Research on Key Countermeasures for Enhancing Intercity Commuting Efficiency in Metropolitan Areas

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Abstract. With the process of urbanization in China, metropolitan areas have become important places where a lot of people live. In this case, the internal part distributes the employment and residential areas in a polycentric and clustering way, so the intercommuting desire rises. At the same time, commuters' expectations of the efficiency and quality of these trips are also going up. But due to the contrast between the wish for commute and connectivity ("commuting without real access, accessing without an effective commute"), as well as the poor integration of different modes of transportation resulting in low commuting efficiency, this hinders the development of these areas. In answer to this, this paper, through the summarizing of commuting characteristics in the Tokyo Metropolis as well as strategies for further improvement, offers key measures and policy suggestions. These planning, construction, operation and management-oriented proposal strengthen cross-regional connectivity, reduce residents' travel costs of time, and in the end, improve the attractiveness, competitiveness, and integrated level of this metropolitan area.

Keywords: metropolitan area, intercity, commuting, efficiency enhancement

1 Introduction

In recent years, under the impetus of the rapid pace of urbanization, China's permanent resident urbanization rate has reached 67%. With projection that it will be about 70% by 2030[1], nearly a billion people would be living in cities by that year. At the same time, the individual city concepts are becoming less defined and the metropolis region has become the central zones for future population agglomerations and the central engines for China's economic development. However, regions also face big problems, mainly terrible pairing between workplaces and homes making it commute with no connection, along with bad business overall and what's provided. Under is the imbalance and lack in terms of transportation resource allocation which is clear with continuous issues such as "not continuous roads", "bottleneck sections", or "inefficient multi-trip transits". The infrastructural and operational shortfalls all together give rise to intercity commuting that has a noticeably low level of efficiency, as well as poor quality. In response the Chinese government has given much attention to urban development,

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and has made specific directions for improving integrated development in metropolitans and launching special initiatives for Elevating Intercity Commuting Efficiency in Metropolitan Regions.

In 2024, China's State Council issued the Five-year scheme of furthering the "People-oriented New Urbanization Strategy", which requires the construction of modern metropolis and improving the commuting smooth and efficient[2]. Following this up in 2025 is the ministry of transport that points out work is being done towards making progress in enhancing intercity commuting in metropolitan regions Identify and rank the main projects concerning the improvements of commutes, conditions and service levels between urban centers and surrounding towns[3].

A, P, C, Silva et al.,[4] they review how to use data-driven method to optimize the urban transportation and public transportation, under the context of smart cities, it is a good reference for metropolitan area transportation planning. Göransson, J., Andersson, H.[5] review systematically the factors that influence commuters from the Metropolitan area choose public transportation and stress the importance of service frequency, reliability and accessibility and put forward some suggestions for improving those influencing factors by investigating further. Li, J., and Zhang. L.[6] has examined the commuter flows between the centre and periphery of the Tokyo Metropolitan Area, using survey data about the city's transportation characteristics. Use social network analysis to study the structural features and effects of the commuting network from a relational perspective Secondly, they've used spatial econometric models to see the parts that change the area of the metropolis. Rewritten version by AI, M, M, Rashid et al[7] points out the role of moderate development of urban sustainable development improvement in intelligent transportation systems, technological applications, difficulties, and future trends about the modernization of the metropolis transportation system. Based on an analysis of the economic, demographic, spatial, and technical evolution of 4 world-class metropolitan areas—New York, London, Paris, and Tokyo—Wang, X, W., and Ye, Z.[8] evaluated the developmental stage of Beijing Metropolitan Area as well as integrated transportation system and strategic proposal for Beijing Metropolitan Area development. Zhao, H., and Zhang, C et al.[9] used mobile phone signaling data to study the spatial aspects of commuting and identified a central urban core as main commuter hub. Analysis has been made to determine the boundaries and growth trends of Beijing Metropolitan Area. They give policy ideas for the grouping of comprehensive transportation networks throughout the city cluster and features of the metropolitan area along with the Beijing-Tianjin-Hebei region as well as fully developed, commuter-focused public transport services.

