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Service quality management of public city transport, a case study

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ABSTRACT : *The majority of cities in Macedonia are small cities that have introduced or are introducing public urban transport in recent years and there is a need to establish a methodology for planning such systems in accordance with the specifics in our country. In Macedonia, there is a more developed public transport in the capital Skopje. Public city transport has been introduced in Prilep, Ohrid, Kavadarci, Tetovo. Public city transport exists in Bitola, the city on whose example this article will be made. For the city of Bitola, an assessment of the quality of the services offered by the public city transport was analyzed and given, by measuring the satisfaction of the passengers in the city. With a survey conducted electronically, in a vehicle of public city transport, and my personal observations in the collection of the data. The collected data were processed and the correlations analyzed using the Statistical Package for the Social Sciences (SPSS) software. The software requires the data to be defined in a way that it will recognize, defining variables, entering and testing various statistical tests, the relationship between two variables, as well as the magnitude of association, i.e. non-parametric tests, where we used the Chi-squared analysis.*
KEYWORDS *Survey, Analysis, Variable, Bitola, Users*

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I. INTRODUCTION

Urban transport is strategically important for economic stability, social cohesion and national growth. Mobility planning at a high level is about the coefficient of self-governance will raise planning in the field of urbanism and traffic on the one hand, economy and advanced technology, accessibility, functional polycentricity and built urban identity.

The main goal of the sustainable transport system plan is to ensure economic efficiency, sustainable environment, safety, quality of life, accessibility and social inclusion. When planning the traffic infrastructure, priority is given to the space for passenger car traffic, freight traffic and vehicles for public city transport, then to the space for walking and bicycles, a special space is never planned only for vehicles of public city transport for the purpose. giving priority. Sustainable urban mobility planning defaults to prioritizing space for walking, cycling and public urban transport over space for car and truck traffic.

Public transport services are important for any city transport system, providing mobility for a large number of passengers to different destinations in different directions and at the same time through the transport of one facility. Public transportation has the greatest potential and is one of the basic ways to achieve the goals of sustainable transportation. Public city transport should offer the following quality conditions: safety, security, congestion environment, ecologically minded towards the environment, social integration, faster, number of lines and frequency of movement.There are 5 licensed private operators in Bitola public transport. The current public transport service in the urban area of the city is represented by 5 urban lines. Public transportation in Bitola is carried out only by circular routes. In the period from 01.21.2023 - 03.11.2023, a survey was published for all users of public city transport in Bitola.

The survey was created on the Google Drive – Google Forms platform. 30 questions were created that analyze the current situation, problems faced by users and solutions to improve the situation. The electronic survey was answered by 148 users, while 167 passengers were in a public transport vehicle. The total number of surveyed users was 315.

II. METODOLOGY OF RESEARCH

The following methodology shown in diagram 1 was applied for the implementation of this research.

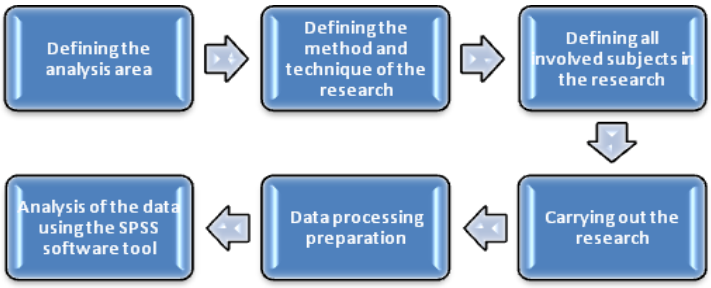

Chart. 1. Methodology for conducting the research

III. DEFINING THE AREA OF ANALYSIS

The area of analysis in this thesis is the city of Bitola. Bitola is the largest city center in the fertile and largest Macedonian valley of Pelagonia and the second largest city in the Republic of Macedonia. The city of Bitola is located in the far south-western part of the Republic of Macedonia. In the results published by the State Bureau of Statistics for the census that was held in September 2021, the Municipality of Bitola has a population of 85,164 inhabitants. Bitola is a city that has a road and rail network.

