, maintain, and update data according to the principle of "the producer is responsible." This ensures real-time interoperability, sharing, and synchronized updates of information at all levels and nodes.

Big-Data Sources for the Monitoring and Diagnosis Modules

The TOD urban big data resource system supporting Monitoring and Diagnosis includes information from sources as diverse as mobile phone signaling, mobile phone heat maps, rail stations, bus routes, bus stops, building data, land use classifications, facility POI (Point of Interest) data, and road network and intersection data. This set of TOD urban big data is organized in a unified resource catalog. The TOD monitoring information is managed and analyzed in a manner that supports various business applications for national supervision and local governance.

Big-Data Sources for the Impact Assessment Module

Data categories that support the Impact Assessment Module include residential population density, the "green visual ratio" (the share of green in the field of view), primary school and middle school data, efficiency assessments, network centrality assessments, and service evaluations.

Data Products

Each of the seven pilot cities can leverage local data and resources provided by various nodes of the information platform, combining them with their own business needs. They can further process the data to create thematic data products focused on TOD monitoring and analysis, including aggregated statistics, application analysis, comprehensive evaluations, and more. These data products can be integrated into the information platform to continuously expand the data service resources of the platform.


SHANGHAI

Part 3: Applications of the National TOD Platform

The national TOD platform has established a national-to-city two-level architecture. At the national monitoring level, the platform consolidates and evaluates the data of urban rail TOD throughout the country. It conducts investigations and documents the characteristics of urban rail construction and development, core indicator performance, and urban development comparisons nationwide. It can summarize the advanced planning and construction experience of pilot cities and promote the demonstration projects. It supports national authorities in rail policy formulation and guidance and in the scientific and rational planning of rail construction.

The local platform consolidates monitoring data, planning data, and geographic information data on local rail transit development. It analyzes and evaluates the current local status of urban rail development. It combines detailed projects and refined spatial data to assist in rail network planning, integrated station construction, and construction sequencing. At the same time, some data resources of the city-level platform can be linked with the national platform to form a dynamic reporting mechanism for core data indicators.

1. Planning Transit-Oriented Cities

The term railway cities refers to metropolitan areas in which the harmonious development of the urban rail transit system along with the city itself has produced a high-quality urban transportation system. These cities focus on giving rail systems a driving role in urban development by providing comprehensive urban services and high-quality supporting facilities around their rail transit lines and stations.

The synergy between city and rail system requires that a high proportion of residential and commuting populations be covered by fast and accessible rail. It also plays a crucial role in promoting urban rebuilding and expansion. Therefore, in order to monitor and assess the level of TOD in urban rail transit systems nationwide, it is necessary to evaluate and analyze the relationship between urban rail construction and urban space from the perspective of multiple indicators, both between and within cities.

These uses are discussed here for three of the seven pilot cities—Beijing, Shijiazhuang, and Shenzhen City.

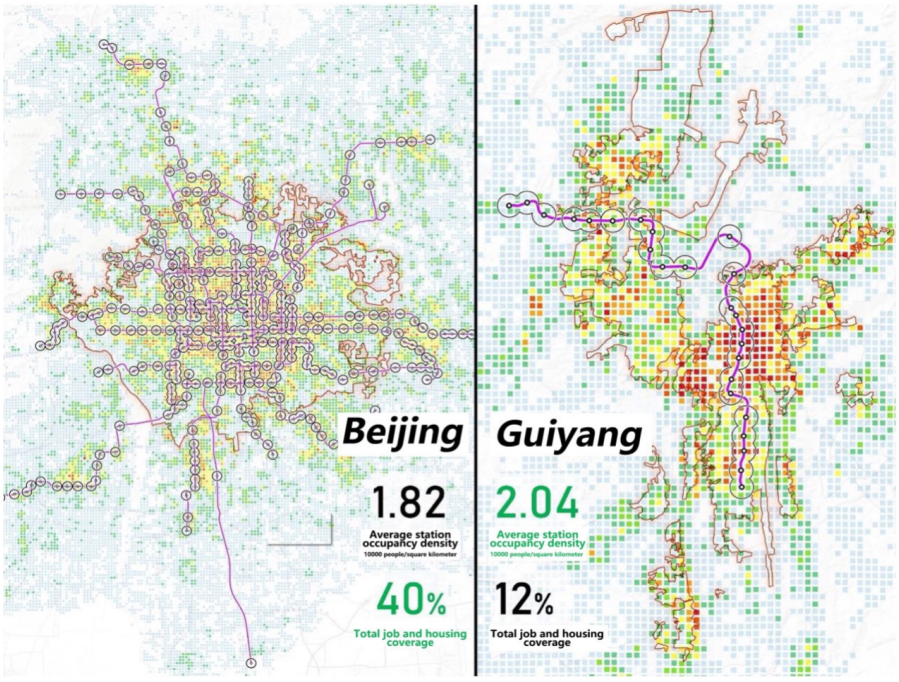
2. Beijing and the Use of Scale Indicators

