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Identification of Factors to Improve Public Transit Services (A Case Study of Prithvi Chowk to Talchowk Section of Prithivi Highway)

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ABSTRACT

This research presents studies on a segment of highway to determine the quantitative factors that influence transit services. Travel time and delay study is one of the method to determine quantitative factors. Tour time is described as the average period of time required to journey from one region to some other. Total departure time consists of gadgets which include total working time, places and general delay time. The examine section was done in Prithvichowk to Talchowk of Prithvi Highway which is turned to be 12.5 km long.

Additionally, it has been found that the principle variables affecting travel time are: postpone time because of forestall selecting and choosing up passengers, bus model and bus size.32 trips public transport carrier and a 10 trips non-public automobile journey have been held during peak hours. Models are developed the use of SPSS software to become aware of the relationship between the causes of delays and the overall-time delays. Travel time and learning delays can help reduce the number of private vehicles operating and increase the number of public vehicles in order to reduce congestion and improve the efficiency of the public transport system. It turned into determined that there was a full-size distinction in tour time among the use of the public transit services and the car.

Keywords--Travel Time, Running Time, Delay, Transit Service, Pickup and Discharge of Passengers

I. INTRODUCTION

Failure of the public transport system leads to the use of private vehicles which has resulted in traffic congestion. With the improvement of transportation, increasing public participation is leading to transport congestion, which is a major challenge these days in urban areas. Total departure time includes items such as total operating time, locations and total delay time. Information obtained in travel time and delay studies provide a good indication of the level of service of the study section. Various data can be collected such as locations, duration and causes of delays during the study[1]. There are different types of delay i.e., fixed delay, congestion delay, operational delay and stop delay[2]. These days, society is more advanced and people are more reliant on travel facilities than ever before. Travel time is defined as the average length of time required to travel from one place to another. Total working time and delay time provide travel time. Travel time and delays are two main steps in road planning. Travel time and delay study can help reduce the number of private vehicles operating and increase the number of public vehicles in order to reduce congestion and improve the efficiency of the public transport system. After reading the travel time, we may have details about the causes of the delay. Travel time is an important indicator of measurement representing the state of traffic. This information also assists a traffic engineer in identifying a problem area, which may require special care in order to improve the overall traffic on the route.

Travel time is the time it takes for a car to cross a certain section of a highway. The constant delay is that part of the delay caused by control devices such as road signs. Performance delays are part of the delays caused by the other car's performance. Travel time consists of total work time and total delay time. The entire delay period also includes operational delays, stop time delays, fixed delays. Set time delay is part of the delay in which the vehicle is rested. Running time is the time when the car stays in motion while passing through the section. Delay time is time lost due to causes beyond the control of the driver.

The results obtained during travel and the study of delays have a high impact on the transport sector to improve service quality. It helps to determine the efficiency of the route in terms of its traffic capacity, and it helps to identify areas with the highest delays and the causes of those delays. It is useful to determine the travel time for specific links to use in travel assignment models. The information can be used in practice studies to assess changes in performance and service level over time.

II. LITERATURE REVIEW

A survey was conducted in Amman-Sweileh line of Amman, Jordan to determine the causes of delay and study of variables affecting it by [3]. It was found that the main variables that affect the trip travel are: The total delay time due to stopping to pick up and discharge passengers and due to stopping at fixed interruptions, the bus model and the bus size. He recommended reducing the number of stops for pickup and discharge of passengers to a minimum value, increasing the number of buses to reduce the waiting number.

Various traffic surveys have been carried out on selected stretches of Kalupur region in Ahmedabad by [4]. In this study, it is proposed to measure the travel time delay and to ascertain the notable factors which result in these delays. License plate method and GPS in car method are used to collect travel time data during peak hours in the morning and evening, respectively. It is found that the travel time delay depends on traffic its composition, slow-moving vehicles, haphazard movement of vehicle without lane discipline, boarding alighting of passengers on the bus stops, and rickshaw stops.

Study was carried out by [5] regarding variation in travel time of Public Transportation- Case study of Micro bus route in Kathmandu. In this study, it is proposed to measure the travel time using GPS (Global Positioning System) which measures total travel time, average vehicle speed, total delay time. The study concluded that the variables that affect the travel time are: Fixed delay, operational delay, stops delay and moving speed. Variation in travel time was found not only by the delay causes but also due to moving speed of the vehicles in Ratnapark-Lagankhel, Ratnapark- Naryan Gopal Chowk and Ratnapark-Chabahil route.