Permits for the transportation of passengers in the territory of the city of Bitola were granted for the first time in 2010, to 9 (nine) carriers and 19 lines. But with the passage of time and due to a number of problems and shortcomings, today public city transport in Bitola is provided by 5 licensed private operators. The current public transport service in the city's metropolitan area is represented by 5 urban lines. Public transportation in Bitola is carried out only by circular routes. As a consequence, the current situation is characterized by an unstable service of public transport. Namely, using only a circular network, the frequent service is provided only in one part or in this case only in the central area of the city. At the municipal level, there are a total of 15 lines, but in the collection of data, only those lines that serve the area of the city of Bitola were considered, that is, line no. 1, in both directions, line no. 4 in both directions, and line no. 5 in one the direction. Carriers: "Transkop-passenger traffic" "Luka express plus" "Gopesh trans". Figure 1 shows the area of analysis, i.e. the lines of public city transport on the territory of the city of Bitola, on which data collection was carried out, i.e. surveying.

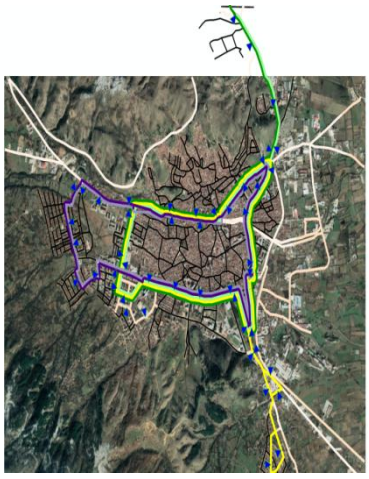

Fig. 1 Area of analysis Source: Created by the author

IV. DEFINING THE RESEARCH METHOD AND TECHNIQUE

One of the most used and strongest methods for market research is the survey. Surveys are the most used because they are the easiest to conduct and the simplest to collect the information that still arrives in a form that is easy to analyze.

A survey was created for this research. The survey was made on the Google Drive - Google Forms platform. 30 questions were created that analyzed the current situation, the problems users face and proposed solutions to improve the situation. The questions refer to the reasons for not using public city transport services, whether you would use public city transport if you were to choose the services, what is the quality of public city transport today, etc. Show in figure 2. But considering the size of the survey, in this paper only a part of the questions will be analyzed with the help of the SPSS software tool.

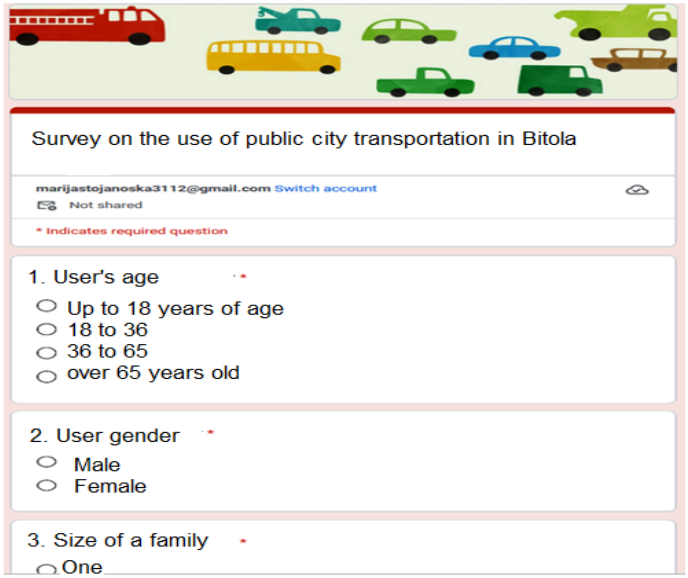

Fig. 2 Display of part of the survey created for the needs of the research Source: Created by the author

Period of analysis

In the period from 01.21.2023 - 03.11.2023, a survey was conducted for all users of public city transport in Bitola. While on 06.03.2023 the survey was conducted in a vehicle of public city transport.