Urban rail transit construction is typically initiated with the most central and important lines in the downtown area, which have inherent advantages in terms of jobs-housing coverage and passenger flow intensity. Later-stage construction often involves connecting the central urban area to peripheral regions with a large number of long-distance lines and widely spaced stations. These stations often have a lower population density and thinner community infrastructure relative to the stations on the early lines.

The proper indicator is needed to assess the result for a rail network that expands in such a fashion. For example, if we use the average population density within 800 meters of each station (figure 3, "Average station occupation density"), rail coverage in Beijing (18 lines, 18,200 people per square kilometer) would appear lower than in Guiyang (one line, 20,400 people per square kilometer). Of course, the reality is that Beijing has a rail transit network with nearly 800 kilometers of track (closely behind only Shanghai both in China and the world), and its jobs-housing population coverage far exceeds that of Guiyang.

To show that reality, the national TOD platform uses an additional indicator scaled to total population to more accurately reflect the overall situation of the rail network. The indicator of jobs-residence coverage at rail stations compares the aggregate population within 800 meters of all rail transit stations with the total jobs-residence population of the entire city. It thus shows the proportion of the city's population that is served by rail transit at the 800-meter scale of coverage—40 percent in Beijing and 12 percent in Guiyang (figure 3, "Total job and housing coverage"). The indicator can thus help plan for the efficient placement of stations in the construction of new rail lines.

Figure 4: Two Metrics for Population Coverage of Beijing and Guiyang Rail Networks

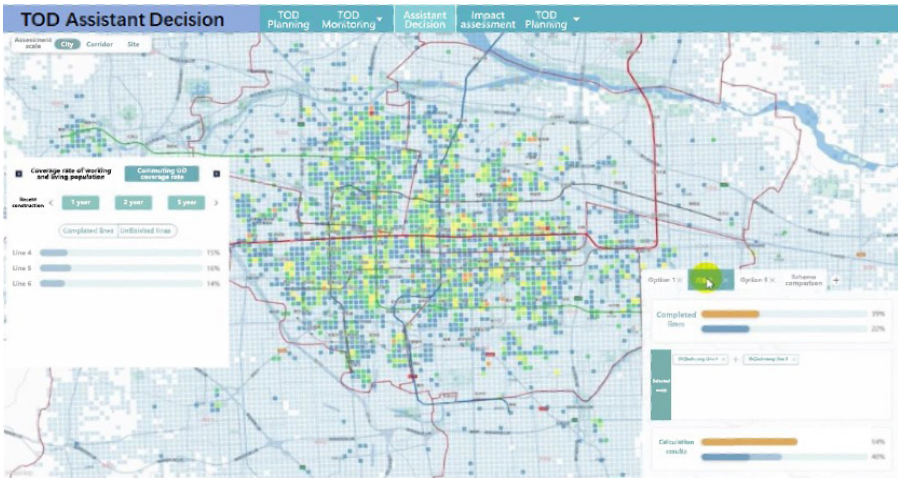


Source: China Academy of Urban Planning and Design, *TOD Achievement Review Meeting*.

