Multimodal Arterial Level of Service

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ABSTRACT

The concept of quality of service from a user perspective of a transportation facility or service is a fundamental concept of the *Highway Capacity Manual*. In determining quality of service of an arterial, six levels of service thresholds are defined in the *Highway Capacity Manual* based on average through vehicle speed. In fact, the arterial level of service is not so much describing the quality of transportation service provided by the facility, as much as the quality of service provided to through motorized vehicles (i.e., automobile users). Although this quality of service concept does address the primary mode of travel, it does not address the quality of service the arterial provides to other major potential modes: transit, pedestrian and bicycle.

Proposed levels of service in the 2000 *Highway Capacity Manual* for pedestrians and bicyclists are essentially based on how crowded the respective modal facilities are. However, recent research on pedestrian and bicycle quality of service indicate that the most important factors are lateral separation of the mode from motorized vehicles, and motorized vehicle volume, speed, and type. For scheduled fixed route bus users the most important factors for quality of service along an arterial are frequency of transit vehicles (headways and hours of service) and pedestrian access.

This paper presents methods of determining the level of service to scheduled fixed route bus users, pedestrians and bicyclists on arterials as well to through vehicles. It is based on level of service research for the individual modes, with a more comprehensive arterial approach based on research being conducted in Florida. It also presents Florida's proposed multimodal arterial quality of service approach at a planning level and how future editions of the *Highway Capacity Manual* could be structured to take a more multimodal analysis approach.

1. INTRODUCTION

Throughout the U.S. there is a desire to evaluate the quality of transportation service of its roadways from a multimodal perspective. The Transportation Equity Act for the 21st Century (TEA-21) and its predecessor the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) call for the main streaming of transit, pedestrian, and bicycle projects into the planning, design and operation of the U.S.'s transportation system. In addition to knowing what are the levels of service for automobile users, the quality of service to transit, pedestrian, bicycle, and truck users along U.S. roadways is also desired. This paper presents an overview of recent research efforts in the determination of transportation quality of service for the automobile, bus, pedestrian and bicycle modes on urban arterials and how future (after 2000) editions of *Highway Capacity Manual* (HCM) (TRB, 1997; TRB, 1999a) could be structured to take a multimodal analysis approach instead of an automobile approach.

2. THE *HIGHWAY CAPACITY MANUAL* AND USER ORIENTATION

The HCM is recognized as the primary source document on the capacity and quality of service for highways in the U.S. The first edition of the HCM was in 1950 and strictly dealt with the capacity of highways. Since that time the document has undergone significant improvements with major restructuring and rewrites in 1965, 1985 and another set for publication in 2000. The concept of six levels of service to describe the quality of highway operations using an A–F letter scale first appeared in the 1965 HCM. The levels of service were presented as being based on perceptions of the individual road user and the document recognized that the user has little realization of traffic volume itself. The level of service concept caught on so well that not only do highway engineers use the concept, but lay people (i.e., elected officials) to this day routinely use it to describe highway operations.

Historically, the HCM analyses have built upon points (e.g., signalized intersections) and segments (e.g., parts of freeways not affected by interchanges). The basic structure (see Figure 1) of the 2000 HCM is to build upon point and segment analyses, leading to facility analyses (e.g., arterial facilities approximately one to five miles in length), and culminating in corridor (parallel facilities) and areawide analyses of highways.

Just as the HCM has expanded in breadth of roadway analyses beyond points and segments it has also expanded in the number of modes addressed. Bus transit was introduced in 1965. Pedestrians (and to a lesser extent bicycles) were introduced in 1985 and incorporated into new chapters. The 2000 HCM will feature significantly improved chapters on bus transit, pedestrians, and bicycles. These modal analyses are not incorporated into the other chapters; rather they are treated distinctly. Conceptually, the modes are brought together at the corridor or areawide level of analysis.

