Travel Time and Cost are Represents the Main Factors for Shifting Travel Mode Policy in Gharian Streets

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الملخص:

وسائل النقل مهمة جدا للمسافرين بمدينة غريان لأداء أنشطتهم ورحلاتهم اليومية. ومن جهة ثانية فإن زيادة العدد الإجمالي للسيارات الخاصة ومركبات النقل الخاص أي (سيارات الأجرة والحافلات الصغيرة) على الطرق يزداد ويسبب العديد من المشاكل اليومية على الطرق مثل الازدحام والحوادث المرورية والتلوث الضوضائي. والهدف من هذا البحث هو دراسة أهم عاملين لتحول للنقل العام، تم إجراء مسح استقصائي في مدينة غريان لدراسة الانخفاض المحتمل للسيارات الخاصة ووسائل النقل الخاص على الطرق من خلال الاستخدام الأمثل لنظام النقل العام المناسب (**PT**) من أجل الحد من مشاكل الازدحام المروري مثل التأخير في وقت السفر. وقد أجريت تحليلات حول العلاقة بين عدد من العوامل مثل وقت السفر وتكلفة السفر للإجابة على أسئلة البحث. و تم استخدام نموذج الانحدار اللوجستي لتحليل العوامل التي تؤثر على المستخدمين لتحويل رحلاتهم إلى بدائل النقل العام.

الكلمات الرئيسية: وقت السفر، تكلفة السفر، السيارات الخاصة، النقل العام(**PT**) ، الازدحام المروري والانحدار اللوجستي.

ABSTRACT :

Transport modes are very important to Libyan's Gharian travellers for their activities and daily trips. However, the increase of total number of private car and private transport namely (taxi and micro buses) on the road increases and causes many road problems such as traffic congestion, accidents and noise pollution. The aim of this research is to study the two important factors to shifting to public transportation. Analyses about relation between factors as travel time and cost have been made to answer research questions. A questionnaire survey in Gharian city was carried out to study the potential reduction of private cars on road through optimal use of suitable public transportation system (PT) in order to reduce traffic congestion problems such as travel time. Logistic regression model has been used

to analyse the factors that influence users to shift their trips to public transportation alternatives.

Key words: travel time, travel cost, private car, public transport (PT), traffic congestion and Logistic regression.

INTRODUCTION :

Private cars are important for most household activities in Libyan societies. They give comfort and convenience to the users to go to different destinations without affecting other users [4]. Private car is one of the important modes of personal transport in Libya cities, mainly because it is cheap and more reliable than the existing transport modes available namely (taxi and micro buses) [5]. Private car use has obvious negative effects, such as the traffic congestion, accidents and noise pollution. The shortage of private and public transportation services especially public buses in Gharian may be the reason why travellers prefer to use private cars [9]. In fact, in Gharian city there are many areas that do not have private transportation and acute shortage public transportation services. This situation encourages travellers in these areas to use private cars to make their daily trips. Increase in parking cost may cause private car users to think many times about their travelling behavior and travelling choices [1]. Finally, the shift will save their expenditure on transportation and may also reduce travel time and traffic congestion.

STUDY PROBLEM :

The private Car is easily available vehicle in Libya [2]. Each Libyan household has owned one or more cars and they can travel by their private cars in a few minutes from place to another and most the people prefer the car because they can travel freely. Understanding travel behavior and the reasons for choosing one transport mode over another is an essential issue. However, travel behavior is more complex. For each trip, commuters have the choice between different modes of transportation. Each mode is having specific characteristics, such as advantages and disadvantages depended on travel time and parking cost [5]. Travellers in Gharian used private transport namely (microbuses, private taxies and coaches) and private cars to their works or study activities. Private transport can be owned and operated by individuals or company. The uncontrolled usage of these transport modes has caused road traffic congestion which has increased travel time, accident and pollution to the city environment [3]. Due to the complex scenarios happening

in Gharian city a study has been carried out to understand the travel behavior and try to establish suitable models to reasonably describe travellers' attitude and perception in the city.

