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REQUIREMENTS OF A TRANSPORT SYSTEM USER

This article deals with the problem of basic parameters which influence the selection of a mode of transport by a transport user. The article suggests the use of Saaty's method as a method suitable for the determination of weights of importance of basic parameters (user's requirements).

Key words: *transport system, transport user, Saaty's method.*

1. Introduction

Public transport, neither road nor rail transport in the Slovak Republic has taken the opportunity to increase its share of the division of transport work. On the contrary, the volume of public transport in the Slovak Republic has been decreasing recently which has led to an increased strain on the infrastructure caused by individual car transport (see Table 1 and Fig. 1). The only solution to these problems lies in the increased quality of public transport and in respecting its users' requirements. This can only be achieved by improving the function of the transport system.

2. Basic parametres

The basic parameters which influence the selection of a mode of transport and thus the success of public transport, are [1]:

- time availability – expresses the possibility of using a given mode of transport at the point in time of reaching the point serviced by public transport until the arrival of a suitable connection,
- travel speed,
- price for the users,
- comfort, quality of the fleet and scope of add-on services in the mode of transport,
- inside safety – in relation to the transport process, probability of an accident,
- outside safety – the risk of an unlawful act, protection against terrorism, vandalism and other similar unlawful acts and pathological social phenomena and protection against natural elements,
- reliability – transport system must operate with a high probability of running according to the published time table,
- accessibility of the public transport system to passengers with limited movement and/or orientation ability,
- passenger awareness.

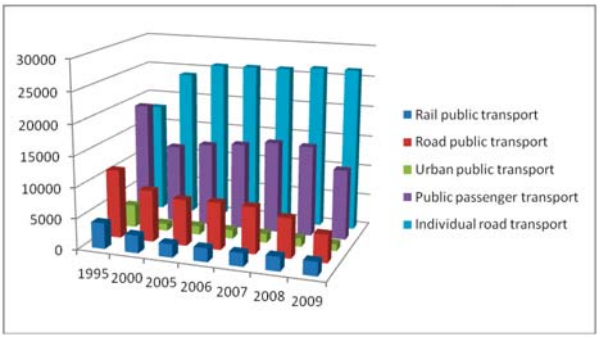

Fig. 1 Total passenger transport performance by mode (mill.pass-km)

In the following part, the article will deal with a suggestion for a method suitable for the determination of weights of importance of basic parameters (users' requirements).

3. Determination of weights of importance

The system of evaluation should be based on the formation of arranged pairs consisting of the weight of importance of a given

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Development of public transport share of transport work for passenger transport Table 1

Modal split with regards to passenger transport performance (mill. pass-km)							
	1995	2000	2005	2006	2007	2008	2009
Total passenger transport performance	39578	37390	39614	40184	41050	41281	37971
of which by mode:							
Rail public transport	4202	2870	2182	2213	2165	2296	2264
Road public transport	11191	8435	7525	7665	7596	6446	4538
Urban public transport	3688	1173	1399	1403	1451	1370	1127
Public passenger transport	19274	12733	13575	14113	14915	14765	11433
Individual road transport	17977	23929	25824	25920	25994	26395	26420
Modal split with regards to transport performance between public and individual road transport (% proportion of public transport)	51.74	34.73	34.46	35.25	36.46	35.87	30.20

Source: Statistical Office of SR

parameter which the user evaluates within the framework of transport and the level (value) of this parameter (relation 1) [2, 3]:

$$MH = \sum_{i=1}^{n} v_i \cdot s_i$$

where:
- MH – total multi criteria valuation,
- v_i – relative weight of importance of the i^{th} parameter,
- s_i – level of meeting the requirements of the i^{th} parameter.

In order to determine the weights of importance of a given parameter we use Saaty's method.

The principle of Saaty's method lies in the fact that instead of using a numerical scale, it enables the users to express their preferences verbally which is often a much easier way of expressing themselves. Verbal expression is automatically transferred into a numerical scale.

The level of importance of one parameter before any other is expressed by the user on a whole number scale 1 to 9. The value 1 means that the pair of parameters has the same importance. The value 9 means that the value of one parameter is absolutely higher than the value of the other parameter. If one parameter is less important than the other, the reverse value of the whole numbers of the given scale is used. The information from pairwise comparison can be put into a matrix $S = (s_{ij}, i,j = 1, 2, ..., k)$ known as Satty's matrix. The elements of this matrix sij can be interpreted as estimates of the share of the i^{th} and j^{th} parameters (relation 2) [4 and 5]:

$$s_i \approx \frac{v_i}{v_j} \quad i, j = 1, 2, ..., k.$$

For the elements of Saaty´s method it applies that s_{ii}, $i = 1, 2, ..., k$, ie. units are on the diagonal; it further applies that $s_{ij} = 1/s_{ji}$, $i,j = 1, 2, ..., k$, ie. elements symmetrical according to the main diagonal carry reversed values.

User's preferences are contained in the matrix of pairwise comparisons S. It is important to use the information about these preferences for the estimate of the weight of the parameters. One of the conditions for usability of this information is its appropriate quality. The matrix of pairwise comparisons must be sufficiently consistent. Matrix S is fully consistent if for any index trio i, j, q it applies that $s_{iq} = s_{ij}\, s_{jq}$. For example matrix (relation 3) [4, 5]:

$$S = \begin{bmatrix} 1 & 2 & 6 \\ 1/2 & 1 & 3 \\ 1/6 & 1/3 & 1 \end{bmatrix}.$$

A good estimate of vector v can be obtained as a geometrical average of elements in each line of the matrix. Matrix S normalized so that the sum of its elements is equal to 1 (relation 4) [4, 5]:

$$v_i = \left(\prod_{j=1}^{k} s_{ij} \right)^{1/k} \quad i = 1, 2, ..., k$$

$$v_i = \frac{v_i'}{\sum_{i=1}^{k} v_i'} \quad i = 1, 2, ..., k$$

If the above given method is used, weights of parameters from one transport system user are obtained. In order to determine the objective value of the weights of parameters we need to obtain data from a representative group of users. The total weight of the ith parameter is then the arithmetical average of the weights obtained from individual users.

4. Conclusion

It is important to realize that while researching these basic parameters (users' requirements) it is important to respect the fact that the value of transport service from the point of view of the user depends on the specific type of transport system and it is individual in relation to the specific type of transport system [6, 7].

It is also important to remember that the users' requirements will change in time, especially as a result of increasing living standards, etc. The question of the internal workings of the system is also an important factor. A correct internal functioning of the system is an important prerequisite for high quality work which demonstrates itself externally towards the users [8–10].

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