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A Study on the Interdependence of Quality and Satisfaction with Public Transport in Rijeka

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Abstract: The paper aims to determine the interdependence between quality ratings and the level of satisfaction of Rijeka's inhabitants with the city's public urban transport system. The purpose of the study is to identify the effects that the individual elements of citizens' satisfaction with public urban transport services have on public urban transport quality ratings. To accomplish the study's objective and purpose, and to prove the main hypothesis that there is a statistically strong and positive relationship between quality ratings and satisfaction with public urban transport, numerous scientific methods have been applied, in particular the survey method, the method of analysis and synthesis, and the methods of descriptive and inferential statistics. The study's main finding points to the low quality of Rijeka's public urban transport system and to the low level of satisfaction of citizens with the system. A statistically strong and positive relationship was found between quality ratings and the satisfaction of citizens with public urban transport services. Citizens are the least satisfied with the frequency of public transport intensity and the availability of urban transport in evening.

Keywords: city; public transport; satisfaction; urban transportation

1 INTRODUCTION

Cities are the greatest invention of humankind. They make us richer, smarter, greener, healthier and happier [1]. Around the world, there are more than 30 cities that have more than 10 million inhabitants and this number is still growing [2]. The purpose of cities is to bring people together, but that is not possible without well-designed and sustainable public urban transport systems. Public urban passenger transport refers to the regular carriage of passengers within the immediate area of an urban agglomeration as well as between that area and suburban settlements, along fixed routes or lines on which most passengers are daily commuters [3]. For any modern city to function, it must have a public urban transport system. The UN [4] estimates that more than half of the world's population lives in cities, so it is not surprising that urban transport is said to be the bloodstream of modern cities [5]. Accordingly, the development of modern cities should focus on public transport. Namely, there can be no sustainable mobility without the use of public urban transport on a mass scale [6-8]. Achieving sustainable mobility calls for curbing car reliance and building cities for people rather than for cars.

In the town of Rijeka, public urban passenger transport is based on bus transport. Rail transport is the only other type of public transport available in urban traffic in Rijeka. It can be argued [9], however, that rail traffic in Rijeka is in its introductory or popularisation phase. Considerable investment in rail traffic infrastructure is required for the growth phase, which could substantially increase the share of rail traffic in Rijeka's urban traffic. How people perceive public urban transport is also of vital importance to city authorities. Studies of this type can provide local officials with information about what is important to urban transport service users and how they perceive the quality of current urban transport services. Dissatisfaction with public urban transport is of an emotional nature, and city authorities are seeking ways to resolve this problem in order to raise citizens' level of satisfaction. The trend in addressing the issue of public urban transport and citizen satisfaction is not linear, however. Namely, when public urban transport reaches the minimum level required for a city to function normally, the increase in citizen satisfaction levels begins to slow down [10].

This paper explores the interrelationship between the satisfaction of citizens with public urban transport and the quality of public urban transport in Rijeka. In addition to the main hypothesis, two auxiliary hypotheses have also been formulated. To confirm the hypotheses, a number of scientific methods have been used, in particular the survey method and the methods of descriptive and inferential statistics.

2 THEORETICAL FRAMEWORK

2.1 Literature Review

Cities have always been hubs of numerous economic, cultural, social, political and other activities, and there has always been an interactive connection between the development of cities and the development of urban passenger traffic. Modern forms of transport have helped to continuously expand the maximum radius of cities. Public urban traffic has enabled the rapid circulation of people within cities while meeting the needs of a city's inhabitants, such as going to and from work, running administrative affairs, and shopping, as well as other needs related to education, health-care, culture, sports, etc. Some ten million people ride the Tokyo subway system daily, more than the number of people living in New York. As lifestyles change, so do the reasons for travelling [11]. Every segment of society – individuals, households, local communities, businesses – benefits from a well-developed urban transport system. Public urban traffic directly helps to alleviate congestion, reduce noise, ensure a clearer environment, facilitate local businesses, enhance safety in urban traffic and increase employment. Cities across the world are investing heavily in their public transport systems to make them competitive with passenger car transport [12]. A 5-dollar return on investment can be made on every dollar invested in public urban transport [13].

