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Interactive Mechanism of Integration Between Land Use Around High-Speed Railway Stations and Urbanization from the Stakeholder Perspective—A Case Study of Typical Stations in the Guangdong-Hong Kong-Macao Greater Bay Area

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Abstract: As key nodes in the regional transportation network, the integration of land use around high-speed railway (HSR) stations and urbanization is a complex process involving multi-subject participation and multi-interest games. Based on stakeholder theory, this paper selects four typical HSR/intercity stations in the Guangdong-Hong Kong-Macao Greater Bay Area (Guangzhou South Station, Hong Kong West Kowloon Station, Zhaoqing East Station, and Zhongshan North Station) as research objects. Through qualitative research methods such as in-depth interviews, field surveys, and policy text analysis, it identifies the core stakeholders in the integration process, analyzes the interest demands and behavioral logic of three major subjects (government, market entities, and the public), reveals the interactive game mechanism among different subjects, and proposes optimization strategies for interest coordination. The research finds that the interactive relationship between the government's planning guidance and policy regulation, market entities' capital investment and operation management, and the public's demand feedback and rights expression determines the direction and effect of the integration. The interest imbalance among core stakeholders is the key inducement for the lagging integration of some stations. From the perspective of interest coordination, this paper provides theoretical reference and practical paths for the efficient land use around HSR stations and the high-quality integration of urbanization in the Guangdong-Hong Kong-Macao Greater Bay Area.

Keywords: Stakeholders; high-speed railway stations; land use; interactive mechanism; Guangdong-Hong Kong-Macao Greater Bay Area

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1. Introduction

As one of the most open and economically dynamic regions in China, the rapid construction of high-speed railway and intercity railway networks in the Guangdong-Hong Kong-Macao Greater Bay Area has promoted the efficient flow of

production factors and the complementary linkage of urban functions within the region. Up to now, the Greater Bay Area has built multiple HSR lines such as the Guangzhou-Shenzhen-Hong Kong Express Rail Link and the Xiamen-Shenzhen Line, as well as intercity railways including the Guangzhou-Zhuhai Intercity Railway and the Guangzhou-Foshan-Zhaoqing Intercity Railway, forming a transportation pattern of a "one-hour living circle". HSR stations are not only transportation hubs but also important engines for urban spatial expansion and urbanization. The land use mode around them directly affects the quality and efficiency of urbanization. Existing research on the integrated development of land use around HSR stations and urbanization has been a hot topic in regional research in recent years. Firstly, it summarizes the development models of typical HSR new towns (districts) at home and abroad, such as the TOD (Transit-Oriented Development) model, business center model, and comprehensive hub model[1-2]. Studies have found that the spatial form around stations often presents a circular structure (core area, impact area, peripheral area), and its functional layout, development intensity, building density, etc., attenuate with distance and interact with the overall urban spatial structure[3]. Secondly, the evaluation of land use efficiency and benefits. Scholars have quantitatively measured the economic efficiency, social benefits, and ecological impacts of land use around stations using methods such as data envelopment analysis, super-efficiency DEA, and Malmquist index[4]. It is found that there are significant differences in land use efficiency among different station types and regions, which are closely related to factors such as urban hierarchy, planning control, and market dynamics. Thirdly, land use evolution and driving mechanisms. Using remote sensing images, GIS spatial analysis, and econometric models, studies have revealed the temporal and spatial evolution laws of land use types such as commercial, residential, and public facilities around stations. Its driving mechanism is summarized as the combined effect of multiple factors including policy orientation (such as planning guidance and land finance), market forces (such as developer investment and changes in housing and land prices), and location value reassessment brought about by improved transportation accessibility[5-7]. Fourthly, the research perspective on the interactive integration of urbanization and HSR has evolved from the early one-way "impact-response" analysis to a complex system perspective emphasizing two-way interaction and collaborative integration[8-11]. In the Guangdong-Hong Kong-Macao Greater Bay Area, relevant research usually analyzes how HSR promotes cross-city living and employment from the perspective of daily activity space, thereby promoting the in-depth integration of the urbanization process[12]. At the same time, some scholars believe that "station-city integration" may be a development trend under the joint action of multiple factors[13]. Overall, existing research mostly focuses on quantitative analysis, providing data support for revealing integration laws, but ignores the subjective role of "people". In essence, land development and urbanization are processes of interactive games among different interest subjects. The demand differences and behavioral choices of stakeholders such as the government, enterprises, and residents profoundly affect the path and effect of integration.

