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Why Many People Wish To Use Public Transport System: A Case Study in Tripoli-Libya

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Abstract

In many cities today, owning a car has become an important and dominant mode of transport. Increasing dominance of own cars as a mode of transport is due to its inherent advantages associated with its usage. In Tripoli, Libya due to rapid increase in car usage associated with poor public transport system has resulted in an increase of traffic congestion, accidents and lack of parking spaces. This study aims to identify the factors preventing owning cars from shifting to public transport system (PT). And to develop model shift from owning cars to public transport in order to formulate policies to achieve this. A policy to enhance public transport system usage and control car ownership simultaneously has become necessary for solving traffic congestion problems. A questionnaire survey was carried out on users of transport in Tripoli such as own car, taxis, microbuses and coaches drivers (n = 900). The probability of car drivers shifting to public transport was examined based on scenario of several options such as reduction in public transport travel time and travel cost. Reduction in total travel time and cost for public transport mode emerged as the most important elements in attracting car users towards using public transport system. Logistic regression technique has been used to analyze the factors that impact users to switch their trips to public transportation alternatives. Statistical Package for Social Science (SPSS) version 19 and Excel 2007 software were used to analyze the questionnaire in this study.

Key words: public transport, car ownership, logistic regression, mode choice and traffic congestion.

Introduction

Tripoli is the largest Libyan city and port, and it is the country's capital. It is the meeting place for the People's Congress representing the government; it is also known in Arabic as Tarabalus Al-Gharb, or Tripoli of the West. The population of Tripoli is about 1,682,000 people with area of 400 square kilometers and population density 2207.32 people / sq km [8]. Figure 1 Shows the location of Tripoli where the survey was carried out.

Fig. 1 Tripoli location and study area

Source: Google Earth 2009

The survey was carried in Tripoli due to the high number of car ownership and poor public transport system services together with high traffic congestion at the selected area. This paper is a part of the study that

focused on model shift initiatives. These initiatives focused on shifting own car users to safer modes of public transport in order to increase road safety and enhance road environment. Many cities have attempted to restrict the use of own cars in favour of public transport, such as policies exist in Egypt [11], Dubai [4], Saudi Arabia [2], Lebanon [7], England [5], Romania [9], Malaysia [1], Asian countries [6], Dublin [13] and France [5]. The attempts have been by changing the public perception to it.

Own car is one of the important modes of personal transport in Libyan cities, mainly because it is cheap and more reliable than the current transport modes available namely taxi, coaches and microbuses. Every Libyan adult person almost owns one or more cars. They can travel from place to place in safe way. Also, it is provided with comfortable mechanisms such as a cover to protect him from the heat and rain. The other transport type available in Libya is Taxi. Taxi is a very reasonable and easily available mode of transport. . Statistics of the secretariat of the Libyan justice in seventies to end of 2009 illustrated that 80% of Tripoli residents used their own cars to go to work, study, shopping and else. The number of vehicles in Libya was steadily increased in 1970s and early 1980s. By 1985 there were 313,000 automobiles and trucks in the country, as well as about 70,000 different types of buses. At the end of 2008 , vehicles has increased approximately to 2,052,679 vehicles [12].

Study Problem

Understanding travel time, cost and the reasons for choosing one transport mode over another is an essential issue. However, travel time is more complex. For each trip, commuters have the choice between different modes of transportation. Each mode has specific characteristics, such as advantages and disadvantages associated with travel time and travel cost. Commuters in Tripoli used public transport namely microbuses, private taxies and coaches and own cars to their works, study and shopping activities. Public transport can be owned and operated by individuals or

private companies. The uncontrolled usage of these transport modes has caused traffic congestion problems which has increased travel time, road accidents and air pollution to the city environment [3]. Nevertheless, own cars users have become more popular and dominant than other modes of transport in Tripoli city due to their availability, flexibility and convenient for travel when required. Own cars also represent high status, comfort and safety. Due to the complex scenarios happening here , a study has been carried out to understand the traffic congestion and try to establish suitable models system to reasonably described travellers attitude and perception in Tripoli city. Figure 2 shows framework factors that has caused traffic congestion in Tripoli city.

