Indicator	Value
Round trip time, min	50
Operational speed, km/h	17
Technical speed, km/h	24,7
Total deadhead mileage on the route, km	25
Daily mileage on the route, km	378
Mileage utilization coefficient on the route	0,938

Based on transport analysis and calculation of the main technical and operational indicators of the route, the number of vehicles on the route, and the qualitative configuration of its segments, Route No. 250e "Pivdennyi Vokzal (Yevhena Kotlyara St.) – Berkosa St. (Sortirovka)" was revised and approved. The need for these measures was determined by actual data on bus occupancy levels on the route. In the morning, it was observed that buses on the route were overcrowded (the static occupancy rate in the outbound direction was 1.2). The mismatch between capacity and actual demand leads to decreased quality of passenger transportation services and reduced operational efficiency of the enterprise.

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APPROACHES TO DETERMINING TRANSPORT DEMAND FOR PASSENGER MOBILITY IN CITIES USING PUBLIC TRANSPORT

Ye.V. Liubyi, Associate Professor

A.A. Orhina, student

Kharkiv National Automobile and Highway University

Language Adviser: T. Gerasymchuk, PhD, Associate Professor

Introduction In the current context of rapid urbanization and population growth in cities, there is an increasing need for effective transport system management. One of the key aspects is the accurate determination of transport demand, which enables the planning of routes, transport volumes, movement intervals, and the optimization of infrastructure use. With growing demands for service quality, environmental safety, and energy efficiency in public transport, the issues of analyzing and forecasting passenger transport demand are becoming especially relevant. Moreover, the development of intelligent transport systems, the digitalization of management processes, and the use of big data open up new possibilities for a more accurate and dynamic approach to transport demand modelling. All of this necessitates a comprehensive scientific analysis of existing approaches, their improvement, and adaptation to modern conditions.

Purpose of the study The purpose of this research is to analyze current approaches to determining transport demand for passenger mobility in urban environments using public transportation, and to identify promising directions for the development of this field considering technological and social changes.

Analysis of approaches The analysis of approaches to determining transport demand includes both traditional and innovative methods, each with its own advantages, disadvantages, and areas of effective application. Among classical methods, surveys and questionnaires stand out, involving direct contact with respondents to collect information about their travel habits. This provides detailed insights into trip motivations, routes, time intervals, and transport mode preferences. However, this method is expensive, requires substantial human resources, has limited timeliness, and is subject to the subjective nature of responses. Another widely used method is passenger flow accounting – observing and recording the actual number of passengers using public transport on various routes. This method ensures data objectivity but is limited to quantitative indicators and does not explain passengers' motivations or behavioral changes. Gravity models, which represent a significant evolution in demand analysis, are based on the assumption that the intensity of movement between city districts is proportional to the "attractiveness" of these areas (e.g., population, number of workplaces) and inversely proportional to the distance or travel time between them. These models provide a generalized picture of transport flows but fail to consider real changes in passenger behavior under external influences.

The gravity model is one of the most widely used and foundational methods for modeling transport demand, especially in urban contexts. It is based on an analogy to Newton's law of universal gravitation, where the interaction between two masses is directly proportional to their size and inversely proportional to the square of the distance between them. In the context of urban transportation, this model assumes that the number of trips between two locations depends on the "attractiveness" of these areas (such as population, employment, or service capacity) and the "resistance" or cost of travel between them (in terms of distance, time, or monetary cost).

This model can be calibrated using historical or observed trip data, often by applying iterative proportional fitting or other mathematical optimization techniques to ensure that estimated trips match known origin and destination totals.

The gravity model has evolved into more complex versions, such as:

- Doubly-constrained models, where both origin and destination totals are fixed;
- Production-attraction models, where zones are classified by whether they generate or attract trips;
- Modified impedance functions, including exponential decay functions or travel time thresholds.

In urban planning, the gravity model is often the second step in the traditional four-step travel demand modeling process (trip generation – trip distribution – mode choice – route assignment).

