EVALUATION OF QUALITY INDICATORS PUBLIC TRANSPORT

VYHODNOCENÍ KVALITATIVNÍCH UKAZATELŮ VEŘEJNÉ DOPRAVY

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Summary: *This paper deals with passengers' satisfaction measuring and urban mass transportation quality evaluation. The presented results of the evaluation of passenger satisfaction were obtained based on experimental verification the methodology for measuring passenger satisfaction and quality evaluation of public transport. The experiment was based on a designed list of questions, which has been used for a traffic survey of the passengers' satisfaction. Criteria of quality have been evaluated from set of passenger's individual points of view in Ostrava urban mass transportation system conditions.*

Key words: Evaluation of quality indicators, Measuring of passenger satisfaction, Public transport

Anotace: Článek se zabývá měřením spokojenosti cestujících a hodnocením kvality městské hromadné dopravy. Prezentované výsledky hodnocení spokojenosti cestujících byly získány na základě experimentálního ověření metodiky měření spokojenosti cestujících a hodnocení kvality veřejné dopravy. Experiment byl proveden na základě navrženého dotazníku pro anketní dopravní průzkum cestujících. Kritéria kvality byla hodnocena z hlediska cestujících v konkrétních podmínkách systému MHD v Ostravě.

Klíčová slova: Vyhodnocení kvalitativních ukazatelů, měření spokojenosti cestujících, veřejná doprava.

INTRODUCTION

The concept of measuring passenger satisfaction is a summary of activities that allow a subjective assessment of quality services in terms of passengers. It is therefore the method of customer-oriented. Expert method does not allow communication with the customer. This method also offers no opportunity to respond to the wishes and expectations, which are critical for the next service option in many cases. Therefore, it is now increasingly applied the direct measurement of customer satisfaction with service quality.

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The metodology for measuring customer satisfaction and quality evaluation of public transport is designed to allow processing of the following basic outcomes:

- evaluation of passenger data,
- evaluation of criteria in terms of subjective importance,
- evaluation of criteria in terms of passenger satisfaction,
- evaluation of survey results using SWOT analysis.

1. EVALUATION OF PASSENGER DATA

The methodology for measuring customer satisfaction and quality evaluation of public transport were practically applied in Ostrava. Altogether, 2120 respondents were interviewed. Respondents have been interviewed at their workplaces. Interviewers monitored the correct and full completion of the questionnaire and also provided an explanation if the passengers did not understand the issues.

The questionnaire survey has been focused on residents of Ostrava and its surroundings using urban mass transportation on the way to work (school). The questionnaire wasn´t presented to residents of other cities or users of the integrated transport system. The first reason is the focus of the survey to passengers on urban mass transportation. The second reason is the possibility of reducing the objectivity of the evaluation criteria of quality urban mass transportation caused by the use of other transport system of public transport during the transfer. There are included all types of urban mass transportation vehicles (bus, tram and trolleybus) and their combinations in the case of transfer.

The results presented in this chapter have been obtained by applying the methodology in Ostrava in the years 2002-2005. Nevertheless, the conclusions can be taken into account in the present. Some of the conclusions show a uniform trend and virtually unchanged since the implementation of traffic survey.

The results presented in this chapter apply to public transport users who are older than 15 years of age and have the opportunity to decide on the choice of means of transport. The following list briefly describes the average relative frequency.

Distribution of respondents by gender

The survey of passenger satisfaction is on average attended 42% of men and 58% of women.

Distribution of respondents by age group

The survey of passenger satisfaction is on average attended 25% of respondents aged 26 years and less. Most respondents who completed the questionnaire were aged 26-44 years (38%) and 29% of respondents aged 45-59 years. At least the respondents were interviewed at age of 60 and over (8%) which may be influenced by the age structure of employees of companies who were asked in the workplace.

The intensity of the use of urban mass transportation

The survey of passenger satisfaction also studied the intensity of use of urban mass transportation during the week to travel to work (school). 67% of the respondent use of urban mass transportation to travel to work (school) daily and 18% of the respondents 3-4 times per

week. 10% of respondent goes to work (school) by urban mass transportation 1-2 times per week and less than 1 times per week use of urban mass transportation services 5% of the respondents (Fig.1).

