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Comparing the Quality of Service of Bus Companies Operating in two Cities in Brazil

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***Abstract*—**The main objective of this work is to compare the quality of service of the bus companies operating in the city of Rio Branco, located in the state of Acre with the quality of service of the bus companies operating in the city of Campos, situated in the state of Rio de Janeiro, both cities in Brazil. This comparison, based on the opinion of the bus users, will determine their degree of satisfaction with the service available in both cities. The outcome of this evaluation shows the users unhappy with the quality of the service provided by the bus companies operating in both cities and the need to identify alternative solutions that may minimize the consequences caused by the main problems detected in this work. With these alternatives available, the bus companies will be able to better understand the needs of their customers in terms of manpower, service cost, time schedule, etc.

***Keywords*—**PubicTransportation, Quality of Service, Riders' Opinion, Bus Companies

I. Introduction

IN Rio Branco, located in the state of Acre as well as in Campos, situated in the state of Rio de Janeiro, both cities in Brazil, there is a need to provide public transportation (mainly buses) to a large number of people; primarily, to those living in the suburbs of the city. The outlying suburbs are essentially caused by the chaotic growth of cities, and, thus, there exists a need for low cost improvement of existing public transportation systems, with the necessary flexibility to adjust the implementation of new lines to the need of potential customers.In two previous papers [1] and [2] we analyzed, respectively, the quality of service of the bus companies operating in the cities of Rio Branco and Campos. These analyses were based on the opinion of the bus customers.The objective of this work is to compare the quality of service of the bus companies operating in the city of Rio Branco, located in the state of Acre with the quality of service of the bus companies operating in the city of Campos, situated in the state of Rio de Janeiro, both cities in Brazil. The results of this comparison, based on the opinion of the bus users, will help us to suggest solutions to minimize the consequences of the main problems related to riders' dissatisfaction identified in our analysis and to help the bus companies operating in both cities to better fulfill their customers' needs.

This is the only possible way the bus companies will have to survive the competition of alternative transportation systems.

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II. Methodology

The research method used in this work was basically exploratory and the work in question consists of case studies performed for the bus companies in the cities of Rio Branco and Campos. In bothsurveys, the populations of both cities were defined as being external clients, the customers of the bus companies.In Rio Branco, a random sample of 250 users was randomly selected among all the 35 existing bus lines. This research was performed in 2009 during the months of June and July.In Campos, a random sample of 200 was selected from the 7 bus companies operating in that city. This enquiry was implemented in 2011 during the months of March and April.Tables Iand II below show, respectively, the bus companies' user population and sample data for the cities of Rio Branco and Campos, both located in Brazil.

TABLE I
Bus Companies' User Population And Sample data (Rio Branco)

Population	Sample
Average of 2,439,229 passengers/month, corresponding to about 55,437.02 passengers/day (considering that all of them travel 22 days per month, twice a day, outbound and inbound).	250 passengers from the existing bus companies

TABLE II
Bus Companies' User PopulationAnd Sample Data (Campos)

Population	Sample
Average of 2,942,684 passengers/month, corresponding to about 66,879 passengers/day (considering that all of them travel 22 days per month, twice a day, outbound and inbound).	200 passengers from the existing bus companies

III. Analysis Of The Results

A. Results Associated with Customer Satisfaction

The results of this survey associated with customer satisfactionfor Rio Branco and Campos can be seen, respectively, in TablesIII and IV for customers per item and in Tables V and VI for percentage (%). After that, we will present in Tables VIIto XXIVthe profile of the bus companies' customer of Rio Branco and Campos. These results will allow us to determine the satisfaction level of all the customers in relation to each one of the items surveyed.

TABLE III
Questionnaire Results For This Survey (Rio Branco)

	Evaluation (250 customers per item)		
Conditions	Good	Average	Bad
Average Trip Time	57	88	105
Bus Itinerary	76	91	83
Interval Between Buses	29	42	179
Nº of Buses in the Line	36	67	147
Cleanness	38	108	104
Conservation	26	107	117
Comfort	13	51	186
Safety	58	70	122

Noise and Air Pollution	17	77	156
Fare	33	64	153
Schedule	57	81	112
Employees' Courtesy	72	132	46
Total	512	978	1,510

TABLE IV
QUESTIONNAIRE RESULTS FOR THIS SURVEY (CAMPOS)

	Evaluation (200 customers per item)		
Conditions	Good	Average	Bad
Average Trip Time	26	109	65
Bus Itinerary	31	92	77
Interval Between Buses	19	72	109
Nº of Buses in the Line	15	78	107
Cleanness	32	82	86
Conservation	35	74	91
Comfort	25	89	86
Safety	35	93	72
Noise and Air Pollution	25	63	112
Fare	44	77	79
Schedule	50	75	75
Employees' Courtesy	36	99	65
Total	373	1,003	1,024

Tables V and VI shows the percentage evaluation (%) results for these two cities.