Assunta. D, C. et al.[10] focus on tthe congestion problem of the bottleneck part of cross-regional public transportation system proposes a congestion-aware multi-modal travel recommendations system framework. It intends to balance user needs (such as user habits, user time), system service performance (such as carriage congestion), so as to make a better load distribution of the overall public transportation network. Ha, J., Lee. et al. [11] re-examined the relationship between urban form and excessive commuting in the USA by reviewing 206 metropolitan statistical areas. Use the latest census transportation planning products to show that using multiple indexes to study excessive commuting in cities is correct. From the results it's visible that urban sprawl or job -

housing dispersion has great influence on excessive commuting. This will add some light on the multi-dimensional relationship betweeen the urban form and excess commuting. Chanwoon, P. et al.[12] studies spatial equity of excess commuting through Gini coefficient and GIS map and the data was taken from the Seoul TMoney transit card system. The result shows that the horizontal equity of excess commuting in Seoul is a weak area, and transportation supply and job-housing balance are two key factors that trigger the spatial differentiation of excess commuting.

Existing research on metropolitan commuting mainly concentrates on commuter demographic features and spatial distribution trends. As for the research related to the general efficiency of intercity travel in metropolitan areas, it is frequent in focus to tie up studies to only one dimension or viewpoint, for instance, only focusing on average commutes or the efficiency of one kind of transport mode. There has also been very little regard for the unique commuting characteristics and demands of each metropolis area, which results in different needs for how integrated development should go about. Furthermore, as the practical development direction of metropolitan commuter sheds, there is a tendency to prefer infrastructure expansion over efficiency in operations, and to place greater emphasis on regulation than on the quality of services. Cross-region and inter-departement coordination issues, there is a lack of integrated planning mechanisms for adjacent land use and transport infrastructure construction, resulting in a split commuting sense, traffic jams are too common, and overall commuting convenience is relatively low. So, we need to follow the inherent characteristics of intercity commuting in metropolitan areas for strategy. A comprehensive approach is needed, put forward some important measures to improve the efficiency of management mechanisms, infrastructure construction, operational services and information management systems.

2 Inter-City Commuting Characteristics and Pervasive Challenges in China's Metropolitan Areas

The Conceptual Framework of the metropolitan area originated in Japan. It was based upon the American Model of "Metropolitan Statistical Area" but it introduced Japanese Characteristics of urban area. It is basically a functional urban area. Metropolises have emerged as a global standard for urban agglomerations, yet differences in the specific definitions and geographical delimitations of metropolises exist among different countries. In China, it’s defined as a regional area within a functional urban region, centered around one or several core urban centers that are well-connected with solid infrastructure; the region also includes peripheral areas around the core cities that are closely tied economically and socially. An example of this: the Beijing Metropolitan area that consists of Beijing’s central urban district province of Hebei as well as areas surrounding like Yanjiao town, Xianghe County, and Dachang County. as shown in Figure 1.

On February 19, 2019, the National Development and Reform Commission issued the "Guiding Opinions on Cultivating and Developing Modern Metropolitan Areas," [13] put forward the goal of cultivating and developing metropolitan areas with global influence. On Feb 2, 2021, the Nanjing Metropolitan Area was the first to be given

official go-ahead. By October 2025, 18 cities such as Nanjing, Chengdu, Xi'an had been setup by China in total. Framework has models of cross-province cooperation, it's going to be our strategic pillar to bring NE China back online.

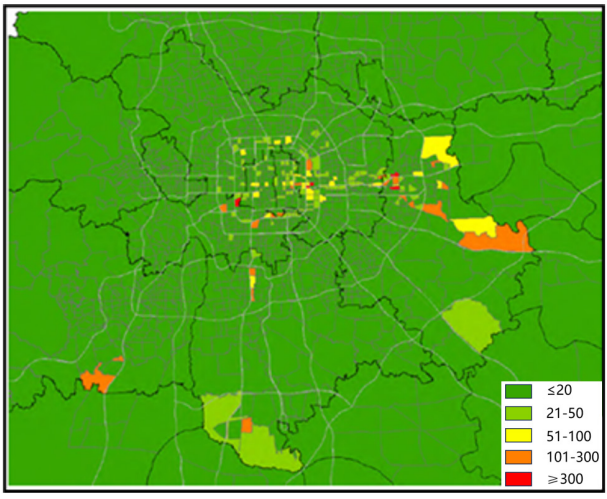

Fig. 1. Schematic diagram of main distribution areas and distances for people traveling to Beijing across cities

