Florida's Mobility Performance Measures and Experience

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ABSTRACT

This paper presents an overview of mobility performance measures, descriptions of the Florida Department of Transportation's (FDOT) reported mobility performance measures, as well as the authors' perspectives on their usefulness and lessons learned.

FDOT has taken a strong position supporting performance based programs. As such, FDOT has an extensive performance measures program covering all aspects of transportation conditions in Florida and FDOT achievements. Since the movement of people and goods is at the heart of all transportation agencies' efforts, mobility performance measures are the key to transportation performance based processes. To adequately address mobility, its four dimensions must be addressed: quantity of travel, quality of service, accessibility, and capacity utilization. Furthermore, multiple performance measures within those four dimensions of mobility need to be developed and used to adequately describe mobility at the national, state and local levels. FDOT's 15 primary mobility performance measures are presented and their calculation is explained.

The authors and FDOT have been tracking and reporting on most of FDOT's 15 performance measures for over ten years. The paper includes the authors' perspectives on management's and operating units' use of the performance measures, administrative requirements for performance measures, and a look to the future of mobility performance measures. Further discussion is placed on the quality of service measures, delay, travel time reliability and Level of Service (LOS).

INTRODUCTION

A former Secretary of the Florida Department of Transportation (FDOT) stated the agency measures itself for two reasons: 1) to make sure FDOT is spending the taxpayers' money as efficiently as possible and 2) to try to improve how we provide transportation to the people of Florida. FDOT has continuously taken a strong position supporting performance based programs. It has an extensive performance measures program covering all aspects of transportation performance in Florida and FDOT achievements. The cornerstone of FDOT's performance measures is its mobility performance measures program. After all, providing mobility for people and goods is transportation's most essential function.

FDOT's initial guidance for the development of its mobility performance measures program was adopted in 1998, with its publication of a Mobility Performance Measures Handbook. [(1)] Since 2000, FDOT has been reporting key mobility performance measures annually in its Highway Data Sourcebook [(2)]. This paper presents an overview of mobility performance measures, descriptions of FDOT's reported mobility performance measures, upcoming measures and discussions of their usefulness, lessons learned, and other items. It is intended to be a broad and motivational overview rather than a handbook for calculations.

FDOT'S MOBILITY PERFORMANCE MEASURES PROGRAM

In the late 1990's, as part of the state's Congestion Management System (i.e., Mobility Management Process), key FDOT staff consulted numerous national experts on the topics of congestion and mobility. From this effort, FDOT's Mobility Performance Measures Handbook was developed. It laid the foundation for FDOT mobility performance measures and their calculation.

Although numerous definitions of mobility exist, they all involve the movement of people and goods. To fully address mobility, four dimensions must be considered and addressed:

- Quantity of travel
  - Magnitude of use of a facility or service
  - More people and goods transported, the better
- Quality of travel
  - Traveler satisfaction with a facility or service
  - User experience is usually most important to the traveling public
- Accessibility
  - Ease with which travelers can engage in desired activities
  - It may not matter how good the service is if it is hard to get it
- Capacity utilization
  - Quantity of operations relative to capacity
  - Indicates how efficiently resources are being used; should be neither too high (no allowance for increased demand) nor too low (wasted resources)

Using only one of the dimensions of mobility can lead to an inadequate assessment at either a project or system-wide level. Furthermore, there are multiple performance measures within each dimension that help frame the mobility picture and can lead to better decisions.

Note that these dimensions apply to all modes. Largely because of the dominance of the automobile mode and highway performance measures, this paper concentrates on mobility measures associated with highways. The following are measures FDOT uses for system-wide reporting:

- Quantity:
  - Vehicle miles traveled
  - Person miles traveled
  - Truck miles traveled
  - Transit ridership
- Quality
  - Average travel speed
  - Vehicle delay
  - Person delay
  - Level of Service
  - Travel time reliability
- Accessibility
  - Proximity to major transportation hubs
  - Percent urban miles with sidewalks
  - Percent urban miles with paved shoulders / bicycle lanes
- Capacity utilization
  - Vehicles per lane mile
  - Percent of miles heavily congested
  - Percent of travel heavily congested
  - Duration of congestion

FDOT has been reporting and tracking trends on most of these mobility performance measures since 2000. It uses a combination of field data and calculation programs to develop the numerical results. Travel time reliability, pedestrian accommodations, and bicycle accommodations are the three measures with most recent development activities. Travel time reliability was first reported in 2011, and using FDOT's calculation program, travel time reliability was calculated for the state's freeway system back to 2005. FDOT's roadway database is still being refined with the intent that the bicycle and pedestrian accessibility measures (as well as a Level of Service assessment for those modes) will be reported by 2012.