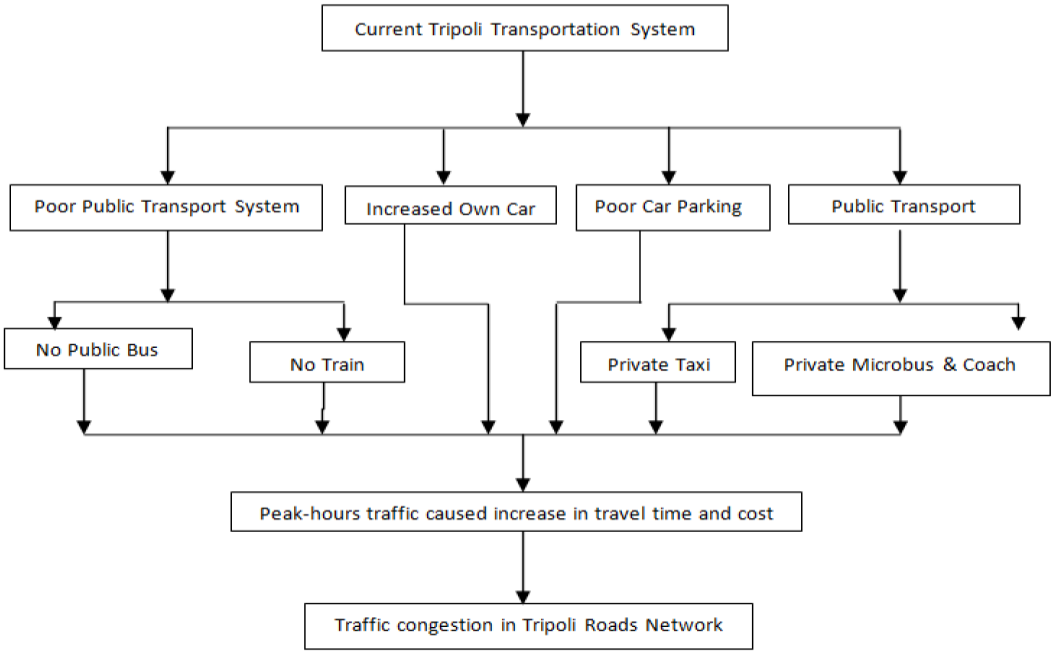

Figure 2 Tripoli traffic congestion factors framework

Methodology

Primary data are generated by researcher who is responsible for the design of the study and the collection, analysis and reporting of the data. These data are used to answer specific research questions [10]. The data collection was done through a field study i.e. observation and survey. The survey was done using questionnaires to get relevant data. The respondents for this survey are the own car users at study areas who use his / her own car to make his / her trips to work, study and shopping. The questionnaires were distributed to the private vehicle users who do not use other modes of transportation. The respondents were selected randomly. Brief questionnaires were formed to ensure user's comprehension and they are in the form of open and close ended questions. The questionnaires were printed by two languages, Arabic and English language, to provide easier understanding and answering for some respondents. There are three sections in this survey. Section A is about respondent's personal information that will help the researcher to get the respondent's basic information for this research. Section B is a section that requires respondents to fill in information about their trip characteristics and purpose such as work, study and shopping trips. Section C is a section that requires respondents to highlight their preference in mode switching in the study area. This questionnaire has 51 questions which covered question three sections as explained above, frequency using a private vehicle for work, study and shopping purposes, problems when using private vehicles and travel time and cost. These questions were formed based on the research questions and the hypothesis. This survey had been conducted in areas under Tripoli authority which do not have public transportation system services, inadequate public transport services and shortage in parking facilities. In total, there are four zones which do not have public transportation services. This survey was done on work days (Saturday through Thursday)

A total of 900 questionnaires were collected in 5 months from (25 July to 23 December 2015).There are several questions that correspond with respondents' views, recommendation and opinions. These questions provide the opportunity for the respondents to give their opinion. The questions are formulated in such a way that could help the respondent answer the questionnaire easily and quickly. Respondents were selected randomly from residential areas which does not have public transportation system services. The selected respondents are based on public transportation vehicles and own car users who use their vehicles as their mode of transportation to go to their trips. The following section will elaborate how this selection is made. Statistical Package for Social Science (SPSS) and Excel software were used for analysis the questionnaire and logistic regression method was used in this study.