Public transport in European cities was traditionally provided by publicly owned enterprises [14]. The same applies to cities and towns in Croatia.

Fig. 1 illustrates the percentage of passengers using local urban transport in EU countries, based on a survey conducted in September 2014 and involving 28 050 respondents.

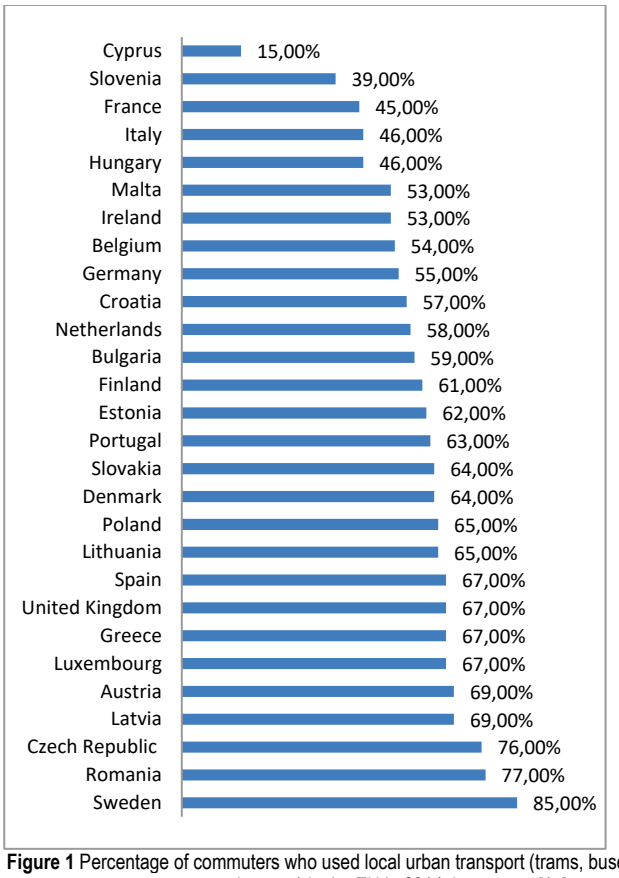

Figure 1 Percentage of commuters who used local urban transport (trams, buses, metro, commuter trains, etc.) in the EU in 2014, by country [15]

Based on Fig. 1, it can be seen that of the then EU-28 countries, Swedes mostly (85 %) used public urban passenger transport services, while the least public public passenger transport services were used by Cypriots, only 15 %. In Croatian cities, 57 % of the population uses public urban passenger transport, which ranks Croatia 19th.

2.2 Research Concept

Public urban transport in Rijeka is carried out by KD Autotrolej, a bus transport service company, and HŽ Putnički prijevoz (HŽPP), the Croatian rail passenger transport company. On 1 September 2018, the two companies signed an agreement introducing integrated passenger transport in the Rijeka region. KD Autotrolej provides urban (local) transport on 18 bus lines that service the entire area of the city. The main bus stations for public urban transport in Rijeka are located on Jelačić Square and the Delta Terminal and are connected with all parts of the city, including neighbouring towns such as Opatija and Kastav. Public urban and county transport is divided into four zones (see Fig. 2).

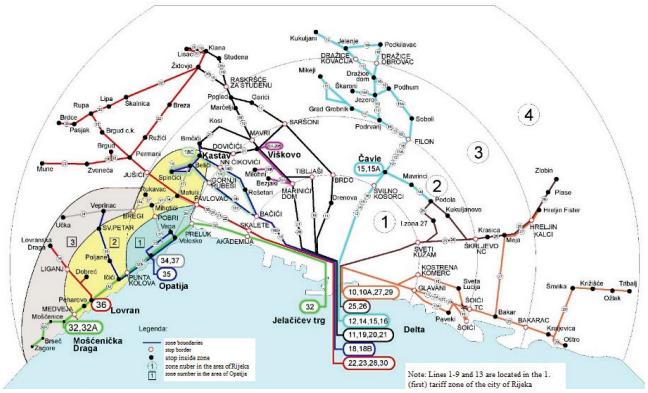

Figure 2 County lines network with tariff zones [16]

The HŽPP zones encompass the following stations and stops (see Fig. 3): Zone 1: Sušak Pećine, Krnjevo and Opatija-Matulji; Zone 2: Škrljevo, Meja, Rukavac, Jušići, Jurdani and Permani; Zone 3: Melnice, Plase and Šapjane; and Zone 4: Zlobin, Drivenik, Lič and Fužine.

