

A STUDY ON LANE CHANGING BEHAVIOR IN THE VICINITY OF JEEPNEY STOPS IN METRO MANILA *

By Jose Regin F. REGIDOR**, Izumi OKURA*** and Fumihiko NAKAMURA****

1. Introduction

Paratransit vehicles are often maligned for their behavior along urban thoroughfares. The basis for this is the perceived influence of paratransit operation on the traffic flow characteristics along urban roadways, particularly on the aspects of traffic congestion and safety. Jeepneys in Metro Manila have been observed to employ various maneuvers as they move toward the curbside to make a stop¹⁾. A similar situation applies when they move out from the stop. This merging and diverging behavior is characterized by frequent lane changing. However, lane changes are not exclusive to jeepneys (or other paratransit) but are common even to private vehicles, which may change lanes, for example, to avoid stopping jeepneys. As such, lane change behavior represents the dynamic interaction among vehicles in the traffic stream and occurs under varying conditions or situations. This paper examines lane changing together with other traffic characteristics in the vicinity of jeepney stops. It also deals with the related concept of weaving as well as on questions regarding the effects of location, upstream and downstream traffic conditions and the appropriate segment length for studying lane change behavior.

2. Objectives

This study has three main objectives. The first is to present the various aspects of lane-changing behavior. This will include pointing out the similarities and differences between highway and arterial lane changes. The second objective is to analyze lane changing behavior by investigating the relationship between lane changing and other traffic characteristics in the jeepney stop environment. To accomplish this, it is necessary to undertake quantitative analysis of factors affecting lane changing which are found in the vicinity of jeepney stops. The last objective is to examine the possible applications of analytical results. The discussion is focused on the level of service (LOS) criteria, stop designation as well as other aspects of lane changing behavior which need to be addressed.

3. Some Concepts on Lane Changing

(1) Lane changing and weaving

Lane changing and weaving are related concepts in that the former is the maneuver employed to effect weaving. Weaving has been defined as “the crossing of two or more traffic streams traveling in the same general direction along a significant length of highway, without the aid of traffic control devices.”²⁾ This definition generally applies when streams converge and diverge as a result of the road configuration. Typical of these is when off-ramps follow closely after on-ramps along freeways.

Weaving occurs along urban roads as drivers maneuver their vehicles with the intent of turning left, turning right or going through at the next intersection. Weaving may also be observed around bottlenecks or in the presence of public transport vehicles operating along the road. However, these types of weaving will be difficult to classify according to those described by the U.S. H.C.M. Therefore, instead of studying weaving altogether, attention is focused on lane changes, particularly the behavior along the jeepney stop environment. This will allow us to consider these maneuvers in more detail rather than as a component of the weaving process.

(2) Lane changing along highways

There have been a number of studies pertaining to lane changes. Among these are findings made by Leutzbach³⁾ regarding the relationship between the total traffic volume and the frequency of lane changes along German autobahns. The general observation was that the frequency of lane changing increases as the total traffic volume increases. However, this increase in the volume is accompanied by an increase in vehicle concentration, which in turn limits the opportunities for changing lanes. Thus, a certain threshold value is reached, from where the frequency of lane changes decline with increasing total traffic volume. Such a relationship is illustrated in Figure 1.

The results from studies made by Heidemann⁴⁾ and Yousif⁵⁾ validated Leutzbach's observation. The first modeled lane utilization and lane changing relationship along 2-lane and 3-lane unidirectional sections along German autobahns while the

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second modeled similar sections along British motorways. It was found that the frequency of lane changes declines beyond flows of 2000 veh/h for 2-lane sections and 3000 veh/h for 3-lane sections.

It should be realized that while there are many similarities between lane change behavior along expressways (or motorways/autobahns) and urban arterials, their differences should not be disregarded. The similarities lie mainly on the decision-making process (i.e., Why change lanes?), which is discussed in a succeeding section. Meanwhile, the distinguishing element for lane changing along arterials is the presence of public transit as well as signalized intersections (i.e., traffic flow along expressways is classified as uninterrupted while arterial flow is under interrupted conditions). In this paper, we focus on the influence of the operational characteristics of jeepneys on traffic flow along arterials, especially lane changing.

4. Data

(1) Explanatory variables

In the conduct of the study, several quantitative and qualitative variables were considered. These variables comprised mainly of traffic characteristics which have been found³⁾⁻⁵⁾ to influence lane changing. The quantitative variables included the fundamental parameters: volume (q), speed (u) and concentration (k). Besides these variables, we are able to add other parameters such as lane utilization and the traffic mix (i.e., amount of jeepney in the traffic stream). The qualitative variables included knowledge about vehicle occupancy, jeepney routes and driver attitudes. These were used to reinforce the interpretation of results.