TABLE V
QUESTIONNAIRE RESULTS FOR THIS SURVEY (RIO BRANCO)

	Evaluation (Percentage %)		
Conditions	Good	Average	Bad
Average Trip Time	22.8	35.2	42.0
Bus Itinerary	30.4	36.4	33.2
Interval Between Buses	11.6	16.8	71.6
Nº of Buses in the Line	14.4	26.8	58.8
Cleanness	15.2	43.2	41.6
Conservation	10.4	42.8	46.8
Comfort	5.2	20.4	74.4
Safety	23.2	28.0	48.8
Noise and Air Pollution	6.8	30.8	62.4
Fare	13.2	25.6	61.2
Schedule	22.8	32.4	44.8
Employees' Courtesy	28.8	52.8	18.4

TABLE VI
QUESTIONNAIRE RESULTS FOR THIS SURVEY (CAMPOS)

	Evaluation (Percentage %)		
Conditions	Good	Average	Bad
Average Trip Time	13.0	54.5	32.5
Bus Itinerary	15.5	46.0	38.5
Interval Between Buses	9.5	36.0	54.5
Nº of Buses in the Line	7.5	39.0	53.5
Cleanness	16.0	41.0	43.0
Conservation	17.5	37.0	45.5
Comfort	12.5	44.5	43.0
Safety	17.5	46.5	36.0
Noise and Air Pollution	12.5	31.5	56.0
Fare	22.0	38.5	39.5
Schedule	25.0	37.5	37.5
Employees' Courtesy	18.0	49.5	32.5

B. Customer Profile of Rio Branco' Bus Companies

TABLE VII
AGE

Age (years)	Customers %(total of 250)
15 or less	7.2
16 to 20	29.2
21 to 25	17.2
26 to 30	14.8
31 to 35	9.2
36 to 40	6.0
41 to 45	5.6
46 to 50	1.6
51 or more	9.2

TABLE VIII
GENDER

Gender	Customers % (total of 250)
Masculine	40.4
Feminine	59.6

TABLE IX
EDUCATIONAL LEVEL

Educational Level	Customers %(total of 250)
Incomplete First Grade	11.2
First Grade	8.8
Incomplete High School	24.4
High School	29.2
Incomplete College Degree	20.0
College Degree	6.4

TABLE X
MANNER OF PAYING FARE

Manner of Paying Fare	Customers % (total of 250)
Pre-paid Discount Card	19.2
Full Fare	37.6
Student	37.2
Free Pass	5.6
Didn't Know	0.4

TABLE XI
REASONS TO TRAVEL

Reasons to Travel	Customers % (total of 250)
Study	38.3
Work	44.4
Shopping	7.0
Multiple Reasons	10.3

TABLE XII
MONTHLY FAMILY INCOME OF PASSENGER (IN EUROS)
1 EURO = 2.28 REAIS

Income (Euros)	Customers % (total of 250)
237 (minimum wage)	18.8
238 to 474	29.2
475 to 711	24.0
712 to 948	7.6
949 to 1,185	6.4
1,186 to 1,422	2.8
1,423 to 1,659	3.2
1,660 to 1,896	1.2
1,897 to 2,133	0.4
2,134 to 2,370	0.8
2,371 to 2,607	0.0
Above 2,608	3.6
Didn't Know	2.0

TABLE XIII
TRAVEL FREQUENCY

Travel Frequency	Customers % (total of 250)
Daily	70.8
Once a Week	2.4
Twice or More a Week	14.0
As Necessary	12.8

TABLE XIV
WORST TIME TO TRAVEL IN THE OPINION OF THE CUSTOMER

Worst Time to Travel	Customers % (total of 250)
During the Day	55.9
Night	43.8
Indifferent	0.3

TABLE XV
WORST DAY TO TRAVEL IN THE OPINION OF THE CUSTOMER

Worst Day to Travel	Customers % (total of 250)
Weekdays	50.4
Weekend	49.3
Indifferent	0.3

C. Customer Profile of Campos' Bus Companies

TABLE XVI
AGE

Age (years)	Customers%(total of 200)
15 or less	11.5
16 to 20	24.0
21 to 25	26.5
26 to 30	8.5
31 to 35	6.5
36 to 40	7.0
41 to 45	6.0
46 to 50	3.0
51 or more	7.0

