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**ACCESSIBILITY OF TRANSPORT SYSTEMS IN PASSENGER TRANSPORTATION***O. Matiychyk, K. Kryshkevych*National Aviation University  
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*The given article considers the issue of accessibility of transport systems as a transport indicator having an effect on the integration of the national transport system. Factors influencing accessibility of transport are regarded. A system of measures for providing transport accessibility is suggested and the indicators of accessibility evaluation are grouped. Methods of evaluating accessibility of transport systems are stated.*

**Keywords:** accessibility, transport system, passenger transportation, evaluating accessibility.

*У статті з'ясовано значення показника доступності транспорту при оцінці стану національної транспортної системи та рівня транспортних послуг. Охарактеризовані фактори, які впливають на доступність транспорту. Запропоновано систему заходів для забезпечення доступності транспорту та класифікацію показників для оцінки рівня доступності транспортних систем. Розглянуті методи оцінки доступності транспортних систем.*

**Ключові слова:** доступність, транспортна система, пасажирські перевезення, оцінка доступності.

**Introduction**

Passenger transportation is a derived demand. The demand is generated by people's needs for labour, education, leisure, recreation, household activities, etc. A given amount of trips per time period illustrates the mobility of population. At the same time the demand for passenger transportation cannot be satisfied and the mobility rates cannot be reported, unless the transport system is accessible for passengers of all categories, social status and physical aptitude. This refers researchers to the investigation of a variety of indicators describing transport systems, such as the affordability of transport, social connectivity, and access to motor vehicles, travel perceptions and accessibility of transport.

The due level of accessibility of the country's transport system shows the degree of its integration. According to the "Transport Strategy of Ukraine over a period up to 2020", one of the major principles for its implementation is "Provision of accessibility and quality of transport service to the population owing to the social standards" [5]. Development of accessibility following such a principle of national transport policy shall eventually improve interregional relations and diminish spatial disparities. Most of all, promotion of transport accessibility shall assist the state in fulfilling its social function of transportation service provider.

**Problem statement**

Accessibility of transport systems is realized through satisfaction of the demand for mobility. There are different profiles for accessibility for transport modes. The given study considers these profiles for non-urban transport systems.

Transport systems should provide equal opportunities for transportation to all social groups. However, this fact is often overlooked in Ukraine.

The theoretical implications concerning accessibility of transport shall enable offering better solutions to transportation problems and, therefore, shall assure improvements into the transport system of Ukraine.

**Analysis of recent researches and publications**

The issue of transport accessibility is studied in the works of such researchers as Todd Litman, Ahmed El-Genaidy, David Levinson L. A. Arabat-skaya, A. P. Petrova, I. V. Spirin, A. N. Nikitina, etc. [1–5]. They focus on urban transport systems and investigate the concept of accessibility and factors that affect it only for land transport, leaving out the transportation carried out by air, evaluation of air transport accessibility and factors affecting it.

**Objectives**

The objectives of the research are investigating the concept of transport accessibility and system of its provision measures, methods of its evaluation and factors affecting it for road, rail and air transport.

**Accessibility of transport**

The notion of accessibility can be regarded from the point of view of a demographic group, a transport mode, a geographic location or a type of activity. Demographic perspective suggests an understanding of accessibility as of a set of travel options for specific groups to particular services. Consideration of transport modes has led to the following implication of accessibility: provision of direct connection to target facilities and infrastructure, such as buildings, intersections, terminals, etc. Relating to a geographic location, accessibility can be defined as relative ease of getting to a particular place or area. Finally, by the type of activity it is possible to categorize the travel purpose, identify the possible time for transportation and the level of accessibility [2].

Generally, accessibility refers to people's ability to reach goods, services and activities, which is the ultimate goal of most transport activity [1]. Thus, there is a suggestion to regard accessibility of transport as a type of interaction and exchange. A number of factors affect transport accessibility and are sufficient for its evaluation.

### **Factors Affecting Accessibility**

The list of factors affecting accessibility of transport systems accounts for the following: transportation demand, transportation activity, mobility, transportation options, user information, affordability, land use, mobility substitutes, transportation network connectivity, roadway design and management, prioritization, integration, the value of inaccessibility.

We shall provide the description of major factors in the given section.