DATA COLLECTION AND ANALYSIS :

The understanding of travel behavior should be done through data collection [6]. The data collection was done through field study i.e. survey. The survey was done using questionnaires to get relevant data. The respondents for this survey are the private vehicles' users at study areas who use their private car and private transport as (taxi, microbuses) to make their different trips. The respondents were selected randomly [8]. The questionnaires were printed by Arabic language, to provide easier understanding and answering for some respondents. Respondents were selected randomly from travellers in study areas which does not have public transportation services. This survey was done on work days (Sunday to Thursday). The total number of respondents who was involved in this research was 170 respondents [8]. Excel software was used to analyse the questionnaire and also logistic regression method was used in this study.

DATA ANALYSIS OF TRAVEL TIME AND TRAVEL COST IN GHARIAN STREETS BY PRIVATE CAR AND PRIVATE TRANSPORT:

This section describes survey results and the analysis of the data collected about the travellers of private car users used. Data was analysed by logistic regression models for probability prediction travelling behaviour in Gharian city streets, model for the private car for all types of trips, to determine the relationship between the two factors that influence the shift to public transport. The probability of private car drivers shifting to public transport is also examined based on travel cost, travel time.

Effect of Travel Cost on Travel Mode :

Figure (1) as shows that 57% of the respondents paid less than 5 Libyan dinar (LyD) cost per trip, 28.9% paid about 6 to 10 LyD, 5.9% paid about 11 to 15 LyD, 8.1% paid more than 15 LyD.

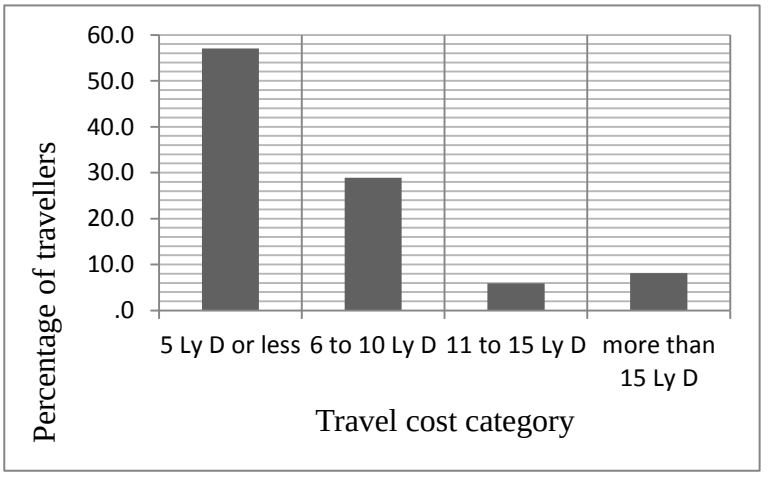

Figure (1): Travel Cost for Trips

The data of travel cost collected for this factor are shown in figure (1). The data are represented in the form of cumulative format in third column in Table (1), which shows the Travel cost category with respect to survey results and the probability of prediction (P) values. P value is derived from Equation (1) which involves constant and alpha (α) values to verify the logistic prediction model used in this study. This function has a continuous derivative, which allows it to be used in back propagation, according to Patterson [7]. The following functional form is used in this study to determine the shift probability of dependent variables.