In terms of additional demand for urban mass transportation in Ostrava are the most important data on the proportion of passengers who travel daily by urban mass transportation to work (school) and who in turn travel by urban mass transportation less than once a week. The first group of passengers is relatively sure clients Ostrava Transport Company. The second group represents a potential customer, which could public transport company to convince its quality of services to increasing urban mass transportation use.

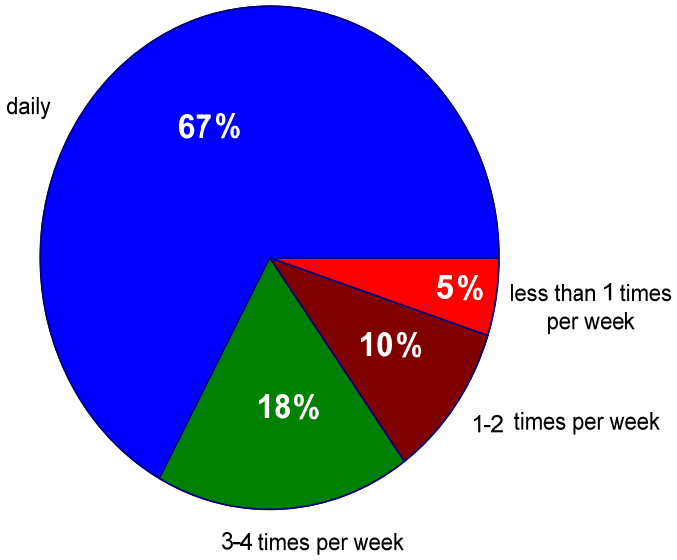

Fig. 1 - The intensity of the use of urban mass transportation

Types of tickets

The largest proportion of passengers in Ostrava (47%) uses a 30-day travel card. A relatively large proportion of passengers (28%) use a single ticket. Fewer passengers use the 90-day travel card (15%) and year's travel card (5%). Other travel document (certificate of entitlement to free transport) uses 5% of the respondents (Fig. 2).

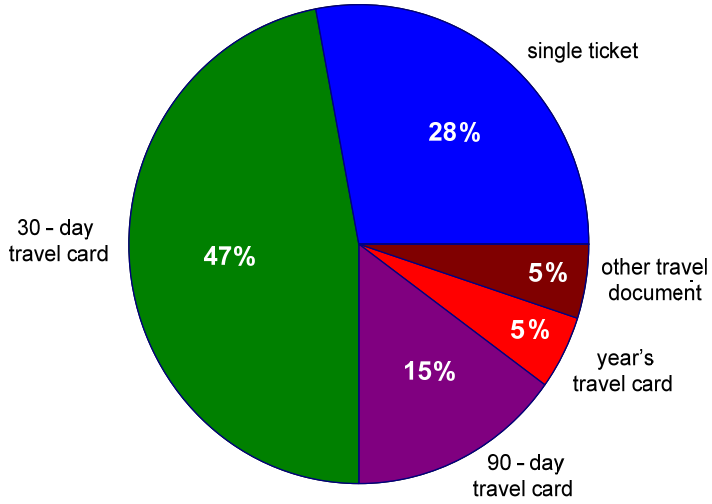

Fig. 2 - Types of tickets

This situation can be explained by lower average income per people in Ostrava. Although they decide to purchase a travel card, probably have not enough money they might spend on a year's travel card or the 90-day travel card. Therefore, passengers often buy a 30-day travel card.

2. EVALUATION OF CRITERIA IN TERMS OF IMPORTANCE

The following procedure was applied to calculate the importance of the criteria:

1. Users (passengers) specify preferential sequence of the criteria. The importance of individual criterion is calculated on the bases of preferential sequence of the criterion. The sum of the importance of the criteria is equal to one.
2. Users (passengers) specify preferential sequence of the sub-criterion. This sub-criterion is a subset of criterion. The importance of individual sub-criterion is calculated on the bases of preferential sequence of the sub-criterion. The sum of the importance of the sub criteria under criterion is equal to one.

