Chapter 3
Research of Urban Land Use Based on TOD Mode

Juan Zhang, Liang Chen, and Xinliang Jiang

Abstract TOD in urban planning improve the efficiency of land use, and promote the rationalization of urban space layout, ease the unrestricted spread of the city due to urbanization and motorization, and then solve the traffic congestion, pollution and automobile exhaust pollution, provides an effective way for the sustainable development of cities. This paper elaborates the basic theory of the system TOD concept, discusses the relationship between urban land use and transport system in detail, analyzes the main problems of China's development of TOD, and gives some suggests about our cities TOD in accordance with our transportation, land use layout and socio-economic characteristics, Finally, analyze of the land use situation of a project of Shenzhen.

Keywords Urban planning • TOD • Land use • Transport system

3.1 Concept of TOD

TOD (Transit Oriented Development) refers to the mode of public transport-oriented urban development. It advocates that urban planning should have a compact layout, the public transport as the support system of city, public transport nodes

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as the basis of urban land use layout, urban service facilities lay around public transport sites [1]. And TOD has three basic elements:

- Transit, Large-capacity public transport. And transport carrier for subway, light rail or bus rapid transit and other high-capacity public transport system.
- Oriented, Guidance. As the goal, the pursuit of the high strength profitable real estate development projects and to guide rational and orderly development of the urban space through the development of high-capacity public transport.
- Development, exploit. Characteristics of the development object is close to public transport facilities, compact land layout, mixed land use and high quality of the environment for walking.

3.2 Analysis of the Relationship Between Urban Land Use and Transportation System

Relationship of modern urban land use and urban transport systems generally can be attributed to three aspects: the impact of urban land use for the urban transport system, the impact of the urban transport system for land use, and comprehensive coordination of the interaction.

The impact of land-use for transport system can be attributed to: (1) characteristics of land use affect the transportation system from different angles; (2) density of urban land use affect the transportation system mode; (3) land use affect the characteristics of the traffic trips.

Transport system of land use can be attributed to: (1) urban transport system has a profound impact on the urban spatial form; (2) urban transportation systems affect land use layout; (3) construction of urban transport has an important influence on urban land prices.

The study of interaction between urban land use and transport system, in the early many scholars study the theoretical relationship preliminarily, but the form a special issue, the modern relationship between the two theories is very rich, but there are still some limitations.

3.2.1 Basic Theory of Relationship Between Urban Land Use and the Transport System [2]

Urban transport systems and urban land use have a relationship, a cycle of a mutual contact, mutual restraint and mutual feedback. First of all, the urban land use is the root of the needs of the urban traffic, it decides the urban traffic sources, traffic and traffic access. See from the macro level, it provides the structure and foundation of the city traffic, different urban land use situation requires a different mode of urban transportation. Second, actual operation level of urban transport system has impact to urban spatial structure and urban development, thus affecting the urban land-use, especially accessibility of urban traffic has a decisive role for urban economic, commercial and cultural activities.

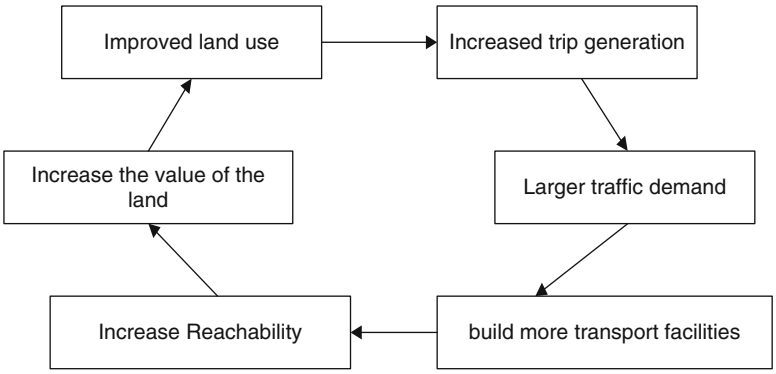

Fig. 3.1 The mutual influence of land use and positive environment of transportation systems (Source: Quoted from the research and development of public transport-oriented urban land)

Figure 3.1 show the mutual influence of land use and positive environment of transportation systems [3]. Land use is a major factor in travel generated activities, the level of trip generation activities within the study area and the propensity to travel will determine the demand for transport facilities, the supply of these facilities can change the accessibility of land use, while accessibility re-determine the value of the land, the value of the land is a major determinant of land use. In this ring, the changes of any part will result in changes of their own or other components.

