

Research on Sustainable Urban Development of Local Cities in the Context of Different Transit-Oriented Development (TOD) Patterns

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(公共交通指向型開発(TOD)を活用した地方都市における持続可能な開発に関する研究)

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論 文 内 容 の 要 旨

Public transportation is an important means of transportation in the daily lives of citizens and is indispensable for the formation of affluent local communities, such as the development of local economies. Transit-Oriented Development (TOD) is regarded as a fast-growing trend worldwide that promotes a compact, walkable, mixed-use community around transit stations. The growth of local cities frequently occurs despite the convenience of public transit, with a rising reliance on automobiles—quite different from the development of megacities. That may result in various difficulties and problems like traffic jams and environmental pollution that would affect residents' lives. So many developed countries have turned their attention to urban planning that focuses on public transportation. The aim of this dissertation is to assess the real impact of TOD methods on urban development in order to increase the appeal of TOD and inspire more regions and cities to adopt TOD-driven planning for sustainable urban growth. We concentrated on two local cities situated in the Kyushu region of Japan to evaluate the impact of TOD on urban growth in order to permit a more intuitive assessment of the effectiveness of TOD in various patterns. This dissertation is composed as follows:

Chapter 1 systematically introduces the core research context of this research, describes the research questions, and explains the research purposes and the structure of the dissertation.

Chapter 2 summarizes previous research on TOD around the world, revealing current trends in research on TOD hotspots. Among them, three key themes are listed: transit station areas, land use, and environmental travel behavior. These topics are explored in depth in the latter case studies. Through the literature review, we can clearly define the research direction and related methods. The results can be connected with existing research progress.

Chapter 3 examines the attributes of Transit-Oriented Developments (TODs) in Fukuoka City, focusing on the perspective of rail stations. The Node-Place model is employed to conduct a spatial analysis of the city's rail stations. Additionally, spatial autocorrelation analysis is used to assess the spatial clustering of these stations and investigate the interplay between land use and transportation in their proximity. This analysis serves as a theoretical foundation for the purpose of logical planning and development in areas surrounding stations that exhibit disparities in development. It seeks to elucidate the intricate relationship between transportation infrastructure and land use patterns surrounding each station.

Chapter 4 delves into an in-depth examination of the relationship between Transit-Oriented Development (TOD) and land use changes within the urbanized area of Fukuoka City. To examine this association, we propose the utilization of a Random Forest-based Cellular Automata (RF-CA) urban growth

model. This model is employed to simulate land use change in Fukuoka City from 1998 to 2018, with a particular focus on the TOD factor as the primary driving force behind these changes. Furthermore, we incorporate the attribute values derived from the Node-Place model discussed in Chapter 3, which characterize the role of each TOD station in the urban development process. This approach can be an effective tool for elucidating the impact of TOD on urban development.

Chapter 5 assesses the implementation of Transit-Oriented Development (TOD) within Kumamoto City, specifically within the context of compact urban planning. The TOD strategy employed in Kumamoto City centers on the establishment of small community centers, aligning with the principles of compact city development. The overarching urban development policy in Kumamoto City emphasizes a collaborative, multi-core approach. By strategically situating public transportation stations around these community-based TOD centers, the city aims to foster high-density, mixed land uses that contribute to the vitality of these communities. In this study, we examine the behavioral patterns of bus users in Kumamoto City, seeking to understand how various built environment factors influence bus ridership. Our analysis delves into the impact of these factors on the spatial distribution of bus usage, with the goal of assessing the efficacy of Kumamoto City's compact urban development policy, which is rooted in the TOD concept. Leveraging a one-month dataset from smart cards, we investigate both the spatial and temporal patterns of transit rider activity within TOD communities. Employing a range of regression models, we explore the public transportation preferences and requirements of the city's residents. The findings from this case study serve to illustrate the effectiveness of TOD principles in facilitating compact urban development within Kumamoto City.

Chapter 6 summarizes the conclusions of each chapter and provides recommendations for future research.

This research significantly advances the existing framework of Transit-Oriented Development (TOD) research by integrating data from multiple sources, thereby enhancing our understanding of local cities. A noteworthy aspect of this dissertation is its explicit focus on local cities, a research component that has been relatively underexplored within the realm of TOD studies. Our in-depth exploration of the unique contexts and challenges faced by local cities not only addresses an existing gap in academic research but also offers significant insights into the planning and sustainable development of similar urban areas. The framework developed in this dissertation holds substantial practical value for mitigating urban planning challenges encountered by local cities and can be readily applied to diverse urban settings. Furthermore, the significance of our research contributions is underscored by their acceptance and publication in peer-reviewed academic papers, further reinforcing their importance within the academic community.

Keywords: Transit-Oriented Development, transit station areas, land use, urban development, compact city, spatial analysis.