3. Shijiazhuang City and the Sequencing of Urban Rail Transit Construction

Analysis conducted through the TOD platform can suggest the optimal sequencing of construction for multiple rail lines in support of TOD. One analysis involves the coverage rates for (1) employment and residence (jobs-housing) and (2) origin-destination (OD) commuting for both current and under-construction rail lines. Data in the platform can show how those coverage rates will vary under alternative construction sequences (figure 4). Taking the example of the planned Lines 4, 5, and 6 in Shijiazhuang, the analysis indicated that building Line 6 first, followed by Line 5 and thereafter Line 4, would yield the best overall gain in the average coverage rate for employment and residence (rising from 16 percent to 47 percent) and OD commuting (from 31 percent to 59 percent). The accuracy of the outcome will be improved by incorporating prediction algorithms for the distribution of employment and residence.

Figure 5: Sequencing Rail Transit Construction in Shijiazhuang



Source: China Academy of Urban Planning and Design, *TOD Achievement Review Meeting*.

4. Shenzhen City and the Assessment of Jobs-Housing Density

Of the 400 stations nationwide with the highest jobs-housing density, Shenzhen accounts for 18.5 percent, the highest proportion of any city in China (its Huaqiangnan Station, at 81,000 people per square kilometer, ranks sixth nationwide). Of the 100 rail lines in China with the highest jobs-housing density, Shenzhen at 10 percent of the lines and Beijing at 9 percent rank second and third, respectively, behind Shanghai at 13 percent. The degree of uniformity in the distribution of jobs-housing density is influenced by the degree of network uniformity.

The national TOD platform can quantify the projected improvement of relevant functional density and development intensity measures arising from TOD and thereby play a key role in measuring the efficiency of existing and future rail lines. For example, the platform can display metrics for Shenzhen that assess the intensity and equity of development around rail lines and the efficiency of urban travel zones (figure 5).

Intensity-Oriented Evaluation

Users can evaluate the impact of rail line construction in Shenzhen from 2016 to 2020 by, first, selecting the base year as 2016, the evaluation year as 2020, and selecting Shenzhen. They can then select the intensity-oriented option to explore the distribution of service facilities and related indicators around the rail lines over the selected period. By zooming in on the left overview map and interacting with the density distribution map of points of interest (POI), users can observe the distribution of POI density around different stations at various scales.

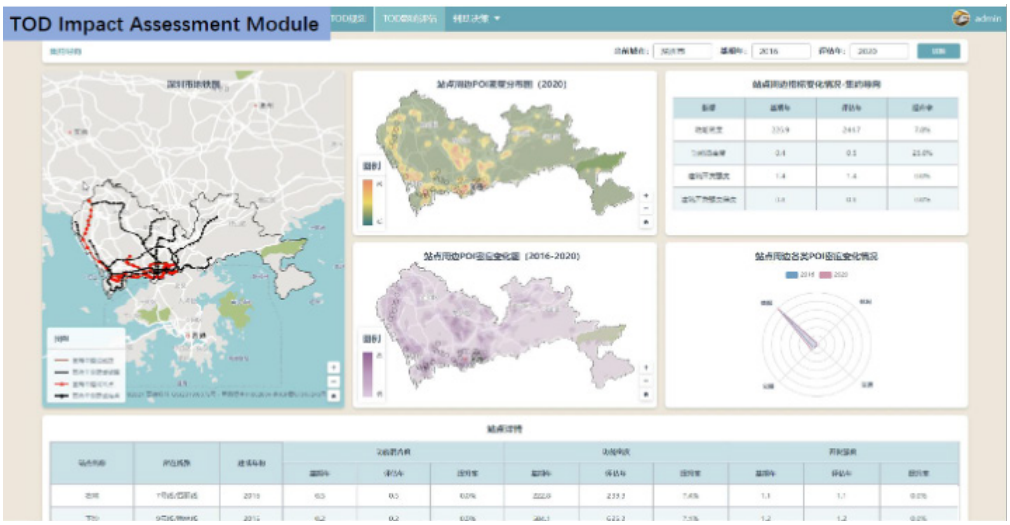
Equity-Oriented Evaluation

The operation for users in this case is similar to that for the intensity-oriented evaluation. But instead of selecting the intensity-oriented option, they select the equity-oriented option. This will allow exploration of the distribution of population density and related indicators around the rail lines over the selected period. By zooming in on the left overview map and interacting with the population density distribution map, users can observe the distribution of population density around different stations at various scales. This allows for the evaluation and analysis of changes in jobs-housing population density. On the right side, users can find detailed information on related indicators, including changes in the population and income structure over the period. By selecting a specific station on the map, users can quickly identify the distribution of population density around that station and refer to specific indicator values in the table below the map.