Travel demand has a major influence on evaluating accessibility of transport systems since it provides a researcher with an accurate description of all possible travel alternatives and enables their quantity consideration against availability, speed, frequency, convenience, comfort, safety, price and prestige.

User information is supposed to notify the passengers on their mobility and accessibility variants.

Degree of integration implies a particular way of connecting locations and areas.

Mobility substitutes are opposing the very fact of mobility as they offer a chance for the client to use a type of telework which totally excludes the need to leave their households for a trip.

Land use is another factor having a significant impact on the degree of accessibility due to possible high connectivity of transport system and lower level of mobility.

Prioritization characterizes the priority of particular transport modes and types of trips to promote efficiency of transport systems. The given factor covers some issues of transport policy and planning, pricing to exclude inefficient vehicles from traffic and favour space- and cost-efficient vehicles.

Inaccessibility of transport systems is another factor affecting transport systems. It is closely related to the new type of travel behavior which implies that more people prefer to live outside urban and metropolitan areas but continue to work in large urban centers. Thus, their households become inaccessible to an extent which imposes the necessity to manage the increased transportation costs, traffic congestion and sprawl on transportation planners.

### **Provision of Transport Accessibility**

Transport accessibility can be provided through a number of economic, technological, informational and organizational measures taken, in particular:

- increasing the affordability of transport services;
- reducing the amount of population living in rural areas and having low access to the network of intercity roads;
- reducing the level of accidents and providing safety of passenger transportation via employment of modernized vehicles which allow comfortable, reliable and quick travel;
- enhancing the quality of user information to help them plan their itineraries;
- providing a possibility of regular travel for a reasonable time to any point of destination in urban, intercity or regional connection.

Low accessibility of transport implies a limited number of ways to access goods and services. These constraints vary in their nature but they all relate to the factor of transport system inaccessibility. Thus, the constraints are: spatial (absence of the required transportation network in a specific area or location), informational (no informational support on the schedules of transport service for the given transport mode), technical (technical hindrances for a passenger to access the transport infrastructure, for example, passengers with physical disabilities), economic (unfavourable pricing policy), limited time to access the transport mode.

### **Indicators of Transport Accessibility**

Therefore, accessibility of transport can be formally represented using a range of qualitative and quantitative indicators. These indicators reflect the degree of access to transport systems on the local and regional level. The indicators of transport accessibility are grouped into general, specific and marginal.

General indicators include:

- rate of economic accessibility (demonstrating a relation between passenger traffic generation and pricing policy for rail, road and air transport);
- rate of technical accessibility (showing the degree of adaptation of transport modes to the needs of socially and physically deprived people);
- rate of spatial accessibility (representing the access to passenger transport service regarding the development of transportation network, availability of passenger terminals and transport vehicles);
- rate of time accessibility (characterizing the time expenses for passengers in O-D travel with regard to stages of passenger service rendering and reference to informational accessibility);

- informational accessibility (reflecting the accurateness and timeliness of travel information support rendered);

- rate of satisfied demand (identifying the degree of passenger satisfaction in transport service obtained).

Specific indicators fall into a different group of transport accessibility indicators since they are normally used by the local authorities only (cities and regions), by the carrier or service provider or by the renderer of individual services (outsourcer).

Marginal indicators are utilized by all transport modes to ensure safe access for passengers to the transport infrastructure and facilities.

### **Evaluating Accessibility of Transport Systems**

Evaluation refers to methods of measuring the impacts of an activity or decision, such as the costs and benefits of various transportation improvement options. The methods used for evaluation affect planning decisions [1].

Current evaluation practices tend to measure mobility rather than overall accessibility. Traffic models are commonly used to evaluate automobile and transit service quality. They measure travel speeds, operating costs and fares. Such models only account for travel between zones, not travel within zones; many fail to account for generated traffic impacts; few incorporate transit service quality factors other than travel speed.

Current transportation evaluation methods often fail to incorporate many these factors. They generally focus on easier-to-measure impacts at the expense of more difficult to measure impacts. For example, current transport models generally assign the same travel time cost value to all travel, regardless of comfort and convenience. This favors transport system improvements that increase vehicle travel speeds over improvements that increase travel comfort and convenience (such as nicer walking conditions, more pleasant transit waiting areas and reduced transit vehicle crowding) [3].