(2) Data collection process

Data collection was facilitated by conducting video surveys at two sites located along different portions of an arterial in Metro Manila. Video surveys were undertaken because the footage allowed for data to be encoded and counterchecked indoors to minimize errors that may be incurred if field surveys were held instead. Both segments chosen were 4-lane, straight, level midblock sections. Pavement condition was satisfactory with no potholes that may affect traffic flow, and lane markings were existent. Segment lengths were 40m and both were located approximately 200m from a signalized intersection upstream, and 130m and 100m, respectively, from the nearest intersections downstream. An additional criterion was the significant amount of jeepney (i.e., >10% of the total volume is composed of jeepneys) operating along the selected segments. Both segments were located along areas with generally mixed land use but the main difference is the higher activity level observed in buildings adjacent to Segment (I) compared with Segment (II). The adequacy of these locations and segment length is discussed under the succeeding sections 5(2) and 5(3). Note that despite the existence of designated stops and regulations for such, jeepneys are able to stop almost anywhere along the roadway to load and unload passengers. Such conditions are true for both segments considered in this study.

5. Analysis of Lane Changing

(1) Factors affecting lane changing

The study of lane changing is made complex by the many factors affecting this behavior. It has been mentioned in the previous section that tendencies in lane changing are affected by several variables. However, to go into more detail about its mechanism, it is necessary to answer the fundamental question: Why change lanes? Yousif⁶⁾ listed several reasons for changing lanes. Among these are: (a) individual lane preference, (b) surrounding traffic concentration on adjacent lanes, (c) surrounding average speed on adjacent lanes; and (d) general traffic regulations. From such reasons, it is easy to identify the main factors influencing lane change. These factors are common to both expressways and urban arterials and may not be considered as mutually exclusive of each other. The decision to change lanes is obviously the result of the combination of various factors that make conditions for switching lanes possible. Individual lane preference refers to factors involving the driver and the type of vehicle he is handling. Consequently, driver behavior or motivation influences lane choices. Drivers of private cars may tend to choose lanes where they can maintain a certain average speed. Meanwhile, jeepney drivers (or public transport drivers, in general) will choose to move towards the curbside lane to load and unload passengers.

The perception of lower densities along adjacent lanes will influence drivers to switch to those lanes. It is a natural tendency to transfer to a lane where one will be able to drive more comfortably (larger spacing between vehicles) even if not necessarily faster. Note also that at higher densities, lane change will be restricted due to the lesser number of acceptable gaps available to change lanes. Switching towards a lane of higher average speed reflects the desire to move in a faster stream. Unless preferring to drive slowly themselves, most drivers would want to avoid slow moving vehicles. Moreover, in the case of arterials where public transport vehicles operate, drivers tend to avoid stopping vehicles. Here, it is easy to see the relation between lane speed and lane density. Higher vehicle concentrations along a lane lead to a perception of slower average lane speeds and vice versa.

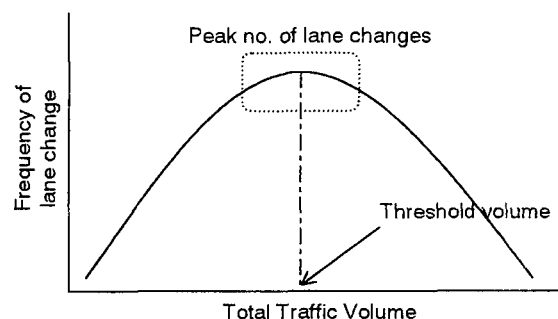


Figure 1: Conceptual relation between total traffic volume and lane changing frequency.

Finally, general traffic regulations refer to various policies that may affect lane change behavior. Metro Manila experimented with what was termed as “yellow lanes” which attempted to separate private and public transport vehicles. Under such a rule, jeepneys and buses were encouraged to stay along the curbside lanes while private vehicles were not allowed to use these lanes unless in the act of turning right at an intersection. Such rules may have a direct influence on lane changing behavior and may help explain certain patterns in lane changing.

(2) Generalizing the effects of location, and the upstream and downstream conditions

It is essential to recognize the effects of location, and the conditions upstream and downstream of the selected segments. Location is very much related to the adjacent land use and therefore, the activities of a specified area. Since this study focuses on activity in the vicinity of jeepney stops, location becomes all the more important. The stop frequency as well as the stop duration is related to the amount of activity since adjacent land use determines the potential passengers boarding or alighting at specific locations.

Upstream and downstream conditions are certain to have an influence on the state of flow at a selected segment. Depending on the research objectives, it may be required to have direct input from these. Intersections, for instance, can greatly influence the segments selected for study. Flow towards the segments will be dependent on the cycle time of the traffic signals upstream. In cases when there is a signalized intersection downstream, it is possible that queues may reach the study segment. For the purposes of this study, it was assumed that the input parameters already incorporated upstream and downstream conditions. Furthermore, it was verified from the surveys that there were no factors upstream or downstream that would have significantly affected the flow along the selected segments. Adjacent land use is always a factor and its effects are apparent in the differences between results for Segment (I) and Segment (II).

