ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Parking Choice Model Based on Parking Behavior Characteristics

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ABSTRACT:

Parking demand most of the time depends on trip characteristics and parking behavior characteristics. To be taught these characteristics more than a few parking demand units had been reviewed. For parking demand estimation established on the buildup of parking the methodology is proposed. As per proposed methodology, the data required is socio monetary traits of parkers for primary evaluation and parking behavior and parking condition characteristics for model development. Primary analysis is applied for different socio economic traits which can be travel purpose, age and earnings for distinctive modes. Variations in parking habits traits with admire to these socio economic characteristics are mentioned. The model progress for estimation of parking accumulation based on parking behavior characteristics was provided. Then the calibration of Multi Linear Regression model (MLR) carried out to deliver out the buildup expression. Subsequently Regression equations and R^2 values are bought for an exact parking area. The model was utilized for chosen stretch in Vijayawada city for two wheelers and cars separately. For the belief of the city parking issues, data gathered from online surveys. Major analyses had been implemented and the critical problems have been identified.

1. INTRODUCTION

Parking demand is the major concern in the transportation study for any city. Demand mainly depends on the usage of parking lots willing to park. So it is necessary to study the characteristics of parkers for choosing a particular parking location in order to use parking lots effectively. This study represents parking behavior characteristics of parkers for choosing parking location. This study gives parking accumulation and demand based on parking characteristics. As mentioned above, the core of the problem lies in the perception of the urban parking problem. A lot of problems are seen in different perspectives. Different stake holders have different opinions about certain problems, while others don't see a problem at all. It is hard to develop widespread accepted parking policies when there is no shared understanding of the actual problem. This brings to problem statement: 'Professionals and decision makers within the parking world perceive the urban parking problem in different ways, making it hard to develop effective parking policies'. The aim is to see this research as a starting point for new discussions, ultimately leading to a more cohesive understanding of the urban parking problem. Therefore research question is: 'How is the urban parking problem perceived by professionals within the parking world and what are the main topics where further research and discussion is needed As part of development of parking demand estimation model based on the parking choice pattern of the trip makers a detailed study is carried out on a selected stretch of Vijayawada City with following objectives:

1) To analyze the existing parking demand and behavioral characteristics i.e walking distance, walking time, parking duration and search and queue time.
2) To evolve a methodology for development of parking demand estimation model based on the parking choice pattern of the trip makers.
3) To estimate the regression equation for parking choice based on parkers behavioral characteristics using Multi Linear Regression Analysis and
4) To analyze the perception of the urban parking problems

1.1 Data collection and analysis

For the present study Vijayawada cross-road stretch is selected. The stretch selected consists of both on street and off street parking facilities with at least two parking choices. The parkers who are willing to park at

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the selected stretch are asked to respond for the questionnaire to know the parking behavioral characteristics of the respondent. This information is used to know probabilities of parking choice, which gives the parking choice preference of parkers. The stretch consists of on street parking are having both sides parking ,off street parking and cellar parking where there is no parking fee. Questionnaire survey is conducted among the parkers who are willing to park at the parking location are asked about the parking condition characteristics of parking choice i.e. on street and off street parking. Fig1.1 below. It shows the Parking accumulation at Vijayawada crossroad between 10:00 am to 01:00 pm duration. The demand values are less for car and other modes when compared to two wheelers at the stretch.

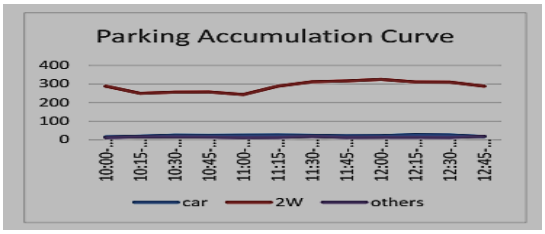

Fig.1.1 parking accumulation curve

Fig 1.2 shows the distribution of modes at the stretch. The existing modes at the stretch are two wheelers, cars and other modes. The two wheeler percentage (89%) is more when compared to other modes.

