Development of a High-Speed Rolling Wheel Deflectometer

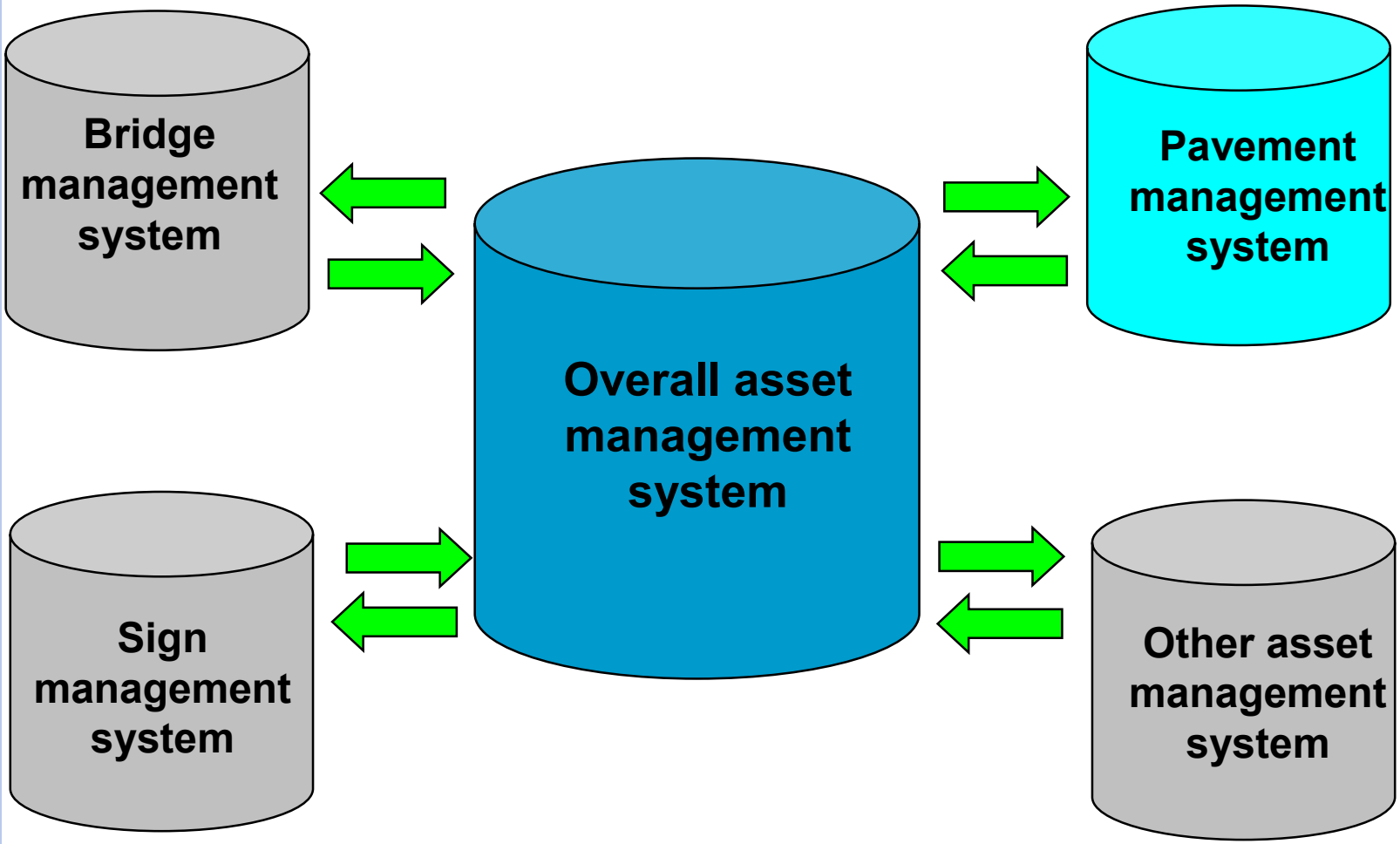
Southeastern States Pavement Conference
Louisville, Kentucky
June 2003

ERES CONSULTANTS
A Division of Applied Research Associates, Inc.