Based on the population distribution, spatial form, and industrial layout, there are 3 types of metropolitan areas. First is the Center-Radiating type: Beijing, Shanghai are typical metropolitan area. High-end main city, long-distance and intercity travel, large commuting scale and range. The second is Center-Agglomeration type, which is like Wuhan, Xian. Here, core city maybe a bit more developed, surrounding towns development still on the way so there is some intercity commuting features, but it has less cross-region commuters and commute distance. The third is the Center-Developing Type, which we can see in elsewhere like Changan and Guiyang. These places began their development later, have smaller territories, are largely focused within the city, present a monocentric pattern, and exhibit limited intercity commute volume and scale.

2.1 Current Situation Characteristics

Metropolitan intercity commuting means going from the middle of big towns, other closer groups of buildings, and nearby smaller places. But it more like intra- urban travel, at the junction between internal city transport and intercity transit, there is complexity. There will be more difficult travel requirements when there are multiple modes and areas of travel. In general,metropolitan intercity travel has large radial differences,long travel times, high concentration in corridor areas, rapid growth of cross-regional travel, and overreliance on public transport. These characteristics show different variations according to different types of metropolitan areas, so it requires an advanced transportation system providing various, saving-time, and seamless services.

According to the *2024 Annual Commuting Monitoring Report for Major Chinese Cities* released by the China Academy of Urban Planning and Design, in 2023, the 45 mins commuter rate (%) in major citieswas as high as 77% and the extreme commuter rate (over 60 mins) was only 12%. Though it could be seen that extreme commuting in megacities and super large cities had zero growth, there were still 8 million exceeding an ultra long commute of 25 kilometers, which has an average commute time of 90 mins [14], as shown in Figure 2.

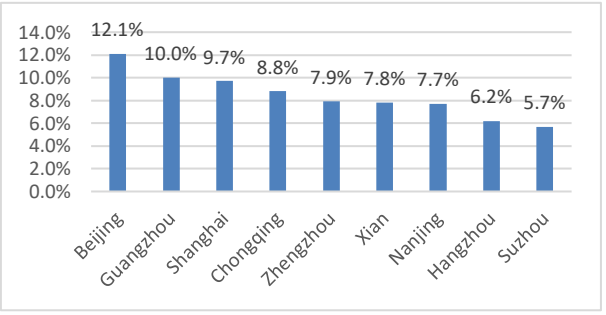

Fig. 2. Share of population with commutes over 25 km in selected netropolitan areas

Beijing, Nanjing, Guangzhou and other Metropolitan areas intercity commutes show "double high" feature, which means average roundtrip duration from neighboring clusters and surrounding towns to central urban area as well as cross-regional trip outside central urban area all more than 90 minutes. In metropolitan region, the proportion of commuters within an hour is no more than 70%. The issue with long travel times in the central urban region compared to neighboring cluster areas in the Metropolitan area is also present. On average 30% of the megacities' population has more than 45 minutes of commute, 42% of people in Beijing have more than 45 commutes, and 28% of people in Beijing have over an hour commute, as shown in Figure 3.