(3) Lane changing and traffic volume

At this point, we refer to a previous section where the relationship between lane change frequency and the total traffic volume was described. Similarly, the frequency of lane changes was plotted against increasing total traffic volume and is shown in Fig. 2. The significance of this figure lies in the realization of similar tendencies of lane change frequency along an arterial segment with that of expressways. That is, the frequency of lane changes increases with increasing traffic flow until such a time when the concentration of traffic restricts the probability of changing lanes and the frequency declines as flow further increases. This trend can be seen from Figure 2 and the increased vehicle concentration is verified from Figure 3. Lane changing for the case of all vehicles and jeepneys in particular for both Segments (I) and (II) are shown in Figure 2.

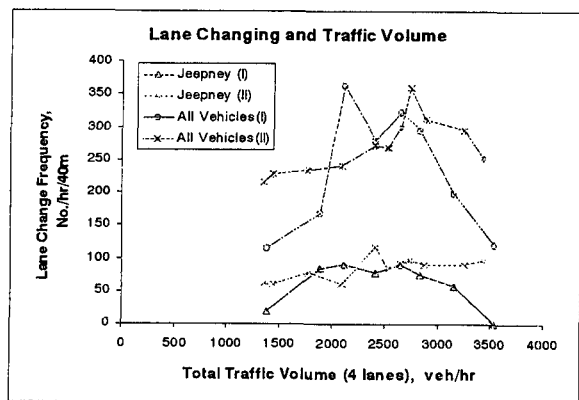


Figure 2: Relation between lane change frequency and total traffic volume.

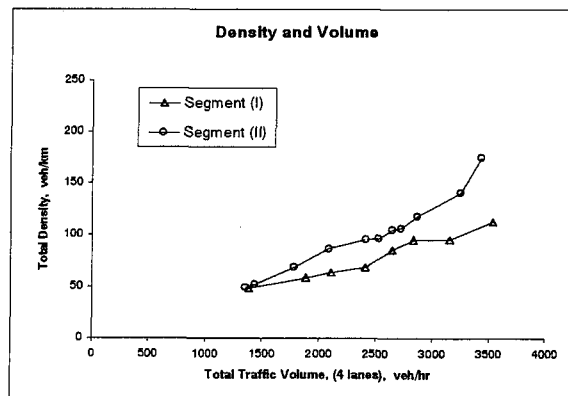


Figure 3: Relation between total density And total traffic volume.

It is interesting to see from the figure that jeepneys appear to change lanes less frequently than other vehicles. This observation underestimates the influence of jeepneys while also failing to take into account the fact that this mode comprises only 15.9% [for Segment (I)] and 16.2% [for Segment (II)] of the total traffic volume. However, jeepneys are concentrated along the curbside lanes (lanes 1 and 2) comprising 21.2 to 31.5 % of the lane volumes. In the succeeding sections, we discuss lane changing with respect to other variables.

(4) Lane changing behavior and lane utilization

From the perspective of congestion, it is easy to see that lane changing may have a direct influence on lane utilization. It was mentioned earlier that previous studies have linked lane change behavior with lane utilization. The following Figures 4 and 5 show plots of lane utilization against the total traffic volume for the two segments considered in this study. Note that lane changes are not explicitly included in the plots. L1, L2, L3 and L4 stands for lanes 1 to 4 with lane 1 being the curbside lane and lane 4, the median lane. The curves in the figures represent the regression lines fitted for the data. These lines help show the general tendencies of lane usage with respect to increasing total traffic volume.

The two figures show different conditions along each segment. On the same vertical and horizontal scales, it can be seen that the value for lane utilization along Segment (II) converged at higher volumes. Meanwhile, there is no clear pattern along Segment (I) aside from the apparent underutilization of the curbside lane. These differences may be explained by the prevailing

conditions at the time the data was taken. In a previous study,⁶⁾ it was shown that jeepneys stopped frequently along Segment (I) compared to Segment (II). Also, most stops were observed to be made along lane 1. The consequence of this is the perception of a higher concentration of vehicles along the curbside lane 1 along Segment (I). It must be realized that lane changes and lane utilization have a dynamic relationship. Lane utilization is a product of the number of vehicles switching lanes while lane changes are influenced by the perceived concentration of vehicles along a particular lane (hence its utilization). Such a relationship will be clarified in the succeeding section.