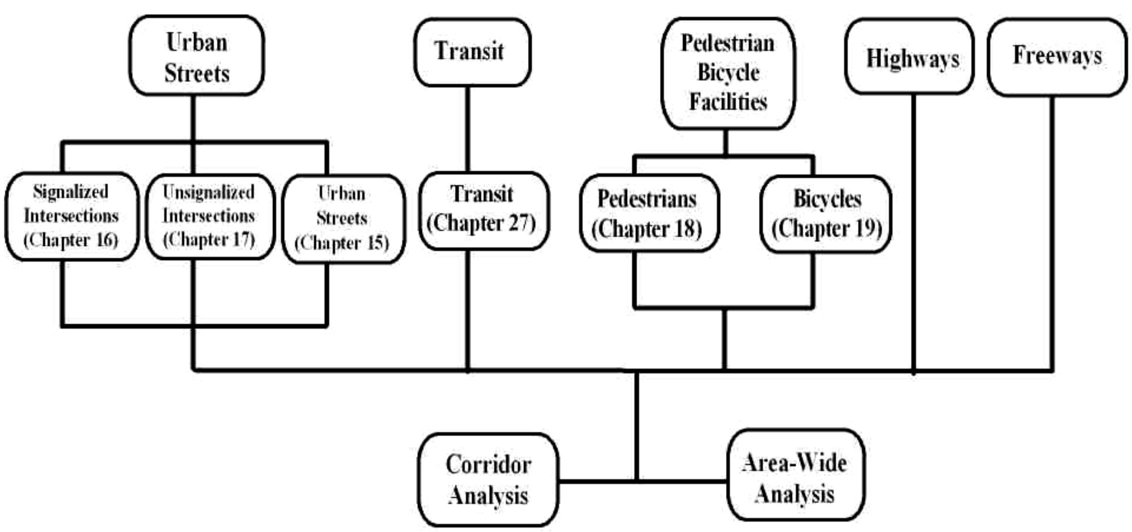


FIGURE 1 Draft 2000 *Highway Capacity Manual* Highway System Structure.

The term “highway” is not defined in the HCM and is used in various ways. The three predominant uses are (1) in a generic sense describing a roadway, (2) as a uninterrupted flow non-freeway facility, and (3) as a mode of travel. This author believes the scope of the HCM properly consists of analyses of modes operating within roadways' rights-of-way. A "highway" should be considered as a roadway with all transportation facilities (e.g., lanes, bus pull-outs, paved shoulders, sidewalks, signals) within the right of way. Major modes of travel possibly served by a highway include automobile, bicycle, bus, pedestrian, and truck modes.

The arterial chapter, perhaps more than any other chapter, with the possible exception of the signalized intersection chapter, should be the centerpiece of a multimodal user orientation. Automobiles, buses, pedestrians, bicycles, and trucks are all potential users of an arterial. The modes also interact with each other such that improvements in quality of service to one mode may improve or lower the quality of service for another mode. For example, higher automobile speeds and corresponding higher quality of service on the arterial may result in lower quality of service to bicyclists on the arterial. Currently, considerations of the non-auto modes are handled as adjustment factors in determining the levels of service for automobiles rather than adjustments to each other.

3. QUALITY OF SERVICE

Before proceeding, the relationship between "quality of service" and "level of service" is presented. As used in this paper "quality of service" is a user based qualitative assessment of how well a service or facility is operating. "Level of service" is a quantitative breakdown of the "quality of service" of a service or facility into six letter grade levels, with "A" describing the highest quality and "F" describing the lowest quality. Although the term "level of service" is widely accepted in the U.S., in general, "quality of service" is more proper when the discussion is about the operations of a highway unless a specific "level of service" (e.g., "A") is being addressed. In determining the quality of service for transit users, pedestrians and bicyclists, the presence of similar modal users is not a significant factor. Existence (availability) of the service or facility is the foremost determinant of quality of service for these other modes.