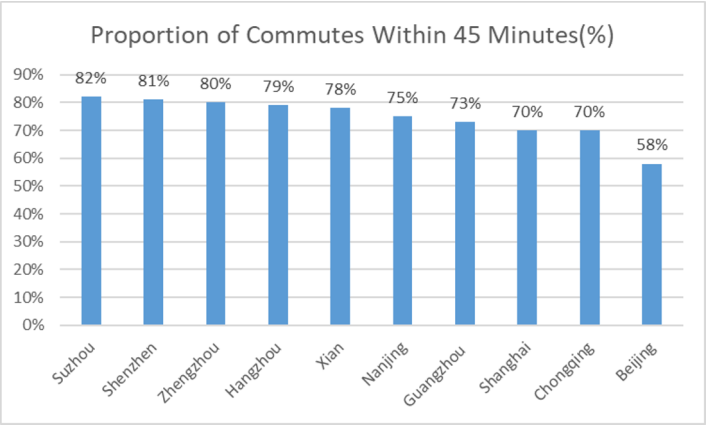

Fig. 3. 45-minute commute coverage rate across selected metropolitan areas

China's lower and middle-income group is an important part of Metropolitan area inter-city commuting. In addition, in some Metropolitan Area, the rail transit is not well developed, and there is serious road jam when people are traveling from and to city centers. So public transport has become a key choice for Metropolitan area Inter-city commuting. Using Beijing Metropolitan area as an example: Inter-city commuting is mainly carried out through three methods, including direct bus traveling, private car rides including self-driving, and combined bus and rail commuting, each taking up 31.1%, 27.8%, and 24.8% respectively. Among residents commuting from Yanjiao to Beijing,68% rely on public transportation.

2.2 Existing Problems

2.2.1 Insufficient Overall Consideration among Various Travel Modes.

First, there's not much connection between Metropolitan area internal transportation and metropolitan area external transportation. At some Passenger transport hub, passengers need to get off from station to transfer to buses or taxis. Also, practically all Railway and Urban rail transit systems don't have mutual recognition for their security checks, so passengers would have to go through two security checks when transferring, which greatly decreases Transfer efficiency.

Second, it is not convenient for the tolls at the entrance and exit in the centralized cities in the Metropolitan area, and it is also inconvenient for the exit of cities, which often cause a long-roads traffic jam at the entrance and exit of cities.

Third, in terms of supplying travel services in the Metropolitan area, the Core City bears a majority of it. Due to lack of uniform management and approval regulations for each city, it is difficult to unify the service standards and ticket prices of inter - regional bus routes connecting Adjacent cities, and also difficult to unify the security inspection standards. In addition, as urban boundaries continue to expand, many national roads and provincial roads have taken on the functions of urban roads. However, due to the lack of unified standards and planning for construction in the early stage, both Construction standard for Municipal road and expressway and Inter - city highway within cities are inconsistent, making it difficult for many roads to be directly connected.

2.2.2 The Intercity Operation Efficiency of Regular Public Rransport Remains Relatively Low.

The public transit access to central city within 1 hour within the 50-kilometer radius of 18 Metropolitan areas is 17% In the metropolis of Shanghai, Shenzhen, Hefei, and Changchun, the proportion of areas with 45-minute access to public transport is 43%, 60%, 44%, and 39%, because there is a shortage of intercity express routes with few stops and fast travel times. Beijing Metropolitan: The cross region average travel time by car, intercity Railway and public transport is around 80 minutes, 105 minutes and 120 minutes respectively. The travel time cost is even as high as 1.5 times more than paris, tokyo and london.

2.2.3 The Service Capacity of Metropolitan Area Rail Transit Still Needs to Be Improved.

Suburban railway serving Metropolitan area travel with 30—70km has no clear functional positioning and there is inconsistency with Technical standard in relation to other rail transit modes. The epitaxy lines of Urban rail transit constructed in the early time have low Technical standards for trains. Like Shanghai Metro Line 11, Xi'an Metro Line 1, and Beijing Metro Fangshan Line, their design speeds are all below 100km/h, and station spacings are 1-2km; it is difficult to achieve the intercity rapid commuting demand.

3 Development Experience of the Tokyo Metropolitan Area Inter - City Commuting System

3.1 Overview of Metropolitan Areas

Tokyo Metropolitan Area is a Metropolitan Area around special wards (city core) of Tokyo. It covers 13,600km2 with 35 million people. Within a 50-kilometer radius of central Tokyo, it is found that 93% of the area's population and jobs live. The region's total traffic volume is less than half of what occurs in its central region, the great majority being inter-district journey from the outlying districts to the cities core. The max commuting radius is about 50 kilometers, most passengers are between 0-30km, less than 30% beyond 50km. The last half-century, Tokyo's metro area doubled its people and car count seven times. Yet far from being destroyed, urban transportation has made significant progress in easing traffic, and the booming rail transit is the most important factor making the Tokyo Metropolitan Area easier to live in and faster to travel.