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

Where,
P = prediction probability of shift to Public transportation (PT)
D = constant
α = coefficient of x
x = Category of travel cost
e = the base of natural logarithms (approximately 2.718)

Table (1) Survey result and data calibration for travel cost category

Category	Travel cost	Cumulative (P) Survey result	1-P	P/1-P	ln(P/1-P)
1	5 LyD or less	0.57	0.43	1.325581	0.281851
2	6 to 10 LyD	0.859	0.141	6.092199	1.807009
3	11 to 15 LyD	0.919	0.081	11.34568	2.428837

4	More than 15LyD	0.99	0.01	99	4.59512

The model shift probabilities were categorized by various categories of travel cost as shown in Figure (2). Mode shift probabilities ranged from 43% probability of private car use with travel cost (5 LyD or less) to 1% probability of private car use with travel cost (more than 15 LyD). In other words, public transport users probability increased from 57% with travel cost (5 LyD or less) to 99% of probability when travel cost (more than 15 LyD).

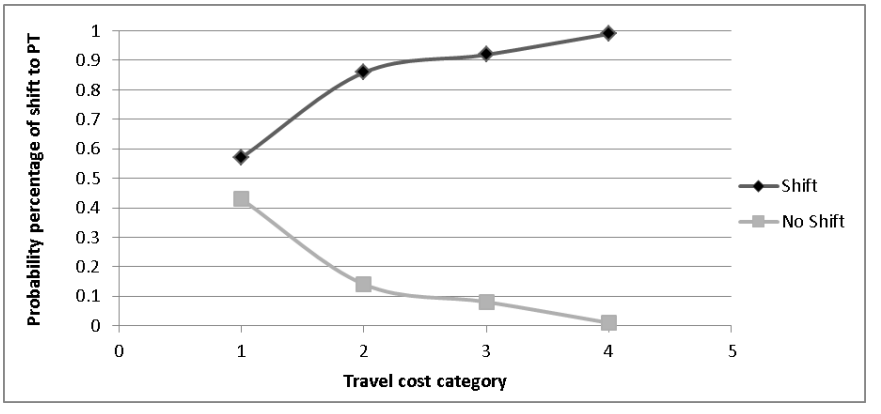

Figure (2): Shifting percent - Travel cost category

A simple linear regression analysis was then conducted by using Microsoft Excel to obtain the intercept constant (D) and the α value. The results of the above Table (1) reflect the model calibration process which then introduced to excel to get the ANOVA table, which is described in Table (2), used to develop the Analysis of Variance (ANOVA) table which some important factors reflect the study significance that the values of R square, intercept coefficient and the important factor was alpha value which is used in the equation (1) above to verify the used model. By using the alpha (α) and (D) values from the ANOVA table, our model achieved the value of P equal to 0.021184 which is somehow acceptable to be significant (significant value is <0.05) as shown in Equation (2).

Table (2): The ANOVA table for travel cost category

	Intercept	X Variable 1
Coefficients	-1.1122	1.356163
Standard Error	0.549324	0.200585
t Stat	-2.02468	6.761046
P-value	0.180186	0.021184
Lower 95%	-3.47576	0.493116
Upper 95%	1.251347	2.21921
Lower 95.0%	-3.47576	0.493116
Upper 95.0%	1.251347	2.21921

Ln D = -1.1122 D = 3.041054

$\alpha = 1.356163$

$R^2 = 0.9581$

Where R^2 approaches one value indicating the model's strong correlation power thus, the result of the prediction models can be as shown in Table (3) and Figure (3)

$$P = \frac{1}{1+3.041054e^{1.356163(x)}} \qquad \text{Equ. (2)}$$

Table (3) shows the respective survey data and model data that correspond to the travel cost.

Table (3): Survey result and logit model result for travel cost category

Category	Travel cost	Cumulative (P) Survey result	Modelling result
1	5 LyD or less	0.57	0.561
2	6 to 10 LyD	0.859	0.832
3	11 to 15 LyD	0.919	0.951
4	More than 15LyD	0.99	0.9868

This result is more identified in Figure (3) which shows a high correlation between survey results and the modelled counterparts