4. ARTERIAL/AUTOMOBILE QUALITY OF SERVICE

The 2000 HCM will contain a chapter titled "Urban Streets," reflecting a change from the title of "Urban and Suburban Arterials" which appears in the 1997 Update to the HCM. Although labeled as "Urban Streets," the analytical methodology only addresses the mobility function (represented by speed) and not the access function, which is so important to the majority of urban streets. Thus, this chapter can still be considered primarily as an "arterial" chapter. Throughout the remainder of the this paper "arterial" will be used as opposed to the more generic "urban streets" term.

Arterials are generally characterized as facilities with lengths of at least 1 mile in downtown areas and at least two miles in other areas. Signalized intersection spacing ranges from as little as 300 feet in downtown areas to as long as two miles, and with turning movements at intersections which usually do not exceed 20 percent of total traffic volume.

Arterial quality of service in the HCM is based on the average travel speed for through vehicles. That speed is strongly influenced by the number of signals per mile and the average intersection control delay. Although the signalized intersection chapter includes adjustment factors to the saturation flow rate for bus blockage, heavy vehicles, pedestrians and bicyclists, the arterial chapter does not consider the quality of service to transit users, pedestrians, and bicyclists.

Two principal components make up the total time that a vehicle spends on the arterial facility: arterial running time and control delay for the through movement. The average travel speed for an arterial is defined by the "2000 HCM equation 15-6"

$$S_A = \frac{3600\ L}{(T_R * L) + \sum d} \tag{1}$$

where:
S_A = segment or facility average travel speed
L = segment or facility length
T_R = total running time per unit of distance on all segments, and
$\sum d$ = summation of control delays for through movements at all signalized intersections.

To compute the running time in a segment, the analyst must know the arterial classification, segment length, and free flow speed. To calculate the summation of intersection control delays the analyst needs to determine individual intersection delays. Input needed for each signalized intersection fall into three main categories: geometric conditions, traffic conditions, and signalization conditions. Depending on the level of analysis, default values may be appropriate.

5. TRANSIT QUALITY OF SERVICE

In this authors opinion the recent publication of the *Transit Capacity and Quality of Service Manual* (TCQSM) (TRB, 1999b) represents a significant advancement to the assessment of transit capacity and quality of service analysis and it is an outstanding work product. A major part of the TCQSM is devoted to quality of service analysis and it provides a valuable contribution to the literature. There appears to be a general consensus among leaders of the HCM and TCQSM (Danaher et al., personal communications, 2000) that the TCQSM should be the primary document where transit capacity and quality of service concepts and analytical procedures are presented. Transit material in the 2000 HCM is a subset of the TCQSM. Given this there probably is merit to integrating transit applications and sample problems in the HCM in the different highway facility chapters.

The TCQSM addresses many forms of transit. As used in this paper "bus" or "transit" refers to scheduled fixed route bus service. For bus service the TCQSM also uses the letter grade scheme ranging from A to F. Its quality of service framework is shown in Table 1. In this framework noteworthy is whereas the HCM has five basic levels of analysis (i.e., point, segment, facility, corridor, areawide), the TCQSM has three levels: transit stop, route segment, and system. Thus, the HCM and TCQSM basic structural levels

TABLE 1 *Transit Capacity and Quality of Service Manual's* Quality of Service Framework

	Service and Performance Measures		
Category	Transit Stop	Route Segment	System
Availability	• Frequency[1] • Accessibility • Passenger loads	• Hours of service[1] • Accessibility	• Service coverage[1] • % person-minutes served • Indexes
Quality	• Passenger loads[1] • Reliability	• Reliability[1] • Travel speed • Transit/auto travel time	• Transit/auto travel time[1] • Travel time • Safety

[1]Service measure which defines the corresponding levels of service in HCM Chapter 27.

do not match perfectly. The analysis of route segments is most analogous to arterials. In terms of length, transit route segments range from an "arterial segment" (e.g., signalized intersection to signalized intersection) to an "arterial facility"; the transit route segment maybe as short as an arterial segment from one signalized intersection to the next or may include the whole arterial facility analysis, say three miles long.