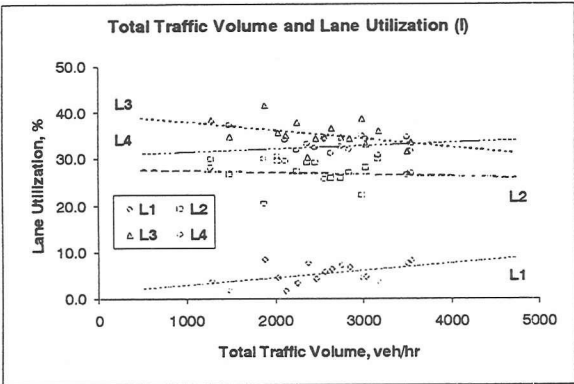


Figure 4: Relation between total traffic volume and lane utilization for Segment (I).

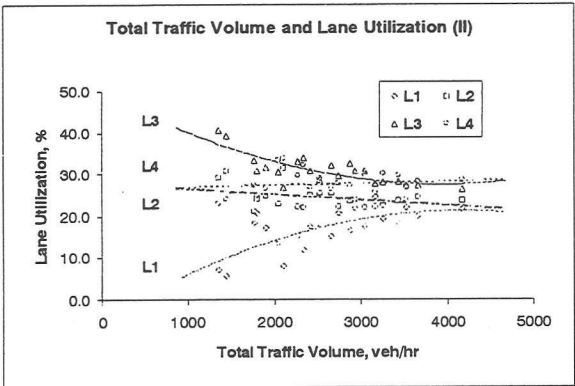


Figure 5: Relation between total traffic volume and lane utilization for Segment (II).

(5) Distribution of lane change activity

Lane changing activity was classified into 6 movements. Such classification was made to adapt to the segment length as well as to simplify the lane change process to be analyzed. Note that unlike previous studies³⁾⁻⁵⁾ in lane changing, the segments considered here is relatively short. In multilane sections, longer segments permit the shift from the median lane, for example, to the curbside lane. This will only complicate analysis since the number of movements to be considered is increased. With shorter segments, lane changing is constrained to adjacent lanes. These lane change movements are shown in Figure 6.

It can be stated from Figure 6 that 2 adjacent lanes (e.g., 2-lane unidirectional section) will have 2 movements and that each additional lane will result in 2 more movements. Thus, a 3-lane unidirectional segment will have 4 lane change movements. The tendencies of lane changes for jeepneys and other vehicles along Segments (I) and (II) are shown in Figures 7 and 8. The tendencies shown in the figures above are affected by factors/sub-factors such as location, time of day, passenger demand and transit routes. As such, variations from the figures shown are expected and dependent on the circumstances by which the data was collected. From Figure 7, it can be seen that jeepney lane changing is concentrated along lanes 1 to 3 while other vehicles tend to switch over lanes 2 to 4. This is easy to understand since jeepneys were observed to stop frequently (34 stops per hour) along Segment (I). Thus, most jeepney lane changing occurs toward the curbside. In the case of other vehicles, it is noted that a significant number of those changing lanes do so from L3 to L2. This activity is rationalized by the underutilization of L1 as shown in the previous Figure 4. A lower concentration of vehicles is perceived along L1 and L2, which then induces vehicles to transfer towards it.

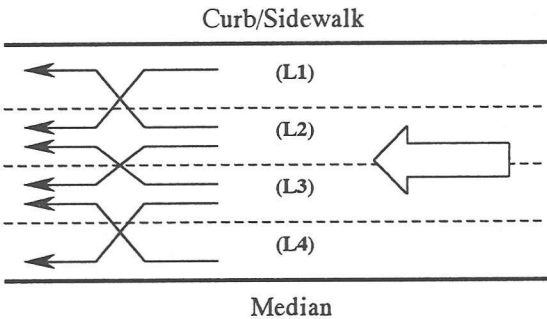


Figure 6: Lane change movements.

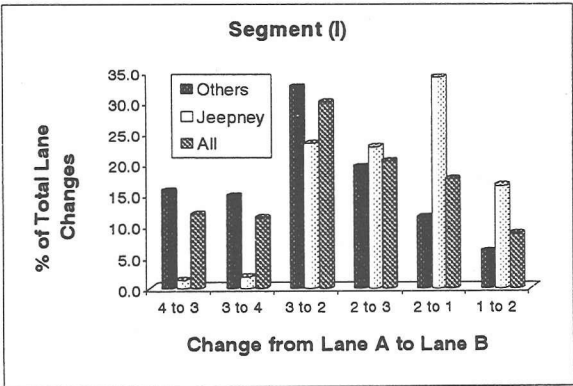


Figure 7: Lane changes along Segment (I).