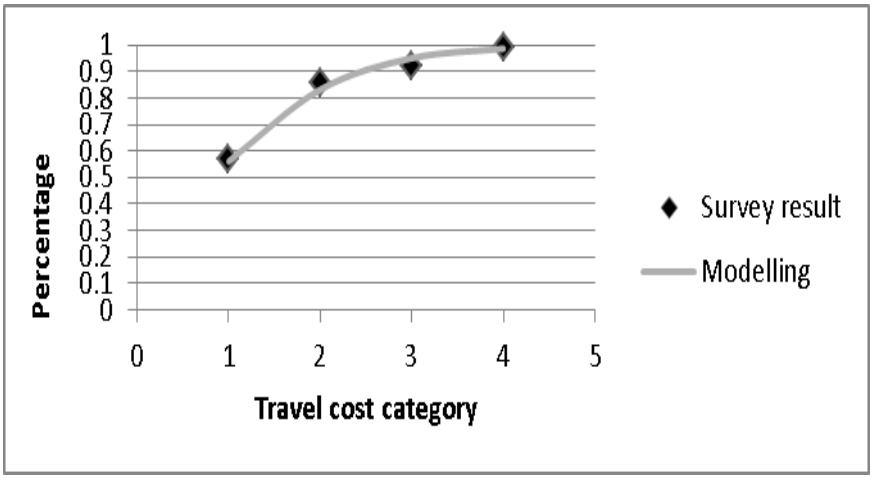

Figure (3): Correlation between survey results and modelling – Travel cost category

Travel time for work to study trip by private car :

Figure (4) shows 41.5% respondents travelling daily from home to work or study in 10 minutes or less, 38.5% between 11 and 20 minutes, 14.1% between 21 and 30 minutes, 1.5% between 31 and 40 minutes, and 4.4% more than 40 minutes.

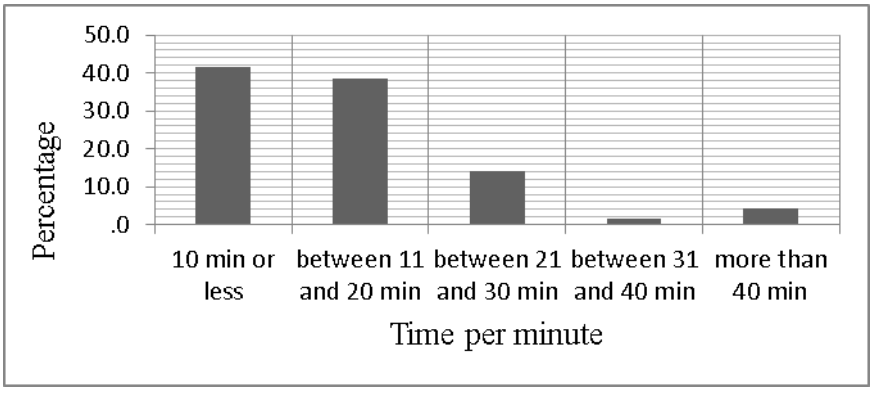

Figure (4): Shows Travel Time

The data of Travel time collected for this factor are shown in figure (4). The data are represented in the form of cumulative format in third column

in Table (4), which shows the Travel time category with respect to survey results and the probability of prediction (P) values. P value is derived from Equation (3) which involves constant and alpha (α) values to verify the logistic prediction model used in this study.

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

Where,
P = prediction probability of shift to PT
D = constant
α = coefficient of x
x = Category of travel time
e = the base of natural logarithms (approximately 2.718)

Table (4) Survey result and data calibration for travel time category

Category	Travel time	Cumulative (P) Survey result	1-P	P/1-P	ln(P/1-P)
1	10 min or less	0.415	0.585	0.709402	-0.34333
2	11 to 20 min	0.8	0.2	4	1.386294
3	21 to 30 min	0.941	0.059	15.94915	2.769406
4	31 to 40 min	0.956	0.044	21.72727	3.078568
5	More than 40 min	0.99	0.01	99	4.59512

The model shift probabilities were categorized by various categories of travel time shown in Figure (5). Mode shift probabilities ranged from 58.5% probability of private car use with travel time 10 minutes or less to 1% probability of private car use with travel time more than 40 minute. In other words, the probabilities of public transport user increased from 41.5% at travel time 10 minutes or less to 99% of probability with a travel time more than 40 minute.