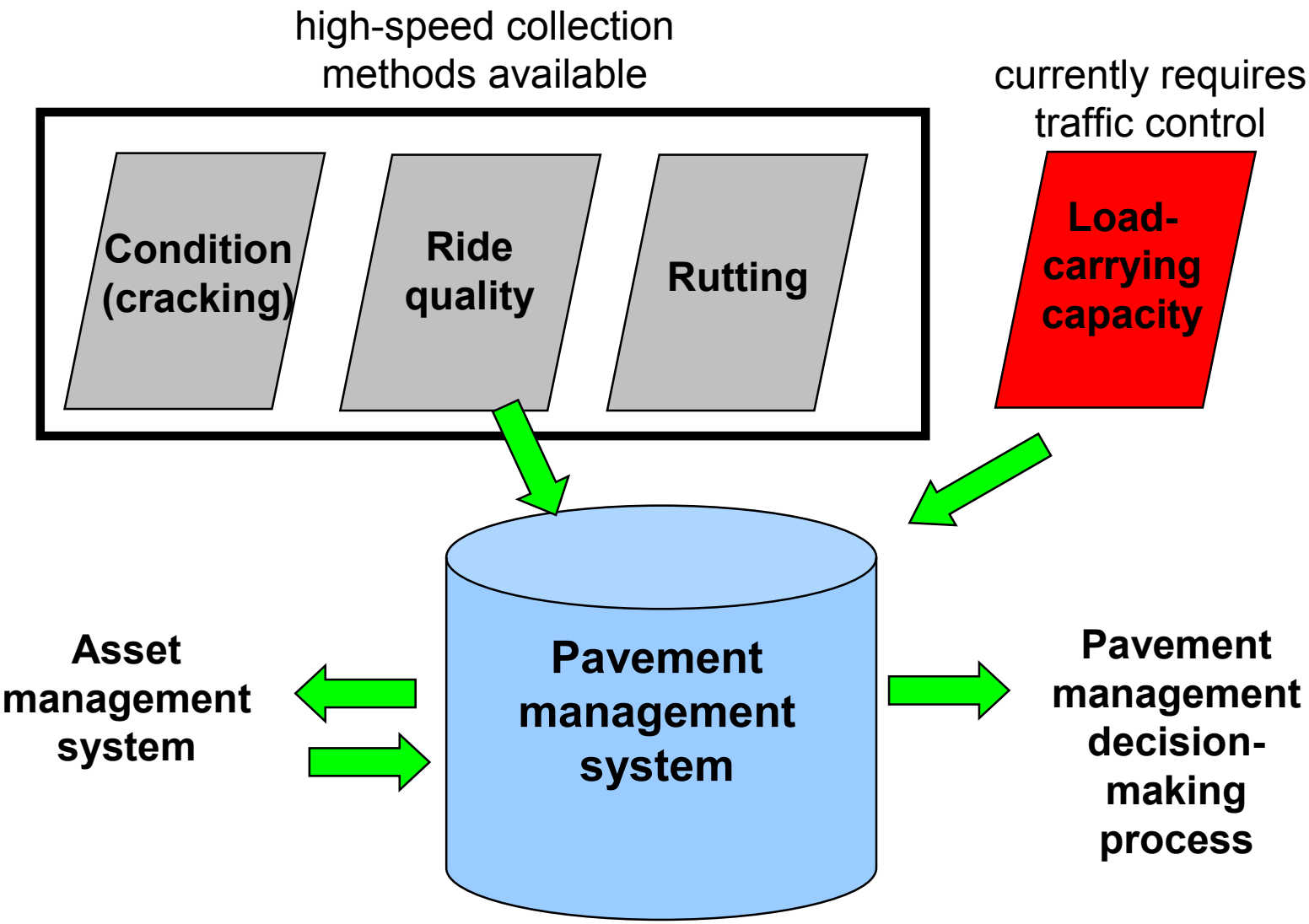
Outline

- Role of the RWD
- SBIR Research Objective
- Research Accomplishments
- Summary of RWD
  - Deflection Measurement Concept
  - Field Trial Results
- Texas Demonstration and Evaluation
- Deployment of Technology
- Benefits of RWD

Role of the RWD (1 of 2)



Role of the RWD (2 of 2)



SBIR Research Objective

SBIR Contract DTRS-57-95-C-00102 to Applied Research Associates, Inc. in 1996 to:

"Develop a rolling wheel deflectometer (RWD) that meets the pavement structural assessment needs of pavement managers"

- Actual moving truck load
- Highway speeds up to 55 mph
- Continuous deflection measurements
- Network-level PMS applications