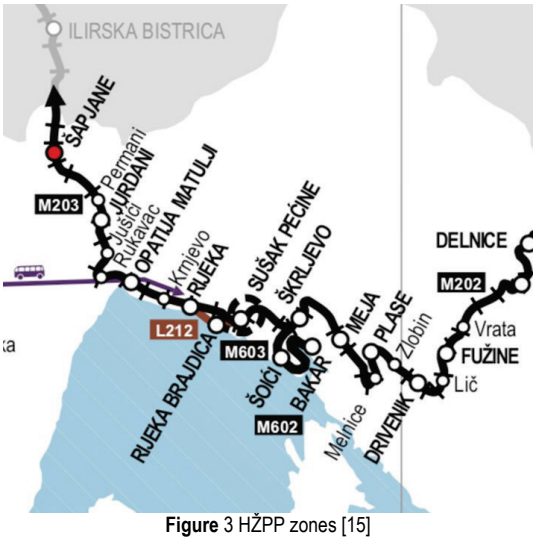

Figure 3 HŽPP zones [15]

A joint ticket allows for transport by train within the four HŽPP zones (to a distance of 40 km from Rijeka) and within Zone 1 of the Rijeka bus transport system. The introduction of joint monthly tickets enables passengers to purchase tickets at a price 40 % lower than the regular price of separately bought train tickets and bus tickets.

The European Committee for Standardization issued the standard EN 13816 which defines a set of recommended criteria to measure the quality of public transport services and those are [17]: availability, accessibility, information, time, customer care, comfort, safety and ecological impact. Accordingly, in this scientific discourse, the construct "Satisfaction with public transport services in Rijeka" is measured using five items: reliability of public transport (*R_PT*), frequency of public transport intensity (*F_PT*), availability of stops (*A_S*), availability of public transport in evening hours (*A_ET*), and price of public transport (*P_PT*). All ratings used the following scale: (0) Don't know, (1) Not at all satisfied, (2) Not satisfied, (3) Partially satisfied, (4) Satisfied, and (5) Completely satisfied.

The reliability of the measuring instrument was analysed using Cronbach's alpha coefficient, which was 0.90. This value suggests excellent internal consistency and stability of the factors and high scale reliability (cf. Tab. 1).

Table 1 Reliability of the measuring instrument

Summary for scale: Mean=11,4739 Std.Dv.=5,41108 Valid N:403 Cronbach alpha: ,906214 Standardized alpha: ,907808 Average inter-item corr.: ,668259					
	Mean if - deleted	Var. if - deleted	StDv. if - deleted	Itm-Totl - Correl.	Alpha if - deleted
R_PT	9,28	18,94	4,35	0,81	0,87
F_PT	9,41	19,25	4,38	0,82	0,87
A_S	8,61	19,24	4,38	0,72	0,89
A_ET	9,39	19,24	4,38	0,73	0,89
P_PT	9,17	18,96	4,35	0,73	0,89

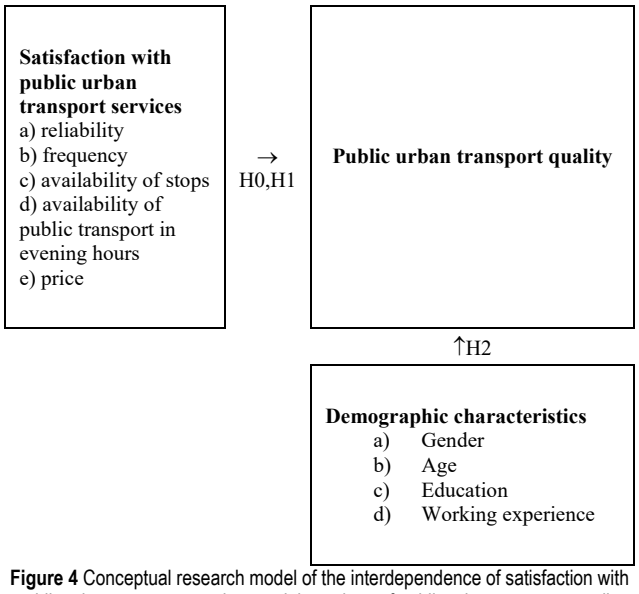

Figure 4 Conceptual research model of the interdependence of satisfaction with public urban transport services and the ratings of public urban transport quality

