

Session IV

Effective Performance Assessment and Communication

Module IV

Data Collection, Sources, Quality Control, and Analysis Techniques

Topics Covered

- Overview:
 - I. Collecting and Using Real-Time Data
 - II. ITS and Data Sources
 - III. Data Modeling
 - IV. Quality Assurance
 - V. Data Archiving

The Challenge of Using and Obtaining Performance Data

- **The Challenge:**
 - **Improve business processes by expanding the use of performance measurements without making significant additional investments in data collection and analysis tools**
- **The Key to Overcoming the Challenge:**
 - **First, organizations must take advantage of the data collection resources that are already in place.**
 - **Second, organizations must build on their performance measurement foundation by seeking more advanced data collection opportunities**

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Section 1

Collecting and Using Real-time Data

Collecting and Using Real-Time Data

- A. Obtain Existing Data**
- B. Develop Data Manipulation Procedures**
- C. Understand the Available Data**
- D. Collect Supplemental Data**

Collecting and Using Real-time Data: Obtaining Existing Archived Data

- Removing or significantly curtailing data archiving functions is commonplace
 - Data archiving procedures has not kept up with the declining costs of data archiving
- Most available performance data are collected for purposes other than reporting performance

Collecting and Using Real-Time Data: Develop Data Manipulation Procedures

Collected data can be:

- Used directly as a measure of performance (*e.g., vehicle volumes, vehicle speeds*)
- Combined with other data from other devices in the field to compute a new performance measure (*e.g., travel times computed from toll tag readers at different locations*)
- Mathematically transformed into a different performance measure (*e.g., point speeds at consecutive locations can be used to estimate travel times along a corridor*)
- Combined with other directly measured data (*e.g., vehicle volume and speed data can be used to compute vehicle hours of travel or vehicle hours of delay*)

Collecting and Using Real-time Data: Understanding the Available Data

- The practitioner needs to know how well data represents the performance of the freeway they are being collected on
- The practitioner needs to know how limitations in the data affect its use in performance monitoring
- Apply common sense and intuition

Collecting and Using Real-Time Data: Collecting Supplemental Data

- Supplemental Data will be used to:
 - Fill gaps in available data; and
 - Provide information that help eliminate biases in the previously collected data
- Examples
 - Vehicle occupancy data
 - Public's perception of the roadways
 - Number or percentage of trucks that are in the freeway traffic stream

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Section 2

ITS and Data Sources

ITS and Data Sources: Leveraging ITS Investments

- ITS investments should enable agencies to gather data on the following measures:
 - Usage levels (e.g. vehicles, people, freight)
 - Mobility (e.g., travel times, speeds, reliability)
 - Geometric data (e.g., number of lanes, cross section widths)
 - Safety (e.g., accidents and other incidents)
 - Environmental conditions and other traffic disruptions (e.g., special events)

