

Influencing Intercity Mode Choice Behavior in Libya

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Abstract—Libya is one of the rich developing countries out of oil revenues. The discovery of oil contributed to a dramatic change and a burden on all public utilities and facilities, especially the transportation system. Increased traffic congestion, road accidents on intercity highways, and environment pollution have been the negative impacts. The time is ripe for a policy to simultaneously improve intercity public transport and control car ownership. The current study is to identify trip-influential parameters and their countermeasures to shift travel modes. The shift may be caused by a reduction in airplane and intercity bus travel time and cost. The suitability of intercity mode choice models and travel reasons are to investigate. The collection of data is conducted through revealed and stated preference surveys handed out to intercity travelers between four major cities in Libya. Their demographic details are highly important. Based on such details, mode choice behavior and discrete choice models will be developed. The results are hoped to assist decision-makers on all levels to allocate resources wisely to public transportation improvement.

Index Terms—Intercity mode choice behavior, modal shift, disaggregate analysis, travel behavior analysis, revealed and stated preferences survey, intercity transport.

I. INTRODUCTION

Libya, a prosperous and economy-flourishing country, has a high private vehicle ownership that causes traffic problems. Public transport needs improving, which prompts the Libyan government to undertake various studies to tackle the problem of road accident deaths and injuries.

Intercity passenger transport is growing fast to meet demand for mobility. Flights and trains are the safest modes. Parameters such as price, travel time, frequency, comfort, and personal safety, have effect on mode choice. Very few people may consider the environment, willing to make sacrifice in terms of cost to better it.

Once an intercity model is created and applied, the consequences will provide the transportation agencies with a tool to maximize their revenue and better allocate their resources. This study will focus on providing personal transport users road transport alternatives as a countermeasure.

The choice of transport mode is an important issue in transport planning. Mode choice affects the general

efficiency with which one can travel and the amount of space devoted to transport functions [1]. Mode choice decisions are influenced by many factors, such as travel time, travel costs and socio-economic characteristics of the trip maker. This decision is also sensitive to the occurrence of unforeseen and key events such as accidents, extreme weather, and substantial changes in one's personal life, like a change of residence, a change of workplace and children [2]. All these factors are expected to motivate changes in mode choice decisions.

All over the world, several intercity mode choice models are developed and used to predict the trip-maker choice. This modeling is quite important from planning point of view since the transportation systems usually receive huge investment [3].

As early as 1973, Watson [4] developed the first disaggregate model for intercity mode choice, in which he discussed two alternatives (rail versus auto) using the information regarding individual travelers on the Edinburgh-Glasgow route in Scotland. It was concluded that the use of disaggregate, behavioral, stochastic models in a predictive framework is preferable to the aggregate approach because the predictions of disaggregate models are extremely promising. Subsequently, there were a large number of studies on disaggregate mode choice within the intercity context [5]-[19]. The studies contain probabilistic models which only focus on making a specific choice, once the traveler has decided to make a trip. Studies progressed from a binary logit model, to a multinomial logit model, and to the nested logit model.

The accelerated number of private cars involved in road accidents has alerted the government to take action. Several studies are required to explore different prospects.

A modal shift occurs when one mode gains a comparative advantage in a travel market over another. The comparative advantage can take various forms, such as costs, capacity, time, flexibility, or reliability. Depending on the kind of passengers traveling and their circumstances (socio-economic characteristics, purpose of trip, etc.), the relative importance of each of these factors vary.

Research efforts have focused primarily on modeling modal shift from private car to public transport. Many cities have attempted to restrict the use of private cars in favour of public transport [20]. Such policies exist in Malaysia [21], [22], France [23], Germany [24], Britain [20], [23], Netherlands [25], [26], Romania [27], Australia [28], Asian countries [29], [30] and Canada [31].