Results

Alternative Mode of Transport for Car Users

The study made an attempt to determine whether car users had access to other modes of transport. Results from the study indicated that about 88% of car users had an access to the public transport mode, while 12 % had no access to alternative modes. The question was written as to explain if the government provides a good level of service by establishing separate lanes of public buses and providing car parking areas in main public bus stations, where these services will encourage the respondents' shift into PT as can be seen in Figure 3. Figure 3 shows that 88% of respondents liked to use PT if the government improved and initiated good PT services, also providing the bus lane and car park facilities and suitable parking cost per hour and just 12% disliked using PT and preferred to use private car.

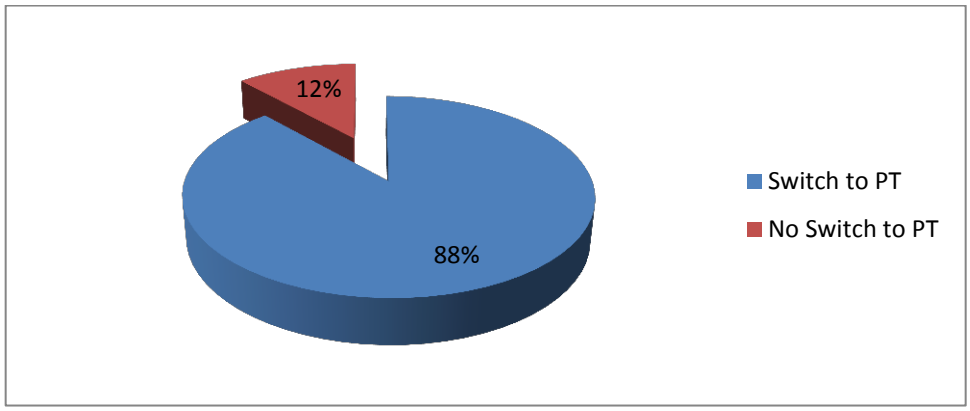

Figure 3 Improvement of the PT services can encourage people to shift

Factors Contributing to Car Popularity

The study describes specific questions in order to explain factors that contributed to car use as opposed to bus and train use. The key factors addressed were: 1) Available, 2) Reliable, 3) Comfortable, `4) Satisfactory, 5) No expensive, 6) Safe and 7) Prestige. Table 1 shows that private cars are more desired over all other available modes in Tripoli. The 39.5% or 296 respondents said the car was always available, 14.7% or 110 respondents pointed out that it was reliable, 23.2% or 174 respondents said that it was comfortable, 5.3% or 40 respondents stated that it was satisfactory, 4.4% or 33 respondents mentioned that it was not expensive, 12.9% or 97 respondents mentioned that it was safe and 0% had seen having the car as prestigious.

Table 1 Reasons support to use your own car

No	Statement	Percent
1	It is available	39.5
2	It is reliable	14.7
3	It is comfortable	23.2
4	It is satisfactory	5.3
5	It is no expensive	4.4
6	It is safe	12.9
7	It is prestige	0

Reasons Convince to Switch from Using Own Car to Public Transport

Considering the reasons to a modeshift from car travel to public transport, it is necessary to understand the factors which support the great majority of active car users t use public transport (bus and train) as a regular means of transport. Table 2 presents the major reasons identified when survey respondents were asked to name or select from a given list, the factors which would influence their decision to use public transport. Table 2 shows the factor of most significance encouraging car users to use the public transport was that the "High traffic congestion and delay". This statement received an average rating of 1) 30.3 % if the PT service is available, 2) 6.3 % if the PT fare is cheap, 3) 20.1 % if the PT service is fast, 4) 29.7 % if the PT covered all desirable routes, and 5) 13.6 % if the PT vehicles are clean and comfortable.