In the framework note that "quality" and "availability" are treated as distinct. It was felt that availability was so important that it should be broken out as separate from "quality," which in this case is used to describe comfort and convenience. Reading the table it would appear that the service measures of route segments would be hours of service for availability and reliability for quality. However, from discussions with the lead authors (Ryus and Danaher, personal communication, 1999), the service measures to the left also apply to the analysis level on the right. For instance, frequency is not only the service measure for transit stops, but also a service measure for route segments and the system. Similarly, hours of service is to apply to route segments and the system.

Although this author thinks highly of the TCQSM's quality of service analysis, improvements are needed. Using Table 1 as a base, Table 2 is this author's recommended quality of service framework. This author believes that from a user's perspective "availability" or the equivalent term "existence" is the primary service measure assessing "quality of service" to a scheduled fixed route bus user. The other performance measures are all important, but the most important consideration is how often the bus comes by in the specified time period. To put a formal distinction between "quality" and "availability" is inappropriate from a user's point of view; in general, to a user the single most important factor in determining the quality of service is bus availability (i.e., bus frequency).

TABLE 2 Recommended Transit Quality of Service Measures Framework

Transit Stop	Route Segment	System
• Frequency[1] • Hours of Service[2] • Pedestrian Level of Service • Accessibility • Passenger Loads • Amenities • Reliability	• Frequency[1] • Hours of Service[2] • Pedestrian Level of Service • Accessibility • Reliability • Travel Speed • Transit/Auto Travel Time • Passenger Loads	• %Person-Minutes Served[1,2] • Service Coverage • Transit/Auto Travel Time • Frequency • Hours of Service • Pedestrian Level of Service • Accessibility • Reliability • Passenger Loads • Travel Speed • Travel Time • Safety

[1]Service measure for an hourly analysis
[2]Service measure for a multi-hour/daily analysis

Note in Table 2 this author has included "pedestrian level of service." In this author's opinion, the second most important factor in transit quality of service is pedestrian level of service. In developing the TCQSM the position taken was that pedestrian quality of service measurement techniques were not sufficiently developed. As shown in the next section of the paper, it is believed they have been developed and should be given greater consideration in the next update of the TCQSM.

6. PEDESTRIAN QUALITY OF SERVICE

6.1 HCM Approach

The 1997 update of the HCM has a chapter on pedestrians with space (square feet or meters per pedestrian) serving as the service measure. Thresholds for speeds, flow rates, and volume to capacity ratios are also provided. The 2000 HCM will feature an improved chapter on pedestrians and will include level of service thresholds for the same performance measures.

A fundamental question remains as to whether the HCM really addresses quality of service of a pedestrian based on a user's perspective. Does the average pedestrian perceive space and speed as the primary measures of effectiveness along an urban street? Research (SCI, 1998) suggests that pedestrians do not. Pedestrians largely evaluate the service provided on arterials and other urban streets based on the simple existence of sidewalks. Other important factors include lateral clearance from motorized vehicles, volume and speed of motorized vehicles, the type of motorized vehicles (i.e., large trucks), and physical barriers separating motorized vehicles from pedestrians (e.g., on-street parking). While crowdedness (space) and speed may be relevant in older downtown areas of large cities, those performance measures are not the overriding concerns in most situations.

6.2 Recommended Approach

In the author's opinion, the Roadside Pedestrian Conditions Model (SCI, 1998) and its modifications since initial development is the best methodology developed to date for assessing the pedestrian quality of service provided by arterials. From a user's point of view it is believed to be far superior to the HCM methodology technically and in general approach. Also many of the model's input variables are commonly used by traffic engineers and are shared with the automobile analysis techniques of the HCM. It is applicable to all urban streets, not just arterials, and has been applied in Florida and large U.S. cities with favorable results.

