Journal of Applied Sciences

ISSN 1812-5654

science alert

ANSInet
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http://ansinet.com

Journal of Applied Science 6 (2): 247-250, 2006
ISSN 1812-5654

Analysis Characteristics and Provide a Prediction Model of Public Bus Accident in Tehran

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Abstract: Safety is an important attribute of public transportation for both the operators and the passengers. For the operator accident will cause additional costs, lost time and out-of-service time. A safe public Transportation system may be a factor to encourage public use. Characteristics of public bus accidents in Tehran from 2000 to 2004 were identified. Analyses were conducted for determining accident characteristics of the major transportation system in Tehran. The united public bus company plays an important rule in the public transportation systems of Tehran; the condition of public transportation of this city will be assessed. Meanwhile the optimization research report of the public transportation system is programmed for Tehran transportation, which is described in this study. In this study, also we provide a model for prediction numbers of public bus accident in Tehran, in the future.

Key words: Public transportation, prediction model, accidents, fatality, injury, impact dynamic

INTRODUCTION

Safety is an important attribute of public transportation for both the operators and the passengers. for the operator, accidents will cause additional costs, lost time and out-of-service time. A safe public transportation system may be a factor to encourage public use.

The safety record of public bus operations has been reasonably good in most cities of the world as compared to other modes of transport but yet people still prefer to use their cars if they can afford it and when it convenient to do so. The main problem of safety is not as a bus passenger but as a pedestrian or bicyclist on the access trip. Accident type sometimes is considered to have direct relationship to accident severity, although a bus is one of the safe transportation modes in Tehran, it might be interesting to look at their relationship. Only a few studies have been reported on public bus accidents.

Only a few studies have been reported on public bus accidents. The analysis method and related finding of these studies are summarized follows. One of the most comprehensive of the public bus accident studies was done in 1989, they analyzed about 1,800 mass public bus accidents that occurred in the Chicago metropolitan area and developed two regression models for measuring public transportation accidents[1]. The accident data were provided by pace, the suburban bus agency. The important finding are summarized as follows:

- Eighty-nine% of the accidents involved collision with another object or person and the remaining 11% involved passenger injuries while boarding, alighting, or moving.
- Severity was generally low; most accidents involved property damage only.
- Drivers of the other vehicle involved in the accident were much more likely to be injured than the bus drivers.
- Gender does not contribute to accident occurrence, but age appears to have of the collision accidents occurred at intersections, whereas 30% occurred at some other locations.
- Bus accidents do not appear to be more frequent during darkness.

A study in 1983 looked at exposure to accident risk, including characteristics of the amount of travel, conditions of travel and characteristics of the driver and vehicle undertaking the travel[2]. A series of paired comparisons of accident rates between trucks and automobiles on the Iranian tollway under different weather conditions of travel and regression analyses were conducted to study the relationship between variables, particularly the influence of on modes Vehicle Miles of Travel (VMT) on the others accident rate (i.e. interference between modes)and effect of the amount of snow, rain and nighttime travel on accident experience. The results from the regression analyses indicated that the occurrence of snow was the single most significant exposure variable and that automobile accident rates were found to increase significant rates were found to increase significantly with truck VMT.

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A study of risk of accidents in Copenhagen concluded that there is no reason for a traveler to choose bus instead of car for the point of view of his own safety and from a social point of view there would be a safety benefit through a change of car driving into bus driving. These conclusions were because the risk of death per trip for a bus user was very high on access trips (Fig. 1)[3].

The high risk of injuries and fatalities in urban areas to pedestrians, bicyclists and commuters in access trips have been documented from all over the world. The greatest risk to schoolchildren from bus related injuries was found to be as pedestrians after alighting from a bus in New South Wales, Australia[4].

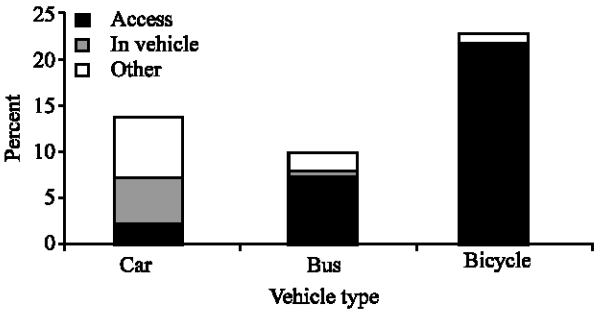

Fig. 1: Fatality rates for different trip types in central Copenhagen[3]

Tehran public bus transportation: Public transportation service (bus services) in Iran: planning for the bus services has concentrated on the week day morning and evening peak two hour periods, 7.00 am - 9.00 am and 6.00 pm - 8.00 pm. This is the critical period of the day and determines the bus fleet requirements to provide the services. Three main types of services are planned.

