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IMPROVING HIGHWAY SAFETY THROUGH PAVEMENT FRICTION MANAGEMENT (PFM) PROGRAMS

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Other Acknowledgements

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- Kurt Smith (APTech)

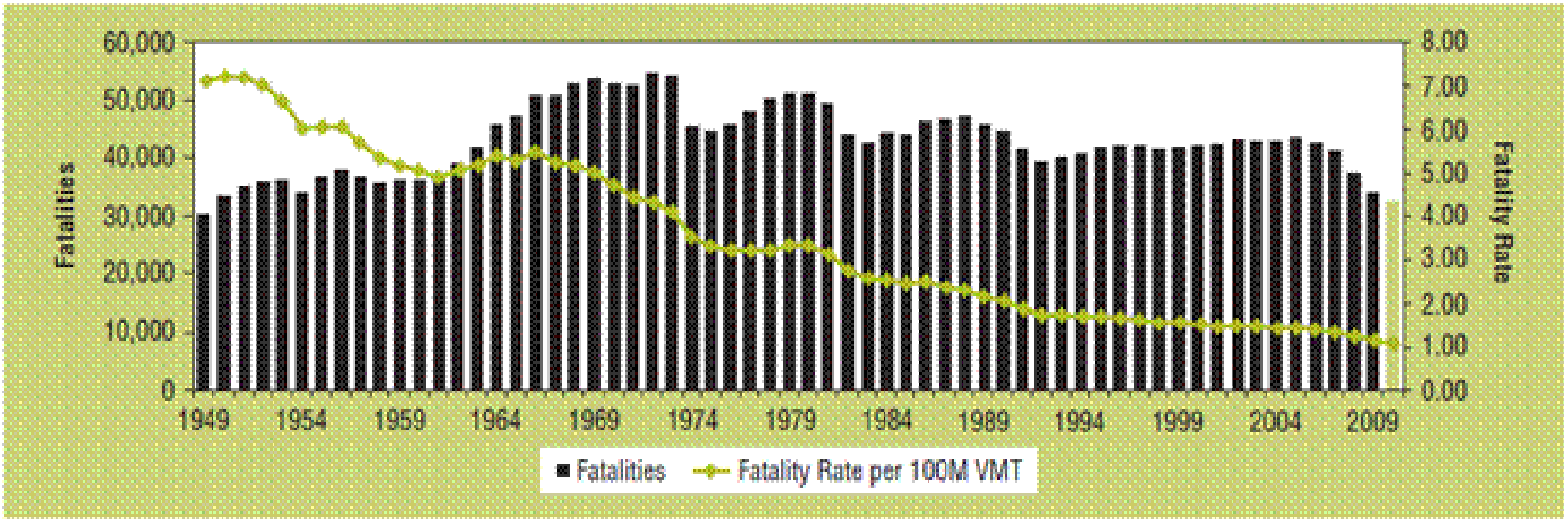
Presentation Overview

- Background on pavement-related safety.
- "Development and Demonstration of PFM Programs."
  - Examinations of past studies investigating the relationship between pavement friction/texture and crashes.
  - Examinations of PFM-related practices.
- Key findings/conclusions.

Background

- **U.S. Highway Safety**
  - **Historical crash trends**
  - **Performance goals**
- **Crash Factor Categories**