DESCRIPTION AND CALCULATION OF MEASURES

FDOT maintains an extensive traffic monitoring program consisting of two types: (1) continuous monitoring at selected locations using permanently installed equipment, and (2) coverage counts at many temporary sites using portable equipment. The approximately 300 permanent counters that continuously monitor traffic are placed at specific locations throughout the state to record distribution and variation of traffic flow by hour of the day, day of the week, and month of the year. They cover a spectrum of facility types (freeways, signalized arterials, two-lane and multilane highways) and area types (urbanized, urban and rural areas). Data from these count stations used in performance measure calculations reflect seasonal fluctuations, weekday/weekend fluctuations, heavy vehicle counts, and peak hour/period traffic distributions

under both congested and uncongested conditions. Coverage counters are used at about 5,000-6,000 locations, collecting hourly data for 24 to 48 hours, and are deployed 1 to 4 times a year. They provide volume estimates for each segment of highway on Florida's 12,088 mile State Highway System, and are adjusted for seasonal variations using factors from the permanent counters.

Traffic variables are especially important to the calculation and reporting of over half of FDOT's mobility performance measures. They include annual average daily traffic (AADT), weekday/weekend adjustment factors, peak season factors, and analysis hour factors (K). AADT is the total volume on a highway segment/section for one year divided by the number of days in the year. Most FDOT planning and preliminary engineering applications begin with AADT volumes. Since most traffic congestion occurs in urbanized areas during weekdays and different parts of the state are subject to significantly different seasonal fluctuations, weekday and peak season distributions are important. The analysis hour factor is the ratio of the traffic volume in the study hour to the AADT. There are numerous potential study hours and K factors depending on the application.

The following presents a brief overview of each mobility performance measure and how it is calculated.

QUANTITY MEASURES

Vehicle miles traveled (VMT) – Vehicle miles traveled is the total number of miles traveled by vehicles using the State Highway System or various subcomponents of it. Its calculation is simply the summation of each roadway segment's AADT times its length.

Person miles traveled (PMT) – Person miles traveled is the total number of miles traveled by people using the State Highway System or various subcomponents of it. Its calculation is the summation of each roadway segment's VMT times average vehicle occupancy. For system-wide reporting, FDOT uses an average figure for each county based on the 1995 National Transportation Survey [(3)]

Truck miles traveled (TMT) – Truck miles traveled is the total number of miles traveled by heavy vehicles using the State Highway System or various subcomponents of it. Its straight forward calculation is the summation of each roadway segment's VMT times the applicable heavy vehicle factor. This factor is determined by collecting vehicle classification data at over 2,000 locations and determining the percent of vehicles that have more than two axles and six wheels (including buses). Road segments without vehicle classification data are assigned a truck percent based on their similarity to roadway segments with the same functional classification.

Transit ridership – Transit ridership is the total number of persons traveling on scheduled fixed route bus or rail services provided in Florida. Each transit agency provides the information to FDOT which sums them for a statewide value. This mobility measure is the only one that is not part of the Highway Data Sourcebook.

QUALITY MEASURES

Average travel speed – Average travel speed is the average daily speed of vehicles using the State Highway System or various subcomponents of it. It is calculated based on speed / traffic flow relationships from the most recently available Transportation Research Board Highway Capacity Manual (HCM) [4] and FDOT's Quality/Level of Service (Q/LOS) Handbook [5] using information such as traffic volume, hourly traffic distributions, speed limit, number of lanes, facility type, signal density and area type. Speeds are calculated on an hourly basis weighted by hourly volumes for each roadway segment/section.

Vehicle delay – Vehicle delay is the total number of hours traveled by vehicles per day or in the peak hour at less than FDOT's level of service average travel speed thresholds for the State Highway System or various subcomponents of it. In general, FDOT's speed thresholds represent corresponding HCM Level of Service C and D speed thresholds in rural and urban areas, respectfully. Its calculation is the summation of each roadway segment's hourly difference in travel time between travel time at average travel speed and at the speed threshold, weighted by the number of vehicles in the hour.

Person delay - Person delay is the total number of hours traveled by people at less than FDOT's speed threshold for the State Highway System or various subcomponents of it. Its calculation is the summation of each roadway segment delay multiplied by average vehicle occupancy. For system-wide reporting, FDOT uses an average occupancy figure for each county based on the 1995 National Transportation Survey.

Level of Service – As used here, Level of Service as defined by the HCM is the quantitative stratification of the quality of service to auto travelers into six letter grades (A the best and F the worst) during the peak hour of travel. FDOT uses generalized service volume tables based on HCM criteria associated with facility type, area type and traffic volumes. Level of Service is calculated and reported by roadway centerline miles for the State Highway System or various subcomponents of it.

Travel time reliability – FDOT's primary travel time reliability measure is the percent of on time vehicle arrivals during the peak travel hours for the state's freeway system or various subcomponents of it. It is calculated based on freeway speed / traffic flow relationships from the HCM and Q/LOS Handbook using information such as traffic volume, hourly traffic distributions, number of lanes, area type, probabilities of adverse weather, probabilities of blocking and non-blocking incidents, and probabilities of work zones.

ACCESSIBILITY MEASURES

Proximity to major transportation hubs – Currently, this measure is under development. Conceptually, it would be the percent of the state's population within a selected distance of major airports, seaports and rail hubs.

Percent urban miles with sidewalks – Percent urban miles with sidewalks is the percent of the State Highway System non-freeway miles in 5,000+ population areas with sidewalks. Sidewalk coverage is a characteristic of FDOT's Roadway Characteristic Inventory.