Study was carried out by [6] regarding evaluation of effective factors on travel time in optimization of bus stops placement using genetic algorithm. From the placement of stops, travel time was calculated and then optimization process was used to determine the best placement of bus stops in order to minimize the total travel time. It was concluded that the greatest incense on determining the travel time of passengers in the bus system in city of Rasht belongs to alighting and boarding time along with bus capacity.

Study was carried out by [7] regarding traffic characteristics evaluation and traffic management measures: A case study of Dharwad City. It found out that the problem of delay, congestion and accidents can be decreased to some extent by controlling the traffic, imposing regulatory measures and enforcing proper management of road space so as to make the most economical use of the roads. Closing the busy roads for commercial vehicles will preserve the utility of the roads, improve the speed, safety and comfort of other road user.

III. METHODOLOGY

3.1 Data Collection

One person was used to record total travel time and another person was used to record total delay time. In case of private car, 2 volunteers were used. On the other hand, data like the travel time, the running time, delay time due to stopping at fixed interruption was collected in a private car case. Data were collected on different days of the week excluding public holidays and Saturday. Data were collected during peak hours, the morning peak hour from 9:30 AM to 10:30 AM, and the afternoon peak hour from 5:00 PM to 6:00 PM. Data was collected for two trip directions, from Talchowk to Prithvi Chowk and from Prithvi Chowk to Talchowk.In this route, travel time and delay time data were the primary data of the study. Primary data has been presented below.

3.2 Study Area

High number of vehicles travels through this route during peak hours and o peak hours which makes this route congested. Prithvi Prithvi chowk to Talchowk section of Prithvi Highway is one of the important and major roads of Pokhara. This road can have high influence on the travel time and delay time due to high number of vehicles traveling. It is one of the busiest roads of Pokhara. This route is connected with all important roads of Pokhara valley. Travel time and delay study can help to have real image of this road and can help to reduce the delay time in order to improve the vehicle operation.

The road length of this route is about 12.5 km. The route contains major market, educational institutions, and offices.

3.3 Sample Size

The sample size table for both public vehicles and a private car has been prepared in accordance of the permitted error in confidence level 95%.According to the average speed, number of trips for both public vehicles and private vehicle was found. In this study, sample run was determined in permitted error 1 mile per hour and confidence level 95% according to the nature of study. The sample size for public transit system is 32 trips and for a private car is 10 trips.

3.4 Data Analysis Method

During the data analysis, the model was designed to determine the relationship between dependence variables and independent variables. In this analysis process, the relationship between the total delay time and the various causes of the delay period are considered.

The SPSS software (Statistical Package for Social Sciences) was used to create Regression Models for this study[8]. SPSS is considered to be one of the most widely used programs by researchers in many fields such as engineering, science, arts, education, and psychology.

The method of least squares that leads to the best line of a postulated form to a set of data is used to form Regression Models between the dependent variable Y_i, and independent variables X_i.

A relationship between the dependent and the independent variables of the form

$$Y_i = ß_0 + ß_1X_1 + ß_2X_2 + \ldots + ß_n X_n$$

The selected dependent variables were de need as a Y variable and the selected independent variables was depended as X variables. For generation of model, relationship of each dependent variables with all dependent variables was found out by using the Regression method in SPSS and analysis was carried out to find out the significance of each regression model.

The different variables were labeled as follow:

Y_1= Travel time in minutes
Y_2= Running time in minutes
X_1= Number of stoppings for pickup and discharge of passengers X_2= Bus model: 1 for new models, 0 for old models
X_3= Bus size: 1 for small buses, 0 for big buses X_4= Total delay time in minutes
X_5= Delay time for pickup and discharge of passengers in minutes X_6= Delay time at fixed interruptions in minutes
X_7= Trip direction: 1 for Prithivi chowk to Talchowk, 0 for Talchowk to Prithivi chowk
X_8= Waiting time in minutes

IV. RESULTS AND DISCUSSION

4.1 Data Calculation

Sample calculations for trips by using the public transit system:
For trip number 1 as shown in table 1
1- Travel time = 34.76 minutes
2- Running time = travel time- total delay time = 34.76-3.11 = 31.65 minutes
3- Total delay time = 2.11+1 = 3.11 minutes

All calculations and results are shown in table 1. Also, sample calculations for trips by using the private car. For trip number 1 as shown in table 3
1- Travel time = 27.27 minutes
2- Running time = 27.27-1.2 = 26.07 minutes
All calculations and results are shown in table 3. Also, simple statistics for trips using the public transit system are shown in table 2. Sample calculations for some items are as follows:
1- Mean value for the travel time = 1236.52/32 = 38.64 min
2- Standard deviation for the travel time = 2.5986 min.

Also, simple statistics for trips by using the private car are shown in table 4.