3.2.2 Analysis of Correlation Between Urban Land Use and Transport System

The main elements affect the relationship between land use and transportation are urban mobility, traffic relative reachability and directional.

Relations of all kinds of motorized transport (mode structure) to determine the mobility of the city, divided into two categories, car mobility and public transport mobility, which are represent two typical traffic structures. Considering car traffic patterns, changes of spatial relations is to promote the city of expansion. Because of car mobility, Suburbs have a lot of development. For the public transport system, the scales of operation need compact and high-density development. The urban mobility determines mode of the urban axial space development, form a different extension shaft, mobility determines the relative reachability of land, mobility influence the evolution of urban space mode by the relative reachability.

Changes in the structure of urban space largely influence city reachability. The meaning of reachability is wide, sociology and psychological, consider optional of space-time in the transport sector. Transportation accessibility refers to arrive at a place conveniently. Travel time or distance to measure the objective optional from one location to another location. Relative reachability means degree of reaching a place relatively. The examples of expansion of urban space show that, the higher

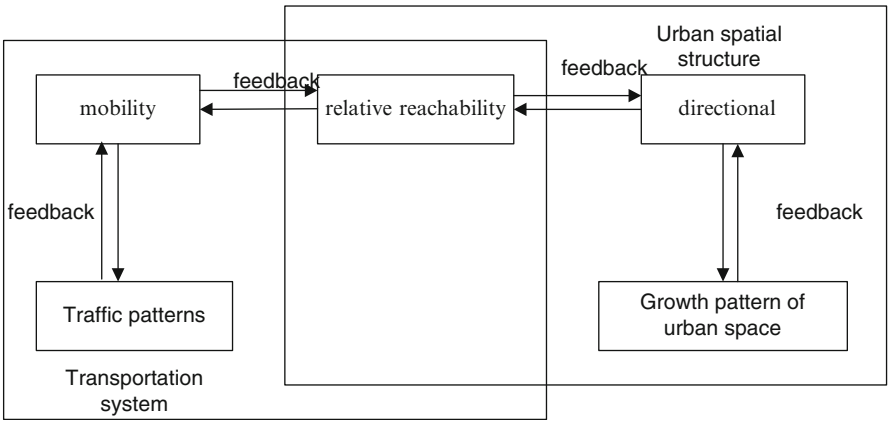

Fig. 3.2 Mutual use schematic diagram of mobility, relative reachability and directional (Source: Quoted from the research and development of public transport-oriented urban land)

relative reachability necessarily located in direction of the least resistance of the expansion of urban space.

The traffic point concept earliest appears in "location theory" by geographers, in regional development and urban construction, t development of the location influenced by traffic point., urban form and mastery time of transportation systems are related., if the main transport in one direction faster than others, it is easy to form constantly axial expansion of land stretching axis by traffic point, and promote axial development of urban land. Scale of urban land use does not exceed the size of the main mode of transport, which has distance of 46 min.

The above analysis shows that the expansion of urban land use and development performance as a result of traffic directional, relative reachability decides traffic directional, relative reachability depends on urban mobility (Fig. 3.2) [4].

3.3 China's Urban Development Problems About TOD and Measures

3.3.1 China's Urban Development Problems About TOD

Many cities in China have begun to develop TOD mode, but there are still a lot of difficulties. (1) the transportation system planning could not consider very well in the overall planning, urban development was an aimless spread state, TOD theory in China is still not widely understood. (2) considers of transportation structure, many cities in China have just begun to implement bus priority development programs. Currently, most of the urban public transport system is not yet developed, and the number of car traffic has a rapid growth, low bus-sharing, low service level, and the

lack of large traffic volume has caused great difficulties of public transportation for development of TOD. (3) in terms of land use, city's land use planning cannot be combined with the transportation system planning, many projects attracted a lot of traffic volume are concentrated on a road leading to severe traffic problems [5].