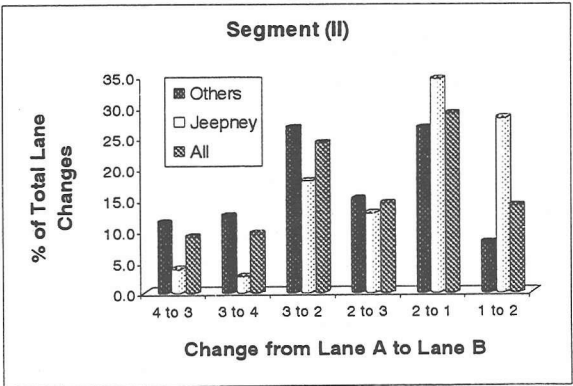


Figure 8: Lane changes along Segment (II).

Along Segment (II), a similar trend for jeepneys is again realized. Moreover, it can be seen from Figure 7 that most lane changing activity occurs between adjacent lanes 1 and 2. This behavior highlights the operation and concentration of jeepneys along the two outermost lanes (i.e., L1 and L2). However, it was also observed that other vehicles are switching towards these lanes. This can be explained by the fact that jeepneys seldom stop along L1 and L2 of Segment (II). As such, other vehicles are encouraged to use these lanes.

To verify the results presented, we look back to a previous study on Metro Manila arterials. Sigua⁷ observed that most private cars and jeepneys actually maintain their lanes with jeepneys concentrating along L1 and L2 of a similar arterial segment (i.e., 4-lane unidirectional). However, majority of lane changes made by jeepneys occurs between these two lanes. The study noted that private cars stayed away from L1 but usually switched to L2. The results for Segment (II) are consistent with these findings.

(6) Lane changing and segment length

Until now, most of the discussions did not mention any effects that may be brought about by the choice of segment length. Meanwhile, lane change frequency has been expressed as the number observed within a unit time period over a specified length of section (i.e., 40 meters). We illustrate in Figure 9 the possible effect of segment length on the measurement of lane change frequency.

It is shown that long segment lengths allows for the measurement of higher lane change frequencies. This is basically due to the available space and in the case of sections with more than 2 lanes in one direction, it is not rare that one vehicle may be observed switching immediately from lane 1 to lane 3 in a single maneuver. It is also possible to observe vehicles switching lanes more than once. Meanwhile, shorter segment lengths tend to limit observations and may only result in the measurement of the minimum number of lane changes corresponding to that length. Such reasoning follows the simplifying assumptions made in the previous section (5).

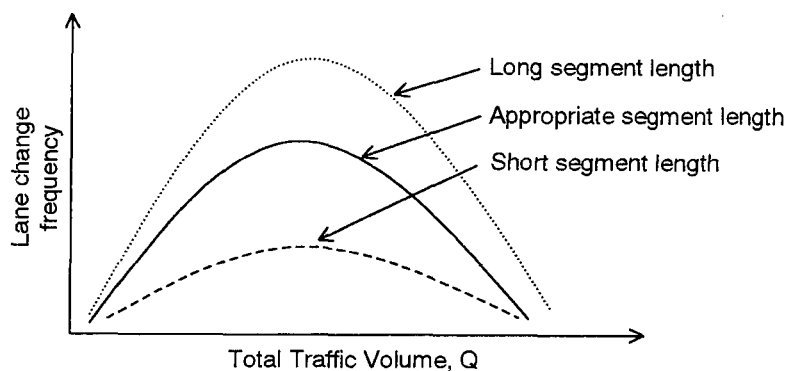


Figure 9: Effects on lane change frequency by varying segment length.

For the purposes of this study, the choice of segment length was influenced by the survey methodology, which relied on video for data collection. 40 meters was deemed adequate because it limited observations to switching between adjacent lanes. Estimating an optimum segment length is not practical because of the many factors that need to be addressed along urban roads. Not the least of these factors is the road network itself, which tends to limit the segment length for study. Note also, that not every arterial midblock will exhibit characteristics comparable to expressways since the traffic flow characteristics along midblocks near major intersections may be entirely dependent on the signals. In these cases, lane changing may be utilized in maneuvering for the purpose of turning (left or right) at the intersection. Therefore, it is important to properly define the unit used for lane changing (e.g., number of lane changes per hour per 40 meters). This definition clarifies the length of road where observations were made and would be easier to compare and understand beside similar data for other locations.

6. Lane Change Mechanism

From the knowledge of the conditions along the jeepney stop environment, it is possible to model the behavior of vehicles along a jeepney stop. The lane change mechanism can be described logically as a sequence of events that are given priority within the driver's decision-making process. This process serves as the basis for the lane change mechanism. However, there is a need to differentiate between the decision-making processes for jeepneys and other vehicles. In this study, we classified vehicles into two groups, jeepney and others. This was both for purposes of simplicity and to isolate the jeepney for study. Thus, in illustrating the conceptual lane change mechanism, we limit ourselves to two diagrams - one for stopping jeepneys and another for all other vehicles. Jeepneys not intending to stop will simply follow the mechanism for other vehicles. Figure 10 illustrates the typical lane change mechanism for stopping jeepneys. For our purposes, it is assumed in the figure that the jeepney is moving along the lane (lane 2) adjacent to the curbside lane (lane 1).