3.2 Overview of Rail Transit Systems in Metropolitan Areas

Tokyo Metropolis rail transit includes subways, JR National Railways and private rail, and Shinkansen and tram, in which suburban railway is the main axis of rail transit. By end of 2022, total length of the Rail network within the Tokyo Metropolitan Area is about 3,465 kilometers. Subway is only 363 kilometers in length, with short intervals and many stations, serving a 15 kilometer radius around the center (similar to the area inside Beijing's fifth ring road) On the other hand, suburban railway system (operated by JR national railway and private railway) with longer intervals have longer distance of 2651km, but more speedier in serving the more metro area which is farther to central area. The Tokyo Metropolitan Area's Rail transit system deals with daily passenger count of 44.14 million, among which suburban railway reaches 31.67 million passengers, more than 70%: It has 3 times more ridership than the subway, and is the critical support beam for the Tokyo Metropolitan Area to function.

3.3 Methods for Improving Commuting System Efficiency

First is variety of train formations. The formations of Tokyo subway and JR local lines and private railways are not constant. Specific form is decided all over the place depending on station situation, number of travelers, and places where vehicle stops, the more is not less than 10 vehicles. Shinkansen is related to the intensity of passenger flow and type of vehicle, with the smallest formation being 8 cars and the largest formation being 16 cars.

Second is the express and local trains combined operation. Suburban railway realizes the mixed operation of express and local train through double-track and crossover lines, mainly providing three types of train services: one is the express train with fewer stops, larger station intervals, and only stops at a few major stations, with high operating speed; one is the local train with smaller station intervals and stops at every station; another is the medium-speed train with a speed and station interval between local train and express train. The mixed operation of express and local trains can avoid the impact of frequent train stop, improve the train operating speed, short the train operation time, and offer better services to long-distance passengers.

The third is the cross-line through permission. Such a huge rail network has different lines created by different companies. To decrease the number of transfers and allow passengers to "make their journey to their destination with only one train," Tokyo lets the same train run on different lines. Technical standard in consistency for the year of track construction has become the technical foundation for a cross line through operation. At transfer station for through operation, passengers don't need to get off the train, just the train driver will be changed. The through operation between subway and suburban railway is very important, it can bring the passengers a convenient transportation from the suburbs to downtown, reduces the number of transfer and eases the traffic pressure during the commuting peak time of Tokyo's 13 subway lines, 10 subway lines has achieved through-operation with suburban railway.

Fourth is waiting mode on the platform It does not provide waiting rooms and there are ticket gates at the entrance of the connecting channel to the platform. After card swiped by passengers at the station, different train numbers and lines can allow passengers to select the platform for getting on and off. Also do not have a security check at the station, allowing passengers as much as possible to enter and leave the station quickly.

Fifth is the high-density comprehensive development. Most centers and sub-centers in the Tokyo Metropolitian Area have mostly been developed with reference to existing comprehensive transportation hubs. Around important comprehensive transportation centers such as Tokyo Station and Shinjuku Station, the floor area ratio of buildings exceeds 10 and incorporates several purposes including Commerce, Office, and Leisure & Entertainment. Bus stop, taxi stop, underground garage, shop, bank, commercial street, and other facilities are all located within the same building around Tokyo's Integrated Transportation Hubs and connected underground. For example, Shinjuku Station has a huge underground channel network and there are up to 243 entrance and exits within 900 meters range, all are widely connected to surrounding buildings and roads system, passengers can gather and disperse from surroundings without any problem.