ITS and Data Sources: Selecting Data Monitoring Equipment

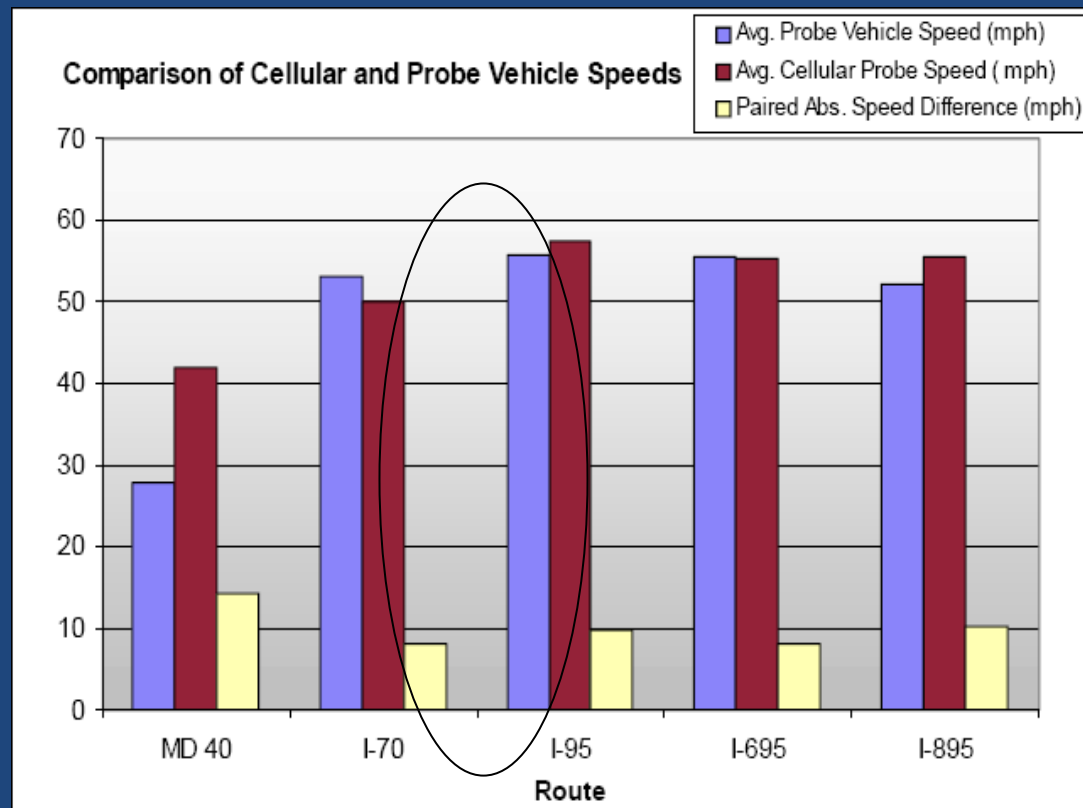
- Type of measures that are actually collected by a given device/technology;
- Accuracy of the data collected (given the environment in which the equipment must be operated);
- Environmental limitations for each technology;
- Capital cost of the devices;
- Installation and deployment costs;
- Ongoing operations and maintenance costs; and
- Communications costs.

ITS and Data Sources: Different Uses of ITS Equipment

Data used for reporting on freeway performance are commonly provided by three different types of data collection mechanisms:

- Permanent monitoring devices and systems
 - Intrusive and non-intrusive sensors (loops) (See Supplemental Slides 1-2)
- Short duration monitoring devices or programs
 - Cameras on arterials (See Supplemental Slide #3-4)
- Data sources external to the freeway agency (vehicle probes cell phones)
 - Cell phones
 - Probe vehicles (See Supplemental Slide #5-9)

ITS and Data Sources: Comparing Probe Car to Cell Phones Data



Source: University of Maryland. *Cellular Probe Data Evaluation: Progress Report –August*. Aug 16, 2006.

ITS and Data Sources: A Word of Advice on Procuring ITS Equipment...

- No single technology has proven to be “better” than the others for collecting the vehicle volume and speed information needed for all traffic management applications
- Each technology has strengths and weaknesses that make it the “best” choice under specific conditions and a “less than optimal” choice under other conditions
- Test the equipment under conditions in which it is expected to be used!

ITS and Data Sources: Helpful Sources to Track the Latest ITS Initiatives

The following resources are good places to start when looking for information on traffic monitoring equipment and their performance:

- **The Vehicle Detector Clearinghouse:**
 - <http://www.nmsu.edu/~traffic/>;
- **The Minnesota DOT tests of non-intrusive detectors:**
 - <http://www.dot.state.mn.us/guidestar/nitfinal/>;
- **The FHWA web site, “Summary of Vehicle Detection and Surveillance Technologies”:**
 - <http://www.fhwa.dot.gov/ohim/tvtw/vdstits.htm>;
- **Middleton, D., and R. Parker, Vehicle Detector Evaluation, October 2002, Texas Transportation Institute, FHWA/TX-03/2119-1; and**
- **The California Center for Innovative Transportation web site on traffic surveillance:**
 - http://www.calccit.org/itsdecision/serv_and_tech/Traffic_Surveillance/surveillanceoverview.html.

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Section 3

Data Modeling

Data Modeling

- Real-time surveillance data is preferable for developing performance measures; but in some cases it is not available.
- The main benefit of using model-based procedures is that the impacts of operational improvements and incident management measures can be predicted.

