FACTORS IN THE DEVELOPMENT OF LEVEL OF SERVICE CRITERIA FOR PHILIPPINE CONDITIONS

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Abstract: Level of service (LOS) describes the operational conditions within a traffic stream based on appropriate measures of effectiveness (MOE) and the perception of motorists and passengers. The prevailing practice is to use LOS values derived from the US Highway Capacity Manual. This practice is both impractical and unrealistic. It is important to define local conditions and to determine the appropriate values of the MOEs. This paper identifies and discusses the requirements for establishing a level of service criteria sensitive to Philippine conditions. It also presents the use of supplementary MOEs such as the frequency of lane changing and lane utilization.

1. INTRODUCTION

The state of traffic along a particular transportation facility is qualitatively described using a parameter termed as the level of service (LOS). The LOS is determined according to an appropriate measure of effectiveness (MOE) as well as the perception of people using the facility. While LOS criteria have been firmly established and published under highway capacity manuals in different countries, the question of whether these standards can be applied directly to the cases of other countries still stands. It is a given that their development took into consideration their own inherent characteristics incorporating the behavior of their people.

The factors that would have a significant effect on the determination of the LOS may be grouped into three categories. These are the traffic flow characteristics, human behavior and the enforcement of traffic rules and regulations. Traffic flow characteristics refer to the measurable quantities such as those that can be derived from the fundamental traffic parameters: speed, flow and concentration. Human behavior particularly pertains to the qualitative aspect of why certain decisions and/or preferences are made (e.g., why there is a propensity for lane changing among jeepney drivers). The enforcement category would include assessment of compliance to certain rules, and the monitoring of actual conditions as well as the enforcement activity itself.

This paper will deal with the first group or category thereby focusing on the measurable or quantifiable aspect of developing the level of service criteria. It will also deal with the proposal of employing other pertinent traffic variables to arrive at a more accurate description of the prevailing traffic conditions.

2. NECESSARY ADJUSTMENTS AND NEW CONCEPTS

Conventional level of service criteria dwells mainly on the relationships among traffic volume, average speed and vehicle concentration. This is primarily true for cases where the LOS is estimated for road segments since for the case of intersections, delay is the designated measure of effectiveness. However, a critical shortcoming for the conventional LOS is that it is not sensitive to interactions in the traffic stream. It is a fact that while the present LOS criteria is able to indicate the general state of traffic in terms of various measures of effectiveness incorporating the fundamental variables, this only gives us the idea of an average state of the stream.

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. To illustrate this concept, we give an example concerning two segments with similar geometry (e.g., both have same curvature, lane width, number of lanes, and grade) and traffic flow conditions. Given the values of q and u (which can easily be estimated in the field), we can easily compute for the corresponding road density. If a difference in the speed-flow curve (e.g., different traffic mix or different amounts of lane changing) exists, we can be able to differentiate the LOS between the two conditions. This case is shown in **Figure 1** where the projected volume q_1 corresponds to two different values of density. Hence, it is possible to determine different LOS for each condition represented by the two curves, respectively.

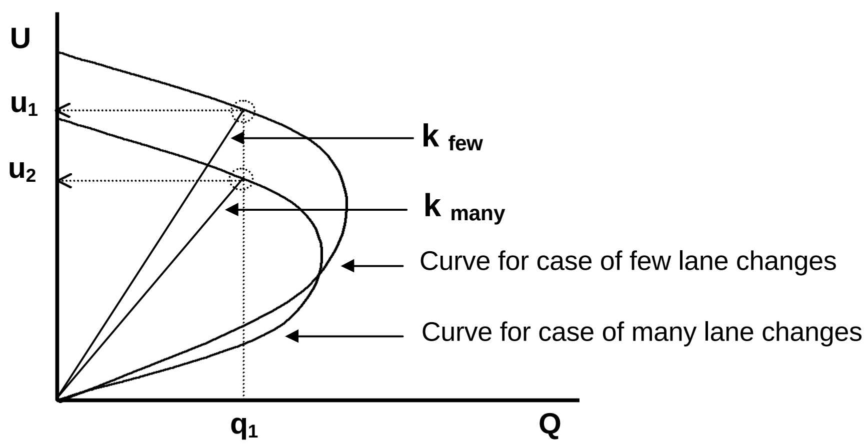

Figure 1. Discriminating LOS with different conditions in the speed-flow curve. (Case I)

Note from Figure 1 that it is already clear from the onset that there is a significant difference in the speeds corresponding to q_1 (i.e., u_1 and u_2) for the two curves. Therefore, there will be no need to try to distinguish the LOS among the two curves with respect to a variable like, for example, lane change frequency. A problem arises if we have the same values of q, u and k for two segments like the case shown in

Figure 2. As a result, it follows that they would have the same LOS under the criteria mentioned in the previous sections.