Efficiency-Oriented Evaluation

The operation for users here is again similar to the other evaluations, but in this case it involves selecting the distribution of commuting travel zones and related indicators around rail lines. Users can zoom in and out on the left overview map and interact with the travel zone distribution map to observe the changes in the distribution of travel times around different stations at various scales. This allows for the evaluation and analysis of the changes in travel zone distribution before and after the construction of the metro lines. Users can also find detailed information on related indicators on the right side, including changes in travel zone coverage before and after the construction of the rail lines. By clicking on a specific station on the map, users can quickly identify the distribution of travel zones around that station and refer to specific indicator values in the table below the map.

Figure 6: Assessment and Calculation of the Impact of Related Line Planning in Shenzhen City



Source: China Academy of Urban Planning and Design, *TOD Achievement Review Meeting*.

Part 4: Conclusion

Developed as part of the Global Environment Facility 6 - China Sustainable Cities Integrated Approach Pilot Project, and launched in 2022, the National Platform for TOD Information Management is an advanced open-data digital system presented to users in the form of a website for the support of transit-oriented development (TOD). It provides cases, data query, comparison, monitoring, diagnosis and other services for users according to different user rights and can provide visual display and customized services according to city needs. Its users are stakeholders at various levels in China's cities, corridors, and station areas participating in TOD projects. With a project guidance committee established by MoHURD, the platform enables the seamless integration, co-construction, and sharing of information at both the national and city levels.

The platform architecture, designed and built by the World Bank, integrates national and city levels. The national platform collects and evaluates monitoring data on TOD development in cities across the country, gaining insights into the characteristics and features of urban construction nationwide. It can summarize and promote the advanced planning and construction experience from pilot cities and demonstration projects. (The 2018-2022 project introduced advanced TOD planning in seven cities—Beijing, Tianjin, Shijiazhuang, Nanchang, Guiyang, Shenzhen, and Ningbo.) The local platform aggregates monitoring data, planning data, and geographic information data on local rail transit development. At the same time, some data resources at the city level can be linked to the national platform, forming a dynamic reporting mechanism for core data indicators.

The platform incorporates differentiated city assessments. While emphasizing certain baseline indicators, it incorporates the following types of differentiation:

- Differences in scales between cities, corridors, and stations
- Differences in city scale, such as population size, economic development level, scale and maturity of the rail network
- Differences in construction periods and functional layout along the rail lines
- Differences in spatial location and functional types at the station level

Now that the overall Global Environment Facility 6 TOD project is completed, the continued operation and maintenance of the national TOD platform will require active, continuous seeking of policy and financial support from government at all levels and from international organizations. The support is essential to ensure the continued integration of data monitoring and evaluation on the platform. Moreover, adding TOD platforms to more cities will strengthen the overall effectiveness and validity of the integrated local-national TOD platform network.

Bibliography

China Academy of Urban Planning and Design. (2020). *World Bank TOD National Platform - Demand Research Report.* Author.

China Academy of Urban Planning and Design. (2020). *Technical Report - Demand Research Report.* Author.

China Academy of Urban Planning and Design. (2021). *Work report at the end of 2011.* Author.

China Academy of Urban Planning and Design. (2021). *Technical report at the end of 2011.* Author.

China Academy of Urban Planning and Design. (2021). *Research Report on TOD System Architecture.* Author.

China Academy of Urban Planning and Design. (2021). *TOD development monitoring and evaluation index system.* Author.

China Academy of Urban Planning and Design. (2021). *Technical Report - Detailed Design Report.* Author.

China Academy of Urban Planning and Design. (2022). *TOD Case study Report.* Author.

China Academy of Urban Planning and Design. (2022). *Technical Report - Platform Instructions.* Author.

China Academy of Urban Planning and Design. (2023). *Summary and Evaluation Report.* Author.