Percent urban miles with paved shoulders / bicycle lanes - Percent urban miles with paved shoulders / bicycle lanes is the percent of the State Highway System non-freeway miles in 5,000+ population areas with at least 4 feet of paved and delineated shoulder width for bicycle travel. Paved shoulders / bicycle lanes coverage is a characteristic in FDOT's Roadway Characteristic Inventory.

CAPACITY UTILIZATION MEASURES

Vehicles per lane mile – Vehicles per lane mile represents the average density of vehicles during the peak hour of travel on the State Highway System or various subcomponents of it. Its calculation is the summation of each roadway segment's number of peak hour vehicle miles traveled divided by number of lane miles.

Percent of miles heavily congested – Percent of centerline miles heavily congested is the percent of centerline miles of the State Highway System, or subcomponents of it, operating at Level of Service E or F during the peak travel hour. Its calculation is the summation of each roadway segment centerline miles operating at Level of Service E or F divided by the total number of miles.

Percent of travel heavily congested - The percent travel under heavily congested conditions is the percent of vehicle miles traveled for each segment of the State Highway System, or subcomponents of it, operating at Level of Service E or F. It is calculated based on speed / traffic flow relationships from the most recent HCM and Q/LOS Handbook using information such as traffic volume, hourly traffic distributions, number of lanes, facility type, and area type. Level of Service is calculated on an hourly basis weighted by hourly volumes for each roadway segment/section. Its calculation is the summation of each roadway system's vehicle miles traveled operating at Level of Service E or F divided by the total vehicle miles traveled for the system.

Duration of congestion – Duration of congestion is the average number of hours per day that roads on the State Highway System, or subcomponents of it, operate at Level of Service E or F, weighted by lane miles. Its calculation is based on speed / traffic flow relationships from the most recent HCM and Q/LOS Handbook using information such as traffic volume, hourly traffic distributions, number of lanes, facility type, and area type.

PRESENTATION OF RESULTS

Each of the mobility measures is calculated in tabular form and typically reported annually at:

- The state level
- For specific area types
    - All counties with 1,000,000 population (Florida has 7)

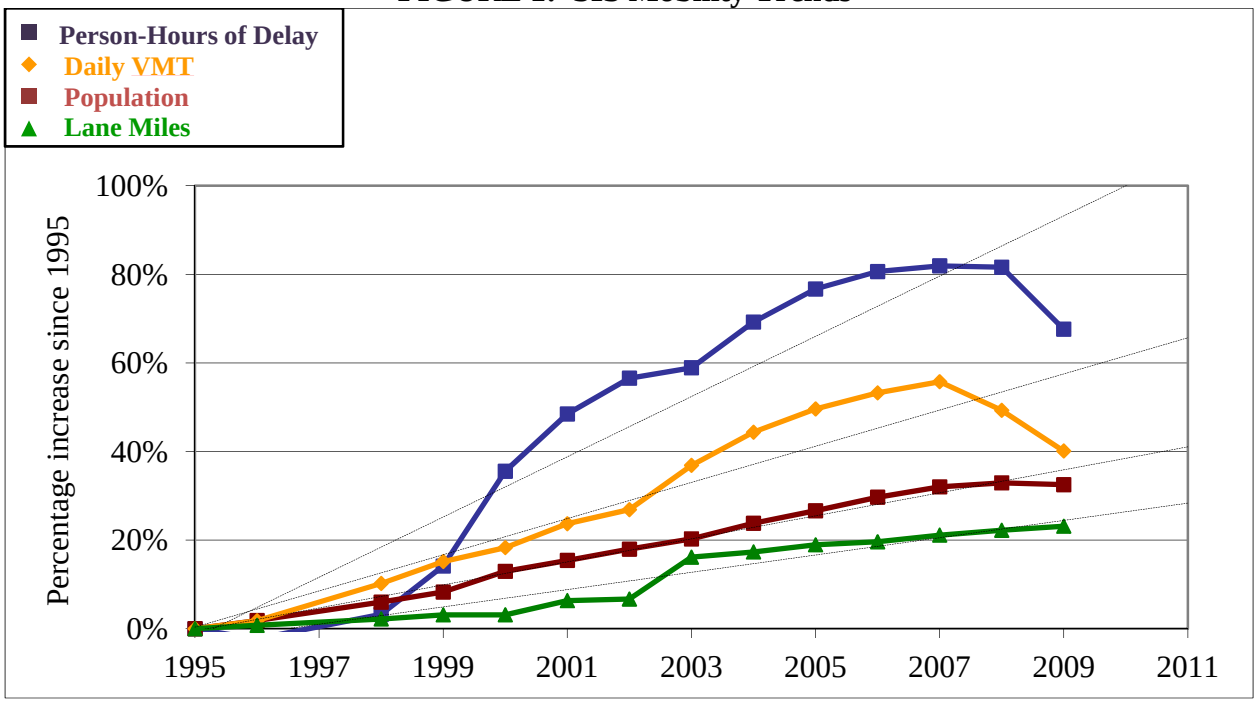
- All other urbanized areas (Florida has 26 urbanized areas with at least 50,000 population)
- All rural areas

FDOT does not report at the individual county or roadway level. Although FDOT believes it has one of the most accurate methods for predicting and reporting mobility measures for system-wide reporting, FDOT does not believe they are precise enough for individual county or roadway analyses. Comparisons between specific areas are generally considered neither useful nor desirable, and other more refined traffic analysis tools are more appropriate for individual roadway analyses.

