final report

ITS Performance Measures

Detailed Definition of Performance Measures

prepared for
Florida DOT District 4

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date
November 2005
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1.0 Introduction

Performance measures provide accountability to the public and enhance communication between the operators and users of the system. They can aid in setting policy, allocating resources, and reporting on results. At the statewide level, the Florida Transportation Commission (FTC) is charged with evaluating the performance, operational productivity, and fiscal management of the Florida Department of Transportation (FDOT). The review includes performance measures on 18 major programs within FDOT; the impacts of intelligent transportation systems (ITS) deployments have not yet been recorded but a set of statewide ITS performance measures currently are being developed. This task aims to help District 4 define performance measures to meet objectives of the statewide reporting and to measure performance operations activities of the District. Specifically, this report will detail the measures selected by District 4 for periodic reporting and specify the needed functional requirements for the development of a data archive.

This report is the second and final of two reports to identify and recommend performance measures to assess the ITS program in District 4. The focus of the District 4 ITS performance measurement program is to measure outcomes and activities that are responsibilities of the Traffic Operations Division. The measures reported will be the accountability assessment of the District’s ITS Program. Data on activities conducted by partner agencies may be collected but will not be reported as part of this program. The first report produced in May 2005 describes the development of a data collection plan and performance measures that will complement a number of existing FDOT activities and assist in achieving the goals and objectives established by the District. This task is intended to assist the District in meeting the goals and objectives of the ITS Business Plan and in achieving the stated vision of being the number one ITS program in the United States and will further the District as a leader in Florida in data collection and performance monitoring.

This report begins by identifying five general performance measure categories and 60 selected performance measures and the data required to support the reporting of those measures. A recommended set of functional requirements for a District 4 data archive is presented along with the current status of each of those requirements. In the final section lists of suggested measures for different audiences is presented. The appendix includes an example mock-up of a District 4 monthly performance report.
2.0 Recommended Performance Measures

This section of the report presents detailed definitions of outcome and output performance measures introduced in the Data Collection and Performance Measures Report. These performance measures will aid in achieving a number of District Business Plan goals and fulfilling statewide requirements for Florida’s ITS Program.

Outcome measures relate to how well the agency is meeting its mission and stated goals. These measures will allow the District to report on the benefits of the ITS program from the perspective of the ultimate customer - the traveling public. In some cases outcomes measures will use ITS data to assess the outcome of District activities that are beyond the control of the Traffic Operations Division or even the FDOT. Output measures relate to the physical quantities of items, levels of effort expended, scale or scope of activities, and the efficiency in converting resources into a product. These are sometimes called “efficiency” measures and will allow the District to evaluate the effectiveness of their ITS operations.

It should be noted that the goal of the FDOT District 4 ITS program is to measure the performance of all the FIHS roadways within the District. Currently, ITS equipment is available on a portion of the freeways in the District. In the near future there is unlikely to be significant data available on non-instrumented roadways, particularly arterials. Manually collected data will be used as it is available and over time the ITS coverage will be expanded to the entire FIHS.

2.1 Outcome Measures

- **Congestion and Reliability** – Measures that capture average congestion conditions and those that identify travel reliability, or the variability in performance of the selected route.

- **Incident Duration** – Measures that capture incident conditions and delay from travel lane blockages.

- **Customer Satisfaction** – Measures that capture the perception of users of the transportation system and ITS infrastructure.

2.2 Benefit/Cost Measures

Benefit/cost measures are needed to indicate the effectiveness of components of the District’s ITS program or the program as a whole. As District 4’s program is
being developed the entire program will be measured in terms of benefits and costs. As the program matures individual program elements also may be measured.

The Federal Highway Administration defines performance measurement as “a process of assessing progress toward achieving predetermined goals, including information on the efficiency with which resources are transformed into goods and services (outputs), the quality of those outputs (how well they are delivered to clients and the extent to which clients are satisfied) and outcomes (the results of a program activity compared to its intended purpose), and the effectiveness of government operations in terms of their specific contributions to program objectives.” Input measures indicate the resources that go into a process and they useful in reporting efficiency measures (input versus output to show productivity and cost-effectiveness). A benefit/cost measure takes both the outputs and outcomes of the program into account, which is why this report includes these measures as a separate category.

2.3 Output Measures

- **System Coverage** – Measures that capture the coverage of traffic detectors, video cameras, traveler information, and communications equipment.

- **Traffic Flow** – Measures that capture the performance of traffic flow on the roadway network.

- **Incident Management** – Measures that capture incident management performance.

- **System Performance** – Measures that capture the equipment availability and performance.

- **Traveler Information** – Measures that capture the use and performance of traveler information infrastructure.

The complete list of recommended performance measures are presented in Table 2.1. Organized by the outcome and output measures categories described above, the table details the specific performance measures, with a brief definition, a list of qualifiers for the measure (i.e., recommended time response), its status (whether it is an existing district measure, a new performance measure, or is under development – the procedures and/or infrastructure are not yet in place to evaluate the measure), a reference to the formula (listed in Appendix A), and data needs. The data needs column details raw data needs to report on each individual measure, as well as the status (existing or new data field) and the source of the data points (i.e., SMART and/or SunGuide, see Detailed Definition of Performance Measures, May 2005 for descriptions of these systems).

The following details the qualifiers (“Reported By”) contained in Table 2.1 and the potential benefits they may have:
• **Roadway** – Segments of roadway on the network. This may aid in identifying problem areas or sections that need further analysis, more instrumentation, and/or closer proximity of emergency equipment.

• **Time period** – Time of day, day of week, month, season, year. This may aid in identifying temporal or seasonal problem areas as well as provide a historical reference.

• **Incident severity** – Incident severity level as defined by the Florida DOT. This may aid in identifying ways to better allocate resources and provide a better understanding of the incidents.

• **Type of incident** – Accident, road work, disabled vehicle. This may aid in identifying improvements for incident management strategies.

• **Type of equipment** – Equipment or software type. This may aid in identifying problem equipment.

• **System** – The entire transportation network under study, which currently is the freeway network in Broward County. This may aid in identifying overall performance and areas for improvement.

It should be noted that the area within District 4 is covered by the South Florida 511 traveler information system. This system is managed and reported by FDOT District 6, therefore 511 activities are not included in this report.
### Table 2.1  Recommended Performance Measure Matrix