Table 2 Reasons can convince to switch from using own cars to public transport

No	Statement	Percent
1	If the service is available	30.3
2	If the fare is cheap	6.3
3	If the service is fast	20.1
4	If the desirable routes are covered by public transport	29.7
5	If the vehicles are clean and comfortable	13.6

Deterrents to Mode Shift from Car to Public Transport

Considering the deterrents to a modeshift from car travel to public transport, it is necessary to understand the factors which deter the great majority of active car users from using public transport (bus and train) as a regular means of transport. Table 3 presented the major deterrents identified when survey respondents were asked to name or select from a given list, the factors which would influence their decision not to use Public transport(PT). Table 3 shows the factor of most significance discouraging car users from using the public transport was that the 1) 31.2 % PT do not covered all desirable routs, 2) 26.4 % PT vehicles are too crowded, 3) 21.7 % in frequented PT, 4) 10.9 % PT unreliable services, and 5) 9.7 % PT uncomfortable.

Table 3 Factors can discourage you from riding public transport instead of your car

No	Statement	Percent
1	Vehicles are too crowded	26.4
2	Unreliable services	10.9
3	Uncomfortable	9.7
4	In frequented public transport	21.7
5	Desirable routes not covered by public transport	31.2

Improving Travel Time for Public Transport

The main factors affect decision making in choosing travel mode from, in and to Tripoli city are travel time and travel cost. Travel time is considered an important reason for mode choice. Using public transport services is perceived as a waste of time by almost all own car users. The data were represented in the form of cumulative format in the third column in Table 4. The main factors affecting travel mode from/to Tripoli city are travel time and travel cost which had been supported by the findings in this study. Given its significant impact, travel time is a salient consideration criterion in travel mode shift. The mode shift probabilities were categorized by various categories (percentages) of travel time reduction, simplified in Figure 4. According to Table 4 and Figure 4 the mode shift probabilities ranged from 92.8% probability of private car use with public transport reduction travel time by 10% to 1% probability of own car use with a travel

time reduction of 90%. At the same reduction time level (10%), the probabilities of public transport user increased from 7.2% to 99% of probability when the reduction level of travel time per trip reached 90%. A 50:50 split (or own car to public transport ratio 1:1) may be achieved if travel time of public transport was to reduce approximately 50% per trip. For instance, if 70% of respondents were to use public transports, the travelling time has to be reduced by approximately 85%.

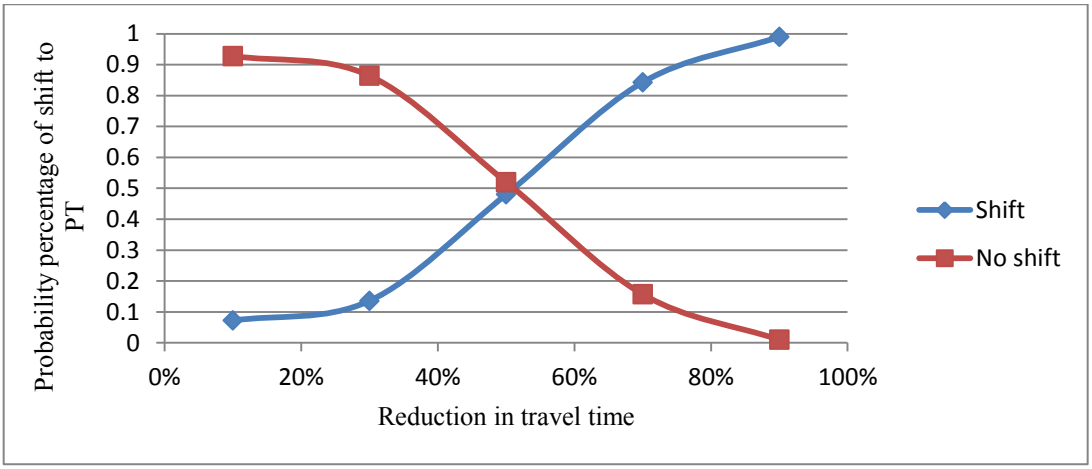

Figure 4 Shifting to public transport if the travel time improved

The study further reveals that the main factor influencing decision making in choosing travel mode in Tripoli city is the reduction of travel time. Table 4 shows reduction Of travel time to work and study by public transport with respect to survey results and probability of prediction (P) values. The P value is derived from Equation 1 which involve constant (D) and coefficient (α) values to verify the logistic prediction model used in this study.