Representative mobility performance measure graphics used by FDOT appear in Figures 1-4. All the figures present information on the Strategic Intermodal System (SIS), Florida's system of transportation facilities of current and emerging statewide and interregional significance. The SIS makes up approximately 1/3 of the State Highway System centerline mileage.

Figure 1 has been the main graphic used by FDOT management to show travel trends and the resulting need for additional revenue to keep congestion at reasonable levels. The rate of growth in delay and vehicle miles traveled (VMT) compared to available lane miles in the graphic has been very effective in illustrating highway needs. Note the graphic includes a quantity measure (VMT), a quality measure (delay), and indirectly includes the concept of capacity utilization (lane miles and heavy congestion). Also, note the major drops in delay and VMT as a result of the recent major national and state recessions.

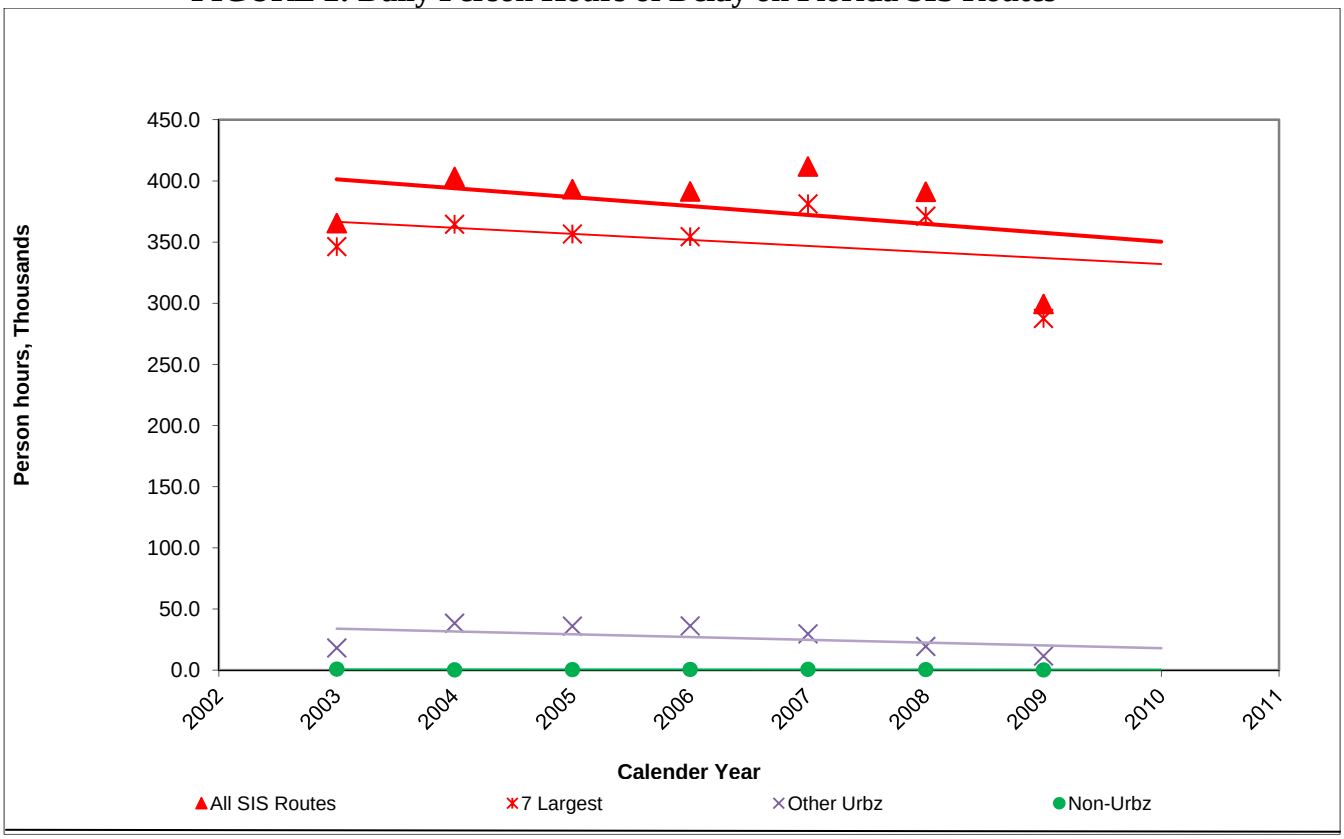
FIGURE 1: SIS Mobility Trends



"Delay" is a popular mobility performance measure. Interesting conclusions can be obtained from Figure 2. While approximately 60% of all of Florida's population live in its seven largest counties, approximately 87% of the delay on the SIS occurs in those counties. Minimal delay exists in Florida's rural areas; delay is not a good performance measure to address mobility

in those areas. Better measures would include Level of Service (i.e., percent time spent following on two-lane highways, density on freeways) and an accessibility measure.