In the Roadside Pedestrian Conditions Model pedestrian levels of service are based on four variables with relative importance ordered in the following list: lateral separation of pedestrians from motorized vehicles, motorized vehicle volumes, motorized vehicle speeds, and large truck volumes. Lateral separation, the most important variable, is calculated based on eight factors including the existence of a sidewalk. Each of the four variables is weighted by relative importance and a level of service numerical score, generally ranging from 0.5 to 6.5, is determined and converted to level of service letter grade. Thus, unlike the determination of automobile level of service in the HCM in which there is only one service measure (speed), pedestrian level of service is determined based on multiple factors, weighted by importance, converted to a numerical score, and changed to a level of service grade based on numerical thresholds.

7. BICYCLE QUALITY OF SERVICE

7.1 HCM Approach

The 1997 update of the HCM has a limited chapter on bicycles, and does not address bicycle quality of service. It essentially deals only with some capacity issues. The 2000 HCM will feature a significantly improved chapter on bicycles, including level of service analysis. Quality of flow as opposed to quality of service is the concept used with "hindrance" serving as the service measure. Hindrance is in terms of the fraction of users over a path experiencing hindrance due to passing and meeting maneuvers. Bicyclists operating on arterials is also addressed with average travel speed of the bicyclists serving as the service measure.

While the 2000 HCM represents a significant improvement for bicycling analysis, a fundamental question remains as to whether it really addresses quality of service based on a user's perspective. Does the average bicyclist perceive hindrance and speed as the primary measures of effectiveness along an urban street? Research (Landis et al., 1997) suggests they are not. Bicyclists largely evaluate the service provided on arterials and other urban streets based on the width of the outside travel lane, presence of a paved shoulder or bicycle lane, and the volume of motorized vehicles. Other important factors include the speed of motorized vehicles, the type of motorized vehicles (i.e., large trucks), and pavement conditions. Under the vast majority of circumstances the degree of crowdedness is unimportant and bicyclists' speed is not that relevant.

7.2 Recommended Approach

In the author's opinion, the SCI's (Landis) Bicycle Level of Service Model and its recent modifications is the best methodology for assessing the bicycle quality of service provided by arterials. From a user point of view it is believed to be far superior to the HCM methodology technically and in general approach. It is based on field research and is linked to HCM motorized vehicle techniques. It also appeared superior to other methodologies developed to date. It is applicable to all urban streets, not just arterials, and is believed to be the most widely used technique in the U.S. having been applied to over 35,000 miles of U.S. roads.

Bicycle levels of service are based on five variables with relative importance ordered in the following list: average effective width of the outside through lane, motorized vehicle volumes, motorized vehicle speeds, large truck volumes, and pavement condition. Average effective width is largely determined by the width of the outside travel lane and striping for bicyclists, but also includes other factors. Each of the five variables is weighted by relative importance and a level of service numerical score, generally ranging from 0.5 to 6.5, is determined and converted to a level of service letter grade. Thus, like the pedestrian level of service approach, bicycle level of service is determined based on multiple factors, weighted by importance, converted to a numerical score, and changed to a level of service grade based on numerical thresholds.

8. INTEGRATING MODES INTO A MULTIMODAL ARTERIAL QUALITY OF SERVICE ANALYSIS

8.1 2000 HCM Approach

As stated previously, automobile, bus, pedestrian, and bicycle movements along an arterial are treated separately in the HCM 2000. Although labeled in the 2000 HCM as the arterial (i.e., Urban Streets) chapter, Chapter 15 is actually a chapter dealing with automobiles operating on arterials. The 2000 HCM addresses bus quality of service at a route segment level and also addresses the impact of buses on arterial operations. The pedestrian and bicycle chapters have small sections devoted to urban streets with level of service based upon travel speed. For both modes, the speed level of service criteria are generally based upon urban street level of service criteria for motor vehicles, with thresholds set at similar percentages of base speed. Essentially, there is no chapter in the HCM that addresses arterial operations from a multimodal perspective and there is no clear guidance as how to evaluate an arterial from a multimodal perspective. Each mode is treated separately with minimal linkage to the other modes.