II. TRAFFIC ACCIDENTS IN LIBYA

For at least the last forty years or so Libya has had to acknowledge the fact that road accidents are a major cause of death and injury. Over this period substantial sums of money

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have been spent on trying to contain the road safety problem. According to World Health Organization (WHO) [32] latest figures, Libya is the second Arab country with the highest number of accidents; Oman is the first. In Libya the situation is worse. Unfortunately, the highest number of dead people in Libya is accompanied with the road accidents. Most of traffic accidents in Libya happen on intercity highways. Furthermore, car accident victims are disproportionately young and economically disadvantaged. About 65% between the ages of 14 and 44 die from car accidents. There are 5950 car accident injuries (Public Administration of Traffic, 2009). However, the estimate does not include minor and unreported injuries. A high proportion of car accident victims are in the younger group. The young drivers also have less experience, and are, therefore, more prone to accidents than older drivers. In 2009, there were 2301 deaths from road accidents. The reason why the young drive is that own transport accords them flexibility, faster travel, comfort and prestige.

According to the Statistical Report of the Libyan Ministry of Health for the year 2009, increased road traffic accidents on highways between major cities are very high, i.e., 6 deaths a day. This number will keep augmenting if no action is taken. The report indicates that the number of traffic accident deaths in 2009 is 2301 deaths, 6791 cases of severe injuries, and 7338 minor injuries as illustrated in Table I. Besides, the report indicates that the total number of road accident deaths from 1995 till 2009 is 24476 deaths. Table II and Fig. 1 shows the number of deaths due to road traffic accidents in Libya for the duration specified above.

TABLE I: NUMBER OF DEATHS, SEVERE INJURY AND MINOR INJURY DUE TO ROAD TRAFFIC ACCIDENTS IN 2009

Death	Severe injury	Minor injury	Total
2301	6791	7338	16430

TABLE: II. NUMBER OF DEATHS FROM ROAD TRAFFIC ACCIDENTS IN LIBYA (1995 TILL 2009)

Years	The Number of Deaths
1995	1296
1996	1080
1997	1119
1998	1224
1999	1204
2000	1504
2001	1320
2002	1751
2003	1758
2004	1783
2005	1800
2006	1866
2007	2138
2008	2332
2009	2301
Total	24476

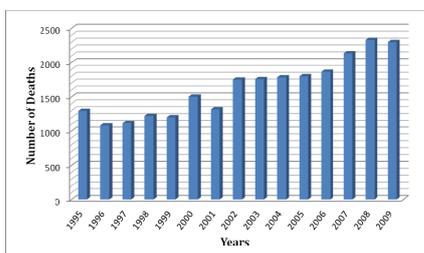


Fig. 1. Number of deaths of road traffic accidents in Libya (1995-2009)

III. THE PROBLEM STATEMENT

Mode choice is an essential step in transportation planning. In Libya, people rely heavily on private cars for intercity trips as well as short intercity trips. This is due to many factors related to the availability of autos to almost all household members, mode characteristics and people’s attitude towards public transportation systems. Only small percentage of people relay on buses, taxis or airplanes for their intercity trips. Most of these people do not have automobiles.

However, travelers consider a multitude of modes when they make their choice for intercity trips; this due to the vastness of Libya (1,759,540 km²) and long distances between cities, which makes travel by automobile difficult, unsafe and tiresome. For such trips, travelers can choose between intercity bus, plane, car and taxi. Only few people rely on taxi, so this mode will be excluded from the analysis.

The escalating number of private vehicles in Libya has created serious problems such as traffic congestion, air pollution and accident casualties. These are signs of unsustainable transportation development. One of the measures to reverse this situation is to promote public transport. However, there is evidence that simply providing high quality service is insufficient to attract private vehicle users. Motivation or strategic policy aimed at modifying their habits and behavior is deemed effectively for sustainable reduction in private vehicle usage.

The prediction of mode choice for intercity trips is important to balance the government spending on the development of transportation systems. The investment on transportation projects should be balanced between different transportation systems based on the usage of each. To avoid the problems associated with under-design or over-design of the components of the transportation systems, it is considered necessary to study the behavior of travelers and to determine the factors influencing their mode choice.

The present intercity traffic problems in Libya should be alleviated by encouraging more commuters to use public transport. However, despite speculation, there has been no authoritative identification of the real factors influencing car use. This study attempts to model car drivers’ mode choice and the likely effects of various inducements to shift them to intercity public transport.