<table>
<thead>
<tr>
<th>Measure</th>
<th>Definition</th>
<th>Reported By (as available)</th>
<th>Units</th>
<th>Reporting Frequency</th>
<th>Formula</th>
<th>Data Required</th>
<th>Status</th>
<th>Source</th>
<th>Use of Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Outcome Measures</strong></td>
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<tr>
<td><strong>Congestion</strong></td>
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</tr>
<tr>
<td>Travel Time Index</td>
<td>The ratio of average travel time to a free flow travel time.</td>
<td>Roadway, time period, system</td>
<td>None</td>
<td>Monthly</td>
<td>(2) Actual travel time&lt;br&gt;Speed (from detectors)</td>
<td>New</td>
<td>SunGuide</td>
<td>Indicates congestion level. Reporting is required by FHWA and FDOT Central Office. Planners travel time as alternative to level of service.</td>
<td></td>
</tr>
<tr>
<td>Total Delay</td>
<td>The additional time that is incurred when actual travel times are greater than free-flow travel times.</td>
<td>Roadway, time period, system</td>
<td>Vehicle-Hours</td>
<td>Annually</td>
<td>(2) Actual travel time</td>
<td>New</td>
<td>SunGuide</td>
<td>Indicates congestion level. Alternate indicator to Travel Time Index. Should be calculated monthly and summed for annual reporting.</td>
<td></td>
</tr>
<tr>
<td>Percent of Congested Traffic</td>
<td>The ratio of congested VMT to total VMT. VMT is the sum of distances traveled by all motor vehicles in a specified highway system for a given period of time.</td>
<td>Roadway, time period, system</td>
<td>Percentage</td>
<td>Annually</td>
<td>(3) Total VMT = Total traffic volume x the length of the road section (for the time period of interest)&lt;br&gt;Congested VMT = Traffic volume x the length of the road section that occurs below a preset threshold (for the time period of interest)</td>
<td>Existing</td>
<td>SunGuide</td>
<td>Indicates congestion level. Alternate indicator to Travel Time Index. Should be calculated monthly and summed for annual reporting.</td>
<td></td>
</tr>
<tr>
<td><strong>Travel Time Reliability</strong></td>
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<tr>
<td>Planning Time Index</td>
<td>The 95th percentile travel time index.</td>
<td>Roadway, time period, system</td>
<td>None</td>
<td>Annually</td>
<td>(4) Travel time index</td>
<td>New</td>
<td>SunGuide</td>
<td>Indicates variability of roadway congestion. Alternate indicator to Buffer Index. Should be calculated monthly and summed for annual reporting.</td>
<td></td>
</tr>
<tr>
<td>Buffer Index</td>
<td>The extra time most travelers add to their average travel time when planning trips.</td>
<td>Roadway, time period, system</td>
<td>Percentage</td>
<td>Monthly</td>
<td>(5) Actual travel time:&lt;br&gt;• Volume&lt;br&gt;• Speed&lt;br&gt;• Free flow speed&lt;br&gt;• Distance</td>
<td>New</td>
<td>SunGuide</td>
<td>Indicates variability of roadway congestion. In urban areas travel time reliability provides a customer experience indication of freeway performance. Reporting is required by FHWA and FDOT Central Office.</td>
<td></td>
</tr>
<tr>
<td>Accuracy of Congestion (Travel Time) Information</td>
<td>Difference between predicted travel time information presented to public and the actual travel time experienced.</td>
<td>Roadway, time period, system, evacuation</td>
<td>Minutes, Percentage</td>
<td>Annually</td>
<td>(6) under development Actual travel time:&lt;br&gt;• Volume&lt;br&gt;• Speed&lt;br&gt;• Free flow speed&lt;br&gt;• Distance&lt;br&gt;Predicted travel time</td>
<td>New</td>
<td>TMC Operators</td>
<td>Indicates validity of the travel time algorithm and accuracy of system detectors. Should be calculated monthly and summed for annual reporting.</td>
<td></td>
</tr>
<tr>
<td><strong>Incident Duration</strong></td>
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</tr>
<tr>
<td>Total Incident Duration</td>
<td>Difference in time from when first agency is notified until all evidence of the incident is removed.</td>
<td>Roadway, a.m./p.m. peak, and off-peak time period, incident severity, incident type</td>
<td>Minutes</td>
<td>Weekly</td>
<td>(7) Time of incident occurrence&lt;br&gt;Time of return to normal traffic flow if not possible, time when Road Ranger leaves site</td>
<td>Existing</td>
<td>SMART</td>
<td>Indicates the total time of incident impact. Measures overall efficiency of TIM activities by partnering agencies.</td>
<td></td>
</tr>
</tbody>
</table>

2-4
## ITS Performance Measures

### Performance Measure Data Needs

<table>
<thead>
<tr>
<th>Measure</th>
<th>Definition</th>
<th>Reported By (as available)</th>
<th>Units</th>
<th>Reporting Frequency</th>
<th>Formula</th>
<th>Data Required</th>
<th>Status</th>
<th>Source</th>
<th>Use of Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Incident Duration (continued)</strong></td>
<td></td>
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</tr>
<tr>
<td>TMC Detection Time Period</td>
<td>The difference between when the TMC is notified and when any agency is notified.</td>
<td>Roadway, a.m./p.m. peak, and off-peak time periods</td>
<td>Minutes</td>
<td>Weekly</td>
<td>(8) Time of incident occurrence - Time of initial notification</td>
<td>Existing</td>
<td>SMART</td>
<td>Measures the time it takes other agencies to notify the TMC. Value is zero when TMC detects the incident. A measure of agency coordination.</td>
<td></td>
</tr>
<tr>
<td>TMC Verification Time Period</td>
<td>The difference between the initial TMC notification time and when the incident is verified.</td>
<td>Roadway, a.m./p.m. peak, and off-peak time periods</td>
<td>Minutes</td>
<td>Weekly</td>
<td>(9) Time of initial notification - Time of verification</td>
<td>Existing</td>
<td>SMART</td>
<td>Measures camera coverage and Road Ranger coverage, which are the primary factors in reducing verification time.</td>
<td></td>
</tr>
<tr>
<td>TMC Response Time Period</td>
<td>The difference between the initial TMC notification time and the time Road Rangers/SIRV arrive.</td>
<td>Roadway, a.m./p.m. peak, and off-peak time periods, incident severity</td>
<td>Minutes</td>
<td>Weekly</td>
<td>(10) Track Road Rangers and SIRV separately: Time of initial notification - Time of Road Ranger (RR) arrival</td>
<td>Existing</td>
<td>SMART</td>
<td>Measures time for Road Rangers/SIRV to arrive on the incident scene. Provides an indication of Road Ranger routes and coverage areas.</td>
<td></td>
</tr>
<tr>
<td>Road Ranger Dispatch Time Period</td>
<td>The difference between initial TMC notification and when a Road Ranger is contacted for dispatch to an incident.</td>
<td>Roadway, a.m./p.m. peak, and off-peak time periods</td>
<td>Minutes</td>
<td>Weekly</td>
<td>(11) Time of initial notification - Time of Road Ranger (RR) dispatch</td>
<td>Existing</td>
<td>SMART</td>
<td>Component of TMC response time.</td>
<td></td>
</tr>
<tr>
<td>Road Ranger Response Time Period</td>
<td>The difference between when a Road is dispatched and when that Road Ranger arrives at the incident scene.</td>
<td>Roadway, a.m./p.m. peak, and off-peak time periods</td>
<td>Minutes</td>
<td>Weekly</td>
<td>(12) Time of dispatch - Time of Road Ranger (RR) arrival</td>
<td>Existing</td>
<td>SMART</td>
<td>Component of TMC response time.</td>
<td></td>
</tr>
<tr>
<td>Incident Clearance Time Period</td>
<td>The difference between the time Road Rangers/SIRV arrive and the lanes are cleared.</td>
<td>Roadway, a.m./p.m. peak, and off-peak time periods, incident severity, lane</td>
<td>Minutes</td>
<td>Weekly</td>
<td>(13) Track Road Rangers and SIRV separately: Time of Road Ranger (RR) arrival - Time that the lanes are cleared</td>
<td>Existing</td>
<td>SMART</td>
<td>A measure of interagency coordination since vehicle removal is primarily the responsibility of other agencies. Measures adherence to “Open Roads Policy.”</td>
<td></td>
</tr>
<tr>
<td>Incident Delay</td>
<td>Total delay per lane mile.</td>
<td>Roadway, a.m./p.m. peak, and off-peak time periods, incident severity</td>
<td>Vehicle-Hours</td>
<td>Annually</td>
<td>(14) Incident duration: Under Development</td>
<td>SMART</td>
<td>SMART</td>
<td>Provides a quantitative measure of the congestion impacts of an incident.</td>
<td></td>
</tr>
<tr>
<td>Number of Secondary Incidents</td>
<td>The number of events that occur due to the congestion from the primary event (designated as secondary incident by TMC).</td>
<td>Roadway, a.m./p.m. peak, and off-peak time periods, incident severity</td>
<td>Incidents</td>
<td>Annually</td>
<td>(15) Number of blocked lanes</td>
<td>New</td>
<td>SMART</td>
<td>Provides an indication of reduced crashes, an important public benefit of incident management.</td>
<td></td>
</tr>
</tbody>
</table>

## Customer Satisfaction

| Satisfaction with ITS Program | Percentage of respondents satisfied with overall ITS program. | Annual survey | Percentage | Annually | Percentage responses from survey | Random public survey results | New | Central Office/ District 4 Annual survey | Provides a qualitative measure of public satisfaction of the ITS program. |
| Satisfaction with DMS | Percentage of respondents satisfied with DMS usage and performance. | Annual survey | Percentage | Annually | Percentage responses from survey | Random public survey results | New | Central Office/ District 4 Annual survey | Provides a qualitative measure of public satisfaction of the ITS program. |
| Satisfaction with Traveler Information SMART Sunguide and ITMS Web Site | Percentage of respondents satisfied with the traveler information web site. | Annual survey | Percentage | Annually | Percentage responses from survey | Random public survey results | New | Central Office/ District 4 Annual survey | Provides a qualitative measure of public satisfaction of the ITS program. |
| Satisfaction with Road Rangers | Percentage of respondents satisfied with Road Rangers service. | Annual survey | Percentage | Annually | Percentage responses from survey | Random public survey results | New | Central Office/ District 4 Annual survey | Provides a qualitative measure of public satisfaction of the ITS program. |
| Ease of Database Accessibility | Percentage of partnering agencies satisfied with database accessibility. | User feedback/survey | Percentage | Annually | Percentage responses from survey | User survey results | New | District 4 Annual survey | Provides a qualitative measure of system usability and indicates any user problems with the database and its accessibility. |
## ITS Performance Measures