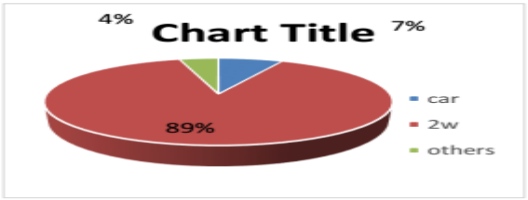

Fig 1.2 Composition of modes

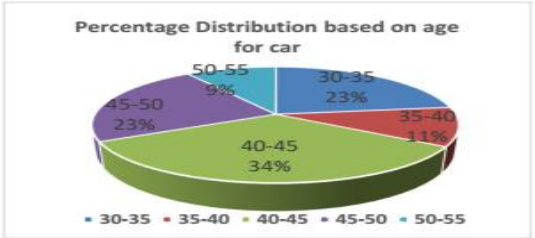

Fig.1.3 Composition on age for car

1.2 Mobility management

The increase of car traffic and the decrease of available land for parking spaces needed to park cars forces municipalities to regulate both car traffic and parking in urban areas. In recent years, parking has become an important part of governments' mobility management programs (CROW, 2002). Mobility is defined as the possibilities an individual has to move and to use these possibilities. Possibilities consist of all kinds of roads including bus lanes, bicycle paths and footways, and all kinds of parking facilities including bicycle stalls. Mobility management includes a set of activities aiming to improve choice alternatives of travelers; remove obstacles to use favorable choice alternatives; informing individuals about available choice alternatives; spread out the demand of mobility in time and space and reduce the necessity of moving

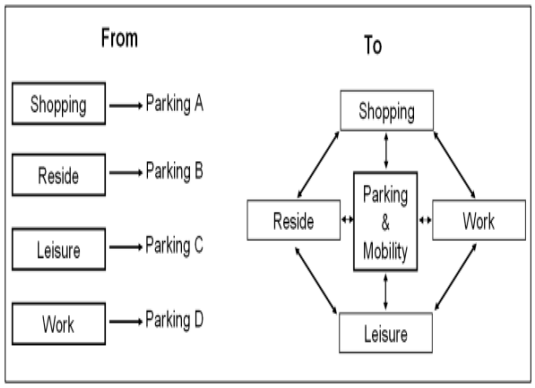

Fig 1.4: Parking as element of urban dynamics

1.3 Parking in shopping areas

In the context of shopping trips, the car is still a considerable travel mode, both for weekly and non-weekly shopping (Table 1.1). This holds especially for the Dutch context where central shopping areas are highly congested because of the high level of car use. Therefore, infrastructure that facilitates car trips plays an important role in the accessibility and, in addition, in the attractiveness and economic performance of shopping centers (e.g., WPM Consultants, 2002). Planners are aware of this and try to optimize the parking facilities in the surroundings of shopping centers.

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Aspect	Total	Car driver	Car passenger	Other
Distance traveled per person per day (km)	2.90	1.31	0.83	0.76
Number of trips per person per day	0.60	0.19	0.09	0.32

Table 1.1: Modal split for weekly and non-weekly shopping trips (Rijkswaterstaat,2009)

2. LITERATURE SURVEY

2.1 Introduction

To get insight into the impacts of parking policy, in the past a variety of parking models has been developed. This chapter aims to give a brief overview of the scope and structure of existing parking models and the characteristics used to develop parking models for supporting parking policy. Attention is paid to existing parking models in general, models that describe parking choice behavior and parking choice set generation in particular. Special attention is paid to parking choice behavior in the case car drivers face a fully occupied parking facility which often occurs in(congested) shopping areas.

2.2 Parking choice models

As described in the previous section, parking choice models focus on car drivers' requirements regarding the parking situation at the destination of a car trip. These models can be used to analyze and simulate the effects of parking measures on different car drivers' travel decisions and behavior. In the past, a variety of spatially implicit model studies have been set up to describe parking choice behavior of car drivers in different circumstances (Gillen, 1978; Van der Goot, 1982; Axhausen &Polak, 1991; Bradley et al., 1993; Hunt &Teply, 1993; Miller, 1993; Van derWaerden et al., 1995, 2006, 2010b, 2010c, 2010d; Van der Waerden & Borgers, 1995;Van der Waerden&Oppewal, 1995; Lambe, 1996; MuConsult, 1997; Tsamboulas,2001; Guan et al., 2005; Harmatuck, 2007; Borgers et al., 2010; Ottomanelli et al.,2011) In general, the adopted approaches differ from each other on the following features.

2.3 Combined travel choice models

In contrast to what most models presented above assume, parking choice is only one choice in a series of choices an individual has to make when he or she wants to participate in out-of-home activities such as shopping. Together with the choice of a parking facility various choices have to be made, including the choice of destination, travel mode, and time of departure. These choices are strongly interrelated: the outcome of one choice process might influence another choice process. As for the parking decision, motorists also have to decide which route to take to reach the parking facility, and how long to stay at the parking facility or final destination.

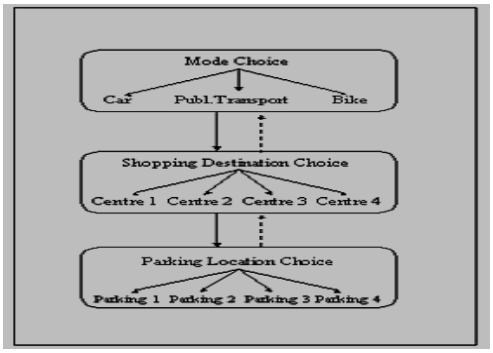

Fig1.5: Hierarchy in choice behavior of consumers according to Meurs et al.