3.3.2 Propose of China's Urban TOD Implementation

In order to solve the problems of TOD in China, we should not only to learn successful experience of the world, but also to get the strong support and cooperation of various government departments. At the same time, efficient operation and financing mode is essential for TOD whether it can transfer from theory into practice from theory into practice.

1. the introduction of TOD concept in the overall planning of cities is widely publicized and learned successful TOD cases and advanced experience. The urban land-use planning combine with transportation system planning reflect the mutual benefits.
2. vigorously develop public transport, improve the public transportation network density and service levels, moderately develop rail transportation, bus rapid transit (BRT) and large capacity public transport system, adopt congestion pricing and other measures to curb the growth of the demand for car travel, and optimize the urban transportation structure, increasing the bus sharing rates, to provide better support for the implementation of TOD.
3. TOD and urban planning coordinated development

Practice has proved that the urban space based on TOD planning is a continuous feedback loop process, as shown in Fig. 3.3. Specific planning should be based on urban spatial structure, then determine the initial program of urban spatial structure and track network, analysis for space growth and TOD strategy coordination, proposed adjustment and optimization for the layout of the bus network into the next cycle, until the space growth and the degree of TOD coordination strategy to meet the planning target, so as to get a bus network coordinated development and orderly growth of urban spatial structure.

China's urban space development has three basic modes, the axial development mode, sector development mode, multi-core development model. Combine the characteristics of urban land development and characteristics of bus travel, cities should adopt a form of the urban continuity axial expansion plus balanced low-cost multi-center urban land layout. Continuous axial expansion mainly rely on various large capacity of highway system to set urban settlements and jobs. Multi-center equalizer mode focuses on land partition, highlight the nature of the key sites, which also have tour production, work, life, living, entertainment and other buildings and facilities, within the district also has its own commercial and cultural center as near as possible, to solve their daily problems between the various tours that are relatively independent, closely linked, also form an organic whole.

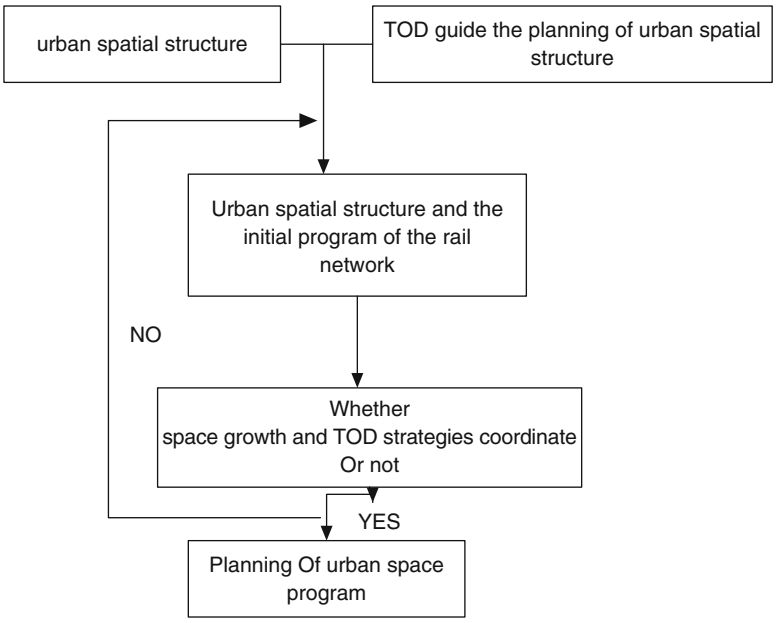

Fig. 3.3 Planning of urban space layout based on TOD

Now our major cities' land layout mostly is centralized, [6] for the current situation of China, urban planning model should be carried out in the city center, district center, the center of the residential area, the hierarchical structure of the cell center, form multi-center in cluster, to adapt low cost implementation of the strategy to limit traffic; also consider the relationship between the place of residence and place of work, adjust industrial layout and staff accommodation; balance of production and living place, reflects the travel convenience and economy; multi-level center services for the production and living, alleviate downtown burden, to maximize the use of public transport commuter.