$$P = \frac{1}{1 + De^{\alpha(x)}} \qquad (1)$$

Where P = Probability prediction of shift to PT

D = constant

α = coefficient of x

x = level of travel time reduction

e = the base of natural logarithms (approximately 2.718)

Table 4 Survey results and data calibration

Category	Reduction Travel Time	Cumulative survey result (P)	1-P	1-P/P	Ln (1-P/P)
1	10%	0.072	0.928	12.88889	2.556366
2	30%	0.136	0.864	6.352941	1.848918
3	50%	0.48	0.52	1.083333	0.080043
4	70%	0.843	0.157	0.18624	-1.68072
5	90%	0.99	0.01	0.010101	-4.59512

Simple linear regression analysis was then conducted by using Microsoft Excel to obtain the intercept constant and the α value. The results in Table 4 above reflect the process of calibration which then introduced into Excel to estimate the alpha (α) and intercept values in ANOVA which is described on Table 5. Based on the ANOVA table, some important factors reflect the study significance which is the values of R^2, intercept

coefficient and the important factor was alpha value which is used in the equation 1 above to verify the used model. p values of 0.00395 as well as 0.00643 showed that the coefficient (-1.7833) and intercept (4.99168) were significant at 0.05 significance level. With R^2 value of 0.956148 shows that the variable, namely travel time reduction was able to explain 95.61% of variation in the dependent variable, Ln (1-p/p). The probability function for transport shift is written in Equation 2.

Table 5 The ANOVA table result

	Intercept	X Variable 1
Coefficients	4.99168	-1.7833
Standard Error	0.73128	0.22049
t Stat	6.82593	-8.0877
P-value	0.00643	0.00395
Lower 95%	2.66441	-2.485
Upper 95%	7.31895	-1.0816
Lower 95.0%	2.66441	-2.485
Upper 95.0%	7.31895	-1.0816

LN D = 4.99168, α = -1.7833

D = 147.1835

R^2 = 0.956148

Where R^2 approaches one value that indicates the model's strong correlation power. Thus, the result of the prediction models can be shown in Table 6 and Figure 5

$$\mathbf{P = 1/(1 + 147.1835e^{-1.7833(x)})} \qquad \mathbf{(2)}$$

Table 6 shows the respective survey results and model prediction results pertinent to the travel time reduction. Respective results can be substituted into the calibrated logit model to validate its functionality. For instance, at 50% level of reduction travel time, the predicted cumulative p = 0.588581, which has maximum 10.9% (0.588581-0.48) probability different from the data collected from the survey. Furthermore, Figure 5 shows the plots for both survey and prediction results. From the graph, the steep slope was discovered from 30% to 70% travel time reduction, indicates that high probability of shifting into public transport occurred at time reduction level range 50%-70%. Based on prediction model, the probability to shift at 50% is 0.39 (0.588581-0.19354) while probability to shift at 70% is 0.31 (0.894859-0.588581). These findings have implied that the majority of commuter users desired the travel time to be reduced by 50% to 70% if they were to take public transport.

Table 6 Survey results and logit model results

Category	Travel time reduction	Survey result (P)Cumulative	Result from logit model (P)
1	10%	0.072	0.03885
2	30%	0.136	0.193854
3	50%	0.48	0.588581
4	70%	0.843	0.894859
5	90%	0.99	0.980633