TABLE XVII
GENDER

Gender	Customers % (total of 200)
Masculine	45.5
Feminine	54.5

TABLE XVIII
EDUCATIONAL LEVEL

Educational Level	Customers %(total of 200)
Incomplete First Grade	18.5
First Grade	5.5
Incomplete High School	21.0
High School	17.0
Incomplete College Degree	30.0
College Degree	8.0

TABLE XIX
MANNER OF PAYING FARE

Manner of Paying Fare	Customers % (total of 200)
Pre-paid Discount Card	19.5
Full Fare	24.0
Student	33.0
Free Pass	22.0
Didn't Know	1.5

TABLE XX
REASONS TO TRAVEL

Reasons to Travel	Customers % (total of 200)
Study	53.5
Work	37.0
Shopping	1.0
Multiple Reasons	8.5

TABLE XXI
MONTHLY FAMILY INCOME OF PASSENGER (IN EUROS)
1 EURO = 2.28 REAIS

Income (Euros)	Customers % (total of 200)
237 (minimum wage)	2.0
238 to 474	8.0
475 to 711	24.0
712 to 948	4.0
949 to 1,185	9.0
1,186 to 1,422	6.0
1,423 to 1,659	11.0
1,660 to 1,896	2.0
1,897 to 2,133	0.0
2,134 to 2,370	10.0
2,371 to 2,607	2.0
2,608 to 2,844	2.0
Didn't Know	20.0

TABLE XXII
TRAVEL FREQUENCY

Travel Frequency	Customers % (total of 200)
Daily	82.5
Once a Week	2.5
Twice or More a Week	8.0
As Necessary	7.0

TABLE XXIII
WORST TIME TO TRAVEL IN THE OPINION OF THE CUSTOMER

Worst Time to Travel	Customers % (total of 200)
During the Day	44.0
Night	39.5
Indifferent	16.5

TABLE XXIV
WORST DAY TO TRAVEL IN THE OPINION OF THE CUSTOMER

Worst Day to Travel	Customers % (total of 200)
Weekdays	33.5
Weekend	60.5
Indifferent	6.0

IV. QUALITY LEVEL

Using the results obtained from TablesIII and IV,and applying the same calculation procedure presented in two previous papers[1] and[2], we can determine the overall quality level of the service provided by Rio Branco and Campos' bus companies. These results could be used in the future to evaluate whether the researched bus companies have improved their service and fulfilled their customer's needs.

To determine the overall quality level the following steps should be followed:

1. Determine the total number of customers that:
   a. S_g; considered the items researched as good;
   b. S_{ave};considered the items researched as average;
   c. S_b;considered the items researched as bad.

The following weights were used for each of the classifications:

d. Good: $p_g = 2$;
e. Average: $p_{ave} = 1$;
f. Bad: $p_b = 0$.

2. Multiply the obtained values for each of the classifications by its corresponding weights. As a result we will have the overall quality level (OQL) given by (1):

$$OQL = S_g \times p_g + S_{ave} \times p_{ave} + S_b \times p_b \quad (1)$$

Now, with $p_g = 2$, $p_{ave} = 1$ and $p_b = 0$, we will have:

$$OQL = 2S_g + S_{ave} \quad (2)$$

3. Compare the obtained OQL value with the "maximum theoretical value" that (2) could have, that is, the total number of items multiplied by the number of customers surveyed (in Rio Branco case, 12 items and 250 customers researched, and in Campos case, 12 items and 200 costumers examined), multiplied by 2, the corresponding weight for the classification "good." Since in an "optimal theoretical case" all the customers surveyed will give the classification "good" to all the items researched, the value of S_{ave} in (2) will be equal to zero. This comparison is given by:

$$OQL \leq T_V = 2 \times 12 \times n \quad (3)$$

Here, *n* is the number of customers researched (250 in Rio Branco and 200 in Campos), T_V is the "optimal theoretical value" that (3) could have, 2 is the corresponding weight for the classification "good" and 12 is the number of items surveyed in this work. Then:

$$T_V = 2 \times 12 \times n \quad (4)$$

4. Now to compare the obtained OQL value with the "maximum theoretical value" that (2) could have, we will use the following classification:

a. If the OQL value is located between 90% and 100% of the T_V value: the service level is considered to be "good"; the customers' needs are being fulfilled. The bus companies should keep up the good work.

b. If the OQL value is located between 70% and 89% of the T_V value: the service level is considered to be "satisfactory". However, the service level should be improved in order to exceed the customers' expectation.

c. If the OQL value is located between 40% and 69% of the T_V value: the service level is considered to be "reasonable", but there are complaints about some areas of service rendered by the bus companies.

d. If the OQL value is located between 10% and 39% of the T_V value: the service level is considered to be "bad", and urgent measures should be taken by the bus companies in order to continue operating.

e. If the OQL value is located below 10%: the service level is considered to be "very bad". The city authorities should immediately consider canceling the bus companies' concession.