SBIR Accomplishments

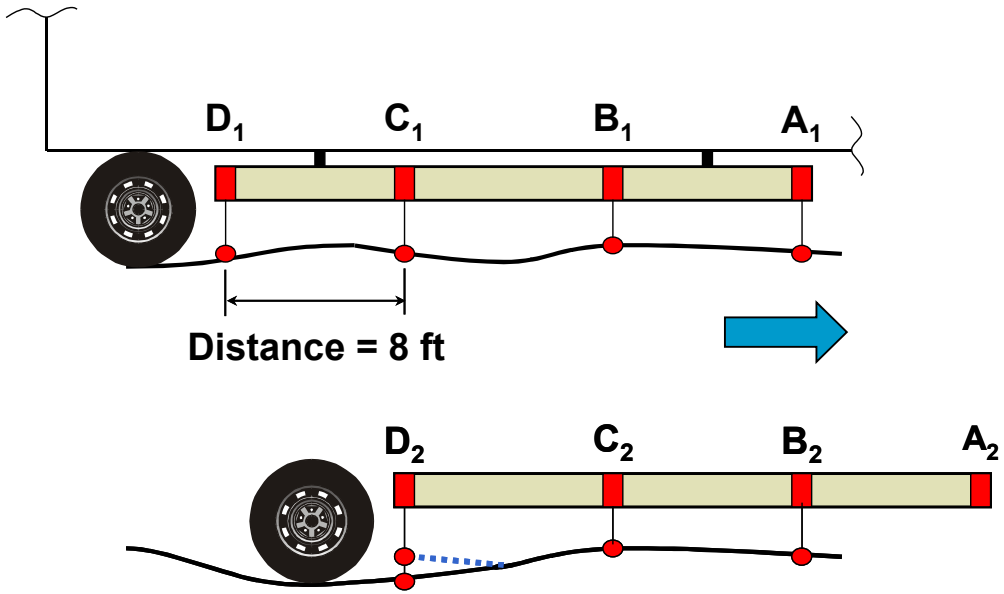
- Time frame 1996 – 2002
- Phase I
  - Assessment of technology
  - Developed specifications for RWD
  - Options for Structural Index
- Phase II (Part 1)
  - Designed and fabricated RWD trailer
  - Installed scanning laser
  - Developed software for data collection and processing
  - Initial proof of concept tests (not successful)

SBIR Accomplishments (con't.)

- Phase II (Part 2) - Amendments to SBIR contract
  - 4-spot lasers (16 kHz Selcom SLS-5000) mounted on rigid beam
  - Spatially coincident approach (not entirely successful in the past)
  - Improved data acquisition and processing
  - Sampling rate – sample every 0.48 inch at 55 mph
- Proof of concept was successful in July 2002
- Current system collects a single point average deflection on flexible pavements along tangent roadway segments

RWD Deflection Measurement

- 4 lasers mounted at 8-ft intervals
- Lasers A, B, and C measure undeflected surface
- Laser D measures deflected surface near load wheel
- Compare readings after each 8-ft of travel



Deflection is difference between deflected and undeflected surfaces (i.e., $D_2 - C_1$)

