A Multi-Criteria Decision Approach to Measure Rail Transit Station Efficiency in Urban Areas

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Abstract:

Planning and constructing public transportation (PT) lines, especially in urban areas, require careful consideration due to the many factors involved in transportation engineering. Evaluating the performance of stations, particularly for railway lines, necessitates taking both costs and benefits into account. This study examines the performance of new rail transit (RT) stations in an urban area by considering structural costs and key benefits such as travel demand and service frequency. Specifically, our analysis focuses on construction costs as the primary expense, while the number of peak-hour trips, average speed, and transit service frequency are treated as the main benefits. We employ the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), a multi-criteria decision-making (MCDM) methodology, to assess the effectiveness of RT stations in a large urban rail system. Notably, this technique has not previously been applied to the particular RT stations which are under our consideration. Our case study evaluates 20 stations on a tram line in a major city in Türkiye, offering 20 alternatives for analysis. The results highlight variations in station efficiency and provide recommendations for improvement. By addressing critical factors and applying MCDM approaches, this research seeks to enhance PT services in large cities, contributing to the development of a more effective and inclusive urban RT system.

Keywords:

Public transportation, multi-criteria decision-making, TOPSIS, transit stations.