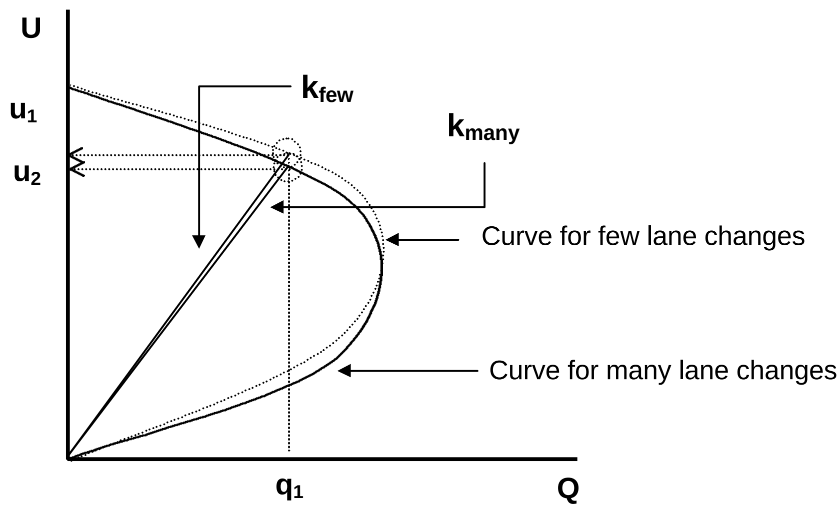

Figure 2. Discriminating LOS with different conditions in the speed-flow curve. (Case II)

In the example in Figure 2, the proximity of the two values for density (i.e., k_{few} and k_{many}) may indicate the same LOS values using the conventional standard. In reality, however, some differences exist due to factors like the traffic mix, operation of public transit vehicles and the frequency of lane changing. Thus, it can be said that within the context of conventional LOS, it is possible to differentiate among various sub-conditions in the state of flow and it is apparent that additional variables like lane usage, lane change, and the percentage jeepney can be utilized to describe these conditions. The introduction of additional measures of effectiveness such that they will reinforce conventional parameters paves the way for the consideration of supplementary LOS criteria. This is discussed in the succeeding section.

3. DEVELOPMENT OF A SUPPLEMENTARY LOS CRITERIA

3.1 Absolute and Comparative LOS Criteria

The conventional LOS criteria can be termed as absolute criteria since they are applied to evaluate distinct cases with comparison only to an ideal situation. This should also be true for supplementary LOS criteria. The main requirement would be the introduction of a parameter or parameters other than those already explicitly included in the existing set of criteria. For example, among the variables that can be considered from the perspective of jeepney operation are lane change frequency (i.e., within a specified segment length) and the amount of jeepney in the traffic stream at a given time.

The development of comparative criteria will require the formulation of some rules as well as assumptions to govern the evaluation or comparative procedure. The prerequisites of such criteria are based entirely on the physical or geometric properties of the segments rather than on the traffic characteristics. It should be pointed out that it is the traffic characteristics that we want to compare in the first place in the process of assessing level of service. These are the following:

a) Same number of lanes,
b) Approximately same curvature,
c) Approximately same gradient,
d) Similar land use of adjacent areas

Note that the term "approximate" is used loosely and there is still a need to determine the values that will define the boundaries for the LOS values. Obviously, such prerequisites will prevent comparison of dissimilar segments. That is, we cannot compare activity along a 4-lane segment with that of a 2-lane segment.

3.2 Supplementary Measures of Effectiveness

Two of the more useful parameters that can be considered to assess the conditions along a roadway are lane utilization and lane change frequency. If we examine the lane usage of particular road sections, it is easy to visualize the concentration of traffic. Meanwhile, lane change frequency provides a measure of the amount of interaction along the roadway. Figures 3 and 4 shows the lane utilization for two typical sections along an urban arterial in Metro Manila. The segments have the same geometric and traffic characteristics. The adjacent land use for each segment, which may have a significant effect on the behavior of traffic, is very similar.