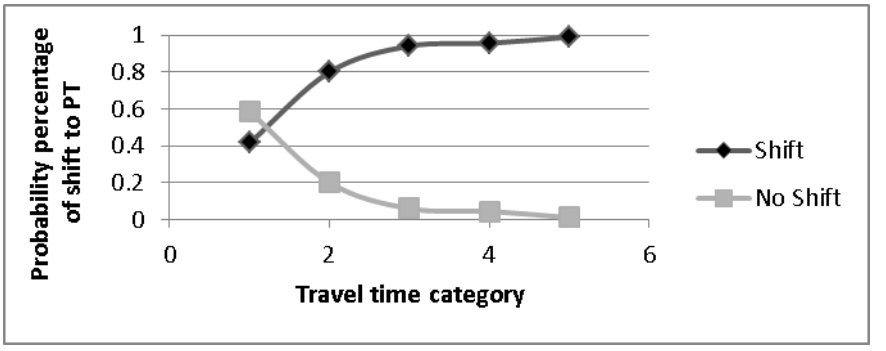

Figure (5): Shifting percent - Travel time category

A simple linear regression analysis was then conducted by using Microsoft Excel to obtain the intercept constant (D) and the α value. The results of the above Table (4) reflect the model calibration process which then introduced to excel to get the ANOVA table, which is described in Table (5), uses to develop the Analysis of Variance (ANOVA) table which some important factors reflect the study significant which is 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. By using the alpha (α) and (D) values from the ANOVA table, our model achieved the value of P equal to 0.003205 which is somehow acceptable to be significant (significant value is <0.05) as shown in Equation (4).

Table (5): The ANOVA table for travel time category

	Intercept	X Variable 1
Coefficients	-1.17354	1.156918
Standard Error	0.441465	0.133107
t Stat	-2.65829	8.691654
P-value	0.07645	0.003205
Lower 95%	-2.57848	0.733313
Upper 95%	0.231396	1.580523
Lower 95.0%	-2.57848	0.733313
Upper 95.0%	0.231396	1.580523

$$\text{Ln } D = -1.17354 \qquad D = 3.233429$$

$$\alpha = 1.156918$$

$$R^2 = 0.961805$$

Where R2 approaches one value indicating the model's strong correlation power thus, the result of the prediction models can be as shown in Table (6) and Figure (6)

$$P = \frac{1}{1+3.233429e^{1.156918(x)}} \qquad \text{Equ. (4)}$$

Table (6) shows the respective survey data and model data that correspond to the travel time.

Table (6) Survey result and logit model result for travel time category

Category	Travel time	Cumulative (P) Survey result	Modelling result
1	10 min or less	0.415	0.495844
2	11 to 20 min	0.8	0.757733
3	21 to 30 min	0.941	0.908646
4	31 to 40 min	0.956	0.969354
5	More than 40 min	0.99	0.990156

This result is more identified in Figure (6) which shows a high correlation between survey results and the modelled counterparts.