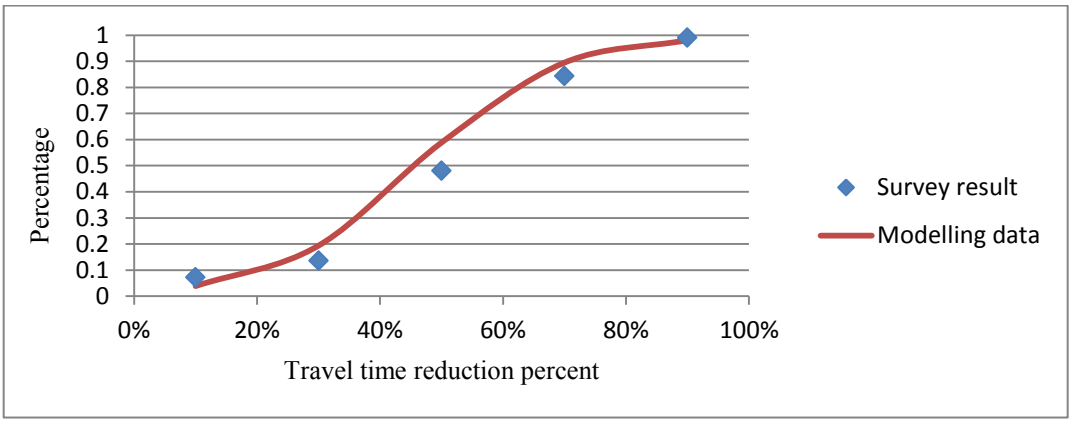

Figure 5 Improving travel time category for public transport shift

Figure 5 shows the high correlation between survey results and Logit model, where both of the survey results and the modelled ones were increased with the reduction of travel time.

Improving Travel Cost for Public Transport

The data are represented in the form of cumulative format in the third column in Table 7 Improving the travel cost for public transport by reducing it may motivate the public transport use. The model shift probabilities were categorized by various categories of travel cost reduction (%) as shown in Figure 6. Mode shift probabilities ranged from 91.7% probability of own car use with public transport reduction travel cost (10%) to 1% probability of own car use with a reduction of travel cost 90%. In other words, public transport users' probability increased from 0.083 with 10% public transport travel cost reduction to 0.99 of probability when 90% reduction in travel cost per trip applied. A 1:1 split may be achieved when travel cost reduction succeeded around 45% per trip by public transport (intersection between two lines).

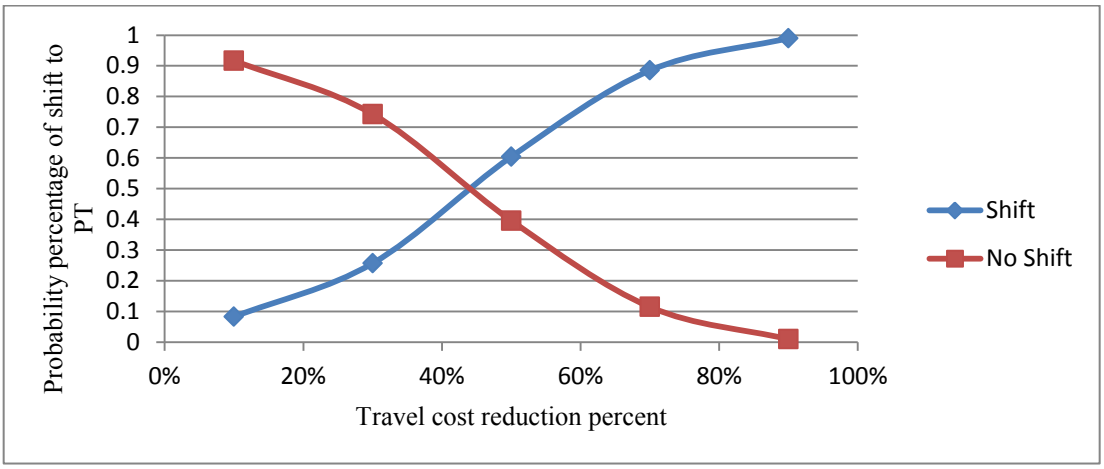

Figure 6 Shifting to public transport if reduction in travel cost

The results as shown in Table 7 below indicate some important statistics which reflect the model significance, such as R^2, T-test, intercept, and coefficient (alpha value). The intercept as well as alpha values were involved in the equation below to verify the used model see Equation 3.

$$P = \frac{1}{1 + De^{\alpha(x)}} \qquad (3)$$

Where, P = probability prediction of shift to PT

D = constant

α = coefficient of x

x = level of travel cost reduction

e = the base of natural logarithms (approximately 2.718)