In the case of stopping jeepneys, the decision to change lanes was observed to be secondary to the desire to load/unload passengers. This consideration will be ahead of the perception and preferences regarding lane density and average lane speed. Thus, it comes as no surprise that jeepney drivers would stop in the middle of the road for boarding and alighting operations. However, other stimulus like a sense of discipline or the presence of traffic enforcers may influence the driver to move towards the curbside. As such, the decision-making process reverts to preferences based on the perceived adjacent lane densities and average speeds. The drivers will assess the density or speed of an adjacent lane and decide whether they will change or maintain lanes at that instant. The diagram from Figure 10 divides these primary and secondary preferences under Sequence A and Sequence B, respectively.

The arguments in Sequence B assume that lane density has more weight than lane speed. These stem from findings that there are generally no significant differences in lane speed among the 4 lanes of Segment (II). The average lane speeds along Segment (II) are 19.6 kph, 22.2 kph, 22.7 kph and 22.3 kph for L1 to L4, respectively. Along Segment (I), only the average speeds along L1 (i.e., the curbside lane) and L2 are significantly different. Average speeds along this segment are 21.7 kph, 29.6 kph, 36.2 kph and 41.9 kph, respectively. This compares to significant differences with respect to lane densities for both segments. These lane densities are given as 7 veh/km, 24 veh/km, 25 veh/km and 21 veh/km for L1 to L4 along Segment (I), and 30 veh/km, 34 veh/km, 40 veh/km and 38 veh/km along Segment (II). For the case of other vehicles, including jeepneys that have no intention to stop, the mechanism is shown in Figure 11. Again, vehicles are assumed to be moving along lane 2 with adjacent lanes 1 (curbside lane) and lane 3 (can be assumed as the median lane if we consider a 3-lane unidirectional roadway).

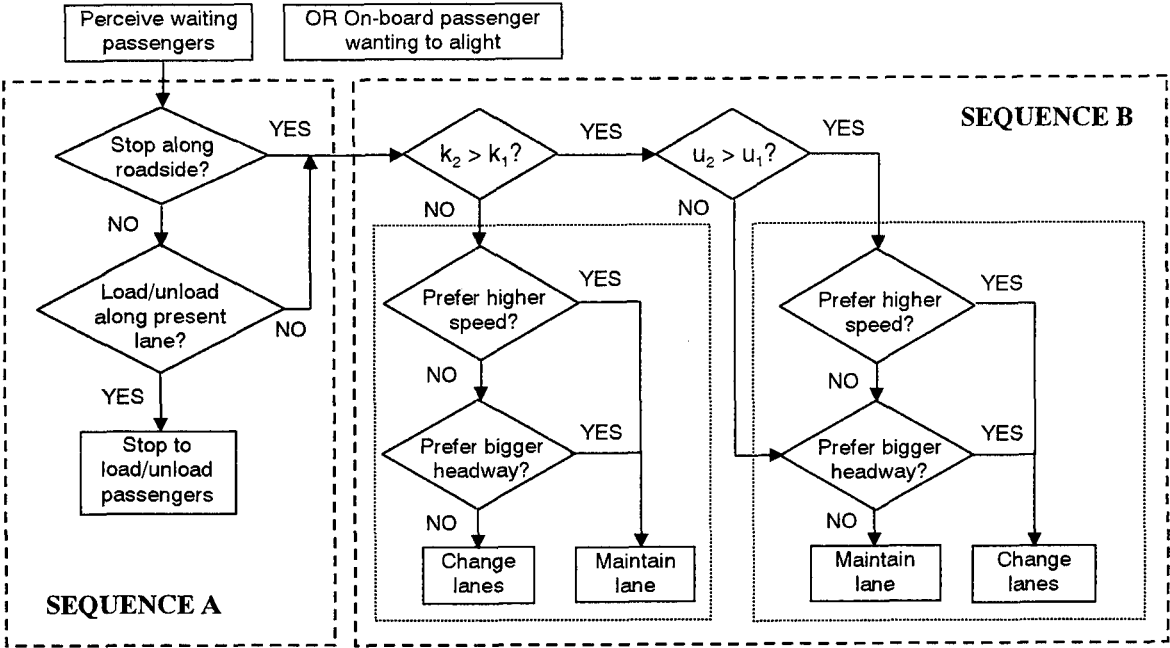


Figure 10: Lane change mechanism for jeepneys.