Tab. 1 shows the average relative importance, which were calculated in total for all passengers (respondents) who participated in the survey.

Table 1 shows the following preferential sequence of the criteria:

1. Travel time - total time consumption on the way to work (school), perceived by passengers as the speed of travel. Passengers are keen to make travel time on the road to work was minimal.
2. Regularity and accuracy - the observance of the prescribed timetable, and the interval between the connections. The passengers requiring the greatest accuracy, and ensure regular intervals.
3. Costs of freight - the passengers expect a low fare.
4. Time and spatial offer of urban mass transportation system. Passengers want as much comfort out of public transportation vehicles. As shown in Table 1, this requirement applies in particular to the minimum of waiting time for connection and accessibility of stops.
5. Comfort in the of urban mass transportation vehicles. Passengers expect reasonable comfort in the vehicle. Table 1 show that this requirement applies in particular to small occupancy vehicle (enough space for seated and standing passengers) and microclimate in public transport vehicles (adequate ventilation, heating and lighting that is to ensure optimal conditions of temperature and lighting).
6. Impact of of urban mass transportation on the urban environment. In terms of public transport passengers have less negative impact on the urban environment, than private transport.

Tab. 1 - Average evaluation of the importance of criteria (sub-criteria)

No.	Criterion	Importance of criterion	No.	Sub-criterion	Importance of sub-criterion
1	Travel time	0,23			
2	Regularity and accuracy	0,21			
3	Time and spatial offer of urban mass transportation system	0,17	3.1	Accessibility of stops	0,22
			3.2	Waiting for connection	0,23
			3.3	Changing in traffic network	0,21
			3.4	Solution of stops	0,14
			3.5	Information about traffic	0,09
			3.6	Solution of ticket office	0,11
4	Comfort in the urban mass transportation vehicles	0,13	4.1	Occupancy of vehicle	0,26
			4.2	Noisiness and vibrations	0,20
			4.3	Microclimate in vehicle	0,23
			4.4	Driving style of drivers	0,19
			4.5	Solution of interior	0,12
5	Costs of freight	0,18			
6	Impact on the environment	0,08			

3. EVALUATION CRITERIA IN TERMS OF PASSENGER SATISFACTION

The criteria (sub-criteria) quality public transport can be divided into two groups according to the method of evaluation:

a) The quantitative criteria - travel time, accessibility of stops, waiting for connection, changing in traffic network. Nominal values were determined objectively on the basis of a traveling data received from passengers through a questionnaire. The values of the quantitative criteria can be formulated in metrical scale.
b) The qualitative criteria - regularity and accuracy, solution of stops, information about city line traffic, solution of ticket office, occupancy of vehicle, noisiness and vehicle

vibrations, microclimate in vehicle, driving style of drivers, solution of vehicle interior, costs of freight and influence of urban mass transportation to environment. Nominal values were determined subjectively on the basis of a traveling received from passengers through a questionnaire. Nominal values were determined subjectively on the basis of satisfaction score received from passengers through a questionnaire. For satisfaction scores were used point scale from 1 to 5, where 1 is the best score and 5 the worst score. The values of the quantitative criteria can be formulated in ordinal scale.

The quantitative criteria (the values of the quantitative criteria can be formulated in metrical scale) and qualitative criteria (the values of the quantitative criteria can be formulated in ordinal scale) for urban mass transportation quality evaluation have been utilized. The values of the quantitative criteria can be statistical evaluated immediately. The values of the qualitative criteria must be formulated in points scale at first. The passengers graduate quality level of every criterion through assignment of points from five points scale. In this way can be achieved the statistical evaluating for qualitative criteria too.

3.1 Evaluation of sub-criterion "accessibility of stops"

The process of calculation will be presented on evaluation of sub-criterion "accessibility of stops". Sub-criterion accessibility of stops was evaluated in terms of time spent walking to the bus stop (from home to the starting stop and destination stop to work) on the way to work.

