Comparative Analysis of the Performance and Synergistic Effects of Urban Mass Transit Systems Using an Integrated Modeling Approach (Case Study: Isfahan)

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Rapid urbanization, increasing urban travel demand, and the need to preserve cultural heritage have created major challenges for public transportation planning in historic metropolitan areas. As one of Iran's most significant historical and tourism cities, Isfahan requires an integrated approach to mass transit development because of its UNESCO World Heritage sites, the physical constraints of its historic urban fabric, and growing mobility demand. This study comparatively evaluates the performance and synergy of urban mass transit systems and proposes a framework for selecting the most appropriate transportation development strategy for Isfahan. This applied, descriptive–analytical study first identified the strengths, weaknesses, opportunities, and threats of Isfahan's transportation system using SWOT analysis. The importance of key evaluation criteria, including transportation performance, tourism, cultural heritage preservation, economic, and environmental indicators, was determined using the Analytic Hierarchy Process (AHP). Five development scenarios—the existing system, metro expansion, tourist tram, electric buses, and an integrated smart transportation system—were then ranked using the Technique for Order Preference by Similarity to the Ideal Solution (TOPSIS). Sensitivity analysis was conducted under different managerial and economic scenarios to evaluate the robustness of the results. The findings indicate that reliance on a single transportation mode cannot adequately meet Isfahan's future mobility needs. The integrated smart transportation scenario, combining the metro, tourist tram, electric buses, and Mobility as a Service (MaaS), achieved the highest ranking and maintained its superiority across all sensitivity analysis scenarios. These results suggest that sustainable transportation development in Isfahan should adopt a heritage-oriented, tourism-oriented, and network-integrated planning approach.

Keywords: Integrated Urban Mass Transit, Sustainable Development, SWOT Analysis, TOPSIS, Sensitivity Analysis