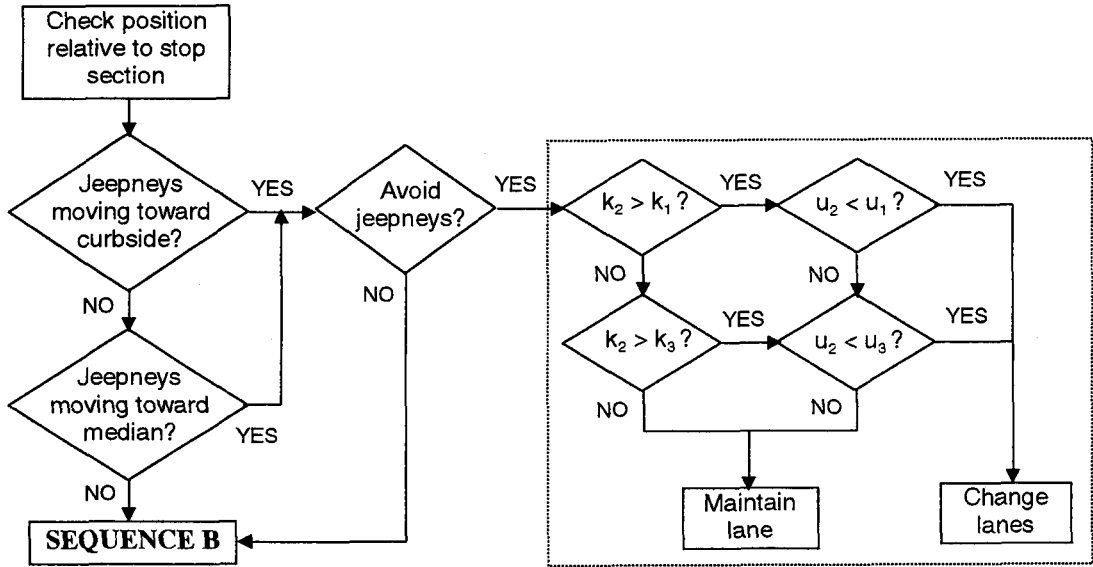


Figure 11: Lane change mechanism for other vehicles.

In Figure 11, the first few arguments assume that stopping jeepneys influence other vehicles in such a way that the latter’s tendency would be to avoid them. Avoidance will entail assessing the situation along both lanes 1 and 3 for the driver to determine if it is possible to switch lanes to the adjacent lanes. Otherwise, he will opt to maintain his lane or try to maneuver

towards lane 1. Note that the sequence of arguments points to lane density as the variable of priority. This is consistent with the logic in Figure 10 as Sequence B refers to the group of arguments labeled as such in Figure 10. The underlying assumption here is that the curbside lane is underutilized that other vehicles may opt to switch towards this lane especially as the traffic volume increases.

It should be noted that our discussions did not mention about the acceptable gaps for lane changing to take place. Such information is needed if one is to analyze the traffic stream using a discrete approach. In this study, we can assume that the acceptable gaps are incorporated with the concept of lane density as discussed in the previous section 5(1). Thus, the higher the density, the less the availability of acceptable gaps for successful lane changes. The lane change mechanisms shown in Figures 10 and 11 form the logical framework for simulating lane changes. While it is possible to express lane changing in probabilistic terms as shown by Heidemann⁴, it is very difficult to establish a general model for predicting or estimating lane change frequency. This argument is especially true if one is to incorporate individual preferences like those exhibited by public transport drivers. As such, simulation provides us with probably the best tool for approximating the frequency of lane changes and its inherent behavior.

7. Applying the results of the analysis

(1) Practical applications

The previous sections have pointed out in certain detail the relationship between lane changing and various traffic characteristics including the total traffic volume, lane density and lane utilization. While more evidence is needed to firmly establish the lane change mechanism over a range of traffic conditions, the influence of lane changing on road traffic flow is strongly suggested by the results presented in this paper. Such results may be applied to several areas of interest, particularly regarding road level of service and the designation of jeepney stops. This will facilitate the development of countermeasures or short-term solutions to promote smoother traffic flow. Moreover, such analysis of lane changing and its results will serve as part of the scientific basis for the formulation of stop criteria and related policies.

The knowledge and comprehension of the fundamental lane changing characteristics are essential to better understand the nature of traffic as this behavior becomes an important factor in the evaluation of LOS. The LOS criteria under the US HCM² are based on several measures of effectiveness. However, while it addresses the delays at intersections and incorporates the travel time to characterize arterial conditions, it falls short in pointing out flow conditions in detail. The guiding concept and assumption here is that under similar conditions in volume, speed and density for two distinct segments, different levels of service exist due to the differences in the traffic mix as well as the amount of activity present. The frequency of lane changing reflects the interactions in the traffic stream and together with information regarding traffic mix (e.g., amount and distribution of jeepneys in the stream) can be used to define LOS more clearly.