FIGURE 2: Daily Person Hours of Delay on Florida SIS Routes



"Congestion" is another popular mobility measure. It can be measured as either percent centerline miles or person miles traveled at a lower quality than Level of Service D. In Figure 3, again note how dramatically it dropped in 2008 and 2009 as a result of the recession. Also, consider the shape of the trend line with and without those years.

FIGURE 3: Percent Mileage Congested in Peak Hour on Florida SIS Routes

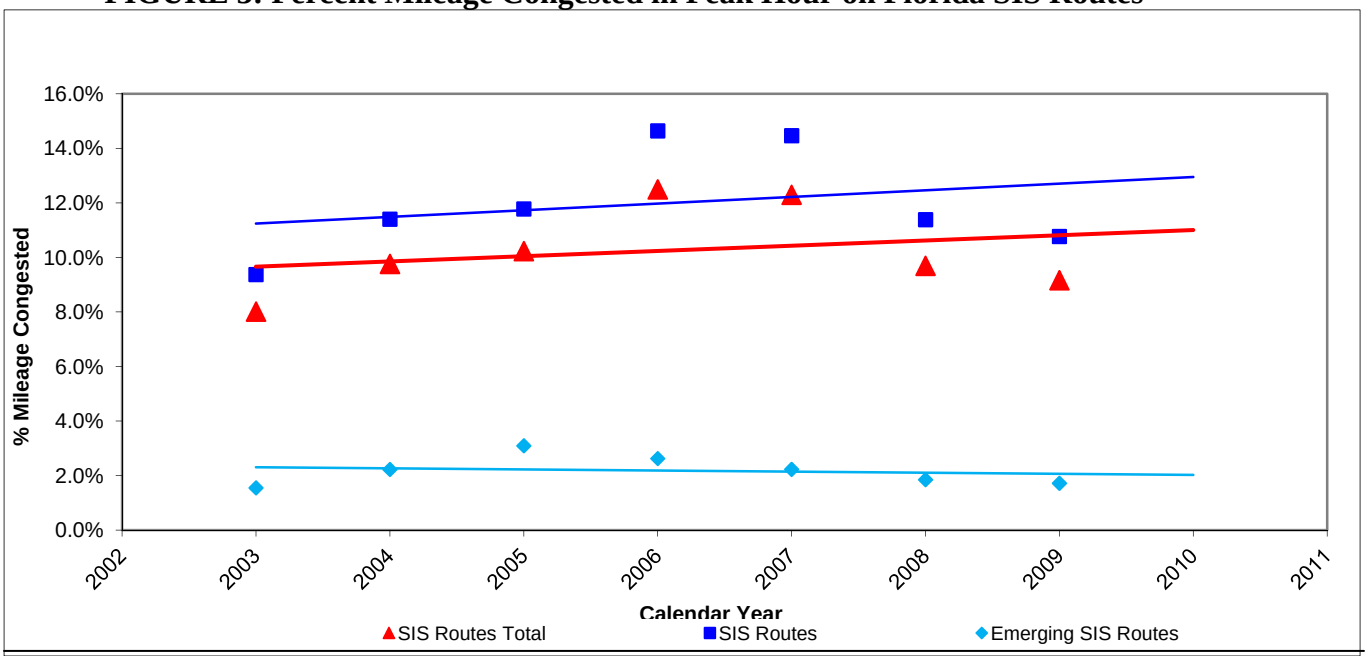
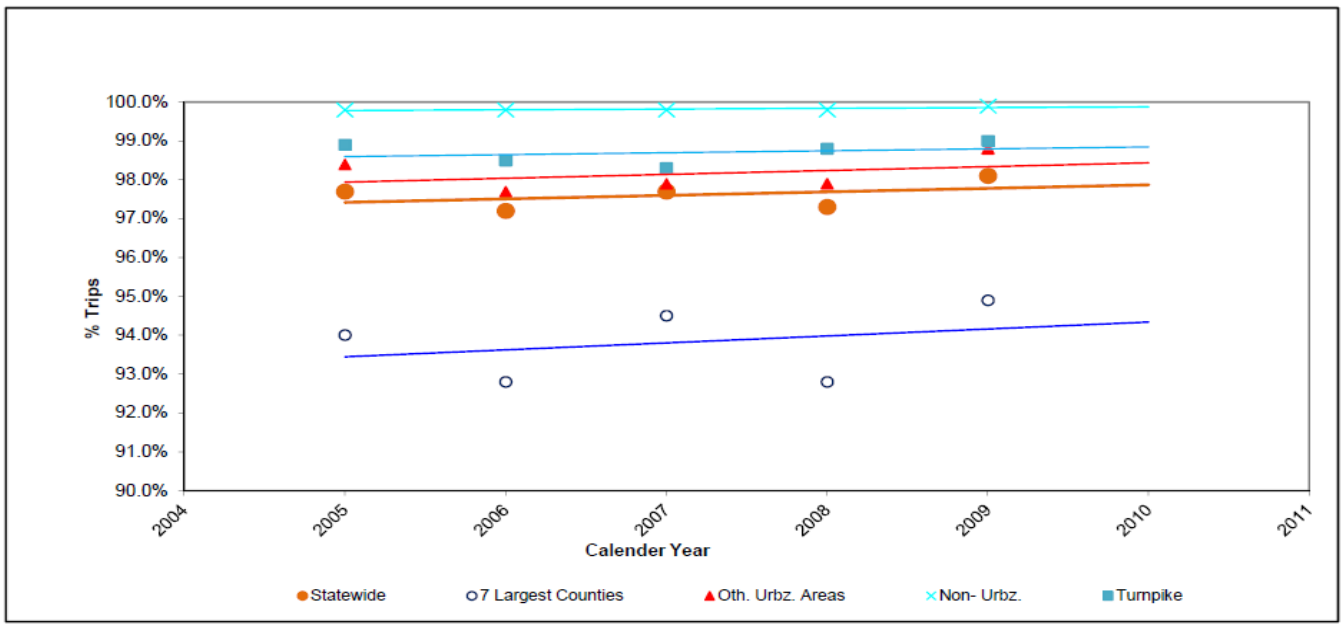