More recently, some other less comprehensive combined travel choice models have been suggested, mostly related to network assignment. Tsamboulas (2001) developed two models describing the change of parking location and car mode change to other modes, because of parking fare increase. Respondents responded to different choice scenarios. In addition to other studies, he introduced additional variables to the ones usually employed, i.e. trip distance, walking distance and parking price.

2.4 Parking choice sets

A special point of interest related to (parking) choice modeling concerns the set of available choice alternatives. In general, the individual choice set refers to the set of discrete alternatives considered by an individual in the decision process

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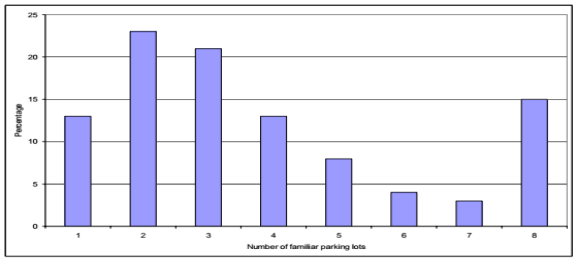

Fig 1.6: Car drivers' familiarity with parking facilities, N=438

2.5 Adaptive parking choice behavior

In several cases, especially in central shopping areas, car drivers are confronted with congested or fully occupied parking facilities. This situation stimulates car drivers to reconsider their first chosen parking facility. In this study, reconsidering a parking choice is called adaptive parking choice behavior.

3. METHODOLOGY

Analysis of parking behavior characteristics based on socio economic characteristics is done separately for on street and off street parking for two wheelers and cars. For two wheeler users on street parking: The variation of parking characteristics for 2-wheeler users based on age group parameter for on street parking. In the case of on street parking..

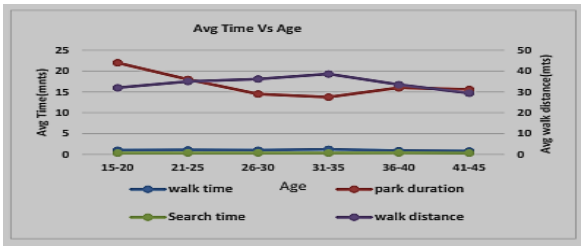

Fig 1.7 Average parking characteristics of age for on street parking for 2W

For two wheeler users off street parking: The variation of parking characteristics for 2-wheeler users based on age group parameter for off street parking. In the case of off street parking, it is observed that the parking duration is high for the age group of 41-45 years, walking distance from parking lot to destination is high for the age group of 15-20 years, walking time is high for the age group15-20 years. Search time is almost similar for all age groups.

Fig 1.8 Off street parking survey

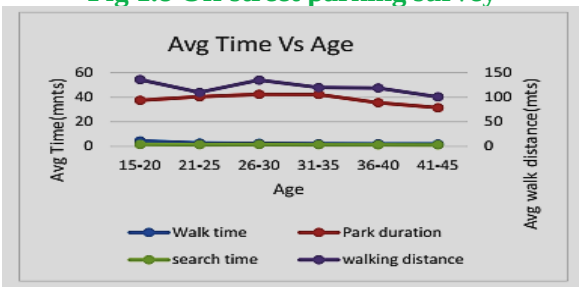

Fig 1.9 Parking characteristics of age for off street parking for 2W

For car users on street parking: The variations of parking characteristics for 2-wheelerusers based on family income parameter for on street parking are shown in below Fig 3.7.In the case of on street parking, it is observed that the parking duration is high for the income group of Rs.60000-Rs.100000, similarly walking distance is high for the income group ofRs.45000-Rs.60000. Walking time and search time is almost similar for all income groups.

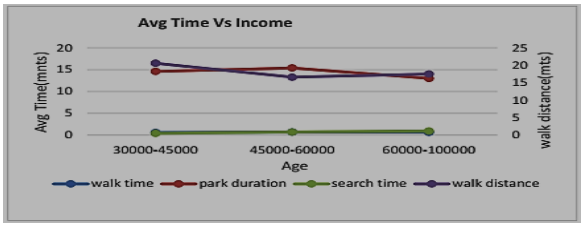

Fig 1.10 Parking characteristics based on income for on street car parking

Fig 1.11 On street survey

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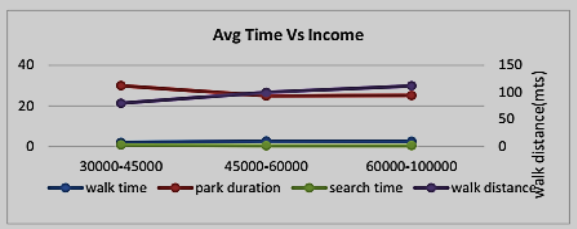

Fig 1.10 Parking characteristics based on income for off street car parking

4. RESULTS AND DISCUSSION

Data collection:-

a) Parker's behavior characteristics:- Parking types like On street parking, Surface parking and Multi storey parking

b) Parking characteristics: - Like parking duration, parking accumulation and parking demand

Improvements of the facility:

Much of the remainder of these guidelines addresses issues and elements of parking structures that should be considerations during the conceptual design phase.

