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Travel Time and Delay Analysis of an Emerging City with Linear Road Pattern

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Abstract: In this study, the travel time for taxi cabs were assessed and the average and running speeds as well as delay experienced were obtained. The result showed that the speeds and delay varied for different directions along the same link. It also identified various causes of delay and their individual contribution to the total delay. It concluded by pinpointing the major causes of the low level of service experienced and recommended measures that could help ameliorate the situation.

Key words: Travel time, delay analysis, emerging city, linear road pattern

INTRODUCTION

Travel time or the time required to traverse a route between any two points of interest is a fundamental measure in transport (Shawn *et al*., 1998). Every man desires to reach his destination as quickly as possible and when the time involved in such movement is unduly extended, it becomes undesirable. In fact, one of the aims of any traffic management measure is to ensure quick movement within safety limits. Travel time has thus been used since 1920's to evaluate transport facilities and plan improvement.

However, interest has recently been renewed in travel time studies in the 1990's due to the following reasons:

- The need for congestion management systems.
- A changing analytic and funding environment.
- Increasing involvement in transport decision especially by non technical persons.

Several techniques have therefore been brought about in assessing and analyzing it. Some of these include:

- Test vehicle techniques often referred to as "floating car".
- License plate matching techniques.
- Emerging and non-traditional techniques.

In this study, the test vehicle technique has been chosen for the study since it is relatively cheaper than others. Data collection process took place between August and September, 2004. It considered the entire taxi route of Ekiti-State capital, Ado-Ekiti.

Emerging cities: With increasing population, economic development and state creation in Nigeria, several towns are beginning to gain more recognition (Adeniji, 2004). This is more with towns characterized with increasing commercial and job opportunities. This urbanization is couple with attendant increasing mobility. However, many of such towns have very poor network of roads with some characterized with linear network with very many feeder roads adjoining them. This, therefore, constitutes a very serious problem for free flow of traffic. Ado-Ekiti is such a town. It is therefore, the intent of this research to report the result of the travel time study conducted along the major length of this linear road pattern for taxi cabs. It is important to note that taxi cabs were chosen since this is the most widely used mode of transportation in the study area.

The study area was selected based on its following characteristics:

- It is an emerging city.
- The problem of traffic congestion was noticeable.

It is becoming unbearable given the value of time especially for those hurrying to work in the morning peak hour and the delay experienced by through traffic.

Various studies have been carried out on traffic operation and management in Ado-Ekiti (Aluko, 2004). Such studies addressed the traffic situation and problems. But none made effort to study the travel time characteristics.

The primary aim is to quantify the travel time for taxi cab plying this road network. The secondary objectives are to:

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- Estimate stop delays experienced by taxi cabs.
- Identify the causes of such delays.
- Compare the relative contributions of various causes.
- Make recommendation on ameliorating this situation.

In an extensive study undertaken in the U.S.A on various roads in Texas (Travel Time and Delay study, 2001) three Arterials namely Alameda, Baldwin and Everhart, classified as Minor Arterials are of interest. A minor arterial is a road for which mobility is an important function with substantial access to abating land uses. The study showed that few links had free traffic flow. It also showed that low traffic speeds were usually accompanied with high stopped delays. Moreover, the speeds were usually very low in high traffic generating zones such as commercial centers, or where there were substantial direct ingress and egress to the road.

Finally, the study showed very wide variation in stopped delays experienced across the links and very often, the speeds and delays along the same direction greatly varied for the same time of the day.

MATERIALS AND METHODS

The study area is the entire taxi cab route of Ado-Ekiti, Ekiti State capital city.

Road pattern in Ado- Ekiti is more of a linear pattern than a radial one. It has two major axes crossing each other at the central business district area of the town. Adjourning these are feeder roads which are more or less not interconnected. They rather lead straight to these 2 major axes.

As such, the most common means of transport, the taxi cabs, ply only these two axes. All roads, mainly feeder roads, not covered by taxi cabs are, therefore, not considered since they carry lower traffic volume and so do not constitute critical zones requiring immediate study. A map of the road network is attached.

The research was carried out in two stages: Field operation and data analysis. In the field, the links to be studied were first defined and the checkpoints and locations where measurements are required were identified. A total of 39 links were selected.

Data collection took place both in the morning and the evening peak hours, i.e., between 7.30 and 9.30 am and between 3.30 and 5.30 pm on week days. An adaptation of the test vehicle method of traffic survey was employed to make three runs per peak period in each direction of the sample links during the two peak periods of each day. Using the sample size formulae:

$$n=\left(\frac{t\times c.v}{\ell}\right)^2$$

the required number of runs to attain 90% level of confidence desirable in the research was obtained. By employing the passive test vehicle method together with simple tools such as stop watch and data collection forms, the time required to move from one checkpoint/ measurement location to another and the stopped delay experienced were read off and documented. In all three data collection personnel were recruited, each traveling one of the legs of the taxi routes from the central business district of the town at a time.