FIGURE 4: Percent Trips with On-Time Arrival

Peak Period

	2005	2006	2007	2008	2009					Annual Growth
Statewide	97.7%	97.2%	97.7%	97.3%	98.1%	0.0	0.0	0.0	0.0	0.1%
7 Largest Counties	94.0%	92.8%	94.5%	92.8%	94.9%	0.0	0.0	0.0	0.0	0.2%
Oth. Urbz. Areas	98.4%	97.7%	97.9%	97.9%	98.8%	0.0	0.0	0.0	0.0	0.1%
Non- Urbz.	99.8%	99.8%	99.8%	99.8%	99.9%	0.0	0.0	0.0	0.0	0.0%
Turnpike	98.9%	98.5%	98.3%	98.8%	99.0%	0.0	0.0	0.0	0.0	0.0%



TRAVEL TIME RELIABILITY

Travel time reliability is widely recognized as one of the most important quality of service measures to travelers, both personal vehicle motorists and freight haulers. Travelers frequently desire to arrive at their destinations on time. Total travel time is significant, but it is frequently the variability of travel time that becomes more significant. The University of Florida and FDOT have developed and applied a travel time reliability model [(6)] to the state's entire freeway system. Figure 4 provides statewide results from 2005 through 2009 using FDOT's recommended on-time arrival approach (10 miles below the free flow speed). For reporting purposes, FDOT felt the peak travel period approach (4:00-7:00 p.m. in urbanized areas and 2:00-5:00 p.m. in rural areas) was the best way to report results. However, results are also available for the peak travel hour (5:00-6:00 p.m.) and for the day as a whole.

AUTHORS' PERSPECTIVES ON USEFULNESS OF MEASURES AND LESSONS LEARNED

The authors of this paper may be thought of as "middle managers" who deal with the development, calculation and reporting of mobility performance measures. They have been in their respective positions for over 10 years each. The following perspectives are from their viewpoints and do not necessarily represent the perspectives of FDOT as a whole, or current or previous agency senior management leaders who have had various perspectives on the usefulness of the measures and performance based planning in general.

INSTITUTIONAL TOPICS

It is the experience of the authors that most people approach performance measures from their own job perspectives rather than a broader transportation or societal perspective. Compared to such measures as pavement condition and bridge adequacy, mobility measures span much more of a transportation agency's roles and offices, and their selection and use are especially subject to individuals' job perspectives. For example, the primary use of Florida's system level mobility performance measures by FDOT senior management has been for reporting mobility trends of the highway system and to illustrate additional resource needs. Florida is the nation's fourth largest state in terms of population and it is expected to continue to be one of the fastest growing. As such, its congestion levels are relatively high and continue to grow. Although FDOT actively pursues congestion management programs, revenues for construction of additional lane miles do not come close to accommodating additional travel. As noted above, Figure 1 has been the main graphic used by FDOT management to show travel trends and the need for additional revenue.

An oversight committee may have another perspective, staff overseeing project priories another, design staff another and traffic operations another. Depending upon their respective jobs, each may choose to emphasize certain mobility measures, because they are more directly related to their work efforts. Considering the quality of FDOT's system level performance measures, there is potential for increased utilization in Department-wide planning and in specific operating units.

Closely related to the topic of individuals' own perspectives is the level of detail at which the mobility performance measures are being used. Performance measure calculations and results

vary between the system level, project level and day-to-day operations level orientations. It is the authors' perception most performance measurement advocates tend to be upper management who have an interest in performance based system measures. The mobility performance measures presented earlier in this paper were developed primarily for systems level reporting and analysis. Quality of service and capacity utilization measures - and their calculation techniques vary by analysis level. For example, FDOT uses generalized service volume tables in the calculation of delay, Level of Service and travel time reliability for both statewide system level reporting and initial project prioritization. The service volume tables are based on the HCM techniques with statewide defaults as input values. They probably are the most accurate in the U.S.; however, they are not accurate enough for project level analyses or traffic operations work where project specific results are desired (e.g., roadway specific hourly traffic distributions, probabilities of rain for the specific area). Calculation techniques should become more precise as an analysis moves from a systems level to a project level.