Although often studied in the field of economic sciences, the concept of satisfaction has rarely been the subject of research in transport [18]. Instead, research has mostly focused on the modal redistribution from passenger car to other means of urban transport [19] or on the selection of and preferences for various types of transport [20]. Fellesson and Friman [18] highlight the important role of safety/security, system (supply and reliability), comfort, and staff behaviour for traveller satisfaction. According to Friman, Edvardsson and Garling [21], users who had negative experiences with urban transport primarily reported dissatisfaction with staff (drivers), the unreliability of transport, and the lack of timely information. Morfoulaki, Tyrinopoulos, and Ayfantopoulou [22] argued that the main factors of satisfaction with urban transport are waiting time, circumstances on board vehicles, frequency and on-time performance, ticketing policy, and terminal safety. According to Castillo and Benitez [23], the overall satisfaction of public urban transport users can be measured by collecting the opinions of users regarding their satisfaction with transport network coverage, transfers between lines, and waiting times, among other things.

The construct "Public urban transport quality" was measured with the question "On a scale of 0 to 5, how would you rate the quality of public urban transport services?"

In line with the above-mentioned, a conceptual research model was developed (Fig. 4).

Accordingly, the following hypotheses were constructed:

H0: There is a statistically strong and positive relationship between satisfaction with public urban transport services and the ratings of public urban transport quality.

H1: There is a statistically strong and positive relationship between all of the elements used to measure public urban transport user satisfaction and the ratings of public urban transport quality.

H2: There are no statistically significant differences in the ratings of public urban transport quality with regard to the demographic characteristics of the respondents.

Table 2 Demographic characteristics of respondents

	N	%
SEX		
Male	119	29,53
Female	284	70,47
EDUCATION		
Elementary school (ES)	-	-
Secondary school (SC)	99	24,56
Higher expertise (3 years Professional schools or Polytechnic according Bologna Declaration or 2 years according to old system of education) (HS)		
Faculty (3 years - university baccalaureus) (F_UB)	45	11,17
Faculty (4-6 years according to old system of education) (F_OS)	33	8,19
Faculty (5 years according Bologna	121	30,02
Declaration masters degrees) (F_MD)	61	15,14
Master of science (MSc)	12	2,98
Doctorate (PhD)	32	7,94
AGE		
18-20	2	0,50
21-30	37	9,18
31-40	90	22,33
41-50	142	35,24
51-60	91	22,58
61 and more	41	10,17
WORKING EXPERIENCE		
Less than 3 years	18	4,66
From 3-5 years	12	2,97
From 5-10 years	46	11,41
From 10-20 years	131	32,51
More than 20 years	193	47,89
No working experience	3	0,74

3 SAMPLE

Research was conducted from May to August 2021. The targeted sample consists mostly of highly educated people, followed by people with secondary school qualifications, all of whom are resident in Rijeka, thus making the sample representative and reliable. A survey was publicly distributed via Facebook and Facebook Groups (*Volim grad koji teče* and *Nova riječka enciklopedija – Fluminensia*). In the three months that the survey was accessible, 403 valid questionnaires were collected. The questionnaire was

completed by inhabitants aged 18 to 61 and over. Only three of the 403 respondents had no work experience (Tab. 2).

4 RESEARCH RESULTS AND DISCUSSION

Survey participants were supposed to evaluate with grade from 0 to 5 the quality of public urban traffic in Rijeka. Based on the gathered data (cf. Tab. 3) a brief descriptive analysis of their evaluation was made.

The average grade of public urban transport is (M = 2,23; SD = 1,23). Low median value (M_e = 2) that divides the set into two equal parts shows low quality of public urban transport in Rijeka. This assertion is supported also by the fact that the first quartile is made up of survey participants who gave the grade to public urban transport less than one and the last quartile is made up of survey participants who evaluate public urban transport with a grade higher than 3. The remaining 50 % of survey participants evaluate the quality of public urban transport with a grade ranging from 1 to 3.