Access to Destinations study uses detailed data on land use, travel behavior, and population demographics to evaluate accessibility in a particular situation. It involves the following steps:

1. Accessibility definition (definition of accessibility is needed that can be applied to various modes).

2. Land use activities (destination information can be developed by activity type (e.g., employment, housing, retail, education, and recreation).

3. Accessibility by mode to destinations. This information can be used to measure accessibility by mode for specific activities and geographic locations in order to compare accessibility for different groups

(such as motorists versus non-drivers, and residents of specific neighborhoods), and track how this changes over time or in response to planning decisions.

A computer application called the Time-Based Transit Service Area Tool (TTSAT) which incorporates total trip travel time into the transit service area maps it generates.

For evaluation and planning it is often useful to identify specific accessibility constraints. No single evaluation method can evaluate all accessibility factors; various overlapping methods reflect different impacts, scales and perspectives. A particular planning decision may require use of multiple methods.

Accessibility-based evaluation models are available that take into account both mobility and land use factors. These use geographic information systems (GIS) to measure the travel distance between various activities, such as average distances between homes and services, or the number of jobs within a half-hour travel distance of residents. However, even these models generally overlook some factors affecting overall accessibility, such as transit service comfort, user information availability, and perceived pedestrian security. Additional analysis may therefore be required to account for these factors [2].

Current transport evaluation practices are economically inefficient and regressive because they exaggerate the benefits of automobile-oriented improvements and undervalue improvements to alternative modes, which skews planning decisions to favor the mobility-rich to the detriment of the mobility-poor. To correct these problems he recommends the following changes to transportation modeling and economic evaluation techniques:

- evaluate transport improvements primarily in terms of accessibility rather than mobility. For example, improvements should be rated based on the number of public services and jobs accessible to people, taking into account their ability (i.e., ability to walk and drive), travel time and financial budgets, not simply travel time savings to vehicle travelers.

- assign value to accessibility gains inversely related to people's current levels of accessibility, to reflect the principle of diminishing marginal benefits. Accessibility gains for the mobility-poor should be valued higher than the same increase in accessibility by the mobility-rich.

Planners can therefore evaluate:

- the quality of accessibility by different modes and in specific areas;

- the quality of accessibility by various groups and how they compare, with particular attention to

the relative quality of accessibility by disadvantaged groups;

- possible strategies for improving accessibility, including increased user comfort, convenience and affordability, not just travel speed;

- possible strategies for improving alternative modes and reducing automobile travel;

- groups bearing excessive time or financial costs for basic mobility.

It is interesting to consider the levels of accessibility and mobility that are overall optimal, and how this is affected by the evaluation methods used. Transportation planning often assumes that any increase in mobility is beneficial and desirable, but there are, of course, various economic, social and environmental costs.

The optimal levels of accessibility and mobility are the amount that consumers would choose in an optimal market, in which they have an appropriate range of travel and location options, and prices reflect costs (users bear directly all costs resulting from their transport activities). Beyond this optimum, increased mobility is economically excessive and harmful to society.

More comprehensive analysis, which takes into account more transportation impacts and options, tends to justify more support for alternative modes, constraints on driving, and accessible land use patterns. Accessibility and mobility demand varies depending on the quality of options available. Many consumers would prefer to reduce their vehicle travel and rely more on alternative modes and more accessible locations, provided those alternatives are suitably convenient, comfortable, safe, affordable and prestigious. Accessibility can be improved by developing new transport and location options that better respond to consumer needs and preferences.

### Conclusion

The issue of transport accessibility has been identified as significant for development of modern transport systems. The factors influencing accessibility of transport include transportation

demand, transportation activity, mobility, transportation options, user information, affordability, land use, mobility substitutes, transportation network connectivity, roadway design and management, prioritization, integration, the value of inaccessibility. Major attention of transport systems planners should be attached to indicators of transport accessibility so that to evaluate the accessibility of transport systems. There are a number of techniques to evaluate accessibility of transport systems. Each group of methods follows accessibility or mobility-oriented approach. Rational usage of results of accessibility evaluation enables efficient solution of transportation problems, optimal planning of transport systems and encouraging social and economic policies towards equal transportation service rendering.

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