The stakeholder theory was proposed by Freeman in 1984. This theory regards enterprises as a contractual collection of stakeholders and emphasizes that enterprises need to balance the interests of multiple subjects such as shareholders, employees, suppliers, and the government. In recent years, this theory has been widely applied in public fields such as urban planning, land development, and ecological governance, providing an important theoretical framework for analyzing multi-subject interactive relationships[14-15]. Based on this, this paper introduces stakeholder theory into the research on the integration of land use around HSR stations and urbanization. Following the principle of "type differentiation", it selects four typical stations in the Guangdong-Hong Kong-Macao Greater Bay Area, covering hub-type HSR stations (Guangzhou South Station, Hong Kong West Kowloon Station), node-type HSR stations (Zhaoqing East Station), and commuter-type intercity stations (Zhongshan North Station). The research scope is the core impact area within 1-3km around each station. Through qualitative research methods such as semi-structured interviews, field surveys, and policy text analysis, it analyzes the interest demands and behavioral logic of core stakeholders, reveals their interactive mechanisms, in order to make up for the deficiencies of quantitative research and provide a new research perspective for optimizing the integration of land use around HSR stations and urbanization in the Greater Bay Area.

2. Identification of core stakeholders in the integration of land use around hsr stations and urbanization

According to the interest correlation, participation, and influence of stakeholders in the integration of land use around HSR stations and urbanization, this paper divides core stakeholders into three categories: government subjects, market entities, and social public subjects. Each subject includes multiple subdivided groups (**Table 1**).

Table 1. Core stakeholders in the integration of land use around hsr stations and urbanization

Stakeholder Type	Subdivided Groups	Interest Connection Points	Core Demands
Government Subjects	Central government, governments of various cities in the Guangdong-Hong Kong-Macao Greater Bay Area and relevant departments (Bureau of Natural Resources, Housing and Urban-Rural Development Bureau, Transportation Bureau, Investment Promotion Bureau, Industry and Information Technology Bureau, etc.)	Regional coordinated development, urban spatial expansion, land finance income, public service supply	Optimize territorial spatial layout, improve urbanization quality, increase fiscal revenue, and safeguard public interests
Market Entities	Real estate developers, commercial operators, transportation operators, industrial investors	Capital appreciation, project profitability, market share expansion	Reduce development costs, obtain land appreciation benefits, and ensure project operation efficiency
Social Public Subjects	Surrounding residents, merchants, commuters, employees	Improvement of living environment, travel convenience, business opportunities, employment positions	Improve transportation connection and public services, safeguard legitimate rights and interests, and enhance quality of life

2.1. Government subjects: planners and policy regulators

Government subjects occupy a dominant position in the integration of land use around HSR stations and urbanization, and their behaviors directly determine the direction and rhythm of station development. The central government promotes the construction of intercity railways in the Guangdong-Hong Kong-Macao Greater Bay Area from a national strategic perspective and coordinates regional coordinated development; governments of various cities in the Greater Bay Area are the direct managers of land development around stations. They guide the integration of land use and urbanization by formulating regulatory detailed plans, formulating land transfer policies, and improving infrastructure supporting facilities. The government's core interest demands are dual: one is public interest demands, that is, expanding urban space through station development, improving urban functions, enhancing urbanization quality, and meeting residents' demand for a better life; the other is economic interest demands, that is, obtaining fiscal revenue through land transfer, driving industrial development relying on HSR hubs, and promoting local economic growth.

2.2. Market entities: capital investors and operation managers

Market entities are the core participants in land development around HSR stations, and their behaviors are driven by the profit-seeking nature of capital. Real estate developers develop residential and commercial complex projects by bidding for land, pursuing land appreciation benefits and project sales profits; commercial operators are responsible for the investment promotion and operation of commercial facilities around stations, focusing on passenger flow and commercial return rates; transportation operators are responsible for the operation and management of HSR and intercity railways, focusing on transportation connection efficiency and operation cost control; industrial investors layout high-tech industries and modern service industries relying on the location advantages of HSR hubs to seek industrial development dividends. The core demand of market entities is to maximize capital interests on the premise of reducing development and operation costs.