Defining all involved subjects in the research

Subjects involved in conducting the research: Students and employees from "Taki Daskalo" Secondary School - Bitola, "Josip Broz Tito" Secondary School - Bitola, "Gyorgji Naumov" SOTU - Bitola, users of public city transportation services in the vehicle itself and other users who answered the survey posted on the website from the Faculty of Technology - Bitola.

Carrying out the research

The survey was carried out in two ways, ie online and in paper form. The survey was electronically distributed to students and employees, where the number of respondents was 148 users of public city transport. As part of the subject Collection and analysis of transport data, a survey of the users of public city transport services in Bitola was carried out with students from the second year, fourth semester, the survey was carried out in the vehicles of public city transport, line 1, line 4 and line 5. 167 public city transport users were surveyed.

Data processing preparation

After the process of data collection was finished, preparations for their processing began. The data that were answered electronically were automatically processed and displayed in a graphic display and tabular form, while those that were collected in a vehicle, since the registration was paper-based, were entered into the previously created excel table. The total number of annexed was 315 users of the services offered by public city transportation in Bitola.

V. ANALYSIS OF THE DATA USING THE SPSS SOFTWARE TOOL

General information about the software tool SPSS

SPSS is a computer application program for statistical data analysis. With SPSS, we can use almost any type of data file to create reports in the form of tables, graphs, distribution plots, descriptive statistics, and complex statistical analysis. Thus, it can be said that SPSS is a complete, comprehensive, integrated and highly flexible system for statistical analysis and data management. The advantages of SPSS include that it implements a menu and dialog box interface that makes it easy for users to record data (data entry), provide commands and subcommands for analysis, and display results. In addition, SPSS also has reliability in displaying the graphs of the analysis results, as well as ease of editing if needed. Since SPSS is a software package for processing and analyzing data, in order to use this program, we must first prepare the data to be processed and analyzed.

To be understood by the processor in SPSS for Windows, data must have a certain structure, format, and type. After understanding the concept of data and the concept of windows in SPSS for Windows, another thing to consider in the analysis is the selection of procedures that are appropriate for the case. The data to be processed must be in the form of m rows and n columns. Each row of data is called a case, and each column of data has a title called a variable. Show in figure 3.

The variable could be:

- Qualitative variables (classification/category), such as: male/female, which is unranked and by ranking list, for example: bad, good, very good and excellent.
- A quantitative variable (numerical value), such as for family size, years, etc.

Figure 3 shows how to enter a variable name into the software.

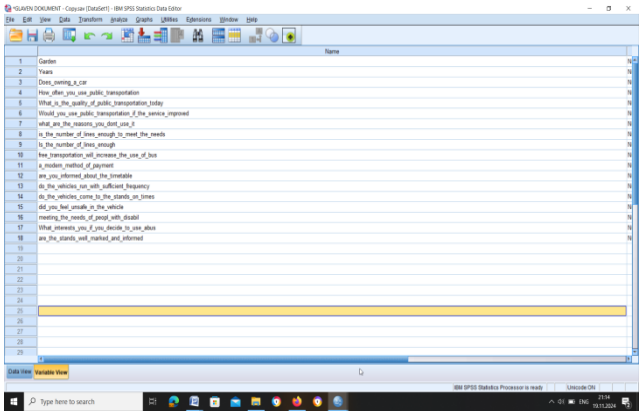

Fig.3 Shows how to enter a variable name into the software Socure: Created by the author

For the type of the variable, we enter numeric, this means that the answers will be given via a numeric number.

In the variable label box, you can enter the label for the variable. Meanwhile, in the value label field, there are two input fields namely value (the value to be entered) and value tag (a description of the value, for uniformity) and 3 associated buttons that can be used to define labels in the form of categories. For example: type 1 in value and male in value label, you can see the support button change color (active), then press add button, you will see the caption 1='male'. This means that the male category is given a value of 1. Shown in figure 4.