Table 3 Descriptive statistics of evaluation of the quality of public urban transport

	Q_PT
ARITHMETIC MEAN (M) case 1-403	2,23
MEDIAN case 1-403	2
STANDARD DEVIATION (SD) case 1-403	1,23
VALID N case 1-403	403
SUM case 1-403	900
MIN case 1-403	0
MAX case 1-403	5
25th% case 1-403	1
75th% case 1-403	3

The data in Tab. 4 indicate that the average satisfaction of respondents with public urban transport is also low (M = 2,29; SD = 1,26).

Table 4 Descriptive statistics of elements of satisfaction with public urban transport services

	R_PT	*F_PT*	*A_S*	*A_ET*	*P_PT*
MEAN case 1-403	2,18	2,05	2,85	2,07	2,30
MEDIAN case 1-403	2- Not satisfied	2- Not satisfied	3 – Partially satisfied	2- Not satisfied	2- Not satisfied
SD case 1-403	1,23	1,17	1,30	1,29	1,33
VALID N case 1-403	403	403	403	403	403
SUM case 1-403	881	828	1152	836	927
MIN case 1-403	0 – Don't know	0 – Don't know	0 – Don't know	0 – Don't know	0 – Don't know
MAX case 1-403	5 – Completely satisfied	5 – Completely satisfied	5 – Completely satisfied	5 – Completely satisfied	5 – Completely satisfied
25th% case 1-403	1 – Not at all satisfied	1 – Not at all satisfied	2- Not satisfied	1 – Not at all satisfied	1 – Not at all satisfied
75th% case 1-403	3 – Partially satisfied	3 – Partially satisfied	4 – Satisfied	3 – Partially satisfied	3 – Partially satisfied

Respondents are the less unsatisfied with the availability of stops (M = 2,85; SD = 1,30) and the least satisfied with the frequency of public urban transport intensity (M = 2,05; SD = 1,17) as well as with the availability of public urban transport in evening hours (M = 2,07; SD = 1,29).

The constructed hypotheses are tested in the following section.

H1: *There is a statistically strong and positive relationship between all of the elements used to measure public urban transport user satisfaction and the ratings of public urban transport quality.*

Table 5 Correlation analysis of the interdependence between public urban transport quality and the elements used to measure the respondents' satisfaction with public urban transport services

Correlations Marked correlations are significant at p < ,01 N = 403 (Casewise deletion of missing data)								
	Means	Std.Dev	Q_PT	R_PT	F_PT	A_S	A_ET	P_PT
Q_PT	2,23	1,23	1,00	0,84	0,78	0,65	0,64	0,69
R_PT	2,18	1,23	0,84	1,00	0,81	0,67	0,66	0,65
F_PT	2,05	1,17	0,78	0,81	1,00	0,65	0,70	0,67
A_S	2,85	1,30	0,65	0,67	0,65	1,00	0,59	0,62
A_ET	2,07	1,29	0,64	0,66	0,70	0,59	1,00	0,61
P_PT	2,30	1,33	0,69	0,65	0,67	0,62	0,61	1,00

In proving the main hypothesis of this paper, it was deemed appropriate to first test hypothesis H1, which is based on the assumption of interdependence between public urban transport quality and all of the elements used to measure the respondents' satisfaction with public urban transport services. The results of the test are shown in Tab. 5.

The data in Tab. 5 indicate that there is a statistically positive relationship between all of the elements used to measure the respondents' satisfaction with public urban transport services and the quality of public urban transport. A statistically strong correlation was found between the reliability of public transport and the quality of public transport (Pearson's correlation coefficient r = 0,84; p < 0,01) and a moderately strong correlation between public transport quality and the other elements used to measure the respondents' satisfaction with public urban transport services (0,50 < r > 0,80). Based on this finding, hypothesis H1 can be conditionally accepted.

H0: *There is a statistically strong and positive relationship between satisfaction with public urban transport services and the ratings of public urban transport quality*.