### Performance Measure Data Needs

<table>
<thead>
<tr>
<th>Measure</th>
<th>Definition</th>
<th>Reported By (as available)</th>
<th>Units</th>
<th>Reporting Frequency</th>
<th>Formula</th>
<th>Data Required</th>
<th>Status</th>
<th>Source</th>
<th>Use of Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Benefit/Cost Measures</strong></td>
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</tr>
<tr>
<td>ITS Program Benefit/Cost Ratio</td>
<td>Total ITS program benefits divided by total program cost.</td>
<td>Program</td>
<td>Ratio</td>
<td>Annually</td>
<td>Benefits/Cost</td>
<td>Estimates of ITS benefits, including travelers' time saved, freight time saved, crashes reduced, and secondary crashes reduced. Total District ITS programs costs</td>
<td>New</td>
<td>FDOT District 4</td>
<td>Provides an overall indication of the effectiveness of the District’s ITS program.</td>
</tr>
<tr>
<td><strong>Output Measures</strong></td>
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<tr>
<td><strong>System Coverage</strong></td>
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<tr>
<td>ITS Miles Managed</td>
<td>Number of centerline miles covered/managed by ITS equipment in the network.</td>
<td>Roadway</td>
<td>Miles</td>
<td>Annually</td>
<td>(16)</td>
<td>ITS roadway coverage</td>
<td>Existing</td>
<td>FDOT District 4</td>
<td>Measures ITS geographical coverage. Required by FDOT Central Office.</td>
</tr>
<tr>
<td>Percent Centerline Miles Managed</td>
<td>Percent of centerline miles covered/managed by ITS equipment in the network.</td>
<td>Roadway type</td>
<td>Percentage</td>
<td>Annually</td>
<td>(17)</td>
<td>ITS roadway coverage</td>
<td>Existing</td>
<td>FDOT District 4</td>
<td>Indicates the portion of the roadway system covered by ITS.</td>
</tr>
<tr>
<td>Number of ITS Devices</td>
<td>Number of ITS devices.</td>
<td>Type, roadway</td>
<td>Devices</td>
<td>Annually</td>
<td>(18)</td>
<td>Number of ITS devices</td>
<td>Existing</td>
<td>FDOT District 4</td>
<td>Indicates total number of ITS devices.</td>
</tr>
<tr>
<td><strong>Traffic Flow</strong></td>
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</tr>
<tr>
<td>Average Volume</td>
<td>The average number of vehicles.</td>
<td>Roadway, time period</td>
<td>Vehicles</td>
<td>Annually</td>
<td>(19)</td>
<td>Traffic count (detectors)</td>
<td>New</td>
<td>SunGuide</td>
<td>Traffic volumes are used by FDOT Planning.</td>
</tr>
<tr>
<td>Average Occupancy</td>
<td>The average percentage of time, during the sample period, that the detector sensed a vehicle.</td>
<td>Roadway, time period</td>
<td>Percentage</td>
<td>Annually</td>
<td>(20)</td>
<td>Traffic occupancy (detectors)</td>
<td>New</td>
<td>SunGuide</td>
<td>Vehicle occupancy measures traffic density. Occupancy is used in some traffic algorithms.</td>
</tr>
<tr>
<td>Average Travel Time</td>
<td>The average time to traverse a given highway segment.</td>
<td>Roadway, time period</td>
<td>Minutes</td>
<td>Monthly</td>
<td>(21)</td>
<td>Actual travel time</td>
<td>New</td>
<td>SunGuide</td>
<td>Travel time is the basic measure of congestion and reliability.</td>
</tr>
<tr>
<td>Average Density</td>
<td>The average number of vehicles that occupy one mile of road space.</td>
<td>Roadway, time period</td>
<td>Vehicles-Miles (all lanes in a direction)</td>
<td>Annually</td>
<td>(22)</td>
<td>Traffic flow (vph) - Hourly equivalent of count volumes: count, speed, distance</td>
<td>New</td>
<td>SunGuide</td>
<td>Density is used in some traffic algorithms. An alternate to occupancy measure.</td>
</tr>
<tr>
<td><strong>Incident Management</strong></td>
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</tr>
<tr>
<td>Total Number of Incidents</td>
<td>Number of incidents managed.</td>
<td>Roadway, a.m./p.m. peak and off-peak time periods, incident severity</td>
<td>Incidents</td>
<td>Weekly</td>
<td>(23)</td>
<td>Incident type</td>
<td>Existing</td>
<td>SMART</td>
<td>Indicates level of TMC activity, used in managing resource needs and benefit calculations.</td>
</tr>
<tr>
<td>TMC Incident Detection Method</td>
<td>System by which the TMC was notified.</td>
<td>Roadway, a.m./p.m. peak and off-peak time periods, incident severity</td>
<td>None</td>
<td>Weekly</td>
<td>(24)</td>
<td>Incident detection type</td>
<td>Existing</td>
<td>SMART</td>
<td>Provides indication of the portion of incidents detected by TMC or Road Rangers.</td>
</tr>
<tr>
<td>Incident Level</td>
<td>Severity of lane blockage incidents.</td>
<td>Roadway, a.m./p.m. peak and off-peak time periods, incident severity</td>
<td>None</td>
<td>Monthly</td>
<td>(25)</td>
<td>Incident detection type</td>
<td>Existing</td>
<td>SMART</td>
<td>Tracking incident severity provides stratification of incidents for incident duration calculations.</td>
</tr>
<tr>
<td>Incident Management Dollars Spent Per Incident Response</td>
<td>Incident management program annual cost divided by annual number of incident responses.</td>
<td>Program</td>
<td>Cost</td>
<td>Annually</td>
<td>(26)</td>
<td>Incident management program</td>
<td>Existing</td>
<td>FDOT District 4</td>
<td>Provides an indication of the cost-effectiveness of the incident management program.</td>
</tr>
<tr>
<td>Total Number of Requests for Road Ranger/SIRV Response</td>
<td>Number of requests for Road Ranger response.</td>
<td>Roadway, time period, incident type, county, truck, beat, zone, source</td>
<td>Calls</td>
<td>Monthly</td>
<td>(27)</td>
<td>Track Road Rangers and SIRV separately: Call type</td>
<td>Existing</td>
<td>SMART</td>
<td>Indicates level of Road Ranger/SIRV activity. Difference between requests and responses indicates gaps in Road Ranger coverage.</td>
</tr>
<tr>
<td>Total Number of Road Ranger/ SIRV Responses</td>
<td>Number of Road Ranger responses logged.</td>
<td>Roadway, time period, incident type, county, truck, beat, zone, source</td>
<td>Responses</td>
<td>Monthly</td>
<td>(28)</td>
<td>Track Road Rangers and SIRV separately: Response type</td>
<td>Existing</td>
<td>SMART</td>
<td>Indicates level of Road Ranger/SIRV activity. It will assist in Road Ranger resource allocation.</td>
</tr>
<tr>
<td>Total Number of Road Ranger/ SIRV Events</td>
<td>Number of Road Ranger events logged.</td>
<td>Roadway, time period, incident type, county, truck, beat, zone, source</td>
<td>Events</td>
<td>Monthly</td>
<td>(29)</td>
<td>Track Road Rangers and SIRV separately: Event type</td>
<td>Existing</td>
<td>SMART</td>
<td>Indicates level of Road Ranger activity and service performed. It will assist in Road Ranger resource allocation.</td>
</tr>
<tr>
<td>Measure</td>
<td>Definition</td>
<td>Reported By (as available)</td>
<td>Units</td>
<td>Reporting Frequency</td>
<td>Formula</td>
<td>Data Required</td>
<td>Status</td>
<td>Source</td>
<td>Use of Measure</td>
</tr>
<tr>
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</tr>
<tr>
<td><strong>Incident Management (continued)</strong></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Total Number of Road Ranger/ SIRV Activities</td>
<td>Number of Road Ranger activities logged.</td>
<td>Roadway, time period, incident type, county, truck, beat, zone, source</td>
<td>Activities</td>
<td>Monthly</td>
<td>(30)</td>
<td>Track Road Rangers and SIRV separately: Activity type</td>
<td>Existing</td>
<td>SMART</td>
<td>Indicates the type of service performed. It will assist in Road Ranger resource allocation.</td>
</tr>
<tr>
<td>Average Road Ranger/ SIRV Assisting Time</td>
<td>Average length of a Road Ranger assist.</td>
<td>Roadway, time period, incident type, county, truck, beat, zone, source</td>