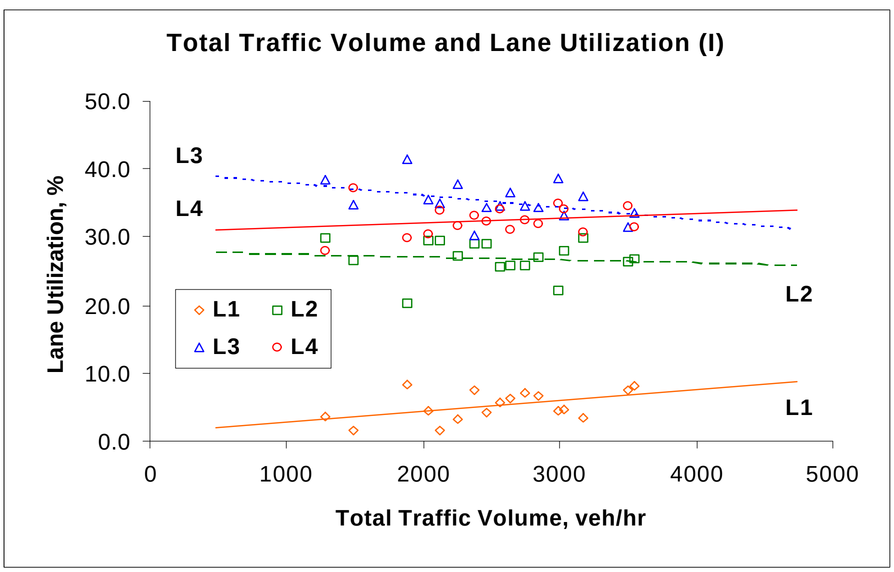

Figure 3. Relationship between total traffic volume and lane utilization along an urban arterial (Segment I).

It is evident from the comparison of **Figures 3** and **4** that there exists the possibility that given the same volume, similar LOS values may be derived using conventional criteria. This would be realized if it is found that there are no significant differences in the average speeds for either road segments. Nevertheless, it is clear that average (i.e., per lane) or total traffic volume alone may not be sufficient to describe the distribution of traffic among the lanes. Underutilization of lanes such as the case of lane 1 in **Figure 3** indicates decreased capacity for the other three lanes and thereby promotes congestion. Thus, lane use may provide a better picture of prevailing conditions compared with density, which is based on the average values of volume and speed.

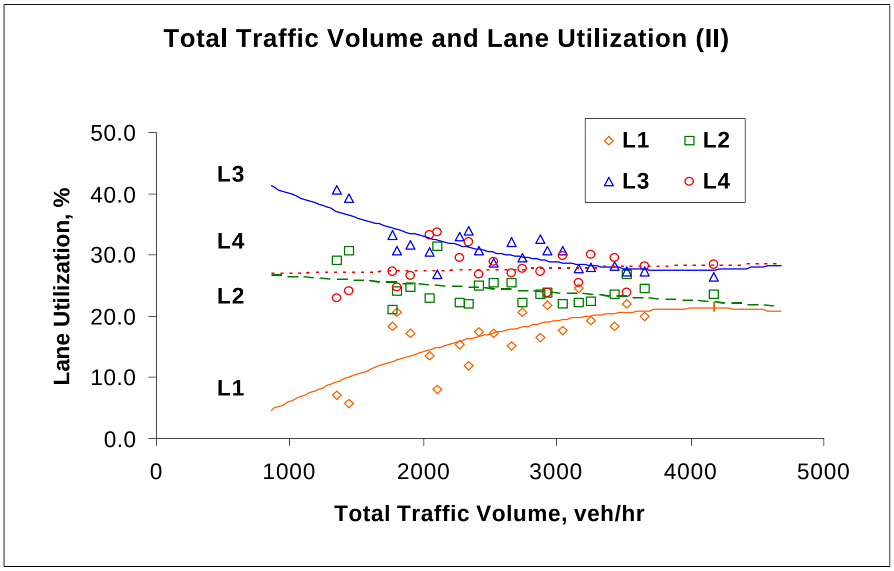

Figure 4. Relationship between total traffic volume and lane utilization along an urban arterial (Segment II).