4 Key Measures for Intercity Commuting Efficiency Improvement in Metropolitan Areas

4.1 Build the Integrated Planning and Policy Mechanism for Metropolitan Area

Cities or clusters within the cities or clusters in a Metropolitan area is encouraged to work together and come up with plans for Metropolitan area comprehensive transport, Urban public transport, highway network, Urban road and so on. The future development aspect will be considered together at the beginning of the plan, and the transportation systems in various places will also be considered together. Operation and management, Multiple departments of the cities or clusters within a Metropolitan area will boost exchanges and contact. Strengthen close cooperation and teamwork with various departments like the government, transportation management department, municipal department, and passenger transport enterprises; together, they will work on formulating policies and implementing related projects for the Metropolitan Area integrated travel. Key metropolitan areas should take the lead in exploring co-construction, sharing, and co-governance mechanisms, and jointly conduct research and formulation of rules for operation routes, ticketing systems and ticket prices, payment and settlement, information sharing and exchange, etc. and to enhance the connection and unity of cross-regional travel services.

4.2 Improve the Service Capacity of Rail Transit

For center-radiating metropolitan area, we should take advantage of the radiating backbone role of rail transit in suburban commuting. This means, on one hand, to unify the planning method and the technical standard and upgrade the facilities in the station such as sign and communication facilities, to prepare for operational innovation such as express/local service, cross-line operation. On the contrary, it's necessary to speed up the integration of multi-network trunk railways, regional (suburban) railways and urban rail transit. Develop a multi-tier, composite rapid rail network system on major commuting corridors, and guide the intensive and concentrated layout of population and industries along the axes.

For the Center-Agglomerating metropolitan areas, then it is on improving the capacity of trunk railways to deal with demands of intercity commute. The improvement of collection and distribution systems at railway passenger hubs and making full use of excess capacity on existing lines, or operating regional/suburban services after necessary upgrades. These are made to improve both the level and the coverage of public transport orientated rail.

For Center-Developing metropolitan areas, encourage the adoption of trunk and intercity railways to meet the travel needs of the metropolitan area. If railway hubs or rail stations are far from main functional clusters, good coordinating feeder bus services must be provided for first/last mile connections.

4.3 Improve the Rapid Bus Transit Service Network

For Center-Radiating and Center-Agglomerating type Metropolitan Areas, it is necessary to establish high-speed bus route directly connecting central urban cores of the main intercity commuting corridors. These routes can adopt an "limited-stop-express" style operation, and at the same time set up continuous bus lanes with bus lanes on the corridor during peak hours to make it efficient and reliable.

For center - It's better to use personalized solutions in the metropolitan area. It includes starting personalized commuter buses from the core city to major neighboring clusters where there is more travel demand. And introduce demand responsive transit or app-based ride pooling services around these towns so as to address service gaps and enhance the coverage of the important peripheral region of the metropolitan area.

Furthermore, “scheduled operation” (or timetable operation) is also of great importance for all intercity commuting route. This approach lets passengers correctly estimate travel times, greatly lowering both seen and true waiting times, and makes the general commuter experience much better.

4.4 Promote the Integrated Transformation of Service Facilities

A priority is upgrading transfer facilities at comprehensive passenger hubs. Include "zero-distance transfers" through level exchanges and prefer to use the same platform or vertical transfers when possible. Do mutual security check recognition between railway stations and other link urban rail transit, as well as the layout of urban bus and taxi and ride-hailing facilities. In order to raise transfer efficiency as well as the capacity for collecting and distributing passengers at these terminals, these measures are all about.

For the intercity commuting problem, MaaS platform must be built. This system has to include operating information from metropolitan as well as suburban transport firms. The final aim is to provide the public with a “one-stop” travel service for the area, from a flawless journey planning to queries of information on the spot, and integrated purchasing of tickets.

5 Conclusion

Based on the classification of intercity commuting types and summarizing the characteristics of intercity commuting in metropolitan areas in China, the paper points out the real problem behind the low efficiency and service levels. Learning from the development experience of the rapid commuting of the Tokyo Metropolitan Area, this paper puts forward some key measures for improving intercity commuting efficiency to different kinds of metropolitan areas, offering some lessons for integrated development. Due to difficulties obtaining all the multi-modal transportation data and a huge amount of data required, this study only discusses the overall characteristics of intercity commuter travel in different area type metro cities in brief and not delving deeper into a specific metro city or mode of transport. So future study will use different kinds of large network data sources to thoroughly look at the where and when and how well different

city travel ways work in one area, and try to give more specific ways to make them better.