Table 7 Survey results and data calibration

Category	Reduce travel Cost	Survey result (P)Cumulative	1-P	1-P/P	Ln (1-P/P)
1	10%	0.083	0.917	11.04819	2.402267
2	30%	0.257	0.743	2.891051	1.06162
3	50%	0.604	0.396	0.655629	-0.42216
4	70%	0.885	0.115	0.129944	-2.04066
5	90%	0.99	0.01	0.010101	-4.59512

Simple linear regression analysis was then conducted by using Microsoft Excel to obtain the intercept constant and the α value. The results in the above Table 7 reflect the process of calibration which then introduced into Excel to estimate the alpha (α) and intercept values in ANOVA which is described in Table8. Based on the ANOVA table, some important factors that reflect the study significance are the values of R square, intercept coefficient and the important factor was alpha value which is used in the equation 3 above to verify the used model. p values of 0.00105 as well as 0.00219 showed that the coefficient (-1.7097) and intercept (4.4103) were significant at 0.05 significance level. With R^2 value of 0.981822 showed that the variable, namely travel cost reduction was able to explain 98.18% of the variation in the dependent variable, Ln (1-p/p). The probability function for transport shift is written in Equation 4.

Table 8 The ANOVA table result

	Intercept	X Variable 1
Coefficients	4.410305	-1.7097
Standard Error	0.44547	0.13431
t Stat	9.90044	-12.7293
P-value	0.00219	0.00105
Lower 95%	2.99264	-2.13715
Upper 95%	5.82797	-1.2823
Lower 95.0%	2.99264	-2.13715
Upper 95.0%	5.82797	-1.2823

Thus

LN D = 4.410305

α = -1.7097

D = 82.29456

R^2 = 0.981822

Where R^2 approaches one value indicating the model's strong correlation power

Thus, the result of the prediction models can be shown in Table 9 and Figure 7

$$P = 1/(1 + 82.29456e^{-1.7097(x)}) \quad (4)$$

Table 9 shows the survey result together with model estimated data pertinent to the traveling cost reduction (%). The largest prediction gap was detected at 50% of travel cost reduction. Cumulative p value of 0.672345, which had maximum 6.8% scores was different from the survey data. Figure 7shows the graph plotted with the proportion (probability) of shift versus travel cost reduction (public transport) for both the survey and model. Based on the graph, it is noted that dramatic increment occurred at 30% to 50% travel cost reduction (model estimated) which suggests that the majority of users will most likely shift to public transport at 50% of cost reduction with probability of 60%.

Table 9 Survey results and logit model results

Category	Improving Travel cost	Cumulative Survey result (P)	result from logit model
1	10%	0.083	0.062938
2	30%	0.257	0.270735
3	50%	0.604	0.672345
4	70%	0.885	0.918976
5	90%	0.99	0.984299

The high correlation between survey results and logit model is clarified in Figure 7 where both of the survey results and the modelled one was increased with the reduction of travel cost.