Understanding why certain vehicles change lanes and how public transport operation influences the movement of other vehicles also allows us to determine the appropriate locations for jeepney stops. Note that along most Metro Manila roads, stops are not designated and thus lane changing due to jeepney operation is dispersed along the roadway. Meanwhile, lane utilization is linked with lane changing and jeepney operation as discussed under sections 5(4) and 5(5). Knowledge of the concentration and distribution of lane changes combined with other pertinent data serves as a guide to the identification of stop locations. Conversely, stop designation allows us to effect optimization of lane usage and control lane change to sections upstream and downstream of the stop.

(2) Generalizing the application of results

In this study, the jeepney stop served as a focal point of activity along two segments in a Metro Manila arterial. The results presented in the previous sections concentrated on the aspect of lane changing which is concerned with traffic flow. However, caution must be taken against generalizing the findings of this study. It should always be remembered that we are limited by the conditions of the two segments considered. Various other scenarios or situations are in existence, most of which may not even involve the jeepney. In principle, the methodology shown in this paper could be applied to other cases and focusing on the interaction of vehicles under different conditions. In the analysis of lane changing, it is also important to take note of the effects of upstream and downstream sections as well as factors like the influence of intersections and side streets. These have been discussed in the previous sections and such analysis may be accomplished using various techniques. Modelling and simulation may be employed to facilitate such a study provided that sufficient assumptions are established and proper model calibration is achieved. In 7(1) it was mentioned that results would ultimately be used for the development of countermeasures and related policies. Such will be possible only after many other cases (i.e., aside from the ones considered in this study) have been examined. Thus, it would be possible to come up with a general criteria for assessing road LOS and designating stops based on the lane change behavior and other traffic flow parameters.

In retrospect, the study of the traffic flow aspect of lane changing is just one (if not the most important) component of its fundamental characteristics. Research must also focus attention on the behavioral aspect of lane changing. In particular, the decision-making process should be clarified in order to determine if there is a distinction between private and public transport drivers, knowing that each are influenced by different motivations. The results of such studies must then be interpreted together with the analytical results of traffic flow related studies. Therefore, it would be possible to establish a concrete understanding of the lane change mechanism and this knowledge can be applied to most cases.

8. Conclusion

Various aspects of lane changing were discussed in this paper. Firstly, the similarities and differences in lane changing behavior along highways and arterials were clarified. The similarities are found mainly among the reasons for changing lanes and the tendency of lane change frequency as flow increases. The differences are found in the flow characteristics (i.e., presence of public transit activities). Secondly, the relationships between lane changing and other traffic characteristics were analyzed. The interrelationship between lane change, lane utilization, lane density and the total traffic volume was examined. It was found that these variables tend to influence each other in a dynamic manner (i.e., lane change changes occur toward underutilized lanes and lane utilization itself is a product of the number of vehicles switching lanes). Thirdly, the conceptual lane change mechanisms followed by jeepneys and other vehicles were illustrated. These mechanisms are primarily dependent on the driver's decision-making process with jeepney drivers responding to the perception of boarding (along the roadside) or alighting passengers. Finally, applications of the results presented were discussed with focus on the concept of LOS and the designation of jeepney stops. In conclusion, it is emphasized that a comprehensive and more detailed examination of lane changing and the related traffic characteristics is necessary to firmly establish the fundamental characteristics of lane changing under general conditions.

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In the analysis of lane changing along jeepney stops, it is necessary to consider the influence of public transport operation on the lane change patterns and traffic characteristics along the study segments. Results show that relationships observed for highways can be replicated along arterials and that there is a dynamic relationship between lane changing and lane utilization. The basic concept here is that the frequency of lane changes increases with increasing traffic flow until such a time when the concentration of traffic restricts the probability of changing lanes and the frequency declines as flow further increases. The lane change mechanism can be expressed in terms of driver preferences while still being dependent on the perceived adjacent lane speeds and densities. The importance of studying lane changing is emphasized and directions for future research are discussed.

マニラ市でのジープニイ停留所付近における車線変更挙動に関する研究*

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一般道路における車線変更挙動は高速道路の場合と類似性はあるながらも、より複雑で、交通信号機や公共交通機関の運行などの影響を大きく受ける。ジープニイ停留所近辺における車線変更特性の分析を行う場合には、公共交通機関つまりここで対象としたジープニイの影響を適切に考慮することが肝要である。分析に通じて、車線変更回数は交通量とは上凸の関係にあること、車線変更と車線利用率には密接な関係が認められることが知られた。また一方、車線変更のメカニズムは隣接車線の速度と密度に依存しながらも運転者の選好に影響されることも推定された。さらに車線変更分析の重要性を論じるとともに今後の研究の方向性について記した。