Examples of use in practice:

- United States (NCHRP). Gravity models are actively used in transportation planning at the national level. For example, the National Cooperative Highway Research Program (NCHRP) uses gravity models to develop master plans for cities and transportation corridors [1];
- United Kingdom – Transport Studies Unit, Oxford. In the MARS model (Metropolitan Activity Relocation Simulator), a modified gravity model simulates trip redistribution based on changing accessibility and urban policy

measures [2];

- Ukraine – Gravity models were used to estimate future passenger flows to newly constructed residential districts and assess the feasibility of expanding metro networks [3, 4];

Japan – Urban Rail Planning. Tokyo's transit authorities have employed gravity models to predict shifts in passenger demand resulting from new metro lines and changes in land use [5, 6].

Perspective directions Modern approaches to determining transport demand significantly enhance the capabilities of classical models through the implementation of digital technologies and new data sources. One of the leading directions is the use of big data, which includes information from GPS devices, mobile phones, electronic tickets, smart cards, and even social media. These methods offer high accuracy, scalability, and dynamic modeling capabilities. For instance, analyzing mobile device movements allows real-time tracking of flow changes, identification of patterns, and the creation of adaptive routes. Microsimulation enables the modeling of the behavior of individual traffic participants, simulating the interactions of vehicles, pedestrians, and passengers in detail. This allows for flexible responses to changing conditions, the implementation of new transport solutions, and assessment of their effectiveness prior to actual deployment.

Intelligent data analysis systems based on machine learning and artificial intelligence algorithms are also widely used. These systems allow for the analysis of large volumes of data, detection of complex dependencies among variables, and forecasting of future transport system development scenarios. Another promising technology is geographic information systems (GIS), which integrate spatial data with socio-economic characteristics of urban environments. This enables the creation of interactive demand maps, route change modeling, and optimization of the placement of transport hubs, stops, and parking spaces.

In the future, data integration approaches that incorporate not only transport indicators but also weather conditions, event-related factors, socio-economic data, and urban planning information will be of great importance. The development of mobile applications that enable passengers to both receive and provide information is especially relevant, thus establishing a two-way communication channel. Digital twins of transport systems – virtual models that simulate scenarios, conduct experiments, and test new solutions without affecting real infrastructure – are also becoming vital tools. Equally important is the involvement of the public in the planning and forecasting of transport demand. Through open platforms and services, citizens can express their preferences, report issues, and participate in the formation of route networks. Open data fosters the development of new analytical services and enhances management transparency. Sustainable development models also play a crucial role, taking into account not only the efficiency of the transport system but also its environmental impact, supporting the growth of eco-friendly transport, reducing private car usage, and improving the accessibility and comfort of public transportation.

Conclusions At the current stage of urban mobility development, determining transport demand is becoming a key tool for planning and optimizing the operation of public transport. A wide range of methods exists – from classical statistical techniques to innovative technological solutions. The application of cutting-edge technologies such as big data, artificial intelligence, and geographic information systems opens new horizons for demand analysis with high accuracy and responsiveness. Promising directions include the development of digital tools, the creation of integrated data collection and processing systems, public involvement in planning processes, and a focus on sustainable transport infrastructure development. All these approaches will help build a flexible, efficient, and user-friendly public transport system that meets contemporary requirements and the expectations of urban residents.

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WAYS TO DEVELOP AN EFFICIENT URBAN PASSENGER TRANSPORT SYSTEM

Kutuzov D.I., master's degree candidate,
Ptytsia N., Ph. D. of Engineering, Associate Professor,
Kharkiv National Automobile and Highway University
Language Adviser: T. Gerasymchuk, PhD, Associate Professor

The low efficiency of urban passenger transport in Ukraine is caused by a lack of funding necessary for its proper operation, which, in turn, results from broader economic challenges. This situation is further aggravated by the high proportion of vehicles operating beyond their standard service life, alongside an almost complete lack of resources for their renewal. Under such conditions, private carriers have become more active, entering the market with vehicles of various brands, mostly with low passenger capacity. As a result, high-speed bus services have nearly disappeared.

The most widespread form of passenger transportation has become route taxis, which mostly operate alongside existing urban public transport routes. Methods of organizing route operations include combined transport modes and various vehicle dispatching