Exclusive bus way services (line haul): These are the services operating on the busway between squares and the principal Interchange. Tehran is requiring that future bus services in Local road be provided by low production, high specification vehicles.

Regular bus services: These are the bus services picking up patrons in the urban areas within convenient walking distance of their homes and accessing the busway at the earliest opportunity and traveling to Tehran central. The last pick up will normally be at the busway station where the bus enters the busway and it will set down passengers as required. This will reduce the need for patrons to transport. Regular services will also operate throughout the day in the opposite direction.

Local bus services: These are bus services usually traveling the same ways as the express services to the busway station but as a substitute of accessing the busway they continue on another route, thus providing the "cross-town" services. In some instances, the local services do use stations of the busway providing both a parochial and feeder service[5].

Transport and land use patterns found in Iranian cities are different from those existing in most cities. These patterns reflect a new phenomenon and have not been seen in the West since its earlier days of motorization and urbanization. Intense mixed land use, short trip distances and high share of walking and non-motorized transport characterize such urban centers. Bicycles, pedestrians and other non-motorized modes are present in significant numbers on the arterial roads and intercity highways. Their presence persists despite the fact that engineers designed these highway facilities for fast moving uninterrupted flow of motorized vehicles.

In Tehran average speeds during peak hour range from 10 to 25 km h^{-1} in central areas and 5 to 60 km h^{-1} on arterial streets and Tehran's traffic fatalities in 2000 was more than double that of other mega cities in Iran[6].

Analysis characteristics of public bus accident in Tehran: According to the Tehran accident reporting criteria, an accident is defined as an unstabilized situation that includes at least one harmful event. Officials determine an incident to be an accident based on several factors, including:

- The incident included loss in the format of damage or at least one injury;
- The incident involved unintentional injury or damage;
- The incident involved at least one motor vehicle in transportation;
- The incident was an unstabilized situation; and those accidents that involve a fatality, injury, or property damage of at least $20 are reported.

Accidents from 2000 through 2004. Besides having, a database that originated over 5 years ago, Tehran also has a rather thorough accident database. As shown in Fig. 2, all but two of the total accidents are included in the city accident database, which included 330000 accidents.

Bus accident involvement by day of week: Table 1 shows the frequency distribution for the days of the week on which public buses were involved in accidents in 2000 through 2004. The day on which most public buses were

Table 1: Distributions for involved public buses by days of week

Day of week	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
Total accident	207	171	197	198	193	153	118
Percent	17%	14%	16%	16%	16%	12%	12%

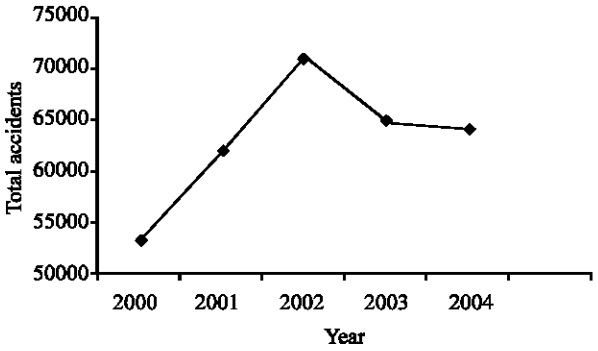

Fig. 2: Comparison of Tehran total public bus accidents, 2001-2004

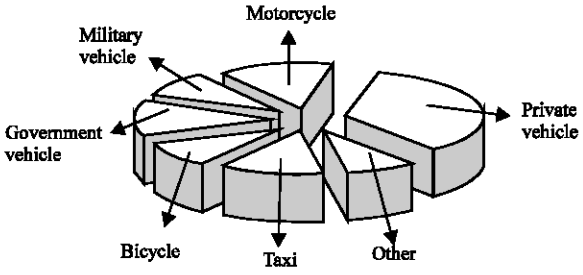

Fig. 3: Distributions for involved public buses

involved in accidents is Saturday (17%), followed by Monday, Tuesday and Wednesday (16%) and Sunday (14%). Thursday and Friday are the days on which the fewest number of public buses are involved in accidents. The remaining weekdays have a consistent number of public transportation vehicles involved in accidents. The dramatic drop in the number of public buses involved in accidents on Thursday and Friday reflect the drop in the amount of public transportation service that typically is provided on weekend days in comparison to weekdays.