4.2 Regression Model

All multiple regression models are as follows:
1) Model between travel time Y1 as dependent variable, and independent variables X1, X2, and X3:
Y_1 = 36.529 + 0.160X1 + 0.110X2 { 3.780X3

Table 1: Data Collected by Using Public Transit System

Trip Number	Y_1	Y_2	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8
1	34.76	31.65	10	1	1	3.11	2.11	1	1	6
2	37.45	34.05	15	1	0	3.4	2.35	1.05	1	7
3	40.44	36.83	17	0	1	3.61	2.25	1.36	1	5
4	33.65	30.6	10	0	0	3.05	2.2	0.85	1	8
5	37.81	34.51	15	1	1	3.3	2.22	1.08	1	10
6	38.66	35.02	19	0	1	3.64	2.54	1.1	1	6
7	40.26	36.64	28	1	1	3.62	2.42	1.2	1	13
8	35.89	32.57	18	0	0	3.32	2.02	1.3	1	11
9	36.65	33.47	14	1	1	3.18	2.22	0.96	1	5
10	37.44	34.2	17	0	1	3.24	2.39	0.85	1	10
11	41.26	37.75	11	1	0	3.51	2.85	0.66	1	5
12	40.86	37.77	16	0	0	3.09	2.24	0.85	1	6
13	39.57	36.2	17	1	1	3.37	2.28	1.09	1	7
14	40.46	37.1	14	1	0	3.36	2.48	0.88	1	6
15	38.62	35.36	20	0	0	3.26	2.63	0.63	1	9
16	32.66	29.17	22	0	1	3.49	2.86	0.63	1	6
17	37.33	34.42	14	1	0	2.91	2.22	0.69	0	8
18	40.09	35.04	26	0	0	5.05	3.85	1.2	0	18
19	38.53	35.29	13	1	1	3.24	2.33	0.91	0	5
20	37.54	33.84	14	1	1	3.7	2.68	1.02	0	6
21	40.04	36.66	18	0	1	3.38	2.42	0.96	0	8
22	42.76	38.86	16	0	0	3.9	2.89	1.01	0	6
23	40.62	37.75	20	1	0	2.87	2.02	0.85	0	14
24	36.76	33.68	14	0	0	3.08	2.39	0.69	0	5
25	41.45	37.8	18	1	1	3.65	2.35	1.3	0	9
26	42.56	38.92	18	0	1	3.64	2.66	0.98	0	10

27	40.45	37.2	14	1	0	3.25	2.05	1.2	0	9
28	42.86	39.51	18	0	0	3.35	2.44	0.91	0	8
29	34.54	31.22	19	1	1	3.32	2.44	0.88	0	7
30	37.43	34.76	18	1	1	2.67	2.02	0.65	0	10
31	39.71	36.5	16	0	0	3.21	2.36	0.85	0	10
32	37.41	33.55	14	1	0	3.86	2.36	1.5	0	8

Table 2: Descriptive Statistics for Trips by Using Public Transit System

	N	Minimum	Maximum	Sum	Mean	Std.Deviation
Y_1	32	32.66	42.86	1236.52	38.6413	2.5986
Y_2	32	29.17	39.51	1127.89	35.2466	2.5127
X_1	32	10	28	533	16.6563	3.9318
X_2	32	0	1	17	0.5313	0.5070
X_3	32	0	1	16	0.5000	0.5080
X_4	32	2.67	5.05	108.63	3.3947	0.4107
X_5	32	2.02	3.85	77.54	2.4231	0.3511
X_6	32	0.63	1.5	31.09	0.9716	0.2233
X_7	32	0	1	16	0.5000	0.5080
X_8	32	5	18	261	8.1563	2.9415
ValidN(listwise)	32					

Table 3: Data Collected by Using Private Car

TripNumber	TravelTime	RunningTime	DelayTime	Direction
1	27.27	26.07	1.2	1
2	28.98	28.09	0.89	1
3	28.87	27.57	1.3	1
4	27.41	26.53	0.88	1
5	28.47	27.27	1.2	1
6	28.74	26.87	1.87	0
7	29.85	27.55	2.3	0
8	29.74	28.2	1.54	0
9	27.14	25.94	1.2	0
10	28.31	26.95	1.36	0

Table 4: Descriptive Statistics for Trips by Using Private Car

Variable	N	Mean	Std.Dev	Sum	Minimum	Maximum
TravelTime	10	28.48	0.9642	284.78	27.14	29.85
RunningTime	10	27.10	0.7781	271.04	25.94	28.2
DelayTime	10	1.37	0.4354	13.74	0.88	2.3

2) Model between running time Y2 as dependent variable, and independent variables X1, X2, and X3:

Y_2=33.794+0.116X1+0.189X2–1.158X3

3)Model between total delay time X4 as dependent variable, and independent variablesX1,X2,andX3:

X_4=2.735+0.044X1–0.079X2–0.062X3

4)Model between travel time Y1 as dependent variable and independent variables X1,X2,X3,X4,X5,X6andX7:

Y_1=34.256+0.095X1–0.105X2–1.023X3+0.658X5+2.464X6–1.239X7

5) Model between running time Y2 as dependent variable and independent variables X1,X2,X3,X4,X5,X6andX7:

Y_2=34.256+0.095X1–0.105X2–1.023X3-0.342X5+1.464X6–1.239X7

6)Model between total delay time X4 as dependent variable and independent variables

X1,X2,X3,X4,X5,X6andX7:
X_4=-0.0035-0.0026X1–
0.0045X2+0.0025X3+1X5+1X6–0.0019X7

4.3 Results

1) The mean value of the travel time by using the bus = 38.64 min. While the mean value of the travel time by using the private car = 23.76 min. It is clear that there is a significant difference between the two travel times.
The difference = 38.64-28.48 = 10.16 min. Percentage difference = 10.16 / 28.48 = 36.67%
By adding the mean waiting time, which is 8.16 min, to the mean travel time by using the bus, the total time will be 38.64+ 8.16 = 46.80 min.
The new difference is 46.80- 28.48 = 18.32 min.
The new percentage difference = 18.32/28.48 = 64.33%
The new difference is significantly high.
2) The mean value of the running time by using the bus = 35.25 min. While the mean value of the travel time by using the private car = 27.10 min. The difference = 35.25-27.10 = 8.15 min. Percentage difference = 8.15 / 27.10 = 30.07%
It is clear that the difference between the two running times is great, but not as much as the difference between the two travel times.
By adding the mean waiting time, which is 8.16 min, to the mean running time by using the bus, the total time will be 35.25+ 8.16 = 43.41 min
The difference = 43.41-27.10 = 16.31 min. Percentage difference = 16.31 / 27.10 = 60.18%
By adding the mean waiting time for the bus to the mean travel time and the mean running time, the percentage difference is significantly high.
3) The difference between travel time by using the bus, and the travel time by using the private car can be reduced to a minimum value if the travel time by using the bus is reduced to a minimum value. This can be done by the following:
a. Reducing the number of stops for pick up and discharge of passengers to a minimum value.
b. Using new models of buses.
c. Using smaller buses
d. Increasing the number of vehicles to reduce the waiting time.
4) The travel speed of the bus and the private car can be calculated as follows:
Average travel speed = Distance / Average travel time.
Average travel speed = 12.5 km / 38.64 min = 19.41 km/h,
For the private car. Average travel speed = 12.5 km / 28.48 min = 26.33 km/h
It is clear that there is a significant difference between the two travel speeds and that is due to the difference in travel time. Also, the average running speed can be calculated as follows:
Average Running Speed = Distance / Average running time.
For the bus: Average Running Speed = 12.5 km / 35.25 min 21.28 km/h and for the private car: Average Running Speed = 12.5 km/ 27.10 min = 27.68 km/h
The difference in average travel speed and average running speed between using the bus and the private car can be reduced to a minimum value by the following
a- Reducing the number of stops for pick up and discharge of passengers to
a minimum value.
b- Using new models of buses.
c- Using small buses.
d- Increasing the number of buses to reduce the waiting time.
5) From the correlation matrix, the following results are obtained:
a- Travel time is most highly correlated with the total delay time X_4, and then with the Delay time atfixed interruptions in minutes X_6.
b- Running time Y_2 is more highly correlated with the number of stoppings for pickup and discharge of passengers X_1
c- Total delay time X_4 is most highly correlated with delay time due to stopping for pick up and discharge of passengers X5, then with delay time at fixed interruptions

V. CONCLUSION AND RECOMMENDATIONS

The study was carried out in Prithvichowk to Talchowk of Prithvi Highway in order to carry out travel time and delay time of public transit system and a private car. There was high difference in travel time between two systems due to high total delay time in public transit system. The study attempted to reduce the delay time of public transit system. It was found out that the travel time of public transit system is 38.64 minutes whereas the travel time of private car is 28.48 minutes.It was found out that high number of stopping for pick up and discharge of passengers, bus size and bus model were highly related with the delay time.

Study was carried to found out the difference in travel time and delay study between public transportation and private transportation is high due to de-lay time. The delay time was highly affected by high number of stopping for pick up and discharge of passengers, bus size and bus model. Decreasing the number of stopping for pick up and discharge of passengers, use of smaller buses and new model of bus can help to reduce the delay time and increase the average speed of public transit system.

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