By means of items up 1, 2, 3, 4 or 5, where 1 is best value and 5 worst value, informants assign utility value u = <1 ; 0> to the nominal value of walking time x. The ordered pairs (x, u(x)) form the point coordinates. These points can be diagrammatized through the point diagram (Fig.3). There are displayed the nominal values of walking time on the axis x and assigned average utility values on the axis y.

The utility function of walking time sub-criteria u(x):

$$u(x) = -0{,}001x^2 - 0{,}0056x + 1{,}0513 \qquad (1)$$

The deterministic index values $R^2 = 0{,}9807$ correspond to approximation rate.

The criteria utility function in the nominal value interval x = <5; 30 > is falling from the function value u (x^1) = 1 to function value u (x^0) = 0. The criteria utility function has the concave course. The walking time sub-criterion has decreasing preference of the nominal value. The equivalent increase in nominal value of the sub-criterion stands in declines of utility.

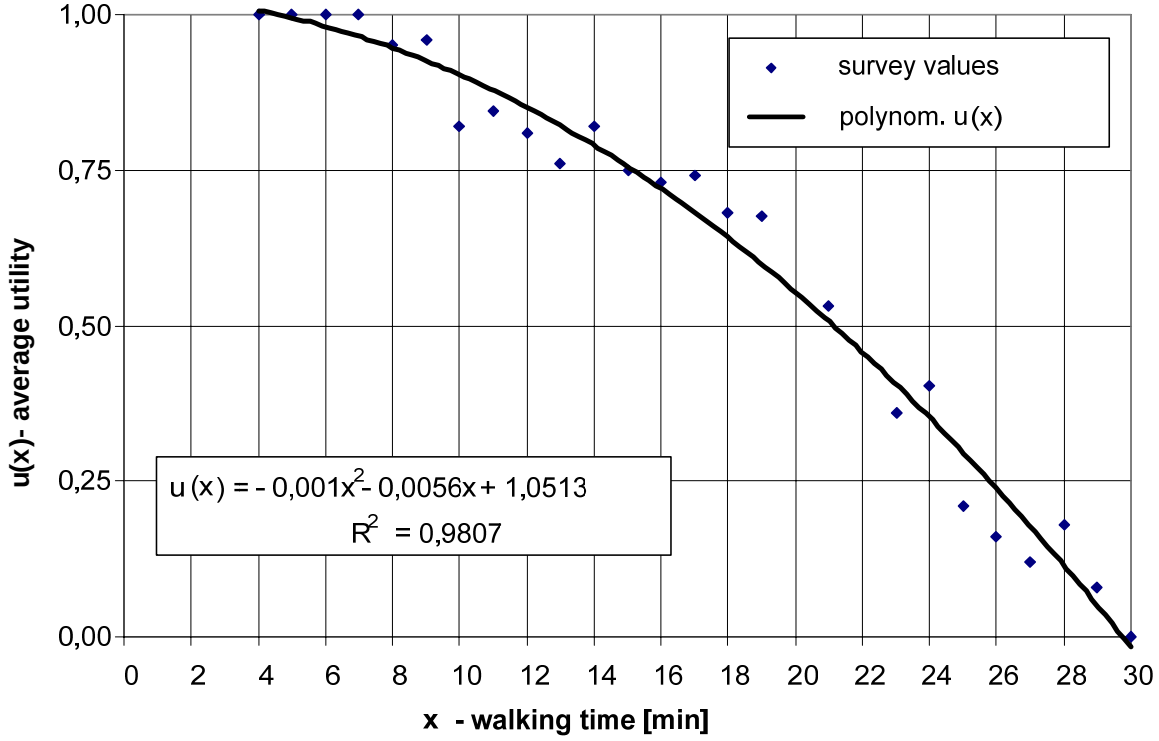

Fig. 3 - The utility function of walking time sub-criterion u (x)

The definition scope can be separated to the five nominal value intervals by means of items up transformation. By means of criteria utility function can be obtained limiting nominal values x^1, $x^{0,75}$, $x^{0,5}$, $x^{0,25}$, x^0, for that u(x) is reaching the values u (x^1) = 1, u ($x^{0,75}$) = 0,75, u ($x^{0,5}$) = 0,5, u ($x^{0,25}$) = 0,25 and u (x^0) = 0. Means of items up transformation can be diagrammatized in the table 2.