By keeping the modal analyses separate, applications of the HCM lead to single modal perspectives rather than a more comprehensive transportation perspective. For example, if an arterial is to be upgraded a designer may consult the 2000 HCM in calculating the level of service. However, he/she would be only calculating the LOS for automobile users. He/she would not be considering impacts of different operating speeds and laneage to pedestrians and bicyclists.

Structuring the HCM into modal chapters rather than multimodal chapters also may lead to a misleading interpretation of how the transportation system user actually views the quality of service provided. This is most notable for the analysis of pedestrians and bicyclists. Essentially, the HCM assumes that sidewalks and bicycle facilities exist and quality of service is based on the interactions among users of the same mode. However, the mere existence of sidewalks, and bicycle lanes and outside paved shoulders are more fundamental to pedestrians and bicyclists than the quality of flow within those facilities. Reflecting the findings in the TCQSM, the 2000 HCM transit chapter properly recognizes the preeminence of bus frequency and hours of service in determining the quality of service to transit users.

8.2 Recommended HCM Restructuring

The HCM need not be structured this way of separating the modes, and in this author's opinion should not. The arterial chapter methodology and software could be structured so that the level of service for automobile, bus, pedestrian, and bicycle modes be calculated simultaneously, and as factors affect one mode they would simultaneously affect another mode. This would allow the calculation of level of service for all four modes rather than just the automobile mode and would allow the view of the arterial as a "transportation" facility rather than just an "automobile" facility.

Most of the 1997 Update and 2000 HCM chapters have planning applications that make use of default values or simplifying assumptions to the operational methodologies. With regards to the arterial chapter, the Florida Department of Transportation (FDOT) has developed software (FDOT, 1998a) to implement the planning techniques of the 1997 Update to the HCM and has developed maximum service volume tables applicable throughout the state (FDOT, 1998b). Corresponding planning applications and service volume tables in the 2000 HCM do not exist for the pedestrian and bicycle modal chapters and partially exist for the transit chapters. For planners and engineers working in transportation planning, having such techniques would be most helpful on a technical basis and to interact with the public.

9. FLORIDA'S PROPOSED APPROACH FOR A MULTIMODAL ARTERIAL LEVEL OF SERVICE ANALYSIS

9.1 Recommended Modal Approaches

Based on a 1998 preliminary analysis, FDOT determined that the techniques that have the greatest potential use for a multimodal analysis approach of arterials are the 2000 HCM (TRB, 1999a) for automobiles, the TCQSM (TRB, 1999b) for buses, SCI's Roadside Pedestrian Conditions Model (SCI, 1998) and its updates for pedestrians, and SCI's Bicycle LOS Model (Landis, 1997) and its updates for bicycles. All these techniques are essentially operational models; however, it was believed that all could be simplified to be useful at two planning levels. The first level is for detailed planning in which the analyst could reach a good level of accuracy without using the full operational models for each mode. The second level is for generalized planning by developing generalized service tables, comparable to FDOT's generalized maximum service volume tables for automobiles. These generalized tables could be used as a first cut approximation for the quality of service offered to transit users, pedestrians, and bicyclists along arterials.

Clearly, the HCM is the foremost recognized analysis tool for automobile quality of service analysis. The arterial planning application of the 2000 HCM, FDOT's arterial planning software (ART-PLAN) and FDOT's generalized maximum service volume tables are considered excellent to address the automobile mode at both a detailed planning level and at a generalized planning level. It was also believed that FDOT's ART-PLAN software could be relatively easily updated to incorporate bus, pedestrian, and bicycle movements to provide a more comprehensive multimodal quality of service approach for evaluating arterials. As part of ART-PLAN the arterial facility is already segmented into shorter segments. Motorized vehicle volumes are inputs and vehicle speeds are calculated based on traffic (e.g., volume), roadway, and control conditions. This set of segment structure, motorized volumes, and speeds are all likely to be useful for bus, pedestrian, and bicycle analyses.