Champions for performance management are crucial for the success of a performance management program and mobility performance measures in particular. Mobility performance measures do not lead directly to project construction or service. Hopefully, they lead to better and more cost effective transportation solutions, but because they do not lead directly to production, they need continuing support from senior management. Strong staff level support is also needed. Few states have personnel devoted to the broad spectrum mobility analyses covering quantity calculations, highway capacity analysis, delay calculations and travel time reliability calculations from statewide planning efforts through traffic operations work. Consultant staff may be hired to support agency staff, but having a core group of agency staff skilled and motivated in measurement, management, and reporting of mobility performance and roadway data is crucial for success both in the short run and in the longer run, as evaluation techniques evolve and improve.

Legislative and administrative mandates are important for performance measurement success. The Intermodal System Transportation Efficiency Act (ISTEA) of 1991 [(7)] required eight management systems, one of which was the Congestion Management System. The Florida Legislature in turn adopted a law requiring all the state's metropolitan planning organizations, not just those covering transportation management areas, have a congestion management system. Largely because of the federal and state requirements, FDOT committed resources towards the development and use of mobility performance measures, their development and use. Since 1991, both federal and state requirements have changed with regards to congestion/mobility management, but the fundamental needs remain. The more recent Florida Transportation Commission (an oversight entity to FDOT) requirements for reporting delay and travel time reliability greatly helped FDOT improve its accuracy in delay calculations and build a sound process to address travel time reliability. Addressing travel time reliability has been especially difficult in terms of time commitment and a large amount of Florida's own transportation research dollars. Having the requirements assisted the authors in "championing" mobility performance measures.

FDOT is required to report two mobility measures to the Florida Transportation Commission, delay and travel time reliability. Both are excellent, meaningful quality measures from the perspective of travelers. These two measures have also received much national interest; however, both have important limitations. First, they only cover one dimension of mobility, and thus provide an incomplete picture of mobility in Florida. They also have significant technical issues associated with their accurate estimation.

Transportation agencies should emphasize improving mobility rather than eliminating congestion. Congestion is primarily associated with the capacity utilization dimension of mobility and its excessive reduction may result in significantly undesirable conditions. For example, in 2008 and 2009, Florida experienced less congestion on its roads, primarily because of the state's and nation's major economic recession. From a broader perspective, was Florida better off because of reduced congestion? Surely not. A highway system that is always congestion free is massively overbuilt and a waste of taxpayer funding, not to mention an invitation to sprawl and a barrier to improved transit services. What Florida and the nation really need is the ability to move people and goods when and where needed (mobility), not just an absence of congestion.

There is a strong national movement towards performance measurement. USDOT and the states should be gearing up to meet this challenge, and mobility measures should be part of any transportation assessment. It is appropriate for the USDOT to do national assessments with data supplied by the states and others. While the authors are comfortable suggesting the earlier referenced mobility performance measures be used as the basis of mobility performance measurement at both state and national levels, they should not be required. Each national, state and even regional or local agency should adopt measures and calculation techniques for its own needs. For example, while the authors believe Florida's calculation of delay, travel time reliability and miles of congested highways at the system level are of better quality than those of other transportation agencies in terms of accuracy, cost effectiveness, and usefulness, FDOT's mobility performance measures and calculation techniques should not be imposed on any other transportation agency and other agencies' approaches should not be imposed on FDOT.

SPECIFIC PERFORMANCE MEASURES

The Level of Service (LOS) performance measure probably is the single most used in the U.S. Since its inception with the 1965 HCM, LOS became the primary concept to determine the need to construct new or widen roadways. Unfortunately, at times it still appears to be used as the "decision" as opposed to one of the factors in making a decision about highway expansion. Overreliance on LOS as a single performance measure has also probably led to a backlash against its use in recent years. However, as discussed throughout this paper, reliance on one mobility performance measure, no matter how good, provides an incomplete picture of mobility. The authors believe HCM's concept of LOS is sound. At the facility level, it frequently is the single best mobility performance measure. It is a tool taught throughout the U.S. engineering schools and helps make traffic engineering complexity relatively easy to understand by elected officials and the general public. LOS is the primary evaluation technique used by practicing engineers. It also can be considered an excellent capacity utilization measure, and as such, provides insights into two mobility dimensions, quality and capacity utilization.

A positive aspect of FDOT's mobility performance measures program is that it has continued the calculation and reporting of its measures over time. Of the primary measures listed above in this paper, few are used in statewide distribution documents; however, most of them have been desired by one agency office or another. For presentation purposes, rates of change in the measures often prove more useful than absolute numbers. Insuring that such measures continue to be calculated and reported requires a commitment by mid-level staff.

A detailed review of FDOT's delay results in 2005 raised significant concerns. One was definitional. Delay in the HCM essentially occurs at any speed below the free flow speed. While

perhaps appropriate as a performance measure at the project level of analysis, the authors believe that definition is inappropriate at the state or national reporting level when applied to signalized arterials. Assuming free flow speed of a signalized arterial is approximately 5 mph over the posted speed limit, an arterial with a posted speed of 45 mph would have a free flow speed 50 mph. Delay would occur with any speed below 50 mph. That concept essentially treats signalized arterials like low speed mini-freeways, which they are not. With implementation of FDOT's "threshold delay" concept, delay is calculated only if the travel speed drops below a generally acceptable HCM-based LOS. In urbanized areas, LOS D is commonly thought of as that threshold. Assuming a typical Florida arterial, delay reported by FDOT is calculated based on speeds less than 17 mph (HCM LOS D threshold for Class II arterials). The amount of delay in the state based on an initial threshold of 50 mph, 40 mph, or 17 mph makes a huge difference in the amount of delay reported—although year-to-year trends are less affected. A modification FDOT made was to set a lower bound on speeds for oversaturated (demand exceeding capacity) conditions on both freeways and arterials. FDOT also made other modifications, including updating its hourly distributions and giving greater consideration to weekday travel. FDOT believes it now has one of the best delay calculation and reporting systems in the United States.