<td>Minutes</td>
<td>Monthly</td>
<td>(31)</td>
<td>Track Road Rangers and SIRV separately: Road Ranger activity log. Emergency management timeline</td>
<td>Existing</td>
<td>SMART</td>
<td>Indicates the service time of Road Rangers. It will assist in Road Ranger resource allocation.</td>
</tr>
<tr>
<td>Average Road Ranger/ SIRV In-service Time</td>
<td>Average length of Road Ranger activity - the Road Ranger is available to provide assists or be dispatched.</td>
<td>Roadway, time period, incident type, county, truck, beat, zone, source</td>
<td>Minutes</td>
<td>Monthly</td>
<td>Track Road Rangers and SIRV separately: Road Ranger activity log.</td>
<td>Total time Road Rangers are in service/number of RR vehicles</td>
<td>Existing</td>
<td>SMART</td>
<td>Indicates the service time of Road Rangers. It will assist in Road Ranger resource allocation.</td>
</tr>
<tr>
<td>Average Road Ranger Billable Time</td>
<td>Average length of Road Ranger billable time.</td>
<td>County, truck, beat, zone</td>
<td>Hours</td>
<td>Monthly</td>
<td>Total Road Ranger billable time/number of RR vehicles</td>
<td>Track Road Rangers and SIRV separately: Road Ranger activity log</td>
<td>Existing</td>
<td>SMART</td>
<td>Indicates the service time of Road Rangers. It will assist in Road Ranger resource allocation.</td>
</tr>
<tr>
<td>Number of Outgoing TMC Calls</td>
<td>Number of outgoing TMC calls.</td>
<td>Type</td>
<td>Calls</td>
<td>Monthly</td>
<td></td>
<td></td>
<td>Number of calls</td>
<td>Existing</td>
<td>TMC Operators</td>
</tr>
<tr>
<td>Number of Incoming TMC Calls</td>
<td>Number of incoming TMC calls.</td>
<td>Type</td>
<td>Calls</td>
<td>Monthly</td>
<td></td>
<td></td>
<td>Number of calls</td>
<td>Existing</td>
<td>TMC Operators</td>
</tr>
<tr>
<td><strong>System Performance</strong></td>
<td></td>
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</tr>
<tr>
<td><strong>ITS Field Equipment and Communications Equipment</strong></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>Operational Field Equipment Percentage</td>
<td>Percent time equipment is operational.</td>
<td>Device type, roadway</td>
<td>Percentage</td>
<td>Monthly</td>
<td></td>
<td></td>
<td>Equipment uptime</td>
<td>Existing</td>
<td>TMC Operators</td>
</tr>
<tr>
<td>Mean Time to Repair</td>
<td>Average downtime per preventative or emergency repair/failure.</td>
<td>Device</td>
<td>Hours</td>
<td>Annually</td>
<td></td>
<td></td>
<td>Time of equipment failure</td>
<td>Existing</td>
<td>TMC Operators</td>
</tr>
<tr>
<td>Mean Time Between Failures</td>
<td>Average time between equipment failure.</td>
<td>Device</td>
<td>Days</td>
<td>Annually</td>
<td></td>
<td></td>
<td>Time of equipment failure</td>
<td>Existing</td>
<td>SMART</td>
</tr>
<tr>
<td>Cost per Equipment Repair/Failure</td>
<td>Cost of repair and impacts on a system due to an equipment failure.</td>
<td>Device</td>
<td>Cost</td>
<td>Annually</td>
<td></td>
<td></td>
<td>Time of equipment replacement/repair/resolution</td>
<td>Existing</td>
<td>FDOT District 4</td>
</tr>
<tr>
<td><strong>TMC Software and Hardware</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Device/Module Uptime Percentage</td>
<td>Percentage of time a TMC device or software module is operational.</td>
<td>Software module, server, switch, firewall, and video wall controller</td>
<td>Percentage</td>
<td>Monthly</td>
<td></td>
<td></td>
<td>Equipment uptime</td>
<td>Existing</td>
<td>TMC IT</td>
</tr>
<tr>
<td>Calls Sent to IT Helpdesk</td>
<td>Number of requests sent the District IT Helpdesk.</td>
<td>Category</td>
<td>Calls</td>
<td>Monthly</td>
<td></td>
<td></td>
<td>Calls</td>
<td>Existing</td>
<td>TMC IT</td>
</tr>
<tr>
<td>Helpdesk Calls Outstanding</td>
<td>Number of unresolved Helpdesk requests at the end of the reporting period.</td>
<td>Category</td>
<td>Calls</td>
<td>Monthly</td>
<td></td>
<td></td>
<td>Call unresolved</td>
<td>Existing</td>
<td>TMC IT</td>
</tr>
<tr>
<td>Helpdesk Calls Closed</td>
<td>Number of Helpdesk requests that were completed.</td>
<td>Category</td>
<td>Calls</td>
<td>Monthly</td>
<td></td>
<td></td>
<td>Calls resolved</td>
<td>Existing</td>
<td>TMC IT</td>
</tr>
<tr>
<td>Helpdesk Call Close Time</td>
<td>Time period from when a call was received by the Helpdesk until it was closed.</td>
<td>Category</td>
<td>Days</td>
<td>Monthly</td>
<td></td>
<td></td>
<td>Call resolve time</td>
<td>Existing</td>
<td>TMC IT</td>
</tr>
<tr>
<td>Performance Measure</td>
<td>Data Needs</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of TMC Web Site Visits</td>
<td>Number of web site visits.</td>
<td>Time period, event</td>
<td>Hits</td>
<td>Monthly</td>
<td>[43]</td>
<td>Web site hits</td>
<td>Existing</td>
<td>TMC IT</td>
<td>Indicates how often the web site is used by the public. Also indicates effectiveness of ITS marketing program.</td>
</tr>
<tr>
<td>TMC Web Pages Visited</td>
<td>Web page hits.</td>
<td>Page</td>
<td>Hits</td>
<td>Monthly</td>
<td>[43]</td>
<td>Web site hits</td>
<td>Existing</td>
<td>TMC IT</td>
<td>Indicates which pages are viewed most. Unused pages may be deleted or combined.</td>
</tr>
<tr>
<td>Referring Web Sites</td>
<td>Referring web sites.</td>
<td>Site</td>
<td>Sites</td>
<td>Monthly</td>
<td>[44]</td>
<td>Referring web pages</td>
<td>Existing</td>
<td>TMC IT</td>
<td>Indicates where users found reference to FDOT web site.</td>
</tr>
<tr>
<td>TMC Web Site Visit Data</td>
<td>Average web site visit data transmitted.</td>
<td>Site</td>
<td>Bytes of data</td>
<td>Monthly</td>
<td>[45]</td>
<td>Data transmitted per visit</td>
<td>Existing</td>
<td>TMC IT</td>
<td>Indicates how visitors use the web site and provides indications of bandwidth needs.</td>
</tr>
<tr>
<td>Number of DMS Messages</td>
<td>Number of DMS messages.</td>
<td>A.M./P.M. peak and off-peak time period, type, event</td>
<td>Messages</td>
<td>Monthly</td>
<td>[46]</td>
<td>Message type</td>
<td>Existing</td>
<td>SMART</td>
<td>Indicates how often DMS are used.</td>
</tr>
<tr>
<td>DMS Message Duration</td>
<td>Average length of time a message is displayed.</td>
<td>A.M./P.M. peak and off-peak time period, type, event</td>
<td>Messages</td>
<td>Monthly</td>
<td>[47]</td>
<td>Message duration</td>
<td>Existing</td>
<td>SMART</td>
<td>Indicates how long DMS are used.</td>
</tr>
<tr>
<td>Diversions Due to DMS Messages</td>
<td>Average increase in detector (ramp) volumes when an incident message is displayed.</td>
<td>A.M./P.M. peak and off-peak time period, type, event</td>
<td>Vehicles</td>
<td>Monthly</td>
<td>[48]</td>
<td>Vehicle counts</td>
<td>New</td>
<td>SunGuide</td>
<td>Indicates how many vehicles change behavior due to DMS.</td>
</tr>
<tr>
<td>Number of DMS Messages Posted in Response Another Agency Request</td>
<td>Number of DMS messages requested by a different agency (i.e., neighboring district, central office).</td>
<td>A.M./P.M. peak and off-peak time period, type, event</td>
<td>Messages</td>
<td>Monthly</td>
<td>[46]</td>
<td>Message type</td>
<td>Existing</td>
<td>SMART</td>
<td>Indicates how often other agencies need to utilize DMS infrastructure.</td>
</tr>
<tr>
<td>DMS Message Posting Time</td>
<td>Difference in time from incident verification to when the first DMS message is posted on a sign.</td>
<td>A.M./P.M. peak and off-peak time period, type, event</td>
<td>Minutes</td>
<td>Monthly</td>
<td>[49]</td>
<td>Incident verification time</td>
<td>Existing</td>
<td>SMART</td>
<td>Indicates operator time needed to post a message, measures operator efficiency and ease of software use.</td>
</tr>
</tbody>
</table>