U.S. Highway Safety



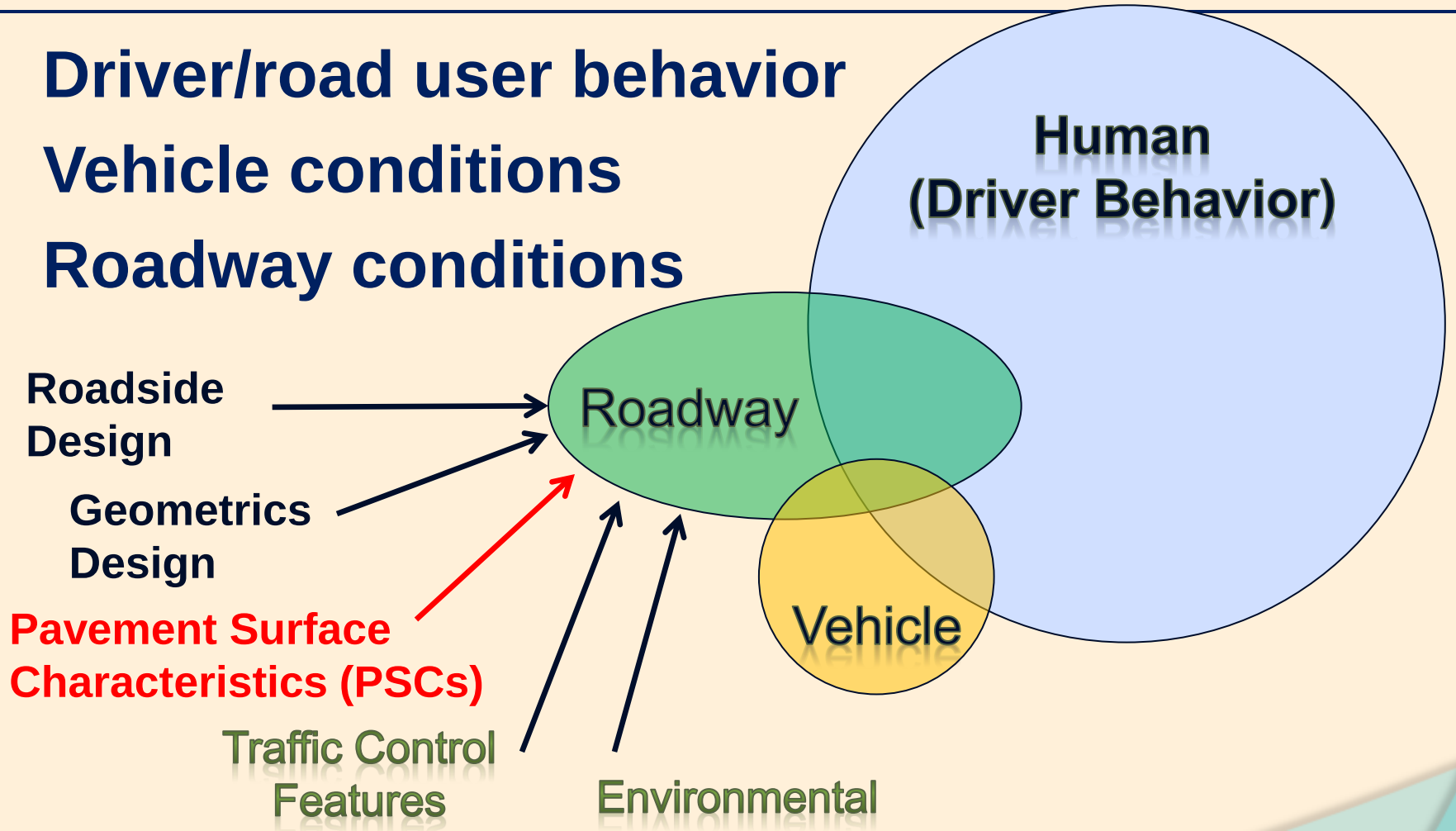
1949–1974: National Center for Health Statistics, HEW, and State Accident Summaries (Adjusted to 30-Day Traffic Deaths by NHTSA)
FARS 1975–2009 (Final) 2010 Annual Report File (ARF); Vehicle Miles Traveled (VMT): Federal Highway Administration.

NHTSA Traffic Safety Facts (Aug 2010)