Multiple regression analysis was conducted to examine the correlation between satisfaction with public urban transport services and the quality of public urban transport (see Tab. 6).

The obtained finding indicates that there is a statistically strong and positive relationship between satisfaction with public urban transport services and the ratings of public urban transport quality (r = 0,87; p < 0,01), thus confirming the main hypothesis H0. Based on the finding, a conclusive multiple regression analysis model was also developed to further highlight the elements upon which the ratings of public urban transport quality in Rijeka are crucially dependent (see Tab. 7).

Table 6 Multiple regression analysis

Regression Summary for Dependent Variable: *Q_PT*; Pearson's correlation coefficient *R* = ,87110190 Coefficient of determination R^2 = ,75881851 Adjusted R^2 = ,75578096 *F*(5,397)=249,81 *p* < 0,0000 *SE* 0,60879						
	*b**	Std.Err. - of *b**	*b*	Std.Err. - of *b*	*t*(397)	*p-value*
Intercept			0,12	0,08	1,63	0,10
R_PT	0,54	0,05	0,54	0,05	11,92	0,00
F_PT	0,17	0,05	0,17	0,05	3,57	0,00
A_S	0,06	0,04	0,05	0,03	1,57	0,12
A_ET	0,02	0,04	0,02	0,03	0,52	0,61
P_PT	0,18	0,04	0,16	0,03	4,91	0,00

Table 7 Conclusive multiple regression analysis model

Regression Summary for Dependent Variable: *Q_PT*; *R* = ,87006151 R^2 = ,75700704 Adjusted R^2 = ,75518002 *F*(3,399)=414,34 *p* < 0,0000 *SE* 0,60954						
	*b**	Std. Err. - of *b**	*b*	Std. Err - of *b*	*t*(399)	*p-value*
Intercept			0,18	0,07	2,72	0,01
R_PT	0,57	0,04	0,57	0,04	12,97	0,00
F_PT	0,19	0,04	0,19	0,05	4,19	0,00
P_PT	0,20	0,03	0,18	0,03	5,73	0,00

The model with the rated parameters can be written in the following form:

$$Q\_PT = 0{,}18 + 0{,}56R\_PT + 0{,}18F\_PT + 0{,}19P\_PT$$
$$(R = 0{,}87;\ F(3{,}399) = 249{,}81;\ p < 0{,}01) \qquad (1)$$

Based on the obtained model (1), it is evident that the ratings for public urban transport in Rijeka first and foremost depend upon the reliability of public urban transport and then upon the frequency and price of public urban transport.

H2: *There are no statistically significant differences in the ratings of public urban transport quality with regard to the demographic characteristics of the respondents.*

The t-test and ANOVA test were conducted to prove the hypothesis that there are no statistically significant differences between the demographic characteristics of the respondents and the ratings of public urban transport quality.

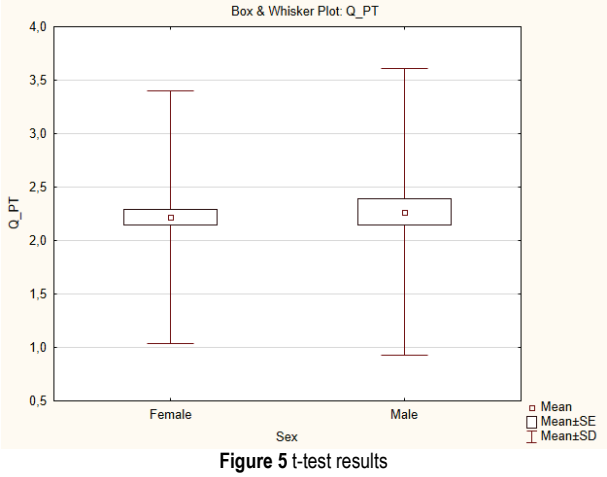

Figure 5 t-test results

Fig. 5 presents the results of the t-test carried out to establish whether they are any differences among the respondents with regard to gender.

Fig. 5 demonstrates that there are no statistically significant differences between men and women (M_{male} = 2,26; *SD* = 1,34; M_{female} = 2,21; *SD* = 1,18; *t-value* = –0,37; *p-value* = 0,707) with regard to the rating of public urban transport quality. The conducted ANOVA tests also did not find any statistically significant differences in the ratings of public urban transport quality with regard to age (cf. Tab. 8), education (cf. Tab. 9) or work experience (cf. Tab. 10).