V. The Overall Quality Level For The Bus Companies

A. In Rio Branco Case

Utilizing the data from Table III and using (2), with $S_g = 512$, $S_{ave} = 978$ and $S_b = 1510$, we will have:

$$OQL = 2S_b + S_{re} + 0 \times S_b = 2 \times 512 + 978 = 2002.$$

Verifying if $OQL \leq T_V$:

$$T_V = 2 \times 12 \times n = 2 \times 12 \times 250 = 6000.$$

As a result, $OQL \leq T_V$, since $2002 \leq 6000$.

Therefore: OQL = 2002, which represents 33.4% of T_V.

This overall quality level (OQL) value of 33.4% is located between 10% and 39% of the T_V value. The service level is considered to be "bad", and urgent measures should be taken by the bus companies in order to raise their level of service.

B. In Campos Case

Employing the data from Table IV and applying (2), here with $S_g = 373$, $S_{ave} = 1{,}003$ and $S_b = 1{,}024$, we will have:

$$OQL = 2S_b + S_{re} + 0 \times S_b = 2 \times 373 + 1{,}003 = 1{,}749$$

Verifying if $OQL \leq T_V$:

$$T_V = 2 \times 12 \times n = 2 \times 12 \times 200 = 4{,}800$$

As a result, $OQL \leq T_V$, since $1{,}749 \leq 4{,}800$

Therefore, OQL = 1,749, which represents 36.4% of T_V.

This overall quality level (OQL) value of 36.4% is located between 10% and 39% of the T_V value. Again, the service level is considered to be "bad," and urgent measures should be taken by the bus companies in order to raise their level of service.

VI. Major Problems Found In This Study

Many of the answers provided by the bus companies' customers have shown that both cities have major problems related with the quality of service furnished by their bus companies.Several of the conditions considered in the questionnaires need to be improved in both cities, especially the ones related to number of buses in the line, interval between buses and noise and air pollution.

In Rio Branco, the conditions that were given a "bad" evaluation greater than 50% were:

Comfort (74.4%);
Interval between buses (71.6%);
Noise and air pollution (62.4%);
Fare (61.2%);
Number of buses in the line (58.8%).

In Campos, the conditions that were given a "bad" evaluation greater than 50% were:

Noise and air pollution (56.0%);
Interval between buses (54.5%);
Number of buses in the line (53.5%).

The suggestions for improvement for the common conditions for both cities are shown in Table XXV. The condition "Comfort" is specific to Rio Branco. In some cases the implantation of one suggestion could help in the solution of more than one problem.

TABLE XXV
SUGGESTIONS FOR IMPROVEMENT OF THE MAIN COMMON PROBLEMS FOR RIO BRANCO AND CAMPOS FOUND IN THIS SURVEY

Suggestion	Objective	Problems to be Solved	Time of Implantation	Cost
Renew, Increase and Maintain the Fleet	To improve the conditions of the buses, replacing the ones that have exceeded their useful life time	Long wait time, comfort, lengthy intervals between buses.	Medium to Long	High
Best Scheduling and Planning	To decrease intervals between buses	Long intervals between buses	Short to Medium	Low to Medium
Utilize Alternative Fuels	To diminish the effects of noise and pollution of air generated by the bus	Great generation of noise and air pollution	Long	High

VII. CONCLUSIONS

The bus companies operating in Rio Branco, state of Acre, and Campos, state of Rio de Janeiro, need to take urgent measures in order to raise their service level. They should initially focus their efforts on the items that have presented the "worst" evaluation by their customers, for example; number of buses in line; interval between buses and noise and air pollution. Rio Branco has also shown low performance on the item comfort.The lack of focus on customers' satisfaction is the main reason for the bus companies' customers moving away to informal and alternative forms of transportation, such as: personal car, motorcycle-taxi, private bus and travel by foot or by bicycle.

As we have mentioned in previous papers [1] and [2], instead of fulfilling their customers' needs, the bus companies treat them as "captive customers", thinking that their low incomes will exclude private transport and the people will, of necessity, use the bus. This is not the present reality in Brazil due to the economic stabilization Brazil is experiencing in the last ten years. The bus companies need to immediately begin the process of changing their attitude in order to improve the quality of their service. They should focus on customer satisfaction, or their future operations could be bleak.

As a final remark, the surveys in both cities were performed while the users were waiting for the bus in a certain location and during a certain time period and the combination of these two factors could have guided the users to answer the questions in a more "severe" way.

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