World Academy of Science, Engineering and Technology
International Journal of Industrial and Systems Engineering
Vol:19, No:02, 2025

Harmonizing Cities: Integrating Land Use Diversity and Multimodal Transit for Social Equity

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Abstract : With the rapid development of urbanization and increasing demand for efficient transportation systems, the interaction between land use diversity and transportation resource allocation has become a critical issue in urban planning. Achieving a balance of land use types, such as residential, commercial, and industrial areas, is crucial role in ensuring social equity and sustainable urban development. Simultaneously, optimizing multimodal transportation networks, including bus, subway, and car routes, is essential for minimizing total travel time and costs, while ensuring fairness for all social groups, particularly in meeting the transportation needs of low-income populations. This study develops a bilevel programming model to address these challenges, with land use diversity as the foundation for measuring equity. The upper-level model maximizes land use diversity for balanced land distribution across regions. The lower-level model optimizes multimodal transportation networks to minimize travel time and costs while maintaining user equilibrium. The model also incorporates constraints to ensure fair resource allocation, such as balancing transportation accessibility and cost differences across various social groups. A solution approach is developed to solve the bilevel optimization problem, ensuring efficient exploration of the solution space for land use and transportation resource allocation. This study maximizes social equity by maximizing land use diversity and achieving user equilibrium with optimal transportation resource distribution. The proposed method provides a robust framework for addressing urban planning challenges, contributing to sustainable and equitable urban development.

Keywords : bilevel programming model, genetic algorithms, land use diversity, multimodal transportation optimization, social equity
Conference Title : ICIEEM 2025 : International Conference on Industrial Engineering and Engineering Management
Conference Location : Tokyo, Japan
Conference Dates : February 24-25, 2025