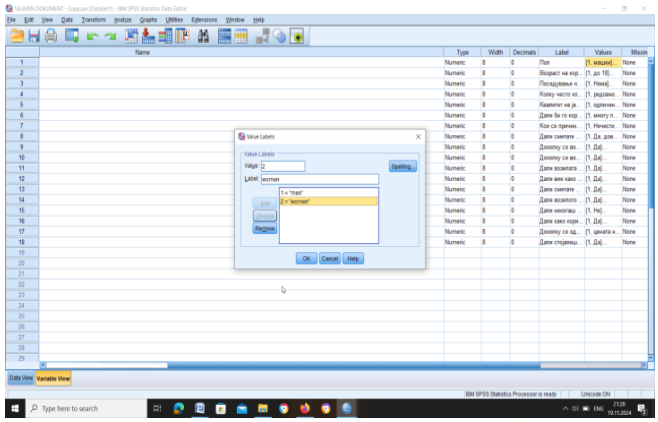

Fig.4 Entering the value of the variable Source: Created by the author

After defining the variables, i.e. the variables, where we have defined a total of 18, the next step is to enter data that we have collected from the survey itself and defined in a way that the program will recognize them. For each defined variable we have entered 315 values. Shown in figure 5.

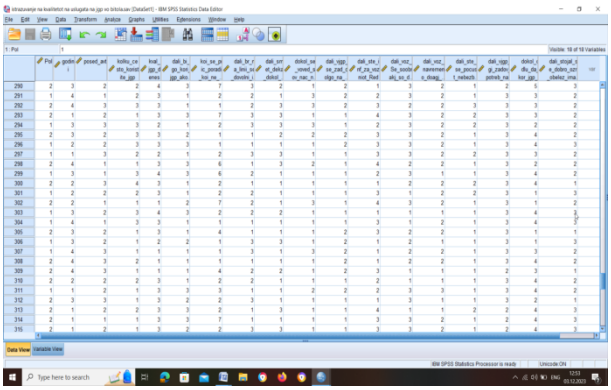

Fig.5 Data entered for each variable Source: Created by the author

Analysis of differences between variables and the implementation of non-parametric tests

With the help of the SPSS software tool, we can do various tests, among them is the cross table that can be used to examine the relationship between two categorical variables, that is, if there are differences in the responses for different categories of respondents. To do this analysis from the toolbox we select Analyze-Descriptive Statistics – Crosstabulation. As well as determining the independence between two categorical variables using the chi-square test. The chi-square test is a statistical test commonly used to compare observed data with the data we would expect to obtain under a specific hypothesis. It is used to determine which categories (cells) were the main contributors to the rejection of the null hypothesis. When the absolute value of the residual (R) is greater than 2.00, the researcher can conclude that there was a large effect on the significant statistic of the chi-square test.

In addition, the analysis between the age and quality of public city transport in Bitola

The participants in the research are divided into four age categories: up to 18 years, between 18 and 36, between 36 and 65 and over 65 years. As can be seen from Table 1, 47.0% of the responses were aged up to 18 years, 26.3% aged 18 to 36 years, 16.5% were aged 36 to 65 years, while over 65 were 10.2%. From the respondents compared to the age and the quality of public city transport today, we can conclude that 57.5% think that the quality of public city transport today is good, 16.2% bad, 12.7% very good, while a very small percentage that is excellent or very bad. In order to test if there is a significant difference in the responses from the different age categories, two statistical tests were performed. Z-test and standard deviations (table 1).

The null hypothesis is: there is no difference in the opinions between the different categories of respondents and the quality of public city transport today. The standard residual 2.3 for poor quality of public city transport among the 36-65 age group and 2.7 for people over 65 and excellent quality of public city transport.