2.3. Social public subjects: stakeholders and rights claimants

Social public subjects are the direct beneficiaries of the integration of land use around HSR stations and urbanization, and also groups whose interests may be damaged. Original surrounding residents pay attention to land expropriation compensation standards, resettlement quality, and changes in the living environment; merchants pay attention to the growth of passenger flow and business opportunities brought by station development; commuters pay attention to the convenience of transportation connection and travel costs; employees pay attention to employment opportunities brought by industrial development around stations. The core demand of the social public is to safeguard their legitimate rights and interests and improve the convenience of life and travel.

3. Analysis of interactive games and integration effects of stakeholders in typical stations

Different types of HSR stations have differences in functional positioning and development models, and the interactive relationships among stakeholders also show different characteristics, leading to differences in the effects of integration between land use and urbanization. This paper selects four typical stations to analyze their integration processes and effects from the perspective of stakeholder interaction.

3.1. Hub-type hsr stations: comparison between guangzhou south station and hong kong west kowloon station

Guangzhou South Station is the largest HSR hub in the Guangdong-Hong Kong-Macao Greater Bay Area, integrating multiple HSR lines such as the Guangzhou-Shenzhen-Hong Kong, Guiyang-Guangzhou, and Nanning-Guangzhou lines. The surrounding area of the station is planned and positioned as “the comprehensive transportation hub in South China and the sub-center of southern Guangzhou”. In the development process, the government’s leading role is prominent. The Guangzhou Municipal Government has clarified the functional zoning of land use by formulating the “Regulatory Detailed Plan for the Area Around Guangzhou South Station”, prioritized the construction of infrastructure such as rail transit and roads; introduced large real estate developers such as Poly Development and Vanke through land bidding, auction, and listing to develop residential and commercial projects; at the same time, issued policies to guide the agglomeration of modern service industries and convention and exhibition economy. In terms of interactive relations, the government and market entities have formed a collaborative model of “planning guidance - capital follow-up”. That is, the government improves land value through infrastructure supporting facilities, and the capital investment of market entities accelerates land development and urbanization. However, there is a certain interest imbalance in the interaction with the social public. Some original residents reflect that the land expropriation compensation standard is lower than expected, and the resettlement housing is located in remote areas; commuters point out that the transportation connection around the station is not perfect, and the walking distance between subway and HSR transfers is too long. Overall, the integration effect of land use and urbanization around Guangzhou South Station is remarkable, and a new urban area integrating transportation, commerce, and residence has been formed, but the protection of public interests still needs to be strengthened.

Hong Kong West Kowloon Station is the terminal of the Guangzhou-Shenzhen-Hong Kong Express Rail Link and an important gateway for interconnection between Hong Kong and the mainland. Its development adopts a TOD model of “station-city integration”, invested, constructed, and operated by MTR Corporation Limited (MTR). In the development process, the interaction between the government and market entities is characterized by “government-enterprise cooperation and interest sharing”. The Hong Kong Special Administrative Region Government grants MTR the land use right around the station. MTR obtains benefits through real estate development and commercial operation to subsidize railway construction and operation costs; the government ensures the supporting facilities of public space and infrastructure through planning control. In the interaction with the social public, MTR fully listens to the opinions of residents and commuters through public consultation meetings and publicizing planning schemes, and optimizes the layout

of transportation connection and public service facilities. For example, convenient entry-exit inspection channels are set up inside the station, and public spaces such as parks and cultural facilities are supporting around the station to meet public needs. The integration of land use and urbanization around Hong Kong West Kowloon Station has realized the organic combination of "transportation hub - urban complex - public space", and the collaborative interaction of stakeholders is the key to its success.

3.2. Node-type hsr station: integration dilemma of zhaoqing east station

Zhaoqing East Station is the intersection of the Guiyang-Guangzhou and Nanning-Guangzhou HSR lines, located in Dinghu District of Zhaoqing City, a node-type station in an edge city of the Greater Bay Area. The development around the station is mainly government-led, but due to the limited financial strength of the local government, the supporting infrastructure is lagging behind; market entities have low investment willingness, and only a small number of developers participate in residential project development, resulting in a serious shortage of commercial and industrial supporting facilities. In the interaction of stakeholders, there is a disconnect in cooperation between the government and market entities. The government hopes to drive the urbanization process of Dinghu District through station development, but lacks sufficient capital and policy attractiveness; market entities believe that Zhaoqing East Station has a small passenger flow and low development return rate, and adopt a wait-and-see attitude. The interaction with the social public is also weak. Surrounding residents reflect that station development has not brought obvious employment opportunities, and commuters point out that the connection transportation between the station and the urban area is inconvenient with few schedules. At present, the land use around Zhaoqing East Station is mainly agricultural land and undeveloped land, and the urbanization integration process is slow. The interest imbalance of stakeholders is the core reason for the integration dilemma.