Note: For all data points specified here, it is assumed that the location and time and date stamp of the measure is collected as well.

1. Actual time of incident occurrence is difficult to measure – often initial notification time is used as event start time.
2. Return to normal flow is difficult to measure and will likely be a subjective estimate by operator. It is recommended that the time when all lanes are open be used until detector data can be used to indicate return to normal flow.
3.0 Functional Requirements of the Data Archive

Currently, the FDOT District 4 TMC is in the process of testing the statewide SunGuide software for traffic data collection and archiving. The SunGuide software collects traffic data from vehicle sensors, controls CCTV camera and DMS signs, evaluates traffic conditions, manages incidents, provides information to the general public and transportation agencies, and performs data logging and archiving. The FDOT District 4 TMC also is developing the System Management for Advanced Roadway Technologies (SMART) Software for incident data collection and archiving. The SMART software replaces FDOT’s Incident Database System and Incident Tracking Database System with a centralized system that provides real-time access to incident data and supports mobile data collection by Road Rangers and Severe Incident Response Vehicles. The District also is building a new SMART module to obtain and archive traffic detector data.

The functional requirements presented here are based upon the discussions held with FDOT District 4 staff as well as the Cambridge Systematics’ experiences with reviewing data archives from other areas. The functional requirements presented here are intended to define formally what needs to be done in TMC data archiving in order to report on the performance measures. A requirement is marked with a ✓ sign if current SMART/SunGuide system capabilities can meet its need, while an X sign means additional software development is needed.

Table 3.1 Data Archive Functional Requirements for Performance Measures

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Provide for the collection and storage of several data types generated by the deployment of ITS and operational systems throughout the District.</td>
</tr>
<tr>
<td>1.1.</td>
<td>Provide for storage of Roadway-Based Traffic Data</td>
</tr>
<tr>
<td>1.1.1.</td>
<td>Provide storage of aggregations of traffic data (time/space summaries of volume, speed, occupancy)</td>
</tr>
<tr>
<td>1.1.1.1.</td>
<td>Provide storage of raw (“as received from field,” unedited) data online for at least 24-hours ✓</td>
</tr>
<tr>
<td>1.1.1.2.</td>
<td>Provide storage of raw data offline for a period of at least one year ✓</td>
</tr>
<tr>
<td>1.1.1.3.</td>
<td>Provide storage of aggregations of 5-minute by lane ✓</td>
</tr>
</tbody>
</table>
1.1.1.4. Provide storage of aggregations of 1-hour by station (one direction)

1.1.1.5. Provide storage of aggregations of 24-hour by roadway (both directions)

1.2. Provide for storage of Incident Data on roadways under the direct management of traffic management centers

Related Performance Measures: Congestion and Reliability, Incident Duration, Incident Management, Customer Satisfaction, System Coverage

1.2.1. Provide for storage of points on the “incident timeline” as follows:

1.2.1.1. Incident Start Time

1.2.1.2. Incident Notification Time

1.2.1.3. Incident Verification Time

1.2.1.4. Road Rangers/Law Enforcement Dispatch Time

1.2.1.5. Road Rangers/Law Enforcement Arrival Time

1.2.1.6. Additional responders (Fire, Rescue, EMS, Wrecker) Dispatch Time

1.2.1.7. Additional responders Arrival Time

1.2.1.8. Incident Lane Blockage Clearance Time

1.2.1.9. Incident Scene Departure Time

1.2.1.10. Normal Traffic Resume Time

1.2.2. Provide for storage of incident characteristics as follows:

1.2.2.1. Incident type (e.g., crash, breakdown, debris) following the District’s definition

1.2.2.2. Crash severity (incident level)

1.2.2.3. Number and types of vehicles involved

1.2.2.4. Incident milepost location and the location relative to the highway cross-section: in-lane, shoulder, median, gore, and combinations of these

1.2.2.5. The number of lanes affected

1.2.3. Provide capability to receive incident information from other TMC centers

1.2.4. Provide capability to extract selected incident data and allow access to incident data via external system interfaces

1.2.5. Provide capability to log Road Rangers activities

1.3. Provide capability to collect and store Roadway Weather Data

Related Performance Measures: Congestion and Reliability, System Coverage

1.3.1. Provide capability to integrate roadway weather data with other (congestion, incident, closure) data by geographic location

1.3.2. Provide capability to access roadway weather data via external system interfaces
1.4. Provide capability to capture and store information regarding **Planned Incidents** (e.g., special events, lane/road closures)  
*Related Performance Measures: Incident Duration, Incident Management*

1.5. Provide capability for storing **DMS messages**  
*Related Performance Measures: Customer Satisfaction, Traffic Information, Incident Management, System Coverage*

1.5.1. Provide capability to create message library to store and recall DMS messages

1.5.2. Provide capability to provide access to traffic and incident (including road closures) information to other centers

1.5.3. Provide capability to receive DMS information from other centers

1.5.4. Provide capability to relate DMS messages to incidents

1.6. Provide capability for collecting and storing **Traffic Detector and DMS Location Data**  
*Related Performance Measures: System Coverage, System Performance*

1.6.1. Provide capability for map displays of detector and DMS locations

1.6.2. Provide capability for matching linear reference location of detectors and DMS to other FDOT-maintained data systems

1.6.3. Provide HPMS Section Identifications for all detectors and DMS

1.7. Provide capability for collecting and storing **Traffic Detector and DMS Installation and Maintenance Activities and Cost**  
*Related Performance Measures: System Coverage, System Performance*

1.7.1.1. Type of activity

1.7.1.2. Activity start/end times and cost

1.7.1.3. Test results

1.7.1.4. Comments

1.8. Provide capability for collecting and storing **Traveler Information Web Site Activities.**  
*Related Performance Measures: Customer Satisfaction, Traveler Information, System Coverage*

1.8.1. Provide capability for collecting and storing web site visitor information (number of visits, durations of visits, page requested, source IP address, referring sites)

1.8.2. Provide tools to monitor and log web site health (peak periods, uptime, downtime, repair cost, load time, transactions, intrusions, server loads)

2. Provide for Traffic Data Processing Functions

2.1. **Data Transformations**: Provide capability of transforming and storing field-measured data from roadway devices  
*Related Performance Measures: Congestion and Reliability, Traffic Flow*

2.1.1. Provide capability of transforming spot speeds to travel times by assuming a link length of half the distance to nearest upstream and downstream detectors