New Goal: Cut fatalities in half by 2030

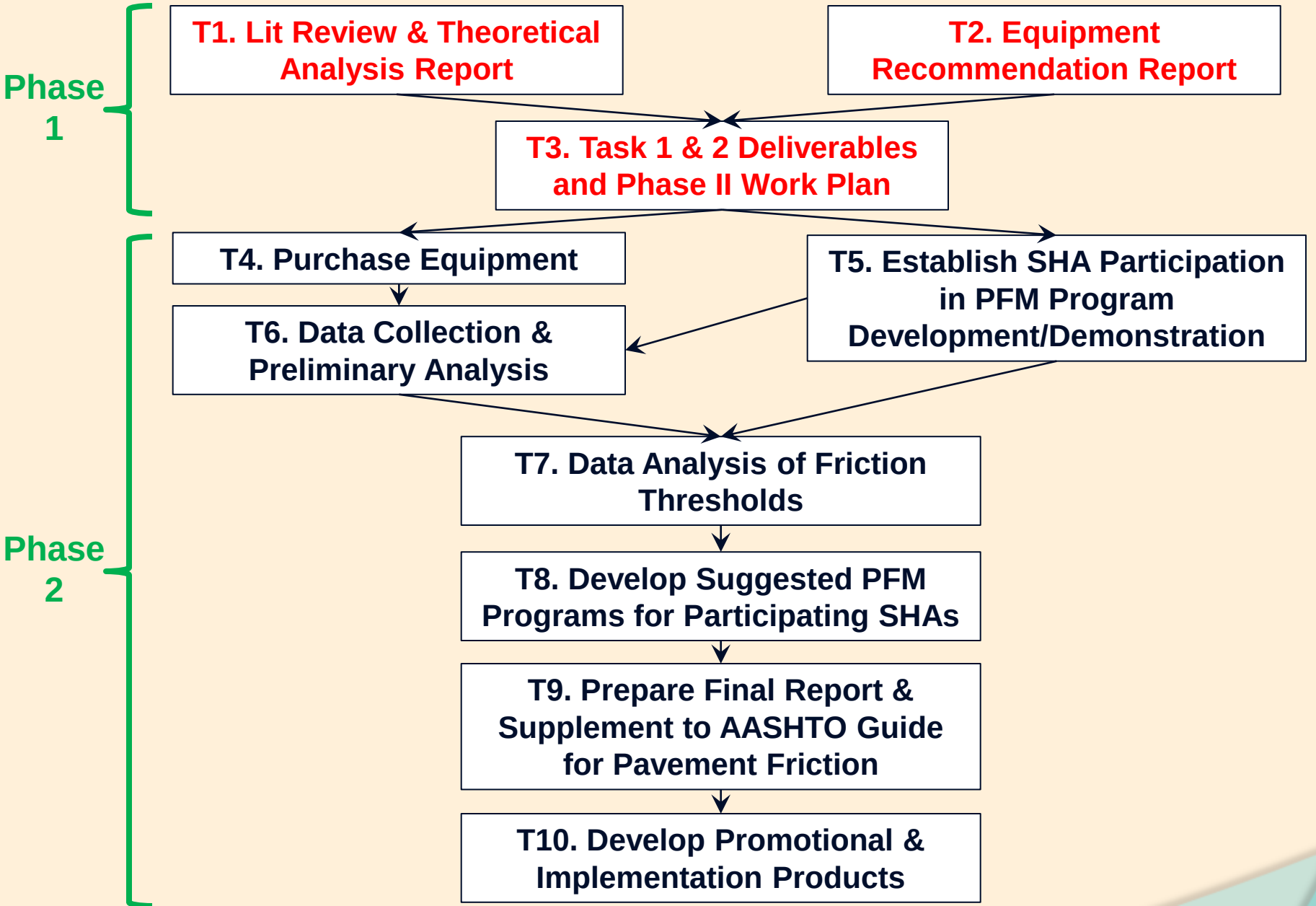
Crash Factor Categories

- Driver/road user behavior
- Vehicle conditions
- Roadway conditions



Development and Demonstration of PFM Programs

- **Objectives**
  1. **Determine criteria and develop methods for establishing investigatory and intervention levels of friction and texture for different friction demand categories on highway facilities.**
  2. **Identify state-of-the-art friction and texture measurement equipment.**
  3. **Work with selected states to develop and demonstrate PFM programs using results from first two objectives.**


Phase 1
T1. Lit Review & Theoretical Analysis Report
T2. Equipment Recommendation Report
T3. Task 1 & 2 Deliverables and Phase II Work Plan
Phase 2
T4. Purchase Equipment
T5. Establish SHA Participation in PFM Program Development/Demonstration
T6. Data Collection & Preliminary Analysis
T7. Data Analysis of Friction Thresholds
T8. Develop Suggested PFM Programs for Participating SHAs
T9. Prepare Final Report & Supplement to AASHTO Guide for Pavement Friction
T10. Develop Promotional & Implementation Products

Task Focus

- **Activity 1—Examination of past studies investigating the relationship between vehicle-tire-pavement interactions and crashes.**
- **Activity 2—Examination of PFM-related practices.**

Relationships Between Pavement Friction/Texture and Crashes

- **Literature Search/Review**
  - **Studies in last 10 years**
  - **State DOTs, other countries**
- **Evaluate studies in terms of:**
  - **Physical scope of the study and the timeframe**
  - **Area of safety interest and crash types examined**
  - **Types of friction/texture and crash data evaluated**
  - **Analysis techniques used**
  - **Findings/results of the study**

Synopsis of Studies

Physical Scope (highway segments analyzed)	Projects–interstates, trunk highways Corridors–interstates, US routes, state routes Networks–interstates, freeways, 2-lane roads, multi-lane divided and undivided roads, strategic routes, principal roads
Spans of Years for Data Analyzed	Various–anywhere from 1 to 8 years
Type of Friction/ Texture Data	**Locked-wheel FN** (various speeds, ribbed or smooth)–primarily states **SCRIM SFC and MSSC**–other countries Mu-Meter FN **High-Speed profiler EMTD or SMTD** Sand patch MTD Generic surface texture type or material type (e.g., tined PCC, HMA of various gradations, microsurfacing, high-friction surfacing)

Synopsis of Studies (cont.)