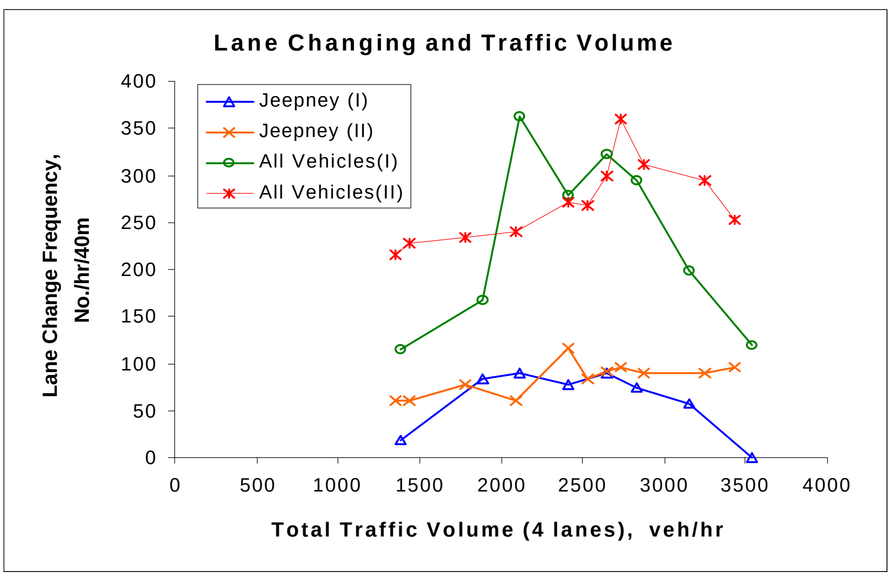

Figure 5. Relationship between total traffic volume and lane change frequency along an urban arterial (Segments I and II).

Figure 5 shows the variation in lane change frequency with respect to increasing traffic volume at the segments considered for the previous two figures. It can be seen that the frequency of lane changing may vary significantly with respect to the traffic volume. This may be attributed to a number of factors like the traffic mix and the operation of public utility vehicles (i.e., jeepneys). For example, there is the tendency for jeepneys to linger along the curbside lane, inducing other vehicles to switch lanes to bypass stopped and stopping jeepneys. As such, jeepney lane changing frequencies may be similar for both segments while the response of other vehicles may significantly differ as shown in the figure.

4. ADVANTAGES AND DISADVANTAGES OF USING SUPPLEMENTARY MEASURES OF EFFECTIVENESS

At this point it is necessary to determine the acceptability of using alternative measures of effectiveness. It is required that the advantages and disadvantages of using such MOE's be identified. Table 1 shows the strengths and weaknesses of supplementary LOS (SLOS) criteria.

Table 1 Strengths and weaknesses of supplementary LOS criteria.

Strengths	
☑	Can be used to evaluate imbalance in lane use and excessive lane changes;
☑	Sensitive to the interactions in the traffic stream (e.g., effects of paratransit operations;
☑	Allows for more detailed treatment of the traffic stream without getting to the microscopic level of analysis.
Weaknesses	
☒	Needs to satisfy certain conditions in traffic flow, particularly its dependence on the fundamental traffic parameters;
☒	Requires additional data to supplement basic parameters.

Despite the obvious advantages of using alternative criteria for the assessment of road LOS (i.e., more detailed treatment of the conditions along the traffic stream), there is a need to address its weaknesses. In particular, the requirement for additional data renders the criteria unattractive. It was pointed out that among the required data to establish SLOS are the frequency of lane changes and the amount of jeepney in the traffic stream. While it is easy to determine the percentage of the volume comprised by jeepneys, lane change frequencies may vary depending on the segment characteristics. This presents the planner/engineer the additional task of formulating the appropriate methodology for quantifying interactions along the traffic stream.

5. CONCLUSIONS AND RECOMMENDATIONS

This paper discussed the necessity of developing LOS criteria that is appropriate for the Philippine setting. Factors significant to such development were identified and focus was given on the traffic characteristics that need to be evaluated in order to yield a more accurate assessment of traffic flow conditions.

Two traffic variables were proposed for use as supplementary measures of effectiveness. These are lane utilization and lane change frequency. Lane utilization gives a description of the distribution of traffic among the lanes. This parameter provides a better estimation of vehicular concentration than the density values derived from average volume and speeds. Lane change frequency provides a measure for the amount of interaction taking place along a roadway. The amount of interaction reflects the ease or difficulty (i.e., driving comfort) by which a motorist may proceed along the section given vehicles weaving around him.

The advantages and disadvantages of using supplementary data were also discussed. This was taken from the perspective of acceptability especially among those who will use the parameters for planning and assessment. While the level of detail that can be provided by supplementary data is significant for evaluation purposes, this may be outweighed by the prospect of collecting additional data as well as formulating the appropriate methodology or procedure for estimating such.

It is expected that future researches will help clarify the relevance of supplementary LOS for the analysis of arterial traffic characteristics. It is necessary to provide more evidence in relation to the effects of the amount of activity in the traffic stream. Moreover, there is a need to establish the threshold values or criteria for requiring the use of supplementary traffic characteristics. Further studies should also be undertaken to investigate the logic behind certain behavior and inputs that lead to preferences like those pertaining to lane usage and lane changing. Lastly, it is important to focus on the shortcomings with respect to enforcement, as it is always a critical factor that ultimately influences behavior and therefore the traffic characteristics along transportation facilities.

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