3.3. Commuter-type intercity station: integration characteristics of zhongshan north station

Zhongshan North Station is a core station of the Guangzhou-Zhuhai Intercity Railway, undertaking the commuter passenger transport function between Guangzhou, Zhuhai, and Zhongshan. The surrounding area of the station is planned and positioned as "the commuter hub in northern Zhongshan and the urban commercial sub-center". In the development process, the interaction between the government, market entities, and the social public is characterized by "demand-oriented and coordinated development". The government has improved the connection facilities such as buses and shared bicycles around the station according to the needs of commuter passenger flow; introduced developers through land transfer to build residential and commercial projects to meet the living and consumption needs of commuters. Market entities have developed small-sized residential buildings and community commerce according to the needs of commuters, improving the adaptability of projects. The demands of the social public have been well responded to, the travel convenience of commuters has been significantly improved, and the living supporting facilities of surrounding residents have become increasingly perfect. The integration of land use and urbanization around Zhongshan North Station presents the characteristics of "commuter-oriented and industry-city integration", and the demand matching of stakeholders is the key to its good integration effect.

4. Interactive mechanism of land use and urbanization integration from the stakeholder perspective

Through the analysis of typical stations, it can be seen that the interactive mechanism of the integration of land use around HSR stations and urbanization is essentially a process of interest demand expression, game, and coordination among three core stakeholders: the government, market entities, and the social public. Its interactive relationship can be summarized as a triple mechanism of "guidance - driving - feedback".

4.1. Government's planning guidance and policy regulation mechanism

The government is in a dominant position in the interactive mechanism, coordinating the interest relationship between

market entities and the social public through planning guidance and policy regulation. On the one hand, the government guides the investment direction of market entities through formulating regulatory detailed plans for the surrounding areas of stations, clarifying indicators such as functional zoning of land use and development intensity, so as to avoid blind development; on the other hand, the government balances the profit-seeking nature of market entities and the public interests of the social public through formulating land transfer policies, industrial support policies, land expropriation compensation policies, etc. For example, the Hong Kong Special Administrative Region Government has realized the win-win situation of interests among the government, MTR, and the public through the "railway + property" development model, linking land appreciation benefits with railway operation costs; the Guangzhou Municipal Government has attracted market entities to invest by improving infrastructure supporting facilities, increasing land value, and promoting the urbanization process. The effectiveness of the government's guidance and regulation mechanism directly affects the direction of integration. When the government's planning and policies can balance public interests and market interests, the interaction of stakeholders presents a collaborative state, and the integration effect is remarkable; when the government excessively pursues land finance income and ignores the needs of the social public, it is easy to trigger interest conflicts and hinder the integration process.

4.2. Market entities' capital-driven and operation feedback mechanism

Market entities are the core driving force of land development, and their capital investment and development and operation behaviors react on the government's planning and policies. Market entities convert capital into actual results of land use through participating in land bidding and project development, promoting the urbanization process; at the same time, in the process of development and operation, market entities will adjust their development strategies according to market demand and operation benefits, and feed back policy suggestions to the government. For example, developers around Zhongshan North Station adjusted the residential unit design and commercial format layout according to the needs of commuter passenger flow, and suggested to the government to improve the connection transportation. The government optimized the bus routes according to market feedback, realizing positive interaction. The driving mechanism of market entities is dominated by the principle of profit maximization. When the development return rate around the station is high, market entities have a strong investment willingness, which can accelerate the integration process; when the development return rate is low, market entities adopt a wait-and-see attitude, leading to lagging integration. Therefore, the government needs to stimulate market vitality through policy incentives, reduce the development costs of market entities, and improve the investment return rate.