Tab. 2 - Means of items up of quality of walking time transformation

Means of items up	Nominal value intervals [min]	Limiting nominal values x [min]
very favourable	4-11	5
favourable	12-18	15
neither favourable – nor unfavourable	19-23	21
unfavourable	24-27	26
very unfavourable	28 - 30	30

Evaluation of walking time can be evident from values set forth above. Highest utility answer the accessibility of stop by 11 minutes. Walking time 18 minutes is evaluated by passengers "favourable". Increase of time spent walking to the bus stop is evaluated neutral – "neither favourable – nor unfavourable" (by 23 minutes). Next extension of walking time is unfavourable from passengers' point of view.

3.2 Average evaluation of satisfaction with quality criteria (sub-criteria)

Table 3 shows the average values (utility) of various criteria (sub-criteria) were calculated overall for all passengers (respondents) who participated in the survey.

Tab.3 - Average evaluation of satisfaction with quality criteria (sub-criteria)

No.	Criteria (sub-criteria)	Average evaluation of satisfaction
1	Travel time	0,54
2	Regularity and accuracy	0,73
3.1.	Accessibility of stops	0,83
3.2.	Waiting for connection	0,73
3.3.	Changing in traffic network	0,44
3.4.	Solution of stops	0,63
3.5.	Information about city line traffic	0,66
3.6.	Solution of ticket office	0,52
4.1.	Occupancy of vehicle	0,46
4.2.	Noisiness and vibrations	0,68
4.3.	Microclimate in vehicle	0,67
4.4.	Driving style of drivers	0,47
4.5.	Solution of interior	0,77
5	Costs of freight	0,47
6	Impact on the environment	0,47

Average evaluation of criteria (sub-criteria) in terms of total passenger satisfaction is graphically illustrated in Figure 4. The figure shows that the average evaluation "very favorably" is not associated with any criterion (sub criterion).Most of the criteria (sub-criteria) is located in the upper part of the chart, i.e. passengers are satisfied with them (a total of 10 components of services were evaluated above 0,5).

Below this threshold are 5 criteria (sub-criteria) were evaluated in neutral - the stage of "neither favorably nor unfavorably". Despite neutral evaluation passengers are dissatisfied with these criteria and that means the potential for improvement for the public transport company. The following section outlines the criteria of quality, which should improve as soon as possible.