The data collected was analyzed; those with excessive deviations were discarded and, using simple arithmetic, the necessary information was got.

RESULTS AND DISCUSSION

The highest average speed observed was found to be 39.01 km hr^{-1}. This was along link 31 which has a length of 1180 m with minor intersections along it. It is a length positioned relatively toward the outskirt of the town and is thus devoid of most traffic within the town-thus its relative high speed value. The lowest average speed observed was found to be 5.54 km hr^{-1}. This was along link 23. This link extends between a roundabout and a T-intersection, two very busy intersections and has a very short length of 145 m, thus the low speed. This compares well with the observation on Weber Road in Texas (Travel Time and Delay study, 2001) made up of 7 links. On this road the speeds varied from 12-53 km hr^{-1} which gives a variation in speeds of as much as 41 km hr^{-1} along the road.

Vehicles on link 15 experienced stopped delay of 31.32 sec and the average and running speed are 11.45 and 16.02 km hr^{-1}, respectively on the south bound. Delay of 5.32 sec and average and running speeds on the north bound are 21.41 and 23.50 km hr^{-1}. The link has two major intersections and the ancient Okesha Market. This shows how the same link can vary both in speed and delay when traveled in different directions.

Delay was most pronounced on link 20 having a value of 60.88 sec, while the average and running speeds are 7.87 and 9.41 km hr^{-1}, respectively (Table 1). The low speed and high delay recorded on this link were as a result of some important places, such as king's palace, main market, central post office, NITEL and town hall, along the link. This is worthy of note more so as the link is a one-way street arrangement. Moreover, it was found that in addition to the numerous traffic generating facilities along it, further observation showed that the link had numerous failed sections along it . Aside this, the parking spaces provided along the link was poorly managed and was thus abused to the detriment of free traffic flow. This observation re-echoes the fact that traffic management measures without proper coordination

Table 1: Delay and speed characteristics of critical link

Link	Northbound delay (s)	Southbound delay (s)	Northbound Ave. Speed (km hr^{-1})	Southbound Ave. Speed (km hr^{-1})	Northbound running speed (km hr^{-1})	Southbound running speed (km hr^{-1})
15	31.32	5.32	11.45	21.41	22.42	23.50
20	-	60.88	-	7.87	-	9.41
22	24.70	3.42	6.87	8.96	9.71	16.78
23	19.68	31.73	9.10	5.54	12.06	8.53
24	23.36	7.50	20.92	24.48	25.85	26.34
31	13.63	13.53	38.38	39.01	43.77	42.64

Table 2: Northbound: Percentage contribution of various causes to stopped delay at critical locations

Link	Intersection delay(s)	Bad driving(s)	Passenger services(s)	Pedestrian crossing(s)	Bad road(s)
15	78.66	8.37	13.06	0.00	0.00
20	-	-	-	-	-
22	48.18	38.82	17.00	0.00	0.00
23	45.50	4.16	50.35	0.00	0.00
24	65.37	9.73	21.40	0.00	3.50
31	0.00	0.00	100.00	0.0-0	0.00

Table 3: Southbound: Percentage contribution of various causes to stopped delay at critical locations

Link	Intersection delay(s)	Bad driving(s)	Passenger services(s)	Pedestrian crossing(s)	Bad road(s)
15	17.13	3.87	79.00	0.00	0.00
20	3.82	4.87	17.71	0.00	74.61
22	56.10	0.00	49.30	0.00	0.00
23	77.05	0.50	22.43	0.00	0.00
24	1.64	15.83	76.67	5.83	0.00
31	0.00	12.45	87.55	0.00	0.00

and enforcement may sometimes worsen traffic operations as in the case of the provided parking spaces here.

Finally, Table 2 and 3 shows the percentage contributions of various observed causes of stopped delay. While the normal passenger services accounted for the greatest percentage of delay, it was obvious that many other factors made their contributions. For example, bad road section accounted for 74.61% of delay along link 20. This value in time is about 45sec which is greater than the delay experienced along any other link. Definitely, therefore, traffic performance would improve if proper management measures are put in place to address the problems identified as causes of the delays.

CONCLUSION

In this study, it has been observed that travel speed is generally low across the study area. It was also shown that speed is related to abutting land usage and that there is usually high variation between speed and delay even along the same link. Finally, capacity inadequacies at intersections, bad roads, bad driving practices and passenger services were found to result in delays.

RECOMMENDATIONS

Since delays affect both work and personal trips leading to low productivity and increased cost, it is essential that certain measures be taken to reduce it.

The following measures are therefore recommended:

- Road safety education.
- Parking restriction.
- Access management i.e., coordinating between road way design and land use.
- Introduction of traffic controls at intersection.
- Rehabilitation of the roads.

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