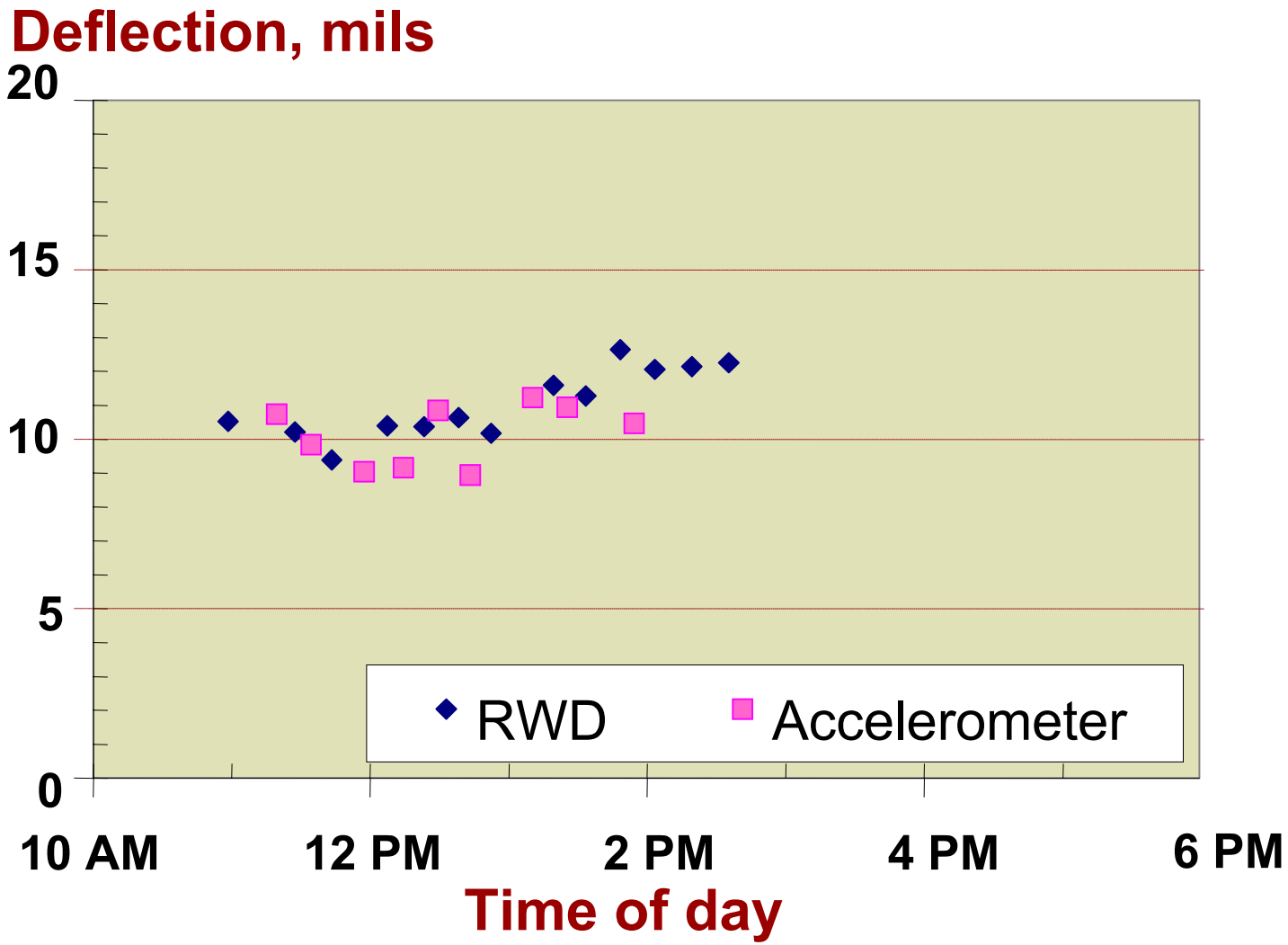
Photos of RWD Components

Proof of Concept Field Trials

- Field Testing Site
  - Field trials conducted in July 2002 on Staley Road near Champaign, Illinois
  - Thick and thin AC pavement sections tested
- Testing Details
  - Multiple runs at speeds from 30 to 55 mph
  - RWD deflection measurements were average over 500-ft runs
  - Reference accelerometer installed in pavement
  - FWD deflections for comparisons