For scheduled fixed route bus transit the TCQSM techniques, supplemented by FDOT's Transit Level of Service software program (FDOT, 1998c), provide excellent operational tools. Because of data requirements and lack of clear planning techniques, however, current HCM transit and TCQSM planning techniques are generally considered inadequate.

The Roadside Pedestrian Conditions Model approach appears the best for assessing pedestrian quality of service. It also appears well suited to address a more comprehensive multimodal approach for assessing arterials. By adding sidewalk data the pedestrian level of service could be calculated at a planning level either with generalized tables or with ART-PLAN.

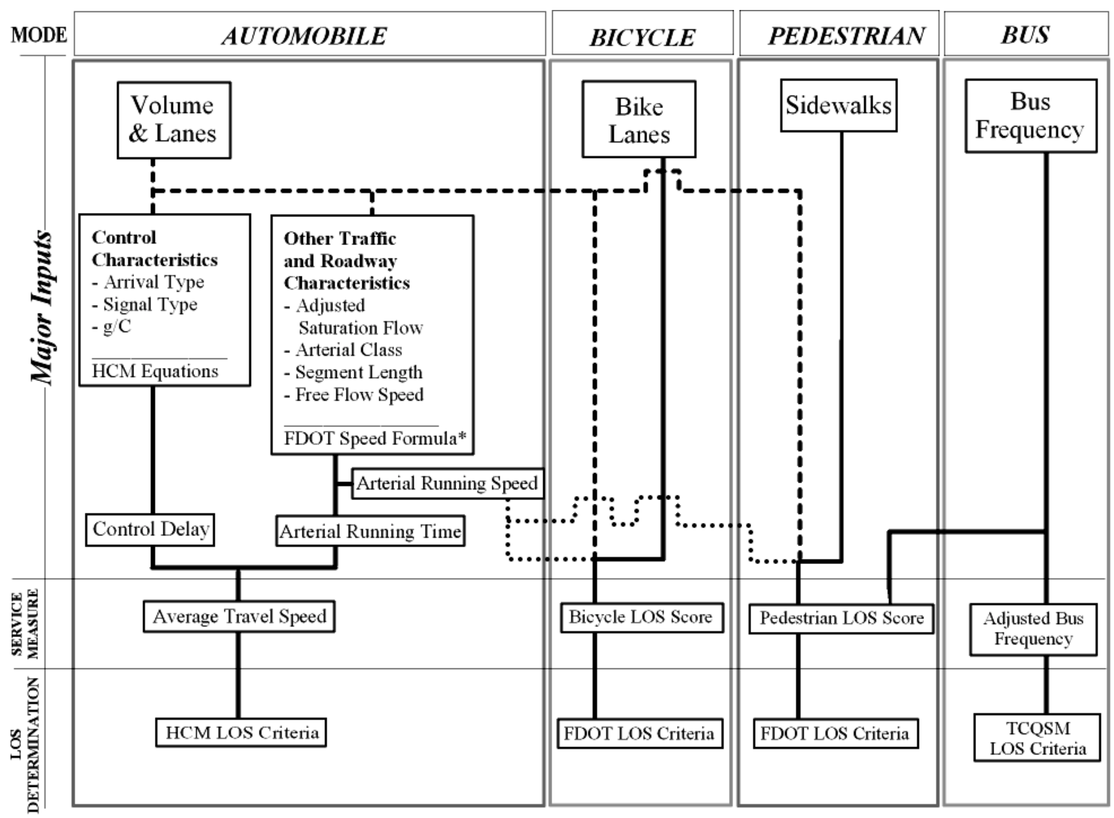
The Bicycle Level of Service Model approach appears the best for assessing bicycle quality of service. It also appears well suited to address a more comprehensive multimodal approach for assessing arterials. The primary missing elements for planning analyses using generalized tables or ART-PLAN are width of the outside travel lane and whether there is a bicycle lane or paved shoulder.