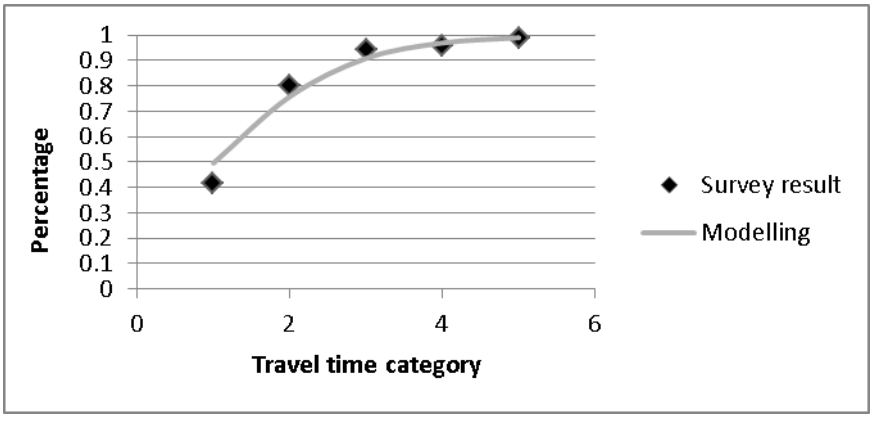

Figure (6): Correlation between survey results and modelling – Travel time category

DISCUSSION :

This study has also revealed that positive and negative operations are needed to encourage travellers to shift from private 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 for example if increases the parking fees and reduce number of the parking spaces in the city. The collected data were obtained from our survey which was subjected to the logistic 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 private car and private transport for work or study trips, and these scenarios have encouraged the travellers to shift to the public transport (PT) system. The logistic regression applied depending on the factors affecting the shift from car to public transport (Travel cost, Travel time). These factors have encouraged the travellers to shift to the public transport (PT) system. About the travel cost, public transport users probability increased from 57% with travel cost (5 LyD or less) to 99% of probability when travel cost (more than 15 LyD). For travel time, the probabilities of public transport user increased from 41.5% at travel time (10 minutes or less) to 99% of probability with a travel time (more than 40 minute).

CONCLUSION :

The increasing number of private cars and private transport namely taxi, microbuses and coaches in Gharian city has been named as the cause for increased road traffic congestion, environmental pollution and traffic accidents. This study shows the need to introduce an efficient public transport (PT) system to reduce traffic problems such as traffic congestion,

road accidents and delay in travel time on Gharian roads network as have been reported for all trips. Gharian people need to cooperate and support the use of the public transport (PT) system. It is very important to relieve the traffic problems on Gharian streets. Finally, all these factors have spurred the shift from using private vehicles to using the public transport system for all travellers' trips for various purposes in their daily lives.

ACKNOWLEDEMENT :

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REFERENCES :

[1] Adel Ettaieb Elmloshi, Amiruddin Ismail: Main Factors to Encourage Switch to Public Transport System, Tripoli – Libya Regional Engineering Postgraduate Conference (EPC) 2011

[2] Adel Ettaieb Elmloshi, Probabilities of Policy Shift to Public Transport, Case study: Tripoli – Libya. International Conference on Technical Sciences (ICST2019) March 2019 60 –40.

[3] Alrabotti Fathi Bashir (2007) Traffic Lights, part two (Tripoli)

[4] Amiruddin Ismail, Adel Ettaieb Elmloshi. Logistic Regression Models to Forecast Travelling Behaviour in Tripoli City Proceeding of the International Conference on Advanced Science, Engineering and Information Technology 2011.

[5] Amiruddin Ismail#, Adel Ettaieb Elmloshi# Travel Time is the Main Factor for Switching Travel Mode in Tripoli Street: Proceedings of the Eastern Asia Society for Transportation Studies, Vol.8, 2011

[6] El-Sayed Shawaly (1995). "In Search For Some Low-Cost Engineering Remedial Measures In Heavily Trafficked Corridors In El-Mansoura City ", First Engineering Conference, Mansoura University.

[7] Patterson, Z.; Ewing, G. & Haider, M. 2005. Gender-based analysis of work trip mode choice of commuters in Suburban Montreal, Canada, with stated preference data. *Transportation Research Record* 1924: 85-93.

[8] Sekaran, U. 2003. Research Methods For Business, A skill Building Approach, Fourth Edition. ISBN 978-0-471-20366-7.

[9] Secretariat of the Libyan justice, general Traffic department-Office and licensing of Tripoli, data as of 2009 .