Multi linear regression model for 2w: Regression model on 2w parking demand, which were based on parking information along Vijayawada Cross-road stretch. The model formula is shown as Equation 1.

Accumulation = 1475.79228 + 0.13912 * Duration+ 0.05898 * Total2W +0.114.32799 *

DIST_DEST+ 103.75365 * WALK_T+ 13.80663 * SEARCT_T (R2 =0.9294)…… …… (1)

S.No	Estimated frequency (E)	Observed frequency (O)	(O-E)^2/E
1	297	297	1.450
2	303	302	0.625
3	312	311	0.251
4	332	333	0.778
5	290	289	0.076
6	297	297	0.024
7	319	320	0.041
8	319	316	0.221
9	303	304	0.263
10	305	305	1.003
11	308	308	0.898
12	318	320	1.659
		Total	7.288
	Df=12-1=11	alpha=5%	
	Theoretical Chi-squared=21.03		
		7.926<21.03	Accept it

Table 1 Chi-squared test at Vijayawada cross-road stretch for 2W

Model Testing: The model was first tested for its applicability using the data on the corresponding dependent and independent variables collected during the study. The data obtained from corridors along Vijayawada cross-road stretch were used to test the applicability of the model.

The Chi-squared test at a 5 percent significance level was used to test the applicability of the model for the data collected from 10.00 A.M. to 1.00 P.M. The results of the Chi-squared analysis shown in Table 1 indicate that the model can be accepted as representing the data at this parking place.

Multi linear regression model for cars: Regression model on car parking demand, which were based on parking information along Vijayawada Cross-road stretch. The model formula is shown as Equation 2.

Accumulation = 92.84482598 + 0.250568472 * Duration+ 0.226622363 *

Total2W+1.582839 * DIST_DEST+ 53.2723 * WALK_T+ 17.8283 * SEARCT_T (R2 =

0.5897)…… …(2)

Model Testing: The model was first tested for its applicability using the data on the corresponding dependent and independent variables collected during the study. The data obtained from corridors along Vijayawada cross-road stretch were used to test the applicability of the model.

S.No	Estimated frequency (E)	Observed frequency (O)	(O-E)^2/E
1	18	15	0.067
2	14	15	0.831
3	15	16	0.498
4	14	15	0.024
5	15	14	0.547
6	13	14	2.065
7	14	12	4.466
8	15	16	0.221
9	15	12	0.263
10	13	17	1.003
11	14	14	0.898
12	16	17	1.659
		Total	12.540
	Df=12-1=11	alpha=5%	
	Theoretical Chi-squared=21.03		
		12.5401<21.03	Accept it

Table 2 Chi-squared test at Vijayawada cross-road stretch for car

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CONCLUSION

Numbers of methodologies are used for estimating parking demand model using parking behavior characteristics. Multi linear Regression model is used for the present study. It gives the regression equation of parkers for choosing a particular lot. The factors considered are total no of parkers, parking duration, walking distance from parking lot to destination, walking time from parking lot to destination and search and queue time. Using these parameters as input variables the model is developed. Output is the MLR equation for choosing particular parking lot. The observed data were tested by using Chi-squared test. The future parking demand estimated. Comparisons of consensus measurements were tested. The following conclusions are made from the present study.

1. Parking behavior characteristics mainly influence the choice of parking location. From the present study, usage of parking is mostly for two wheelers other than any other mode that is two wheeler compositions is about 60 to 80%. So it is necessary to regulate the parking lots for their efficient use.

2. As walking distance from parking lot to destination, walking time, search time for parking lot increases the probability of choosing particular parking location reduces.

3. The models developed for estimating the demand for parking at different locations give reasonable results and indicate that if no action is taken, shortfalls of parking spaces will occur along roads.

4. The factors that affect the demand for parking include the number and percentage of2w/cars in the traffic stream, the distance between a parking space and the destination, parking duration, walking tine from parking lot to destination and search time.

5. If the parking facilities for 2w/cars are not expanded, it is highly probable that more vehicles will be parked on the shoulders adjacent to the rest areas.

Improvement recommendations include parking operations and management improvements, user group allocation adjustments, signage and way finding improvements, and alternatives for implementing transportation demand management programs.

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