2.1.2. Provide storage of link travel times at the 5-minute by lane level

2.1.3. Provide capability of transforming lane volumes into maximum capacities by location
2.1.4. Provide storage of capacities at the 15-minute by lane level

2.1.5. Provide capability of transforming spot speeds into HCM-based levels of service (LOS)

2.1.6. Provide storage of LOS at the 1-hour by direction level

2.2. Traffic Data Imputation: Provide capability of imputing missing roadway-based traffic data at the 5-minute by lane level

**Related Performance Measures:** Congestion and Reliability, Traffic Flow

2.3. Traffic Data Quality Control: Provide capability of assessing the quality of data received from roadway-based traffic detectors

**Related Performance Measures:** Congestion and Reliability, Traffic Flow, System Performance

2.3.1. Provide capability of automatically detecting data of poor or suspicious quality from roadway-based traffic detectors

2.3.2. Provide periodic quality reports as follows:

- 2.3.2.1. Provide Daily Detector Health Reports
- 2.3.2.2. Provide Quality Control Test Results Report
- 2.3.2.3. Provide Normalcy Reports
- 2.3.2.4. Provide System Quality Control Reports

2.4. Linkage to Legacy Systems: Provide capability of transmitting data to other units within FDOT, as defined by needs of FDOT District 4

- 2.4.1. Provide capability of producing standard traffic measurements for use in Florida TTMS (AADT, K-/D-factors)
- 2.4.2. Provide capability of sending crash information to safety office for identifying crashes not reported by police officers on the Police Accident Report

To ensure data availability in performance measures, data archiving modules in SMART and SunGuide should use the listed requirements as a reference in their software development process. Special attention should be given to the X marked requirements that are not yet implemented in current SMART and SunGuide software.
4.0 Reporting Format

It is recommended that a number of different reports are used to convey the performance measures results to a variety of audiences. Visual representations of the data should be included in the reports (bar graphs, pie charts, and maps, where appropriate). Information regarding the previous reporting period and (when available) the same period from the previous year should be included as a reference to improve readers understanding of the performance measures by providing context and showing trends of improvement or regression. Aberrations in the reports should be explained in text.

Weekly Report (optional)
Audience: TMC managers and staff.
Performance Measures: Currently focused on incident management and Road Ranger activities. Optional information on traveler information and field device maintenance may be added as available.

Event Report (optional)
Audience: TMC managers, EOC managers, other FDOT districts, and the FDOT Central Office. The focus of this report is measures that best summarize hurricane (or other) evacuation management performance.

Performance Measures

- Accuracy of congestion information
- Number of secondary incidents
- Traveler Information
  - Number of web page visits
  - Number of DMS messages
  - Diversions due to DMS messages
  - Number of DMS messages managed by different agency

Monthly Report
Audience: TMC managers and staff.

- **Traveler Information**
  - Smart SunGuide web site
    - Total visits
    - Web site data transmitted
  - Total number of DMS messages
  - Average DMS message duration
  - Number of DMS messages posted due to other agency request
  - DMS message posting time

- **Incident Management**
  - Total incident duration
  - TMC detection time
  - TMC verification time
  - TMC response time
    - Road Ranger dispatch time
    - Road Ranger response time
  - Incident clearance time
  - Total number of incidents
  - Incident detection method
  - Incident level (Lane blocking incidents)
  - Number of requests for Road Ranger response
  - Number of Road Ranger responses
  - Number of Road Ranger events
  - Number of Road Ranger activities
  - Average Road Ranger assist time

- **Congestion and Reliability**
  - Systemwide Travel Time Index
  - Systemwide Buffer Index
  - Speed map – average speed or travel time (weekday peaks) by road segment
• Devices (for detectors, CCTV, DMS, and Road Rangers vehicles)
  – Total number of devices by type
  – Operational field equipment percentage
  – TMC device/module uptime percentage
  – Calls sent to IT Helpdesk
  – Calls to IT Helpdesk outstanding
  – Calls to IT Helpdesk completed
  – IT Helpdesk call close time

• System Coverage
  – Number of outgoing TMC calls
  – Number of incoming TMC calls

• Miscellaneous monthly
  – Description of one or two worst incidents and analysis of these incidents
  – Segment of roadway where there are the most number of incidents
  – Project updates
  – Discussion of events that affected operations

**Quarterly Report**

**Audience:** FDOT District 4 management, other FDOT districts, and the FDOT Central Office. The focus of this report is outcome measures and select output measures that best summarize an activity. These measures should be presented in no more than two or three pages.

**Performance Measures**

• Congestion and Reliability
  – Travel Time Index
  – Buffer Index

• Total incident duration

• Number of incidents

• Number of severe incidents (Level 3)

• Traffic Flow
  – Average speed
  – Average travel time
Annual Report

**Audience:** Florida Transportation Commission, general public. The focus is on outcome measures and a few high-level output measures. The existing annual report format is sufficient for the internal DOT annual report, but a high-level graphic-oriented brochure format may be better received by the public.

**Performance Measures**
- Congestion and Reliability
  - Travel Time Index
  - Total Delay
  - Percent of congested traffic
  - Planning Time Index
  - Buffer Index
- Total incident duration
- Customer satisfaction survey results
- Traffic Flow
  - Average travel time
- System coverage
- Number of incidents
- Cost per incident response
- Smart SunGuide web site visits

**Required Report for Statewide ITS Measures**

**Audience:** These measures will be included in the *Performance and Production Review of the Florida Department of Transportation* published annually. Please note that these requirements have not yet been finalized.

**Performance Measures**
- Total Annual Road Ranger Stops (by District, State Total)
- FIHS Limited Access Miles Managed by ITS (by District, State Total)
- Incident duration with breakout of response time and clearance time
- Congestion and Reliability
  - Travel Time Index
  - Total Delay
  - Percent of congested traffic
  - Planning Time Index
  - Buffer Index
- Customer satisfaction based on a random general public survey
5.0 Assessment of the FDOT District 4 Performance Measurement Program

FDOT District 4 is in the process of developing one of the Nation’s premier performance measurement programs. The amount and range of data currently being collected is well beyond most traffic management centers performance measurement programs. When traffic data begins to be collected and archived the District will have a comprehensive performance measurement program that will enable the District to assess all aspects of their ITS activities and to describe to FDOT management and the public quantitative benefits of the ITS Program and active management and operations of the District’s freeway system. The data collection and performance measurement program described in this document will enable FDOT District 4 to be a model program for TMCs across the Country.
Appendix A

List of equations for Performance Measure and Data matrix…

For a specific road section and time period:

\[ TTI = \frac{TT}{TT_{freeflow}} \]

1. Travel Time Index:\(^1\)

For several road sections and time periods:

\[ TTI_{average} = \frac{\sum_{i=1}^{n} (TTI_i \times VMT_i)}{\sum_{i=1}^{n} VMT_i}, \text{ for each section and time period} \]

2. Total Delay:

\[ \text{Delay} = (TT - TT_{freeflow}) \times \text{Volume} \]

\[ \text{Total Delay} = \sum_{i=1}^{n} \text{Delay}_n \]

3. Percent of Congested Traffic:

\[ \begin{align*}
T_{congested} &= \frac{VMT_{congested}}{VMT_{total}} \\
&\times 100\%
\end{align*} \]

4. Planning Time Index:\(^2\)

\[ PTI_{average} = \frac{\sum_{i=1}^{n} (PTI_i \times VMT_i)}{\sum_{i=1}^{n} VMT_i}, \text{ for each section and time period} \]

---


\(^2\) Ibid.
5. Buffer Index:

\[ BI = \frac{\sum_{i=1}^{n} (BI \times VMT_i)}{\sum_{i=1}^{n} VMT_i} \times 100\% \]

6. Accuracy of Congestion Information:

Methodology under development

7. Total Incident Duration:

\[ Incident\ Duration = t_{normal\ flow} - t_{incident\ occurs} \]
\[ Total\ Incident\ Duration = \sum_{i=1}^{n} ID_n,\ for\ each\ incident \]
\[ Average\ Incident\ Duration = \frac{\sum_{i=1}^{n} ID_n}{n} \]