4.3. Social public's demand feedback and rights expression mechanism

The social public is the direct beneficiary of the integration of land use and urbanization, and their demand feedback and rights expression are important bases for optimizing the integration path. The social public expresses their demands to the government and market entities through letters and visits, interviews, public consultation meetings, etc., affecting planning and development decisions. For example, Hong Kong West Kowloon Station collected residents' suggestions on the layout of public space through public consultation meetings during the planning stage, optimizing the design of parks and cultural facilities around the station; residents around Guangzhou South Station reflected the problem of transportation connection through letters and visits, promoting the extension of subway lines. The effectiveness of the social public's feedback mechanism depends on the smoothness of public participation channels. When public participation channels are improved, the demands of the social public can be timely transmitted to the government and market entities, promoting interest coordination; when public participation channels are blocked, interest demands cannot be effectively expressed, which is easy to trigger social conflicts and affect the integration process.

5. Optimization Strategies for the Integration of Land Use Around HSR Stations and Urbanization from the Perspective of Interest Coordination

Based on the analysis of the interactive mechanism of stakeholders, the core of the integration of land use around HSR stations and urbanization is to realize the interest coordination of three major subjects: the government, market entities, and the social public. According to the practical experience and existing problems of typical stations in the Guangdong-Hong Kong-Macao Greater Bay Area, the following optimization strategies are proposed.

5.1. Build a multi-subject collaborative governance mechanism

Establish a collaborative governance platform involving the government, market entities, and the social public, and clarify the rights and responsibilities of all parties. The government should play a leading role by setting up a special working group for HSR station development to coordinate the work of planning, land, transportation, and other departments; introduce market entities to participate in planning formulation and infrastructure construction to realize "government-enterprise cooperation and interest sharing"; establish a long-term mechanism for public participation to ensure the public's right to know and participation by publicizing planning schemes and holding public hearings. For example, learn from the public consultation model of Hong Kong West Kowloon Station, and fully listen to public opinions at all stages of station development to avoid interest conflicts.

5.2. Improve the interest distribution and compensation mechanism

Balance the government's land finance interests, market entities' capital interests, and the social public's public interests. In the land expropriation link, formulate scientific and reasonable land expropriation compensation standards, and adopt a diversified compensation method of "monetary compensation + resettlement + employment support" to safeguard the legitimate rights and interests of original residents; in the land development link, reduce the development costs of market entities and improve investment willingness through policies such as "land transfer income return" and "tax incentives"; in the operation link, establish a land appreciation benefit sharing mechanism, and use part of the land appreciation benefit to improve public service facilities and enhance the public's sense of gain.

5.3. Optimize differentiated development models

Formulate differentiated development strategies according to the functional positioning of stations. For hub-type stations such as Guangzhou South Station and Hong Kong West Kowloon Station, strengthen the TOD development model of "station-city integration" to promote the in-depth integration of transportation, commerce, industry, and residence; for commuter-type intercity stations such as Zhongshan North Station, highlight the commuter orientation, improve transportation connection facilities, optimize residential and commercial supporting facilities to meet the needs of commuters; for node-type stations such as Zhaoqing East Station, the government should increase infrastructure investment, issue industrial support policies, cultivate characteristic industries relying on the station's location advantages, enhance attractiveness to market entities, and gradually promote urbanization integration.

6. Conclusion and outlook

Based on stakeholder theory, this paper selects four typical HSR/intercity stations in the Guangdong-Hong Kong-Macao Greater Bay Area and reveals the interactive mechanism of the integration of land use around HSR stations and urbanization through qualitative research methods. The research shows that the interactive relationship between the government's planning guidance and policy regulation, market entities' capital-driven and operation feedback, and the social public's demand feedback and rights expression determines the direction and effect of integration; the interest coordination of core stakeholders is the key to achieving high-quality integration. At present, the Guangdong-Hong Kong-Macao Greater Bay Area is accelerating the construction of a "Greater Bay Area on tracks", and the HSR and intercity

railway networks will be further improved. Future research can expand the scope of cases, combine quantitative research methods to build an evaluation index system for the interactive relationship of stakeholders, and provide more accurate theoretical guidance for the integration of land use around HSR stations and urbanization. At the same time, with the development of digital technology, how to use big data, artificial intelligence, and other technologies to broaden public participation channels and improve the efficiency of interest coordination will also become the focus of future research.

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