

Regional Comparison of Public Railway for Passenger Transportation in Uzbekistan by Using the Analytical Hierarchy Method

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Abstract—The extent of passenger transportation along railway lines is contingent upon a multitude of socio-economic factors. Hence, before commencing any investment in a railway line, comprehensive analyses are conducted concerning line selection and the scope of operations. This article delves into calculating weights that determine the influence of specific socio-economic factors on rail passenger transport volumes, employing the Analytical Hierarchy Process (AHP) methodology. Subsequently, based on these factors, a comparison was undertaken among the 12 regions and Karakalpakstan autonomous republic of Uzbekistan concerning their impact on passenger transport. This comparison facilitated the arrangement of areas respectively of their demographic and economic conditions, offering insights into their relative significance in the realm of passenger transportation.

Keywords—AHP method, consistency, passenger transport, Uzbekistan railways, regions

I. INTRODUCTION

As the railway sector in Uzbekistan continues to evolve rapidly within the country's expanding economy, Uzbekistan Railways is actively exploring various strategies to drive its growth and development. Recognizing the intricacies of passenger transport systems, conducting comprehensive multi-criteria analyses has become imperative before embarking on any investment decisions. The versatile nature of multi-criteria analysis empowers us to evaluate a wide array of social, economic, and environmental factors, enabling a holistic approach to decision-making [1]. By integrating these diverse considerations into our assessments, we can navigate the complexities of the transport landscape effectively and make informed choices that align with our overarching objectives.

The aim of this article is to conduct a comparative analysis of regional railway lines in Uzbekistan, considering the various factors influencing transport volume. It is known that socio-economic factors play a significant role in passenger transport, yet their specific impact on railway transport has not been thoroughly examined. To facilitate the comparison of different regions based on multiple factors, the Analytical Hierarchy Process (AHP) method was employed to assign weights to these factors, ranging from 0 to 1. These weightings were then utilized to evaluate and compare the railway lines. The AHP method, initially developed by Thomas L. Saaty [2], has undergone continuous refinement and adaptation over the years to suit specific problem domains, incorporating psychological assessments and mathematical calculations to aid decision-making in complex scenarios with multiple options.

The AHP method allows for a systematic evaluation of criteria with varying impacts on the desired outcome, particularly when subjective judgments are involved. It has found widespread applications across diverse fields such as business, industry, logistics, and transportation. When applied to the analysis of rail passenger transport, the AHP method proves beneficial in understanding the needs of different passenger groups within the transportation system. The complexity of the transport process, encompassing economic, social, technical, and environmental aspects, underscores the need for a method like AHP to navigate through the intricate decision-making landscape.

While the AHP method excels in hierarchically evaluating criteria and decision variants, its complexity can escalate with many factors or options, necessitating numerous pairwise comparisons. Efforts have been made to streamline and enhance the usability of AHP, especially when dealing with extensive data sets for analysis. The research has been developed with respect to the study carried out by W. Kaminski analysing selected railways lines both for public and freight transportation in Poland using the AHP method [3]. In his study a comparison was made of 12 railway lines located in various regions of Poland in terms of their use in both passenger and freight transport and the study made it possible to arrange the selected lines regardless of their category. Moreover, there have been another similar study carried out concerning the influence of the economic and political factors on the public rail transport in Slovakia [4].

A. Uzbekistan's rail network

During Former Soviet Union Uzbekistan railways played an important role between the transferring with Russia and after the collapse of the Soviet Union Uzbekistan Railways experienced decline in operations however gained strong position after the independence after the economy has expanded. In 2023 Uzbekistan Railways transported 9,7 million passengers and its passenger turnover was 3,9 billion passenger-km [5].

Considering of the pandemic situation all around the world, starting from 2020 up to 2023 UTY's passenger volume increased at an average annual rate of 16% and passenger turnover increased by 32% represented in Table 1.

II. RESEARCH METHODOLOGY

To conduct the regional assessment of rail transport for passenger trafficking, well known multi criteria decision making method AHP (Analytic Hierarchy Process) was applied. Multiple criteria decision aid, originating from operational research, equips decision makers with tools to address complex multi-criteria decision problems. These