8. TMC Detection Time Period:

\[ Detection\ Time = t_{initial\ notification} - t_{incident\ occurs} \]
\[ Average\ Detection\ Time = \frac{\sum_{i=1}^{n} DT_n}{n} \]

9. TMC Verification Time Period:

\[ Verification\ Time = t_{verification} - t_{initial\ notification} \]
\[ Average\ Verification\ Time = \frac{\sum_{i=1}^{n} VT_n}{n} \]

10. TMC Response Time Period:

\[ Response\ Time = t_{RR\ arrives} - t_{initial\ notification} \]
\[ Average\ Response\ Time = \frac{\sum_{i=1}^{n} RT_n}{n} \]

11. Road Ranger Dispatch Time Period:

\[ Dispatch\ Time = t_{RR\ dispatch} - t_{TMC\ notification} \]
\[ Average\ Dispatch\ Time = \frac{\sum_{i=1}^{n} DT_n}{n} \]

12. Road Ranger Response Time Period:

\[ RR\ Response\ Time = t_{RR\ dispatch} - t_{RR\ arrives} \]
\[ Average\ RR\ Response\ Time = \frac{\sum_{i=1}^{n} RRRT_n}{n} \]

---

13. Incident Clearance Time:  
\[ \text{Incident Clearance Time} = t_{\text{lanes cleared}} - t_{\text{RR arrives}} \]  
\[ \text{Average Incident Clearance Time} = \frac{\sum CT_n}{n} \]

14. Incident Delay:  
Methodology under development, interim formula is: \( \text{total volume} \times \text{incident duration (minutes)} \times 5 \text{ minutes per vehicle} \)

15. Number of Secondary Incidents:  
\[ \text{Total Secondary Incidents} = \sum_{i=1}^{n} SI_n, \text{ for each incident} \]  
\[ \text{Average Secondary Incidents} = \frac{\sum_{i=1}^{n} SI_n}{n} \]

16. ITS Miles Managed:  
\[ \text{Total Miles Managed} = \sum_{i=1}^{n} \text{mile}_n, \text{ for each mile managed} \]

17. Percent Miles Managed:  
\[ \% \text{ Miles Managed} = \frac{\text{Total Miles Managed}}{\text{Total miles in system}} \times 100\% \]

18. Number of ITS Devices:  
\[ \text{Total ITS Devices} = \sum_{i=1}^{n} \text{device}_n, \text{ for each device of type n} \]

19. Average Volume:  
\[ \text{Average Volume} = \frac{\sum_{i=1}^{n} \text{volume}_n}{n} \]

20. Average Occupancy:  
\[ \text{Average Occupancy} = \frac{\sum_{i=1}^{n} \text{occupancy}_n \times \text{volume}_n}{\sum_{i=1}^{n} \text{volume}_n} \]

\[ \text{Travel Time} = t_{x_2} - t_{x_1}, \text{ time taken by a vehicle to traverse a fixed segment} \]

21. Average Travel Time:  
\[ \text{Average Travel Time} = \frac{\sum_{i=1}^{n} TT_n}{n} \]

\[ \text{Density} = \frac{52.8}{\text{length}_{\text{avg vehicle}} + \text{length}_{\text{detection zone}}} \times \text{occupancy} \]

22. Average Density:  
\[ \text{Average Density} = \frac{\sum_{i=1}^{n} \text{density}_n}{n} \]

23. Total Number of Incidents:  
\[ \text{Incidents} = \sum_{i=1}^{n} \text{incidents}_n, \text{ for each qualifier of interest} \]

24. TMC Incident Detection Method:  
\[ \text{Incident Detection} = \sum_{i=1}^{n} \text{incidents}_n, \text{ for each detection method} \]
<table>
<thead>
<tr>
<th>Measure</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incident Level:</td>
<td>Incident severity = $\sum_{i=1}^{n} incidents_n$, for each severity level</td>
</tr>
<tr>
<td>Incident Management Dollars Spent per Incident:</td>
<td>$IMS = \frac{\text{Incident Management } $}{\text{Total number of incidents}}$</td>
</tr>
<tr>
<td>Road Rangers Calls:</td>
<td>Total RR Calls = $\sum_{i=1}^{n} RR calls_n$, for each type of call and time period</td>
</tr>
<tr>
<td>Road Ranger Responses:</td>
<td>Total RR Assists = $\sum_{i=1}^{n} RR responses_n$, for each type of response and time period</td>
</tr>
<tr>
<td>Road Ranger Events:</td>
<td>Total RR Events = $\sum_{i=1}^{n} RR events_n$, for each type of event and time period</td>
</tr>
<tr>
<td>Road Ranger Activities:</td>
<td>Total RR Activity = $\sum_{i=1}^{n} RR activity_n$, for each type of activity and time period</td>
</tr>
<tr>
<td>Road Ranger/SIRV Assisting Time:</td>
<td>$RR Assist Time = t_{RR departs} - t_{RR arrives}$</td>
</tr>
<tr>
<td></td>
<td>Average RR Assist Time = $\frac{\sum_{i=1}^{n} RRAT_n}{n}$</td>
</tr>
<tr>
<td>Number of Outgoing Calls:</td>
<td>Total Outgoing Calls = $\sum_{i=1}^{n} outgoing calls_n$, for each type of call</td>
</tr>
<tr>
<td>Number of Incoming Calls:</td>
<td>Total Incoming Calls = $\sum_{i=1}^{n} incoming calls_n$, for each type of call</td>
</tr>
<tr>
<td>Operational Percentage:</td>
<td>Average Operational Percentage = $\frac{\sum_{i=1}^{n} uptime_n}{total time_n}$, for each equipment type</td>
</tr>
<tr>
<td>Mean Time to Repair:</td>
<td>$Repair Time = t_{\text{Trouble Report Closed}} - t_{\text{Trouble Report Created}}$</td>
</tr>
<tr>
<td></td>
<td>Average Repair Time = $\frac{\sum_{i=1}^{n} Repair Time_n}{n}$, for each equipment type</td>
</tr>
<tr>
<td>Mean Time between Failures:</td>
<td>$Failure Time = t_{i, \text{Trouble Report Created}} - t_{i-1, \text{Trouble Report Closed}}$</td>
</tr>
<tr>
<td></td>
<td>Average Time Between Failure = $\frac{\sum_{i=1}^{n} Failure Time_n}{n}$, for each equipment type</td>
</tr>
<tr>
<td>Cost per Equipment Repair:</td>
<td>Average Cost for Repair = $\frac{\sum_{i=1}^{n} cost_n}{n}$, for each equipment type</td>
</tr>
</tbody>
</table>
### ITS Performance Measures

#### Appendix A

38. **Device Uptime Percentage:**

\[
\text{Device Uptime} = \frac{\text{uptime}_{i}}{\text{total time}}, \text{ for each equipment type}
\]

39. **Calls Sent to IT Helpdesk:**

\[
\text{Total Helpdesk Calls} = \sum_{i=1}^{n} \text{helpdesk calls}_{i}, \text{ for each type of call}
\]

40. **Helpdesk Calls Outstanding:**

\[
\text{Outstanding Helpdesk Calls} = \sum_{i=1}^{n} \text{helpdesk calls}_{i} - \sum_{i=1}^{n} \text{helpdesk calls closed}_{i}, \text{ for each type of call}
\]

41. **Helpdesk Calls Closed:**

\[
\text{Helpdesk Calls Closed} = \sum_{i=1}^{n} \text{helpdesk calls closed}_{i}, \text{ for each type of call}
\]

42. **Helpdesk Call Close Time:**

\[
\text{Help Desk Call Close Time} = t_{\text{call closed}} - t_{\text{call received}}
\]

\[
\text{Average Help Desk Call Close Time} = \frac{\sum_{i=1}^{n} \text{HDCCT}_{i}}{n}
\]

43. **Number of TMC Web Site Visits:**

\[
\text{Total Hits} = \sum_{i=1}^{n} \text{web hits}_{i}, \text{ for each page and time period}
\]

44. **Referring Web Sites:**

\[
\text{Referring page} = \sum_{i=1}^{n} \text{web referral}_{i}, \text{ for each page and time period}
\]

45. **Web Site Visit Data:**

\[
\text{Web site data transmitted per visit} = \text{Number of bytes of data transmitted}
\]

