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Multi-criteria evaluation of public transport interchanges

Zofia Bryniarska[a],* , Lidia Zakowska[a]

*a*Cracow University of Technology, Warszawska Str. 24, 31-155 Krakow, Poland

Abstract

Interchanges play a key role in the public transport system at various levels of offered connections: from local or regional transport through national and international transport. Carefully planned and appropriately executed interchanges facilitate integration between different modes of public transport, allow passengers to shorten journey duration and to reduce effort required to change the means of transport.

The question is how to evaluate and compare the advantages and disadvantages caused by various interchanges. The proposed method includes a comprehensive analysis of many aspects of the accessibility of interchanges for passengers. On the one hand, it takes into account the distance to go between tram/bus stops within the interchange, but on the other hand, it considers the quality of the infrastructure maintenance of stops and footpaths, availability and comprehensiveness of information for passengers and personal safety and the safety of traffic as well as the qualitative dimensions of these indicators.

The usefulness of the method is presented on the basis of the assessment of selected interchanges in Krakow.

Keywords: public transport; interchange; multi-criteria evaluation

*Corresponding author E-mail address: z_bryn@pk.edu.pl

1. Introduction

European cities as well as cities around the world are developing faster and faster and it is expected that more than 75 % of the population will live in urban areas by 2050. This process is not proceeding so dynamically in Poland, but even now over 60 % of the population are urban dwellers, and, as indicated by the KPM (2015), residents of urban and located in the close proximity to urban areas constitute even ¾ of the country's population. To ensure the sustainable development of urban areas and to increase the quality of citizens' life, it is necessary to create conditions for the social, economic, cultural development, and the development of education and health care with respect for the cultural heritage and environmental protection. One of the essential conditions is efficient transport of both people and goods. Meeting the growing transportation needs requires integrated actions involving not only infrastructure development, but primarily change of travelling behavior of residents in the appropriate modal split, which is a significant share of journeys by public transport, walking and cycling trips. Public transport can compete effectively with private communication if it uses, in a comprehensive manner, available tools to compete on quality, service, price, communication and information.

Interchanges belong to the crucial locations when using public transport. On the one hand, they allow passengers for any connecting travel by various means of transport and reaching destinations for which there are no direct connections, but on the other hand, they involve extra effort on the part of passengers, uncertainty as to how to continue their journey, waste of time on the movement within the interchange and waiting for another vehicle. The organization of the interchange area requires many adjustments to facilitate their use by passengers. Multi-criteria evaluation uses indicators that cover many aspects relevant and essential for passengers during the their travels and their use of interchanges.

2. Literature review

Urban transport problems and demands were dealt with repeatedly in European documents, for example in the White Papers (2001, 2011) or the Green Paper (2007). The overall objective of the European transport policy is to increase the share of public transport and to reduce the use of private cars.

The discussion on the problem of interchange formation can be found in the manual by Prof. C. Alexander (1977) and the practical documents of transportation organizers in big cities such as London TfL (2009). They formulate a number of tips and rules ranging from the need for a conscious, deliberate and thoughtful planning of the interchange area, its facilities, which should make the interchange not only a safe and convenient part of the transport infrastructure, but a miniature center of public life, to recommendations concerning the distance between stops. Distances comfortable for passengers and accepted by them should not exceed 3 minutes, which means the maximum length of 180-200 m. The more local the character of a journey, the smaller should be this distance.

The subject of conscious interchange development has also been undertaken in various projects financed from EU funds (Mimics, Pirate, GUIDE, LINK, Niches +). In a recently completed NODES project, the methods and tools to support the planning and operation of new and upgraded interchanges that take into account their diverse scale as mobility hubs, stations or public spaces have been developed. In the HUB CITY project, in turn, the comprehensive analysis of existing interchanges has been planned to improve their efficiency and functioning . The project has been carried out jointly by experts, the local authorities and end users, and it provides many examples of good and bad practices.

All of these projects seek solutions (technical and technological, legal and organizational as well as restrictions related to access to city centers) that promote the idea to reduce environmental impact of transport (noise and emissions), especially in urban areas. These activities are also aimed at increasing awareness of alternative and environmentally friendly forms of transport, among others through educational programs and information.

Kruszyna (2013) presented a universal method of describing elements of road infrastructure taking into account the geometry of the road, traffic and the requirements of each user group. The original AMPTI methodology for interchange assessment was proposed by Olszewski (2011) and his research team under the NICHES+ project. Based on years of research and numerous experiments, they proposed a set of quantitative indicators that can be used to assess existing and planned interchanges. The related indicators are included in the tools under the NODES project (Pastor et al. 2014).

3. Methodology of interchange assessment

3.1 Implementation

The competitiveness of public transport in urban areas is on the increase especially where journeys by public transport are characterized by relatively short travel time and ease of use of the transportation system. Buses and trams can run on dedicated lanes in overcrowded streets and thus the travel time is shorter than by private cars. Integrated tariff-and-ticket systems allow passengers to use a single ticket during the travel by various means of public transport. Such travel is much easier for passengers as it does not require constant learning of tariffs of successive carriers and ticket validation. Passenger information systems are available both before and during the trip and they provide not only information about the scheduled time of departure from the stops, but also real times of departure or unexpected