Travel time reliability has recently gained considerable support as a mobility performance measure. The authors believe it is the best quality measure for freeways in large urbanized areas and for freight movement. In an engineering and manufacturing sense, "reliability" primarily deals with the probability of non-failure. Currently, most highway travel time "reliability" analyses associated with the Strategic Highway Research Program 2 deal with travel time "variability", distribution of travel times, as opposed to "reliability". Although their calculation routines are closely related and are based on common data, "reliability" and "variability" concepts are not the same. FDOT and the University of Florida's research [(8)] concluded travel time variability measures are typically more useful to traffic operations work, whereas travel time reliability is more useful for planning work. Traffic operations work primarily relies on real time data. Providing that information to travelers for real time trips is highly desirable. However, for statewide reporting and as a project prioritization factor for all of Florida's freeways, a travel time reliability calculation model is more cost effective than using measured data along all the state's freeways. FDOT's travel time reliability calculation model makes use of the concept of on-time arrival based on the calculation of "routine HCM-related" speeds and capacities, plus probabilities of weather effects, probabilities of blocking and non-blocking incidents, and probabilities of work zones. If desired, the model can also readily report such metrics as "planning index" and "buffer index". Since it is not dependent on Intelligent Transportation System data, we believe FDOT currently has the only program that can calculate travel time reliability at the state level. FDOT has begun reporting travel time reliability on all elements of the state's freeway system from 2005-2009. It is anticipated that refinements will be made to the calculation process, especially through 2012.

FDOT's mobility program makes use of both field data and calculation models. The quantity, accessibility and capacity utilization measures largely rely on field data, with some measures also needing calculation routines. Roadway and traffic inventories are essential for a mobility performance measure program, including quality performance measures. However, for statewide reporting and planning purposes, quality measures should rely primarily on calculation models rather than field measurements. Field measurements are needed to develop and calibrate the models as well as inputs to the models. As discussed above, FDOT changed its delay

calculation routine in 2005. Although the total amount of delay changed as a result, basing the analysis on a model and retaining input data for earlier years allowed FDOT to develop trend lines going back to 2000, enabling FDOT management to continue to illustrate the growth in delay relative to capacity.

FUTURE TRENDS

Looking to the future, the authors foresee mobility performance measures gaining more widespread use within FDOT and other transportation agencies. In Florida's case, there is significantly more interest in using travel time reliability not only for statewide reporting, but also for project prioritization and specific freeway facility project analyses, along with capacity and level of service analyses. Also, the concept of using realistic highway Level of Service standards appears to be gaining momentum as a desirable tool for system analyses and growth management purposes. Over the last ten years, the authors have seen a greater acceptance by FDOT staff on performance based aspects of planning and budgeting and the trend will likely continue.

The authors foresee a greater emphasis on "trip-based", as opposed to strictly "facility-based", mobility performance measures. FDOT's current mobility performance measures program relies strictly on a facility analysis. Values are obtained for a segment, section or facility and aggregated to a system level. To travelers, the total trip is more important than what happens on individual segments. For example, although FDOT's travel time reliability model can calculate reliability from any point on the state's freeway system to any other point, it cannot address reliability before and after the traveler is on the freeway system. Another example is the use of the vehicle miles traveled performance measure. Currently, it is being used as an indication of the quantity of travel (the more mobility the better). However, it is a double edged sword in which it is also seen as a measure to be reduced (to improve the quality of travel). A more positive performance measure could be trips completed in a satisfactory time.

Another area of mobility performance improvement is to make the measures more multimodal. The mobility dimensions of quantity, quality, accessibility and capacity utilization apply to all transportation modes: aviation, bicycle, pedestrian, rail, transit and water. With regards to bicycle, bus transit and pedestrian modes, they are all "highway" modes and should be presented as such. Florida has been tracking transit performance for quite some time; however, pedestrian and bicycle mobility are relatively new. FDOT is currently concentrating on implementing bicycle and pedestrian facilities as accessibility performance measures. In the future, quantity of trips and modal level of service may be added to those modes. The 2010 HCM might help in this area given that, for the first time, the nation's leading capacity and quality of service document will feature an integrated Level of Service approach for all the modes on urban streets.

CONCLUSION

This paper has presented an overview of Florida's mobility performance measures as well as the authors' perspectives on their usefulness and lessons learned. Since the movement of people and goods is at the heart of all transportation agencies' efforts, mobility performance measures should be considered essential to transportation performance based processes. Proper and appropriate presentation of mobility performance measures helps public officials and their

constituents better understand transportation issues and can help improve a transportation agency’s planning and operations.

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