The purpose of this study is to examine the factors that influence car use for intercity trips and the potential to shift the drivers to intercity public transport (intercity bus and air). Mode choice models provide the tool to evaluate the general effect of a transport policy change on mode split. The models have widely been used to predict travel mode choice for business trips, social and recreational, and other types of trips in the development of regional travel models [3]. These models always consider the car as a separate mode as it is such a major mode of transport in developed countries. These countries use mode choice research in their attempts to shift people from using private cars in their intercity trips to public transport.

The factors behind conducting this project include the alleviation of intercity traffic problems and traffic congestion is to establish proper models to reasonably describe commuters’ attitude in the country in question. The research questions addressed in this study are: What are the main

influences affecting people's choice of intercity travel mode? What are the attitudes towards transport? How public transport services are perceived and evaluated? What are the less known factors to sway the choice to public transport? This study is hoped to contribute greater additional details on commuters' mode choice behavior and to better understand the likely measures that would have to be taken to encourage greater intercity public transport use, i.e., the incentives/penalties to be imposed to make drivers less want to drive.

IV. PROPOSAL OBJECTIVES

The main objective of this study is to analyse travellers' mode choice behavior and to understand their considerations in choosing their mode of transport. The specific objectives are to:

- 1) Find parameters that influencing mode choice for intercity travel inside Libya. It is very important to balance the government spending on development of intercity transportation systems.
- 2) Identify the factors preventing own transport users from shifting to intercity public transport.
- 3) Develop mode shift models to study shifting behavior from private cars in intercity trips to safer modes of intercity public transport in order to increase road safety, enhance road environment, formulate the policies to achieve this, and to predict future intercity passenger transport use.
- 4) Develop suitable intercity mode choice models that will allow the determination of share of each mode in intercity trips for business, social and recreational trips. Through these models, it is potential to test the effect of attributes.
- 5) To formulate suitable policies to influence mode choice to intended outcomes.
- 6) Anticipate the impacts of policy measures on the probability of car user's mode choice and its impact on road accidents.

V. SCOPE OF STUDY

To determine the factors that influence mode choice for intercity travel is very important to balance the government spending on development of transportation systems. To achieve the interest and investment projects of transportation should be balanced between different transportation systems based on usage of each mode and it is necessary to study the behavior of travelers to avoid the problems associated with under-design or over-design of the components of the transportation systems.

The study is to focus on a potential travel mode shift from private car to safer modes of intercity public transport such as intercity bus, train and airplane. In order to encourage the shift, the potential factors that discourage car use and incentives for using intercity public transport will be identified. By identifying and understanding the factors likely to encourage the shift, a model for mode selection can be developed. The study also considers car drivers' receptiveness to various policy changes, namely, providing park-n-ride facilities, proposed new low-cost airline and

intercity train system, increasing the car's gasoline price, increasing import, insurance and road taxes on private car users, providing fast access and egress modes, raising the minimum driving age, reducing the travel time by intercity bus and reducing the travel cost by airplane.

The study targets the evaluation policies and strategies that can help to formulate, modal shift of transportation mode from private car to intercity public transportation in Libya, to formulate the modeling of possible modal shift from private car to public transportation, and to predict the future modal shift.

VI. ORGANIZATION OF THE STUDY

This research is composed of seven chapters. Chapter I present the introduction on the background, problem definition, objective and approach of the study. In Chapter II, the literature on the most recent work on car use mode choice and mode switching as influenced by traffic demand management policies is reviewed. The description of the methodology and approach for the analysis and evaluation of the results is discussed in Chapter III. It also describes the explanation of the theoretical foundation of the proposed mode choice methodology and statistical analyses to be used. Chapter IV gives a descriptive analysis of the survey data for using the intercity bus, car and airplane. Chapter V revolves around the estimates from different modelling approaches to car users' mode choice and mode switching behavior. Chapter VI summarizes the findings discussion. Finally, Chapter VII summarizes the recommendations and contributions of the study and how the objectives of the research have been addressed. This chapter will also provide some thoughts for future research in this area.