Table 1. Age of the user versus quality of public urban passenger transport today

User's age * Quality of public city transport of passengers today Crosstabulation								
			Quality of public city transport of passengers today					Total
			Excellent	Very good	Good	Bad	Very bad	
User's age	very good	Count	9_a	22_a	86_a	23_a	8_a	148
		Expected Count	12,2	18,8	85,0	24,0	8,0	148,0
		% within User's age	6,1%	14,9%	58,1%	15,5%	5,4%	100,0 %
	good	% within Quality of public city transport of	34,6%	55,0%	47,5%	45,1%	47,1%	47,0%

		passengers today						
	bad very bad	Standardized Residual	-,9)	,7	,1	-,2)	,0	
	From 18 to 36	Count	9_a	8_a	51_a	10_a	5_a	83
		Expected Count	6,9	10,5	47,7	13,4	4,5	83,0
		% within User's age	10,8%	9,6%	61,4%	12,0%	6,0%	100,0 %
		% within Quality of public city transport of passengers today	34,6%	20,0%	28,2%	19,6%	29,4%	26,3%
		Standardized Residual	,8	-,8)	,5	-,9)	,2	
	From 36 to 65	Count	1_a	$8_{a,\,b}$	25_a	15_b	$3_{a,\,b}$	52
		Expected Count	4,3	6,6	29,9	8,4	2,8	52,0
		% within User's age	1,9%	15,4%	48,1%	28,8%	5,8%	100,0 %
		% within Quality of public city transport of passengers today	3,8%	20,0%	13,8%	29,4%	17,6%	16,5%
		Standardized Residual	-1,6)	,5	-,9)	2,3	,1	
	Over 65	Count	7_a	2_b	19_b	3_b	$1_{a,\,b}$	32
		Expected Count	2,6	4,1	18,4	5,2	1,7	32,0
		% within User's age	21,9%	6,3%	59,4%	9,4%	3,1%	100,0 %
		% within Quality of public city transport of passengers today	26,9%	5,0%	10,5%	5,9%	5,9%	10,2%
		Standardized Residual	2,7	-1,0)	,1	-1,0)	-,6)	

The Chi-square test (table 2) where the null hypothesis is analyzed between the different age categories regarding the quality of public transport today.

Table 2. Chi-square analysis of the age category versus the quality of the public transport today

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	22,159[a]	12	,036
Likelihood Ratio	20,684	12	,049
Linear-by-Linear Association	,422	1	,516
N of Valid Cases	315		
a. 6 cells (30,0%) have expected count less than 5. The minimum expected count is 1,73.			

The null hypothesis has been rejected. Since the chi-square test confirms the result that there is a difference among different categories, $p = 0.0365 < 0.05$. Since 6 cells expected a count less than 5, a look at the likelihood ratio $0.049 < 0.05$ confirms the same result.

Comparison of the age categories with the improvement of the quality of the service of the Public Health Service

From the respondents compared to age and whether they would use public transport if the quality of the service improved, we can conclude that 43.5% think that if the quality of public city transport were improved, they would use it much more, 34% the same as today, 20.3% a little more, 1.3% will not use public transports, and 1% less than today. In order to test if there is a significant difference in the responses from the different age categories, two statistical tests were performed.

The null hypothesis reads: there is no difference in the opinions between the different categories of respondents regarding the improvement of the quality of the service of the Public Health Service.

The Z-test and the standard residuals showed that the null hypothesis has a significant difference in the responses from different age categories. The standard remainder 2.6 for slightly more will use public city transport among the 36-65 age group.

The Chi-square test (table 3) is the null hypothesis set between the different age categories in relation to the use if the quality of public city transport improves today.

Table 3. Chi-square analysis of the age category against the improvement of the quality of public city transport

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	23,356[a]	12	,025
Likelihood Ratio	24,182	12	,019
Linear-by-Linear Association	1,170	1	,279
N of Valid Cases	315		

a. 8 cells (40,0%) have expected count less than 5. The minimum expected count is ,30.