9.2 FDOT Multimodal Arterial Research and Approach

Before committing to the multimodal arterial approach suggested by FDOT's preliminary analysis, FDOT has also taken other actions to test implementation concepts. First was the initiation of a research project with the University of Florida to investigate the multimodal arterial quality of service approach and to apply it in some test cases. Second was to get a review of the merits of an arterial multimodal level of service approach by the current and a former chair of Urban Streets Subcommittee of the Highway Capacity and Quality of Service Committee. Third was to fund a field research project for pedestrian quality of service in the Pensacola area. This research was emphasized because of the four modes of travel it is believed the pedestrian level of service is the least researched.

Figure 2 provides an overview of how level of service for the automobile, bus, pedestrian, and bicycle modes would be determined. Only major inputs are shown in the figure and, in general, the flow of the figure is from the upper left to the lower right. Traffic, roadway, and control characteristics are inputs and the traditional automobile level of service for an arterial is determined. Motorized volume and roadway lane data, the intermediate calculation of arterial running speed, and the presence of bicycle lanes and sidewalks are important inputs in the calculation of level of service for bicyclists and pedestrians. In turn, bus frequency and pedestrian level of service are the major inputs in determining bus level of service. As illustrated in the figure, the level of service for all the modes flows naturally from existing automotive techniques with relatively few major inputs and additional calculation steps.

Based on the above considerations FDOT is intending to update its arterial planning software and generalized maximum service volumes tables to include automobile, bus, pedestrian, and bicycle modes. The ART-PLAN software would be updated to reflect the latest updates to the 2000 HCM and would feature the option to include bus, pedestrian, and bicycle level of service determinations. Bus level of service thresholds would be based primarily on bus frequency, adjusted by the pedestrian level of service along the arterial, and other transit and pedestrian considerations. Pedestrian level of service thresholds would be based primarily on the existence of sidewalks and adjusted by the number of trucks and other motorized vehicles, and speed of and separation from motorized vehicles. Bicycle level of service thresholds would be primarily based on the width of the outside travel lane and whether it includes a designated bicycle lane or paved shoulder to accommodate bicyclists, and adjusted by the number of trucks and other motorized vehicles, and speed of the motorized vehicles.



** Update to 1997 HCM Table 11-4, approved for post 2000 HCM editions.*

FIGURE 2 Simplified flow chart of multimodal level-of-service determinations.

Thus, FDOT intends to update its arterial planning level of service techniques and provide documentation with its next edition of its *Level of Service Handbook* (FDOT, 1998b), scheduled for publication in 2001. Tentatively the title of the document is *Quality of Transportation Service (QUOTS) Handbook*. In Florida it will then serve as the source document for multimodal planning analysis in the state. Implementing the QUOTS Handbook is also intended to serve a test case for consideration by the Highway Capacity and Quality of Service Committee in its next update after 2000 of the HCM.

10. SUMMARY

This paper has presented an overview of leading methodologies for determining automobile, scheduled fixed route bus, pedestrian, and bicycle quality of service analyses along an arterial from users' points of view. It recommends that the arterial be viewed as a transportation facility that serves all those modes and that an arterial analysis should involve calculation of the level of service for each of the modes. Issues remain on implementing a multimodal analysis approach to evaluate arterials, but current techniques exist which can help bring about such an approach. The Florida Department of Transportation is beginning to apply these techniques along many roadways and in many areas of the state and hopes the techniques may benefit others throughout the U.S.

Benefits from altering the current structure of the HCM towards a multimodal approach for facilities include a clearer definition and role for the HCM. It could indeed be structured as the *Highway Capacity Manual* as opposed to the "automobile" capacity manual. From a planning, design and operational approach a restructuring would better allow the facility to be viewed as a multimodal facility and allow the influence of various factors to affect each of the modes. From a policy level the Transportation Equity Act for the 21st Century (TEA-21) emphasizes multimodalism. By structuring the HCM to address the major modes for various highway facilities, it would be more compatible with TEA-21.

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