Fig. 2. Map showing the selection of the study areas

VII. SELECTION OF THE STUDY AREA

The study will be carried in all major cities in Libya because of the high car ownership and availability of intercity public transport, and the crowd of those selected cities seems to come from all over Libya. Specifically, the study will be conducted in four major cities in Libya: Tripoli, Benghazi, Surt and Sabha as shown in Fig. 2. The airports will also be taken account of in this study out of their availability. For the reasons stated above, these cities are expected to be an

excellent case study representing Libya. Respondents will be randomly selected based on a stratified sampling approach in order to achieve a representative sample reflecting demographic and socioeconomic profiles. The demographic details, such as income, age, gender, and educational level, trip characteristics, travel behavior and how to react the scenarios of proposed policy variables (measures) of each transport mode user, will also be collected.

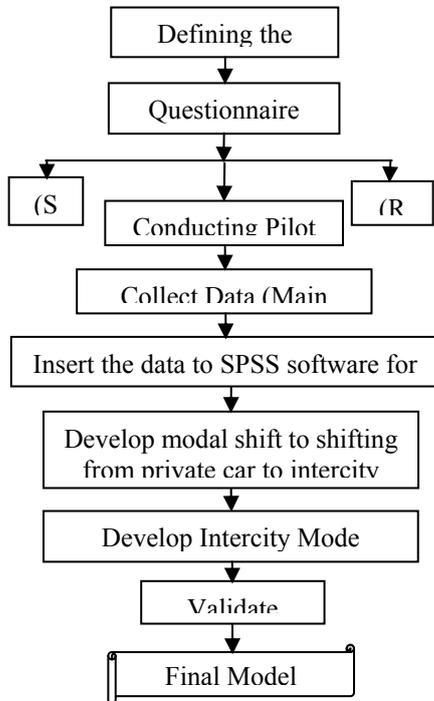


Fig. 3. Overall methodology of the study

VIII. RESEARCH METHODOLOGY

The framework for developing the models on car users' intercity mode choice behavior and potential mode shift from private car to other intercity public transport for intercity travel is shown in Fig. 3. Defining the study problem is the first task in the methodology adopted in this study. The process involved determination of the intercity mode choice variables. The next step is to design the questionnaire suitable for distribution to the participants and conducting the pilot study. The required data will collect from all major cities in Libya. All the models on car users' mode choice behavior and potential mode shift from the car to intercity bus and airplane in the literature require individual data. In this study, data collection will be by Revealed Preferences (RP) and Stated Preferences (SP); the two basic approaches in data collection. Well designed questionnaires (Arabic and English) shall be designed and distributed at airport terminals, bus terminals, and at gasoline stations located midway between the cities under study. The pilot survey will design to test items that will be use in the main survey instrument. After developing the questionnaire, the required data (main survey) will collected, the models for the three forms of intercity transport are specified and considered. This is followed by the model development and the estimates. It is well known for each developed model a validation process is necessary to

prove the developed model's functionality and hence a validation is essential in the current study. Eventually, the model's results shall be obtained and be ready to be used by the general public. The data shall be analyzed using the Statistical Package for Social Science Software (SPSS.19), and the multinomial logit model for mode choice will develop to assess the relative importance of demographic, socio-economic and service attributes that influence travelers' choice behavior.

IX. EXPECTED RESULTS

The prediction of mode choice for intercity trips is important to balance the government spending on the development of transportation systems. The investment on transportation projects should be balanced between different transportation systems based on usage of each mode. The specific expected results are as follows:

- 1) The results expected from developing of intercity mode choice models shall determine the share of each mode in intercity trips for the passenger travel inside Libya and help government, public transportation agencies, and private carriers make marginal decisions.
- 2) It will provide the transportation agencies with a tool to maximise their revenue and better allocate their resources and can be used to prevent under or over-design of their facilities,
- 3) Formulate the modeling of possible modal shift from private car to intercity public transportation and to predict the future modal shift.

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