The null hypothesis has been rejected. According to Chi-square test $p = 0.025 < 0.05$ so the null hypothesis is rejected. Since 8 cells expected a count less than 5, a look at the likelihood ratio $0.019 < 0.05$ confirms the same result. From the respondents compared by gender and the reasons why they do not use public transport, we can conclude that dirty buses as the reasons for not using private public transport have the greatest impact on males 55.9%, bad and irregular timetables on females 57.8%.

In the case of the female gender, too much crowd 56.5%, 68.8% high price of the ticket, 53.8% too much driving, 58.3% lack of information, 62.9% other reasons are the most influencing factors. In order to test if there is a significant difference in the responses from the different age categories, two statistical tests were performed. The null hypothesis reads: there is no difference in the opinions between the different gender categories and the reasons for not using public transport.

The Z-test and standard deviations showed that the null hypothesis had no significant difference in the responses of different genders, and the hypothesis could not be rejected at the 0.05 level of significance. Standard Deviation is less than 2.

In table 4, a chi-square test was conducted to analyze the null hypothesis between genders in relation to the reasons for non-use of public transport.

Table 4. Chi-square analysis of gender and the reasons for non-use of the public transport today

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	5,783[a]	6	,448
Likelihood Ratio	5,804	6	,446
Linear-by-Linear Association	2,954	1	,086
N of Valid Cases	315		
a. 0 cells (0,0%) have expected count less than 5. The minimum expected count is 5,78.			

The null hypothesis cannot be rejected. According to the Chi-square test, p = 0.448> 0.05, so the null hypothesis cannot be rejected and there is no difference in the answers to the reasons for not using public transport. No cell violates the assumption it shows the likelihood ratio 0.446> 0.05 confirms the same result.

VI. CONCLUSION

From this paper we can conclude that the application of public city transport, as a sustainable means of urban transport, requires constant monitoring, analyzing the operation, to perceive the shortcomings, improve and advance. Monitoring and analysis are done by conducting various surveys. It was in this paper that the current state of public city transport in the city of Bitola was analyzed. For statistical analysis, we used the computer program SPSS, which is a statistical package that was first used in 1968 and is one of the most widely used statistical analysis programs within the social and technical sciences.

A statistical analysis was made of the questions and answers that we received from the examinations and the results are given in the appendix. When it comes to the quality of service offered by public city transport, 181 (57.5%) is good. If the quality of the service were to improve, the respondents would use public city transport much more, 137 (43.5%) of them. The answers to why they don't use public city transport can be said to be almost the same, that is, because of bad and irregular timetables (28.6%), too many crowds (21.9%), dirty buses (21.6%).

The following results from the conducted research refer to the testing of two categorical parameters, i.e. whether there are differences in the answers. For comparison, we took gender, age and car ownership into account. We have determined the standard deviation, whether the hypothesis will be accepted or rejected. For this purpose, we used Chi-square analysis, if the standard deviation is greater than 2, the hypothesis is rejected.

For 18-year-olds, out of a total of 90, 35 believe that the reason for not using public city transportation is the bad and irregular timetable, 28.6%.

If the services are improved, users up to 18 years of age will use public city transport much more, and that is 76 out of 137 respondents or 43.5%.

Age and the quality of public city transport, we have the most respondents up to 18 years old, 47%, who think that the quality of public transport is good, or 57.5%. We have a difference in the responses and the standard deviation with 2.3 and 2.7 and this is confirmed by the Chi-square analysis, we have p=0.0365<0.05 and a probability coefficient of 0.049<0.05. The hypothesis is dismissed. Age and the reasons for not using public transport, 28.6% due to bad and irregular timetable, we have a difference in the standard deviation of 2.4 up to 18 years and 2.3 over 65 years. Where p=0.001<0.05 and the probability ratio 0.000<0.05. The hypothesis is dismissed.

As a conclusion from this paper, we can conclude that the use of software tools, programs and packages is of great and crucial importance traffic engineers, because it allows us to quickly, accurately and qualitatively analyze any problems, phenomena and characteristics of the traffic problem. The statistical program SPSS has many tools that can be explored and studied in subsequent papers.

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