Data Modeling: Three Modeling Techniques

- **Travel Demand Models:** the best known way to estimate future travel on specific facilities.
- **Simulation Based Models:** A variety of software programs (FREQ, AIMSUN2, CORSIM, PARAMICS and VISSIM) take detailed geometric and traffic control data to simulate conditions. Very expensive to properly calibrate.
- **Hybrid Approach:** combines the best aspects of both the measurement and modeling techniques to produce an empirically grounded assessment of future conditions.

More information on Supplemental Slide #10.

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Section 4

Quality Assurance

Quality Assurance

- A. Improve data quality at the source
- B. Apply quality control checks.
- C. Visually review and confirm data
- D. Communicate data quality results

Quality Assurance: Improve Data Quality at the Source

- The most cost-effective way to improve data quality is to fix problems at the source.
- Strategies for fixing data quality at the source include:
 - Resource sharing between functional groups
 - Focused resources at selected location
 - Multipurpose data collection

Quality Assurance: Applying Quality Control Checks

- Quality control checks can automate the identification of suspect or invalid data values
- Quality control checks can take numerous forms while addressing a variety of issues
- Many traffic centers and data archives have developed quality control checks to address issues in their traffic data collection procedures.

Quality Assurance: Visually Review and Confirm Data

- Certain traffic patterns and trend that may be more suitable for manual visual checks
- Visual checks require more staff time, but are valuable in building in the quality of the analysis
- Make data quality results available to data collectors. Is there a need for improvements in data collection?

Quality Assurance: Communicating Data Quality Results to Data Collectors

- It is essential that there be an feedback loop between the data collection personnel and personnel that is responsible for analysis.
- Data quality reports should be oriented to the organization structure so that data quality issues can be easily dissected and fixed.

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Section 5

Data Archiving

Data Archiving: Steps to Develop a Data Archive

- **Determine the workgroup(s) or agency(ies) that should have primary responsibility for operating and maintaining the data archive;**
- **Start small but think long-term, and begin with modest prototypes focused on a single source of data (e.g., freeway or arterial street detector systems);**
- **Develop the data archiving system in a way that permits ordinary users with typical desktop computers to access and analyze the data;**
- **Provide access to and distribution of archived data through the Internet or portable storage devices, such as CDs or DVDs;**
- **Save original data as collected from the field for some specified period of time, but make summaries of this data available for most users;**
- **Use quality control methods to flag or remove suspect or erroneous data from the data archive; and**
- **Provide adequate documentation on the data archive and the corresponding data collection system.**

Data Archiving: Archive Development

There are several resources that can be used in the development of data archives for performance monitoring or other applications:

- The National ITS Architecture (<http://www.its.dot.gov/arch/>)
- The Archived Data Management System Data Model Report (<http://www.fhwa.dot.gov/policy/ohpi/travel/adus.htm>)
- The Standard Guide for Archiving and Retrieving ITS-Generated Data (<http://www.astm.org>)
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Conclusion

- The top priority is to take advantage of the data collection resources that are already in place.
- Many ITS options exist for collecting data-choose wisely
- The key to having good data is to control quality at the source of the data

Data Sources and Analysis Techniques for Operational Performance Assessment: Related Resources

- **Primary Source: NCHRP 3-68, *Guide to Effective Freeway Performance Measurement* (2006). With permission.**⁹
- **Steve Gilheany, *Projecting the Cost of Magnetic Disk Storage Over the Next 10 Years*.**
<http://www.berghell.com/whitepapers/Projecting%20the%20Cost%20of%20Magnetic%20Storage%20Over%20the%20Next%2010%20years.pdf>
- **Minnesota Department of Transportation Guidestar**
<http://www.dot.state.mn.us/guidestar/>
- **University of Maryland. *Cellular Probe Data Evaluation: Progress Report – August*. Aug 16, 2006.**
<http://www.transportation.org/sites/ssom/docs/2006meeting/Day%202%20-%20Phillip%20Tarnoff%20-%20MMTIS%20Results.pdf>
- **Texas Transportation Institute. *Cell Phone Travel Time Data Collection White Paper*. September 25, 2006.**
- **The Transportation Research Board's National Cooperative Highway Research Program (NCHRP) Synthesis 311: Performance Measures of Operational Effectiveness for Highway Segments and Systems**