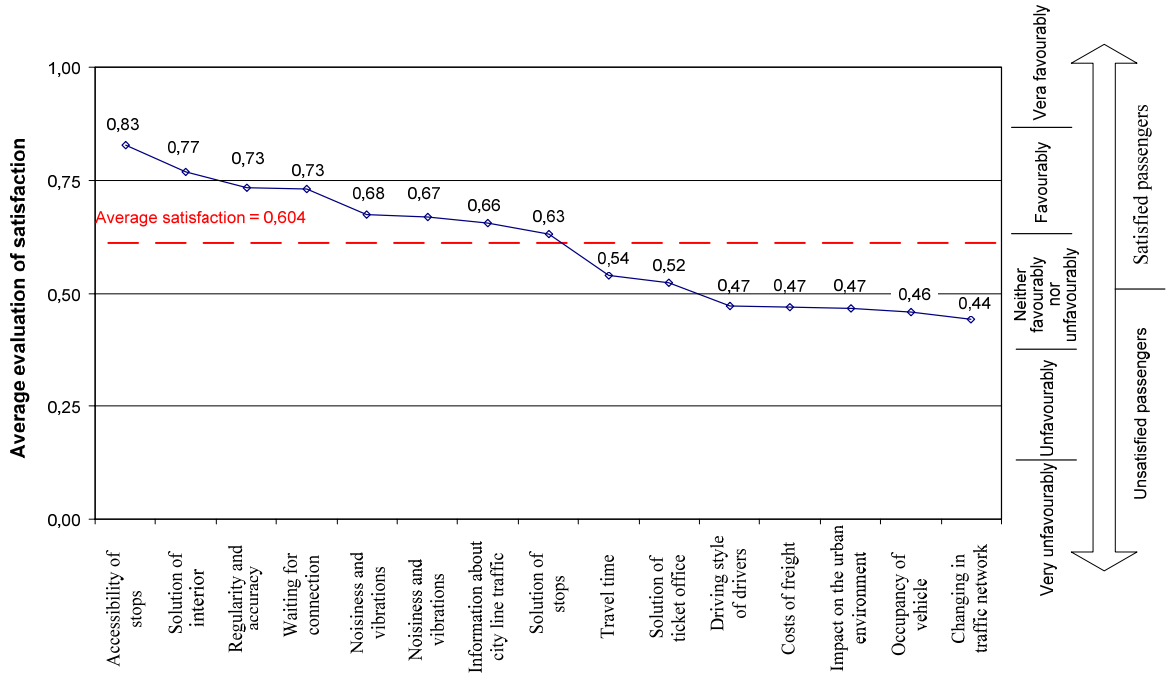

Fig. 4 - Average evaluation of criteria (sub-criteria) in terms of total passenger satisfaction

4. EVALUATION OF SURVEY RESULTS USING SWOT ANALYSIS

Evaluation of the results of satisfaction evaluation was carried out a SWOT analysis. SWOT analysis is a graphical evaluation of various aspects of the company – its strengths, weaknesses, opportunities and the threats.

SWOT analysis is two dimensional chart, which graphically shows the relationship of passenger satisfaction with the given criteria (vertical axis) and their real meaning (horizontal axis). SWOT table is divided into horizontal and vertical lines on the four quadrants in order to interpret and evaluate the importance of various criteria (sub-criteria) for further decision-making of carrier. The horizontal line is the average satisfaction, vertical lines is median of subjective importance for all criteria (sub-criteria). This creates a SWOT table that contains the 4 areas.

The overall evaluation of urban mass transportation services in Ostrava is shown in a SWOT table (Fig. 5). The criteria of urban mass transportation quality are graphically placed in four fields on the basic of values of importance and values of satisfaction:

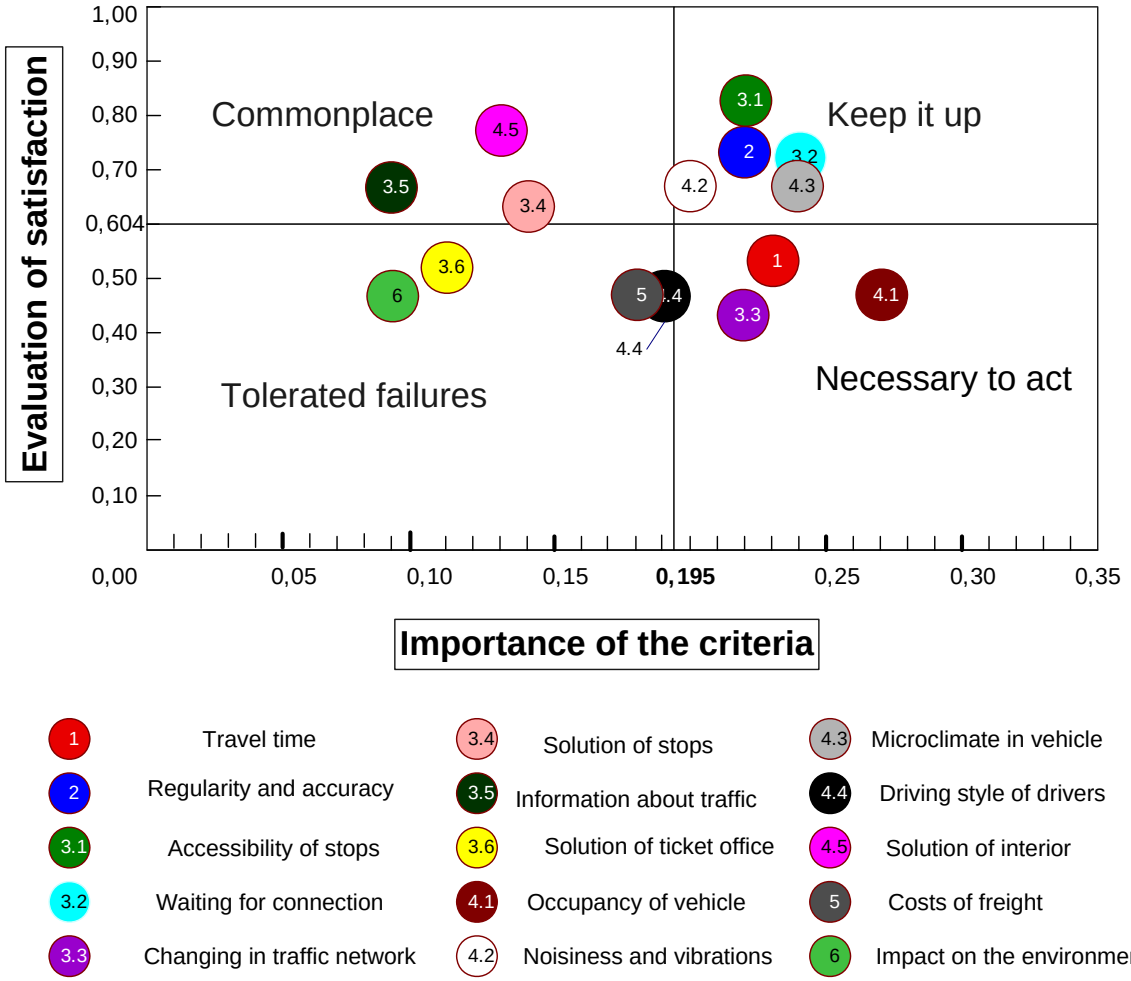

Fig. 5 - Evaluation of satisfaction using SWOT analysis

In the lower right corner called "Necessary to act" are the criteria that have a significant effect on passenger satisfaction, but they are negatively evaluated. These criteria represent a significant threat for the public transport company, is urgently needed to correct. Only 3 criteria (sub-criteria) of 15 evaluated are located in the "Necessary to act": travel time, changing in traffic network and occupancy of vehicle.

In the upper right corner called "Keep it up" are the criteria that have a significant effect on passenger satisfaction and are also positively evaluated. These criteria indicate of the quality of services and the carrier may be satisfied with their evaluation. Five criteria are located in the "Keep it up": regularity and accuracy, accessibility of stops, waiting for connection, noisiness and vibrations and microclimate in the vehicle.

In the upper left corner called "Commonplace" are the criteria that have a relatively small effect on passenger satisfaction, but they are positively evaluated. Three criteria are located in the "Commonplace": solution of interior, information about city line traffic and solution of stops.

In the lower left corner called "Tolerated failures" are the criteria that have a small effect on passenger satisfaction and they are negatively evaluated. Four criteria are located in the "Tolerated failures": solution of ticket office, costs of freight, driving style of drivers and

impact on the urban environment. Attention should be paid to sub criterion driving style of drivers with regard to the safety of passengers. This sub-criterion would be little increase in their importance was transferred to the critical area “Necessary to act”.

5. CONCLUSION

This paper deals with passengers’ satisfaction measuring and urban mass transportation quality evaluation. The model of the passengers’ satisfaction measuring and urban mass transportation quality evaluation has been experimentally validated by the traffic survey of the passengers’ satisfaction (Ostrava urban mass transportation users).

The results of the traffic survey are very important for the designed method evaluation. The results show suitability of the method for practical exploitation, due the following reasons:

- possibility of identification passengers‘ expectations,
- possibility of identification present quality level,
- gives data and information to projects quality improvement,
- gives qualified results with possibility evaluation of trends.

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