Table 8 ANOVA age groups and ratings of public urban transport quality

Age; LS Means Current effect: *F*(5, 397) = 1,2481, *p* = ,28584					
Age	*Q_PT* - Mean	*Q_PT* - Std. Err.	*Q_PT* - 95,00%	*Q_PT* - +95,00%	*N*
18-20	1,50	0,86	-0,20	3,20	2
21-30	2,40	0,20	2,00	2,80	37
31-40	2,15	0,12	1,90	2,41	90
41-50	2,23	0,10	2,02	2,43	142
51-60	2,09	0,12	1,84	2,35	91
61+	2,58	0,19	2,20	2,96	41

Table 9 ANOVA level of education and ratings of public urban transport quality

Ed; LS Means Current effect: *F*(6, 396) = 1,3148, *p* = ,24927					
Ed	*Q_PT* - Mean	*Q_PT* - Std.Err.	*Q_PT* - 95,00%	*Q_PT* - +95,00%	*N*
SS	2,36	0,12	2,12	2,60	99
HS	2,08	0,18	1,72	2,44	45
F_OS	2,27	0,11	2,05	2,49	121
F_UB	2,03	0,21	1,60	2,45	33
F_MD	2,00	0,15	1,69	2,30	61
MSc	2,08	0,35	1,38	2,78	12
PhD	2,59	0,21	2,1	3,02	32

Table 10 ANOVA working experience and ratings of public urban transport quality

W_E; LS Means Current effect: *F*(5, 397) = ,20206, *p* = ,96152					
W_E	*Q_PT* - Mean	*Q_PT* - Std. Err.	*Q_PT* - 95,00%	*Q_PT* - +95,00%	*N*
Less than 3 years	2,50	0,29	1,92	3,07	18
From 3-5 years	2,16	0,35	1,46	2,86	12
From 5-10 years	2,17	0,18	1,81	2,53	46
from 10-20 years	2,23	0,10	2,02	2,44	131
More than 20 years	2,22	0,08	2,04	2,39	193
No working experience	2,33	0,71	0,92	3,73	3

These findings indicate the acceptance of hypothesis H2.

5 CONCLUSION

Rapid and omnipresent public urban transport is a precondition to a city fulfilling its economic, cultural, social and political duties. Achieving sustainability mobility means breaking car dependency and fostering development focused on public transport. In Rijeka, public urban transport is based on bus transport. Although still in the popularisation phase, the inclusion of rail transport in Rijeka's public urban transport system aims to enrich the city's transport offering and provide more options to persuade people to use their cars as little as possible. To this end, integrated transport was introduced in Rijeka to directly improve the quality of public urban transport and enhance the satisfaction of citizens. Despite these efforts, however, the results of the study point

to the low quality of public urban transport services (M = 2,23; SD = 1,23) and to the low satisfaction of citizens with urban transport (M = 2,29; SD = 1,26). Citizens' satisfaction with public urban transport services was measured using five elements: 1) reliability of public transport, 2) frequency of public transport intensity, 3) availability of stops, 4) availability of public transport in evening hours, and 5) the price of public transport. A strong or moderately strong, positive relationship was found between all five elements and public urban transport quality ratings. Citizens are the most satisfied with the availability of stops (M = 2,85; SD = 1,30) and the price of public urban transport (M = 2,30; SD = 1,33), but the least satisfied with the frequency of public urban transport intensity (M = 2,05; SD = 1,17) and availability of public urban transport in evening hours (M = 2,07; SD = 1,29). A statistically strong and positive relationship (r = 0,87; $p < 0,01$) was found between the overall satisfaction of citizens with public urban transport services and the quality ratings of public urban transport services. Accordingly, a multiple regression model was developed, with public urban transport quality as the dependent variable and reliability of public transport, frequency of public transport intensity, and price of public transport as the independent variables. No statistically significant differences were found between the demographic characteristics of the respondents (gender, age, educational level and work experience) and the ratings of public urban transport service quality.

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