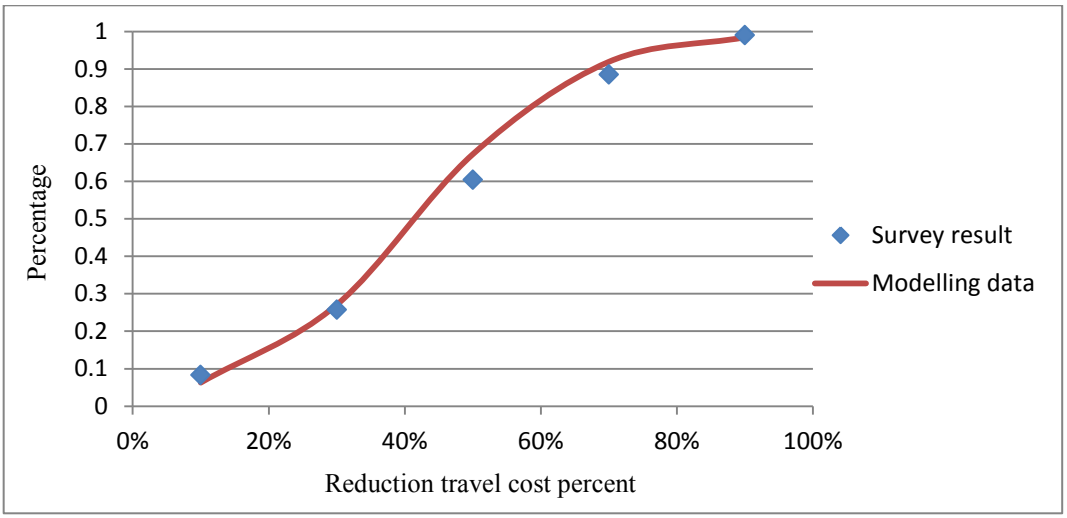

Figure 7 Improving travel cost for public transport

Own Car and Public Transport Mode in Present Time

Majority of Tripoli residents are suffering from the daily congestion in most city streets especially at peak period of working days (Saturday through Thursday). Table 10 shows in Tripoli 494 out of 600 respodents or 82.3 % of the respondents prefer to use public transport to avoid traffic congestion.

Table 10 Would like to use public transport or prefer your own car (n 600)

Statement	Frequency	Percent
Yes, use public transport	494	82.3
No, prefer use own car	106	17.7

Buses is the Best Public Transport Mode use in Tripoli

Table 11 illustrates 33.3% of the respondents prefer to use buses in city streets while, 28% like to use light rail transit, 24.5% for train and low percent about 14.2% prefer to use public taxi.

Table 11 The best public transport mode use in Tripoli (n 600)

Statement	Frequency	Percent
Buses	200	33.3
Light Rail Transit	168	28.0
Under Ground Train	147	24.5
Public Taxi	85	14.2

Discussion

Traffic congestion is not a new problem for the central city; it has spread to cover suburban areas. The study in Tripoli city has revealed that own car and public transport vehicles are becoming popular among urban

travellers which has caused acute traffic congestions and spread out widely, especially along the roads to Tripoli city centre. This study has revealed that positive and negative operations are needed to encourage commuters to shift from own car and private transport to public transport. The positive operation would be to reduce travel time, cost and improve service (more frequent and more on-time trips), and the negative operation such as to increase the parking fees and reduce the parking spaces. The collected data were obtained from our survey which was subjected to the logit model prior to the calibration process. D and α value were extracted to be used in our model equation. Then the validation process took place to fit our results into the model. From the ANOVA results, the value of R square was within the normal range. Based on the given results, our model was approximately significant with the P value of < 0.05. Results of the study have shown that more time will be used to travel by own car and private transport for all trips. These scenarios have encouraged the commuters to shift to the public transport (PT) system.

Conclusion

Transportation sector is an important thing in human daily life to make their daily trips easier. But, the total of private vehicle on road was increased and cause many problems such as traffic congestion, air pollution and else [8]. Private vehicle users in Tripoli are suffering from transportation travel time, congestion and lack parking if compared to public transportation users in some big cities such as Cairo, Dubai, London, Paris and else. Increasing of travel time causes several problems to all vehicles users like increasing daily traffic congestion. Changing to public transport system alternatives namely buses, train and LRT could reduce the traffic congestion. A study has been done at Tripoli areas among private vehicle namely own car, taxi, coaches and microbuses users, who live at areas with acute poor public transportation system services in the city. Logistic Regression Model has been used to analyze the factor that will be

influencing users to switch their travel behaviour to public transport system alternatives. Poor public transportation system services especially public buses at certain places in Tripoli city is the reason why travellers prefer to use own cars. In fact, there are several areas that do not have public transportation services in Tripoli. This situation forces residents in these areas to use own car vehicles to make their daily trips. If public transportation services provide good and adequate, the trip maker might shift their trip behaviour from travelling by own cars to public transportation systems. This will save their expenditure on transportation and reduce traffic congestion. The improvement and enhancement of travel time and cost will encourage switching to use public transport mode in providing the best services and suitable travel facilities. The current mode split is 80% use private car and 20% who use the public transport namely taxi, coaches and microbuses. If improving the public transport travel time by 70% ,this will encourage the 81.2%. And by 70% improve of travel cost, will encourage the 86.2%, to switch from using own cars to use public transport system services. The need of realignment the Public Transport system namely Buses, Light Rail Transit and Underground train is very important to releaf the traffic congestion problems in Tripoli roads network and streets.

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