Areas of Safety Interest	**Hot-spot locations** **Intersections** Congested freeways **Curves** (horizontal and vertical) Roundabouts Interchange ramps
Crash Types Analyzed	**All** **Intersection** **Rear-end** Run-off-road Combination rear-end and side-swipe Rollover Jackknife Object-in-road Fixed-object

Synopsis of Studies (cont.)

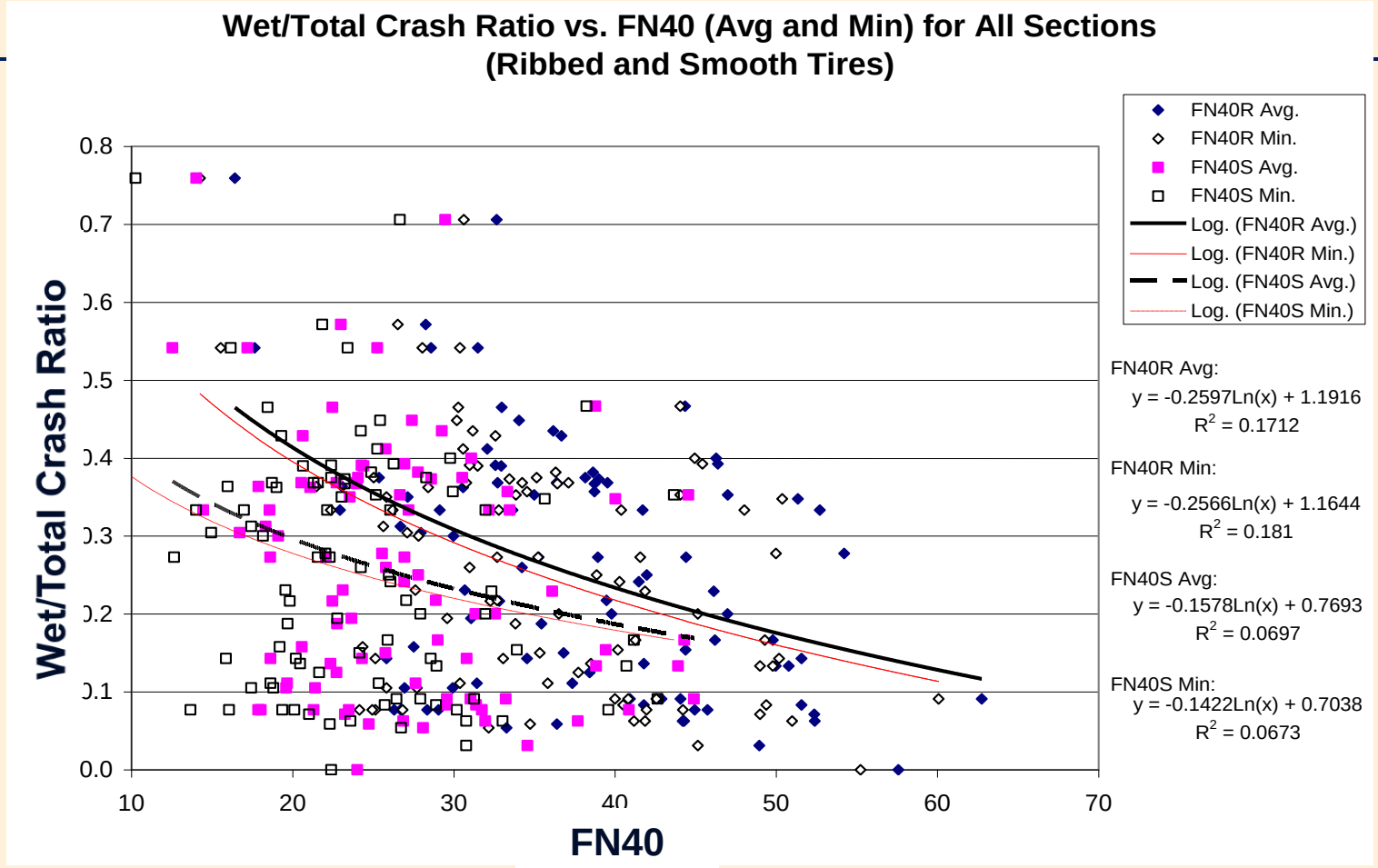
Crash Data Parameter Types	**Total crashes or total crash rate** (all components or just severe [fatal/serious]) **Wet crashes or wet crash rate** Dry crashes or dry crash rate Wet-to-dry crash ratio **Wet-to-total crash ratio** LPSR or WSF (normalize for differences in wet pavement time) Time of day crashes, seasonal crashes
Analysis Techniques Used	Direct comparison **Before-and-after comparison** Comparison to the norm **Regression analysis**