4. public-private partnership financing of development model

First, government departments should actively promote the development of TOD land, become a successful regional urban development. Second, invest public land surrounding the site to reduce the risk of developers, and scientifically assess overall return of TOD project.

5. support of national and local policy

In the implementation of TOD, when many agencies involved in the management of land development and service delivery, coordination and effectiveness of the system is particularly important, so a lot of system security and authorization legislation needed.

3.4 The Land-Use Study of Shenzhen Project [7]

Shenzhen has entered a rapid development period of rail transportation, it will be completed 400 km of backbone network in 2020, formed 542.8 km vision networks in 2030, in order to reach the city center in 1 h in the Pearl River Delta, and half an hour to the main development areas in the SAR, 45 min to the urban sub-centers, the targets greatly improve the efficiency of public travel.

For this reason, there is an urgent need to study how to have a positive effect by track construction of urban development, including the upgrading of the potential land along the track, guiding of optimization model of the land use, the value-added benefits to maximize feedback public. Paper analyzes rail traffic on the utilization of underground space and urban land use function.

3.4.1 Promotion of Rail Traffic Along the Underground Space Utilization

The project promotes the re-development of the areas along the rail, central business district and transportation hub area have frequent activities, greater improvement in the surrounding environment. Rail traffic driven the underground space development, Table 3.1 show main functions in underground space. However, the use of underground space development is single function, lack of co-ordination, the overall quality needs to be improved. According to public evaluation of the underground public facilities, connectivity, identification and comfort need to be improved.

3.4.2 Analysis of Urban Land Use Along the Rail

In 2005, housing, road infrastructure, public facilities commercial, government associations and greenbelt along the rail are main land use, accounted for more than 10 % in the proportion of urban construction land, land use indicators of the reside (28.14 %), commercial public facilities (15.76 %), government (11.67 %) and green (11.62 %) in line with the Shenzhen and national standards. Land for road facilities accounted for 21.9 % beyond the standard of the national standard, mainly because the city main road in the track range and red line wide between 100 and 150 m.

From 1999.1 to 2005.9, urban new construction and transformation have increased a total of 910.5 ha, which represents approximately 1/3 of the land for construction; including new construction is about 384.42 ha, the transformation is

Table 3.1 The main features list of underground space development

Function	Total area (10,000 m^2)		Proportion (%)
Parking in basement	77.04	149.54	65.00
Parking in story underground	72.5		
Commercials in the basement	29.63	57.52	25.00
Commercial in story underground	27.89		
Other functions in basement	11.85	23.01	10.00
Other functions in story underground	11.16		
Total	230.07	230.07	100

526.10 ha of land, with an average 76.9 and 105.22 ha in annual. Commercial public facilities, large living and government and community site increase of 7.70, 6.97 and 3.47 %; unused land and industrial land greatly reduced, the number is 11.22 and 9.79 %; unused land transformed into residential and commercial land for public facilities. The changes in 5 years represent a meaning of attract and opposite to the rail transportation public facilities for commercial, residential, government and community site as well as industrial land.

The present land use situation of Shenzhen track project comply with the major mode of high-density housing business and retail center, which meet the laws of economic development and the effectiveness of urban land; meanwhile the nodes of the track with other transit lines should be different levels of city.

3.5 Conclusion

The ultimate purpose of the urban land development is to promote the optimal allocation of land resources and the most economical use, TOD mode can effectively use our limited land resources, change from extensive to intensive, and avoid consumptive land and traffic problems caused by urban construction. Urban planning, land use and TOD strategy closely linked, complete perfect combination of public investment and private investment development mechanism, curb disorder spread of land, to form “green, efficient and economic” integrated transport system, to further promote the city sustainable and harmonious development.

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