Bus accident involvement by time of day: The time period during which the most buses were involved in accidents is 5:00-5:59 pm (17.6%). One-quarter of the total public buses in question were involved in accidents between 4:00- 5:59 pm (25.4%). This time period coincides with the actual afternoon peak period typically associated with most urbanized areas (i.e. 4:00-6:00 pm). Consequently, the public buses may be exposed to increased amounts of traffic during this time, if they are traveling near or within urbanized areas.

Bus accident involvement by weather conditions: The vast majority of both public buses involved in accidents were noted on clear days or days of no adverse weather conditions. Of the public buses involved in accidents, 8.7 and 4.0% of the accidents occurred on rainy days or snowy days, respectively.

Bus accident involvement by type of involvement: The frequency distribution for the types of involvement related to public buses involved in accidents from 2000 through 2004 is presented in Fig. 3. As evidenced in the table, most public buses experienced accidents that involved other motor vehicles (62.7 and 87.0%, respectively). Besides involvement with other moving motor vehicles.

Bus accident involvement by impact dynamics: The frequency distribution for the particular dynamics of the impacts of accidents involving public buses from 2000 through 2004 is presented in Table 2. The impact dynamics criteria only apply to occurrences where the public bus had a collision with another moving motor vehicle. As given in Table 2 previously, the number of public buses engaged in accidents involving other moving motor vehicles is 32. Table 2 indicate that most public buses were involved in collisions related to rear-end or angle impact dynamics. Eighty-four percent of public buses were involved in accidents related to angle movement; while, 5% were involved in accidents with rear-end impacts.

Accident prediction model for public bus in Tehran: For each city, we have to specify an accident prediction model. In this field great effort had been made at the TRL where accident models had been specified and calibrated with different levels of details by considering traffic attributes[7]. Present study has been addressed to the TRL approach assuming, the number of accidents occurred. λ_j is the expected number of accidents per unit of time and T is the time interval considered. we assume the following functional form that always ensures nonnegative values for the accidents number:

$$\lambda_j = \exp(\beta_j^T X_j) = \exp(\beta_j X_1 + \beta_2 X_2 + ... + \beta_m X_m)$$
$$j = 1,2,...,N \quad (1)$$

Where:

β_j is a vector of model parameters to be estimated

Table 2: Distributions for involved public buses by impact dynamics

Impact dynamics	% Distribution	No. of accident (A weak)
Head on	6	74
Angle	84	1040
Backed into	5	61
Other	5	62
Total	100	1237

X_j is a vector of attributes considered in model specification(explanatory variables vector)for the site.

As shown in the Eq. 1 the log-function of the expected number of accident is a linear function of the parameters vector β .

Thus, let λ_j be the expected number of accidents occurring per unit of time and assume it as variable representing the accident risk on the network elements. According to this approach, accident models could be considered as network performance functions which provide the variation of the network safety level as function of network and traffic attributes. The expected number of accident for Tehran public buses in streets assume by Eq. 2:

$$\lambda_N = \exp(\beta_j^T X_j) = 3\times10^3\times \exp((-0.15X_1 - 0.0078X_2)/10^5) \quad (2)$$

Where:
X_1= Total number of vehicle in Tehran (in year N)
X_2= Total number of tripe in Tehran (in year N)

In general, specifications presented in consider attributes concerning traffic, site geometrical layout and environmental conditions literature. Most of the attributes considered in the accident models are assumed also m the formulation of the road network supply model.

Analysis of the prediction model: In this phase, we consider the results obtained by the simulation of the phase. The evaluation of the considered alternatives can lead to the choice of the safety countermeasure or to the necessity of propose new project if the accident level is still higher than a given threshold.

CONCLUSIONS

A typical accident involving a public bus from 2000 through 2004, according to the database, occurred:

- On a Tuesday;
- Between the hours of 3:00-4:59 pm;
- Under clear weather conditions;
- On dry roadways;
- In connection with another moving motor vehicle; and
- Involving a rear-end or angle impact.

While the data do not reveal any significant unexpected issues or causal factors related to accidents involving public buses, the database contained data for several years affording the user greater opportunity to determine trends and identify issues, if they were to exist.

In order to reduce the increasing number of accidents occurring in urban areas in this paper we shortly described a methodology that allows, by integrating accident and traffic models, to planning road safety in a simulation environment and so to propose accident countermeasures by estimating a prior their consequence (reduction or increasing) in term of accident level.

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