Before-and-After Comparison—Example

Year	Prior to App AR PFC			After AR PFC		
	2001	2002	2003	2004	2005	2006
Total No. of Accidents	25	48	36	17	6	22
Dry Weather Accidents	10	22	13	16	5	21
Wet Weather Accidents	15	26	23	2	1	1
Fatalities	0	1	5	0	0	1
Total Injuries	25	16	21	6	2	13
Incapacitating Injuries	6	4	3	0	1	0
Non-incapacitating Injuries	19	12	18	6	1	5
Annual Rainfall (in)	42.9	36.0	21.4	52.0	22.3	34.7
Total Rain Days (>0.1 in)	57	58	37	70	45	43

Rubber Pavements Association (RPA). 2008. "Safety on Friction Courses-Update." Volume 11, Number 1, Rubber Pavements

Regression Analysis—Example



R.M. Larson et al. 2008. "Relationship Between Skid Resistance Numbers Measured with Ribbed and Smooth Tire and Wet Accident Locations." Draft Final Report, Ohio Department of Transportation.

PFM-Related Practices (Pavement Safety Approaches)

- **Traditional approach**
  - **Based on FHWA Technical Advisory T 5040.17 (*Skid Accident Reduction Program*).**
  - **Basic steps**
    1. **Collect and review crash data to identify high wet-weather crash locations.**
    2. **Analyze wet pavement crash rates to identify locations with potentially inadequate levels of friction and/or texture.**
    3. **Conduct detailed site investigation of hot-spot locations, including testing for friction and possibly texture.**
    4. **Develop, prioritize, and program pavement countermeasures, as necessary.**

PFM-Related Practices (Pavement Safety Approaches) (cont.)

- **Pro-active approach**
  - **Based on AASHTO *Guide for Pavement Friction* and FHWA Technical Advisory T 5040.38 (*Pavement Friction Management*).**
  - **For agencies where friction is recurring problem.**
  - **Basic steps**
    1. **Perform routine friction testing and collect crash data.**
    2. **Identify locations with friction below investigatory level**
    3. **Of these locations, identify which have friction below intervention level and/or have high wet-weather crash rates.**
    4. **Develop, prioritize, and program treatments, as necessary.**

Pavement Safety Approaches

- **Literature Search/Review**
  - **Sampling of US states and international agencies**
- **Evaluate programs/practices in terms of:**
  - **Basic approach (traditional or proactive)**
  - **Components/features**
  - **Noteworthy ideas, procedures, and technical information**

Key Findings/Conclusions

- **Strong Friction/Texture–Crash Relationships Elusive**
  - **crashes largely caused by human error, frequently involve one or more contributing factors—confounds analysis.**
  - **inadequate matching of friction/texture test locations and crash locations also confounding.**
- **Concept of Investigatory and Intervention Levels Important**
  - **Recognizes inaccuracies in friction/texture–crash relationships; logical and reasonable approach to determining if friction/texture is contributing to crashes (or severity of crashes).**
  - **Establish for individual site categories (friction demand)**

Key Findings/Conclusions (cont.)

- **PFM-Related Practices Vary According to Need**
  - **Traditional safety-driven approach practical in some locations.**
  - **Proactive approach necessary or more practical in other locations.**
  - **Successful application of a specific practice in one place, does not guarantee success elsewhere; customization needed.**

Key Findings/Conclusions (cont.)

- **Continue Assessing Role of Equipment in Friction/Texture–Crash Relationships**
  - **No direct comparisons of effectiveness of different friction and texture measuring devices.**
  - **Strong relationships not available from any device (locked-wheel, continuous side-force equipment).**
  - **Potential advantages/disadvantages.**

Closing Thought

- **"Skid resistance (friction) is likely to remain a key element in the provision of a safe road system in the future, although priorities for the detailed manner in which they are provided may change."**

--- Peter Cairney

Cairney, P. 2011. "The Future of Skid Resistance." 3rd International Surface Friction Conference, Gold Coast, Australia.

Thank You!!

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