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During the writing of this manuscript, the author used AI tools during the Chinese-to-English translation process and for checking grammar. The authors take full responsibility for the use of these tools and take full responsibility for the content of the paper.

References

1. Ministry of Housing and Urban-Rural Development of the PRC, 2025, https://www.rmzxw.com.cn/c/2025-05-20/3723774.shtml.
2. The State Council of the PRC, "Notice on Issuing the ‘Five-Year Action Plan for Further Implementing the People-Centered New Urbanization Strategy’," 2024, https://www.gov.cn/gongbao/2024/issue_11526/202408/content_6969191.html.
3. Ministry of Transport of the PRC, 2025, https://www.mot.gov.cn/jiaotongyaowen/202507/t20250717_4172676.html.
4. A, P, C, Silva., L, A, C, P, L, da Costa, and E, F, P, de Luz., "A Review of Data-Driven Approaches for Urban Mobility and Public Transportation in Smart Cities," 2021 IEEE International Conference on Systems, Man, and Cybernetics (SMC), 2021, pp: 2883-2888, doi: 10.1109/SMC52423.2021.9658708.
5. Göransson, J., Andersson, H., " Factors that make public transport systems attractive: a review of travel preferences and travel mode choices," European Transport Research Review, 2023, 15(1), 32, doi: 10.1186/s12544-023-00609-x.

6. Jiang, Z, M., "A study on commuting trip energy consumption reduction by job-housing reallocation in Tokyo Metropolitan Area," CHINA TRANSPORTATION REVIEW, 2021, 09(43), pp: 119-125, doi: 1000-713X(2021)09-0119-07.
7. M. M. Rashid, S. A. M. T. Hasan, and M. K. Alam, "A Comprehensive Study of Intelligent Transportation System (ITS) for Sustainable Urban Development," 2020 IEEE International Conference on Informatics, IoT, and Enabling Technologies (ICIoT), 2020, pp: 301-306., doi: 10.1109/ICIoT48696.2020.9089517.
8. Wang, X, W., Ye, Z., "Analysis of Beijing's Transportation Development Stage and Strategic Recommendations Based on a Comparison of World-Class Cities," Urban Transport of China, 2025(05), pp: 1-8, doi: 10.13813/j.cn11-5141/u.2025.0053.
9. Zhao, H., Zhang, C., Liang, X, H., Li, C, J., Jia, X., "Beijing Metropolitan Area Spatial Boundary Identifcation and Commuting Rate Characteristics Based on Spatial Merge Techniques," SHANGHAIURBAN PLANNING REVIEW, 2023(06), pp: 55-60, doi: 10.11982/j.supr.20230607.
10. Assunta. D, C., Ida, F., Angelo, F., Eugenio, Zi., "Optimizing Urban Public Transportation with a Crowding-Aware Multimodal Trip Recommendation System," Smart Cities, 2025, 8(6), 190, doi: 10.3390/smartcities8060190.
11. Ha, J., Lee, S., Kwon, S. M., "Revisiting the relationship between urban form and excess commuting in US metropolitan areas," Journal of Planning Education and Research, 2021, 41(3), pp: 294-311, doi: 10.1177/0739456X18787886.
12. Chanwoon, P., Justin, S., "Spatial equity of excess commuting by transit in Seoul," Transportation Planning and Technology, 2020, Volume 43, pp:101-112, doi: 10.1080/03081060.2020.1701760.
13. National Development and Reform Commission of the PRC, "A study on commuting trip energy consumption reduction by job-housing reallocation in Tokyo Metropolitan Area," 2019, https://zfxxgk.ndrc.gov.cn/web/iteminfo.jsp?id=16110.
14. China Academy of Urban Planning & Design, "2024 Annual Commuting Monitoring Report for Major Chinese Cities," 2024, https://www.planning.org.cn/news/view?id=16083.