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Organization of Municipal Transport Access Control System. Passenger Service Models

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Abstract

This article presents results of passenger service research (fulfilled within municipal transport stopping points) based on service models elaborated for various transport access control systems. The article presents results of boarding simulation modeling (in condition of access control system organized within the stopping point) which may become an advanced method to solve the problem of stopping point's congestion. Mathematical relations deduced allow evaluating passenger service level as per boarding time expenditure parameters. The article presents (i) results of research and (ii) area of these results application in passenger transport systems planning sphere.

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Keywords: Passenger transport, stopping point, service level, access control system, simulation modeling.

1. Introduction

Modern trends in transport service system define priorities in development of infrastructure providing the quality of transport services provided for town population [Scherbina et al. (2015)]. Particular attention has been paid to issues associated with organization of passenger types of surface transport being the basis of municipal transport system fulfilling mass passenger transportation. Fast rhythm of city life, high speed and intensity of traffic environment define

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the necessity to step up the requirements to the levels of passenger transport safety and comfort at any phase of the traffic route [Larin (2005)].

Object of research (results of which have been presented herein) - stopping point organized within municipal passenger surface transport route; subject of research - organization of boarding procedure being one of crucial issues in passenger transport operation sphere. Relevancy of the aforementioned topic is stipulated by unsatisfactory present-day stopping point's performance characteristics (typical for large cities) which tendency could be vividly demonstrated on the example of Moscow city.

Today, passenger surface transport in Moscow is using access control system which is installed directly inside the vehicle stock. Boarding is performed only via the front door resulting in (i) considerable time expenditures for passengers (waiting + boarding) and (ii) stopping point queues causing passenger transport malfunction and unsatisfactory passenger service [FDOT (2013)].

Experiment (with organization of access control and elimination of turn gate) within stopping point located on tramway traffic route No. 17 "Ostankino-Medvedkovo" was held in Moscow in the year 2013. Boarding was fulfilled via all doors and passengers were paying access fares while entering the vehicle (using validator). Experiment resulted in (i) 11% increase of operating speed en route and (ii) considerable reduction of tramway stoppage time required for boarding. Negative effect displaying imperfectiveness of this type of access control system was 20% decrease of fares collection.

Appropriate example displaying exploitability of external access control point - organization of boarding procedure within "Planernaya" transfer hub. Boarding is fulfilled via frontal parts access to which is provided upon fare payment completion. According to passenger's opinions, such organization of access control system provides comfortable and safe conditions during passengers holding time, boarding and getting off. Besides, experts point out positive points like facilitation of boarding, absence of queues, more balanced loading of the vehicle stock, 30 % reduction of time consumed for boarding.

However, the lack of systematic approach and experience in today's practice of boarding system organization define the necessity to undertake (i) theoretical research in the sphere of access control system organization within the stopping points (legal framework analysis) and (ii) analysis of methods regarding planning and laying out of particular elements of passenger transport system.

Main target of research consists in analysis of stopping point operation aiming to define their influence on passenger service level assessed with reference to comfort ability, safety and boarding convenience [Vuchik (2011)]. Different types of access control systems have been compared on the basis of developed passenger service models. Employment of systematic approach in research, scientific methods of research, mathematical apparatus technique as well as approbation of theoretical research results with the use of computer-aided technologies ensure validity and practical utility of the work carried out.

2. Theoretical framework for the research

From the viewpoint of modern requirements to organization of population transport service it is expected that passenger access control system should be selected with consideration of below requirements [SCDOT (2008)], [WMATA (2008)], [TARC (2013)]:

1. Availability of transport services for all groups of population;
2. Comfortable holding conditions;
3. Safety and comfort of boarding;
4. Minimization of time expenditures for holding and boarding;
5. Necessity for passenger transport to keep to the timetable;
6. Avoidance of connecting traffic jams which may occur due to passengers boarding-getting off delays.

All aforementioned requirements are stipulated by the following factors: location within the transport system, space planning concept and particular features of traffic organization. In order to shape systematic concept regarding the influence of above factors on the necessity to organize external access control system the authors performed functional analysis (of typical stopping point organized on passenger transport traffic route) which allowed them to point out four basic factors defining the stopping point performance during passenger traffic handling (Fig.1) [Ministry of Transport of the Russian Federation (2003)].

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