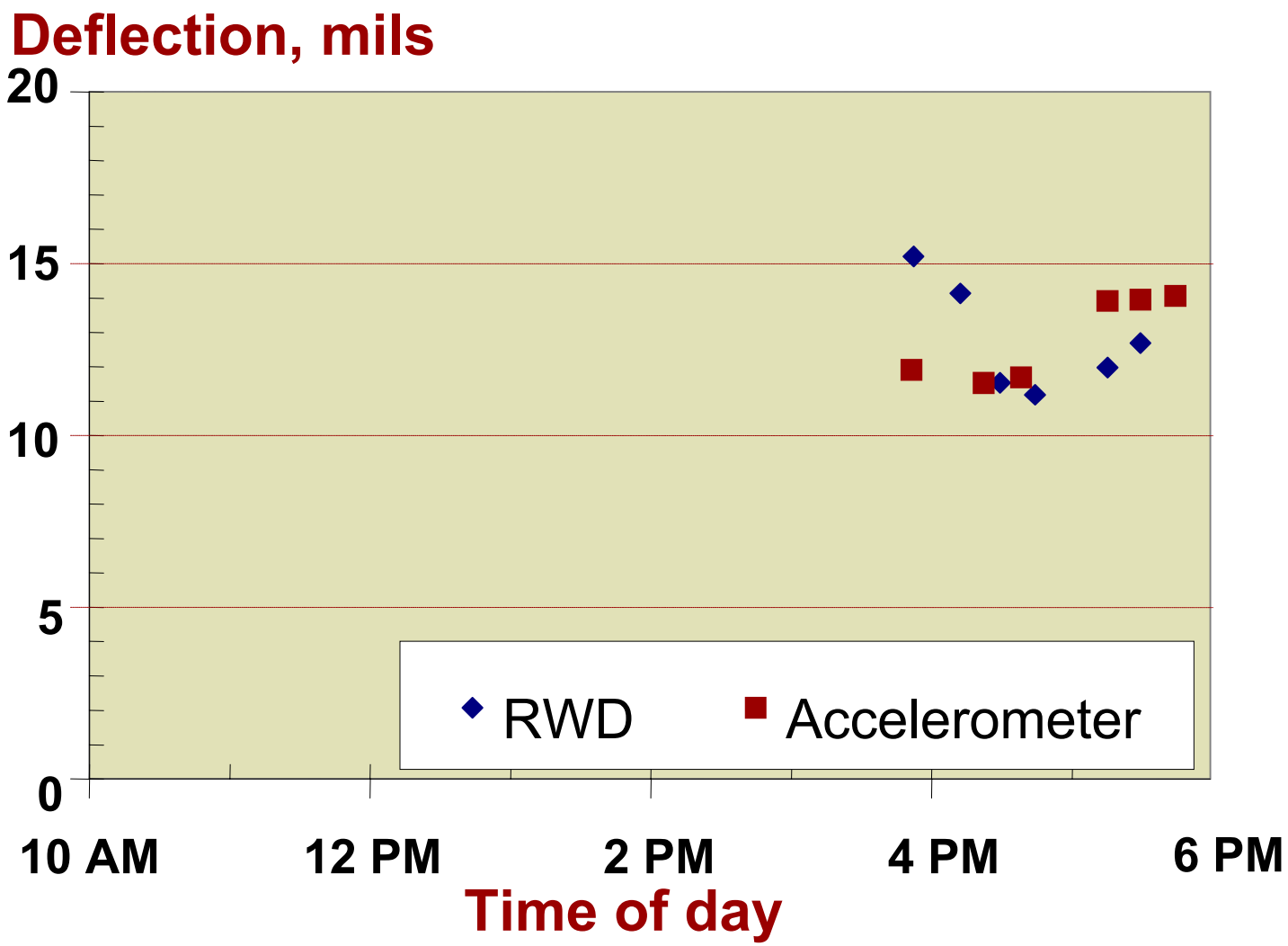
Comparison to Reference Sensor

Thick AC



Comparison to Reference Sensor

Thin AC



Summary of Deflection Results

Proof of Concept Results

Mean Deflection, mils

	RWD	Accel	FWD*
Thick AC	11.1	10.3	8.7
Thin AC	12.8	13.3	14.0

*Tested on different date

Demonstration and Evaluation

- Field Evaluation of RWD Capability
  - July 14 – 25, 2003
  - Near College Station, Texas
  - Funded by FHWA and Texas DOT
- Issues Included in Field Tests
  - Section Length for Data Processing (<500 ft?)
  - Pavement Factors To Be Considered
    - ✓ Surface Texture
    - ✓ Curves and Grades
    - ✓ Pavement Strength (deflection ranges from 5 to 35 mils)
    - ✓ Rutted Surface
  - Effect of Data Collection Speed
  - Comparisons to FWD, Texas RDD, and MDD
  - Repeatability

RWD Deployment (2003-2004)

- Improvements Needed for Deployment
  - Sensors
    - ✓ Improved laser calibration
    - ✓ Additional sensors
  - Controls, data acquisition, and data processing
    - ✓ Move data acquisition to truck cab
    - ✓ Add automated data collection and processing
    - ✓ Add automated adjustment for temperature
    - ✓ On-board GPS
  - Other hardware and software changes
- Deployment Demonstrations
  - Five states to be selected by FHWA
  - Format determined by FHWA and participating states

Future Development (2005-2010)

- Long-term plan for further improvements to prototype and completion of full production unit
- Enhancements include:
  - Addition of Doppler lasers with current spot lasers to provide capability for:
    - ✓ Testing rigid pavements including load transfer efficiency of joints between slabs
    - ✓ Measuring complete deflection basin to provide structural analysis of pavements (FWD replacement)
  - Fully automated data acquisition and processing
  - Addition of GPR, GPS, and other support technologies
- Project level and network level applications

Ultimate Benefits of RWD

- Nondestructive method for measuring the structural capabilities of a pavement network
  - Minimal disruption to highway traffic flow
  - Safe operations
  - Full deflection basin
- Real time assessment of remaining structural life of the nation's highway system
- Information for managing pavements:
  - Improved decision-making processes for preserving pavements (better asset management)
  - More accurate estimates of our Nation's highway funding needs