46. **DMS Messages:**

\[
\text{Total DMS Messages} = \sum_{i=1}^{n} \text{message}_{i}, \text{ for each type, roadway and time period}
\]

47. **DMS Message Duration:**

\[
\text{DMS Msg Length} = t_{\text{end time}} - t_{\text{start time}}
\]

\[
\text{Average DMS Msg length} = \frac{\sum_{i=1}^{n} \text{DMS ML}_{i}}{n}, \text{ for each type and time period}
\]

48. **DMS Diversions:**

\[
\text{Diversions} = \text{volume}_{n,t} - \text{Average Volume}_{n,t}, \text{ for each message}
\]

49. **DMS Message Posting Time:**

\[
\text{DMS Posting Time} = t_{\text{DMS start time}} - t_{\text{incident verification}}
\]

\[
\text{Average DMS Posting Time} = \frac{\sum_{i=1}^{n} \text{DMS PT}_{i}}{n}, \text{ for each type and time period}
\]
Appendix B

2005 October

Monthly
SMART SunGuide TMC
Performance Measures

Notes

• Four new CCTV cameras and one new DMS sign were activated on Monday, October 17 as a part of ITS Deployment Phase II.
• One new Road Ranger Unit was added.
• Construction work on I-75 caused long delays and high 511 call numbers.
• Incident durations and number of were significantly lower than the previous month when major storms impacted the area.

This Month at a Glance

<table>
<thead>
<tr>
<th>Smart SunGuide Web Site Visits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Visits</td>
</tr>
<tr>
<td>Web site Data Transmitted</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DMS Messages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Number of DMS Messages</td>
</tr>
<tr>
<td>Average DMS Message Duration</td>
</tr>
<tr>
<td>Number of DMS Messages Posted due to Other Agency Request</td>
</tr>
<tr>
<td>DMS Message Posting Time</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Incidents Managed</th>
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<tbody>
<tr>
<td>Incident Duration</td>
</tr>
<tr>
<td>TMC Detection Time</td>
</tr>
<tr>
<td>TMC Verification Time</td>
</tr>
<tr>
<td>TMC Response Time</td>
</tr>
<tr>
<td>Road Ranger Dispatch Time</td>
</tr>
<tr>
<td>Road Ranger Response Time</td>
</tr>
<tr>
<td>Average Incident Clearance Time</td>
</tr>
<tr>
<td>Total Number of Incidents</td>
</tr>
<tr>
<td>Systemwide Travel Time Index (weekday peak-hours)</td>
</tr>
<tr>
<td>Systemwide Buffer Index (weekday peak-hours)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filed Equipment</td>
</tr>
<tr>
<td>RTMS</td>
</tr>
<tr>
<td>CCTV</td>
</tr>
<tr>
<td>DMS</td>
</tr>
<tr>
<td>Road Rangers Vehicles</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>System Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Incoming TMC Calls</td>
</tr>
<tr>
<td>Number of Outgoing TMC Calls</td>
</tr>
</tbody>
</table>
Smart SunGuide Web Site Visits

Number of Website Visits

Website Visits per Day

Visit Types

2005 Monthly Website Visits

2005 Website Data Transmitted (in Mbytes)
DMS Messages

Number of DMS Messages

Average DMS Message Durations (minutes)

Number of DMS Messages Posted due to Other Agency Request

Average DMS Message Posting Time (minutes)
Incidents

Number of Incidents

Week 1 | Week 2 | Week 3 | Week 4 | Last Month Weekly Average | Annual Weekly Average

0 | 100 | 200 | 300 | 400

Weekly Average

Incidents per Day

Sun | Mon | Tue | Wed | Thu | Fri | Sat

0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50

Detection Methods

TMC Detected | Caller Reported | Others

0% | 50% | 0%

Incident Types

Accidents, 57%

Construction/Maintenance, 57%

Stalled Vehicles, 9%

Debris, 9%

Road kills, 9%

Special Events, 3%

Others, 9%

Incident Levels & Secondary Incidents

Number of Level 1 Incidents | Number of Level 2 Incidents | Number of Level 3 Incidents | Number of Secondary Incidents

Current Month | Last Month | Annual Monthly

Road Rangers

Number of Requests | Number of Responses | Number of Road Ranger Events | Number of Road Ranger Activities

Current Month | Last Month | Annual Monthly
### ITS Performance Measures

#### Appendix B

**Average Incident Duration (minutes)**

- Current Month Average
- Last Month Average
- Annual Average

<table>
<thead>
<tr>
<th>Measure</th>
<th>Current Month</th>
<th>Last Month</th>
<th>Annual Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>TMC Detection/Verification Time</td>
<td>20</td>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td>TMC Response Time</td>
<td>60</td>
<td>80</td>
<td>100</td>
</tr>
<tr>
<td>Road Ranger Dispatch Time</td>
<td>80</td>
<td>100</td>
<td>120</td>
</tr>
<tr>
<td>Road Response Time</td>
<td>100</td>
<td>120</td>
<td>140</td>
</tr>
<tr>
<td>Incident Clearance Time</td>
<td>120</td>
<td>140</td>
<td>160</td>
</tr>
<tr>
<td>Total Incident Duration</td>
<td>140</td>
<td>160</td>
<td>180</td>
</tr>
</tbody>
</table>

**Average Road Ranger Assist Time (minutes)**

- Current Month Average: 20 minutes
- Last Month Average: 40 minutes
- Annual Average: 60 minutes

*Map showing lane-blocking incident location in the city.*
## Congestion and Reliability

### Travel Time Index (weekday peak hours)

<table>
<thead>
<tr>
<th></th>
<th>Current Month Average</th>
<th>Last Month Average</th>
<th>Annual Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-95</td>
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<td>I-75</td>
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<tr>
<td>I-595</td>
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<tr>
<td>Turnpike</td>
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<tr>
<td>System-wide</td>
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</tbody>
</table>

### Buffer Index (weekday peak hours)

<table>
<thead>
<tr>
<th></th>
<th>0%</th>
<th>10%</th>
<th>20%</th>
<th>30%</th>
<th>40%</th>
<th>50%</th>
<th>60%</th>
<th>70%</th>
<th>80%</th>
<th>90%</th>
<th>100%</th>
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<tbody>
<tr>
<td>I-95</td>
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<td>Turnpike</td>
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<tr>
<td>System-wide</td>
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</tbody>
</table>

### System-wide Congestion Trend (travel time index for weekday peak hours)

<table>
<thead>
<tr>
<th>Month</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>1.0</td>
<td>1.1</td>
<td>1.2</td>
<td>1.3</td>
<td>1.4</td>
<td>1.5</td>
<td>1.6</td>
<td>1.7</td>
<td>1.8</td>
<td>1.9</td>
<td>2.0</td>
<td>2.1</td>
</tr>
</tbody>
</table>

### System Reliability Trend (buffer index for weekday peak hours)

<table>
<thead>
<tr>
<th>Month</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
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</thead>
<tbody>
<tr>
<td>Average</td>
<td>5%</td>
<td>10%</td>
<td>15%</td>
<td>20%</td>
<td>25%</td>
<td>30%</td>
<td>35%</td>
<td>40%</td>
<td>45%</td>
<td>50%</td>
<td>55%</td>
<td>60%</td>
</tr>
</tbody>
</table>

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**Map of Miami Area and Fort Lauderdale**

- Peak Hour Speed
- Speed: 40-50 mph
- Speed: 50-60 mph
- Speed: >60 mph

**Legend:**
- Road Network
- Major Cities
- Interstate
- County Boundaries
- Water Bodies

---

*ITS Performance Measures*

*Appendix B*
Devices

Number of Field Equipment

Operational Field Equipment Percentages

Current Month Last Month

RTMS CCTV DMS Road Rangers

TMC Device/Module Uptime Percentage

IT Helpdesk

Average IT Helpdesk Call Close Time (days)

Current Month Last Month

Current Month Last Month

Server Switch Firewall SunGuide SMART Video Wall TMC Website

Calls sent to Helpdesk Outstanding Calls Completed Calls

Current Month Last Month
System Coverage

![Bar chart showing TMC calls comparison between current and last month.](chart.png)