Government / Industry Brake Research, Rulemaking and Technologies – CV102

Safety Benefits of RSC and ESC for Tractor Semitrailers

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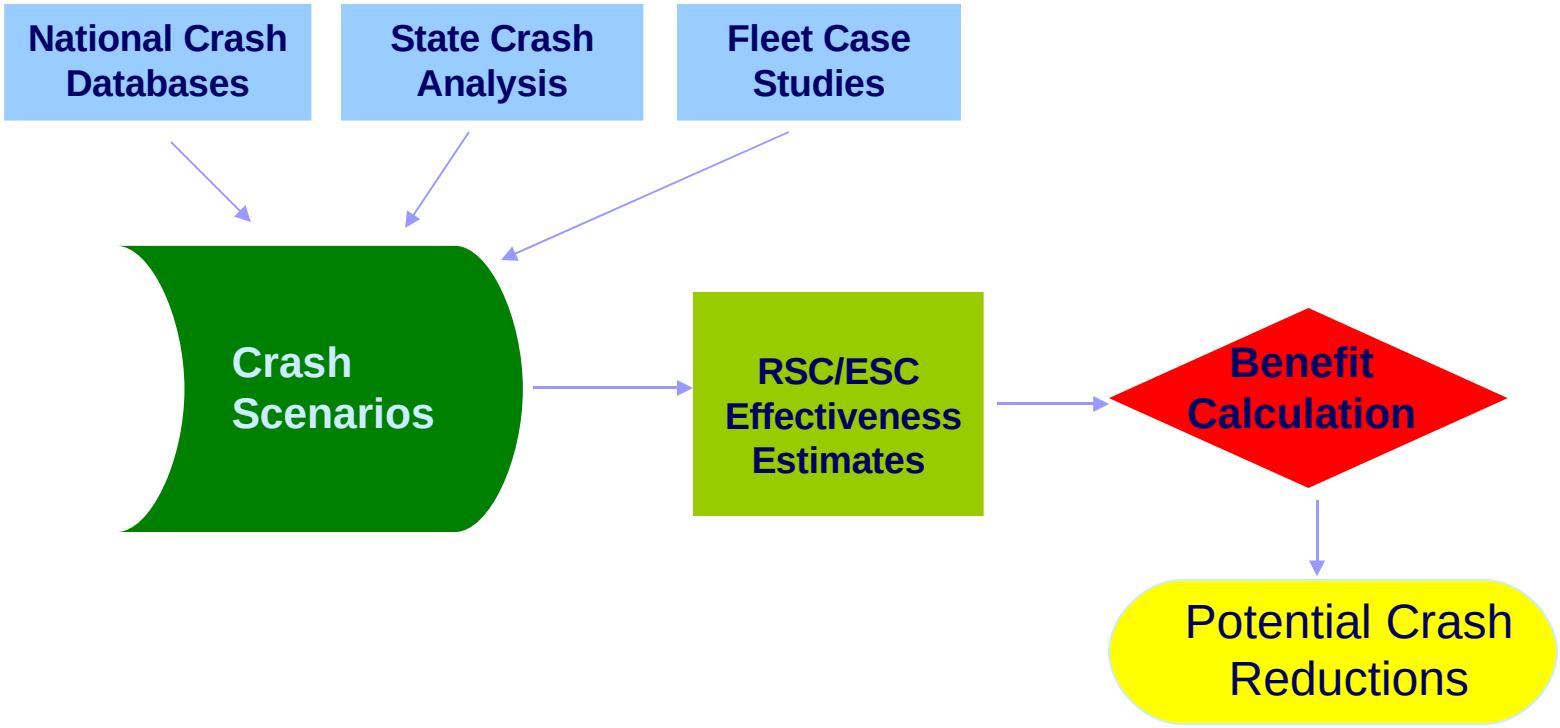
Introduction

- Tractor semitrailer combination vehicles
  - Approximately 75% of large truck fatal crashes annually
  - Comprise 65% of Vehicle Miles Traveled (VMT)
  - Initial industry focus for heavy vehicle stability systems
- UMTRI studied the potential safety benefits from stability control systems for tractor semitrailers
- Determination of safety benefits is challenging
  - Stability control only recently introduced to heavy truck fleet
  - Limited crash exposure of technology in the field
  - Not possible to do a "before/after" study

Study Methodology

- Crash Problem Definition
  - Analysis of National Crash Databases and Fleet Data to Determine:
    - Global crash population
    - “Addressable” crash population
- Develop Representative Crash Scenarios
  - Large Truck Crash Causation Study (LTCCS)
- Determine Effectiveness of RSC and ESC
  - Hardware in the Loop (HIL)
  - Engineering judgment
  - Expert panel analysis
- Calculate Safety Benefits

Methodology Overview



Crash Data Analysis

- General Estimates System (GES)
  - Nationally-representative
  - Coded from police reports
  - All crash severities
- Trucks in Fatal Accidents (TIFA)
  - Census of truck fatal crash involvements
  - Supplements FARS
  - Configuration & crash detail
- Large Truck Crash Causation Study (LTCCS)
  - K, A, or B crash severity
  - Rich detail about pre-crash events and truck configuration

Crash Problem Definition for Tractor Semitrailers

	Crashes+	Injuries+	Property Damage Only (PDO)+	Fatalities*
Total (per year)	178,001	58,714	351,722	3,329
Addressable by Stability Control				
Rollover	6,874	4,873	3,655	197
Loss of Control	4,350	1,673	4,023	58

+ Source: GES 2000-2004 * Source: TIFA 2000-2004

LTCCS Data Review

- LTCCS contains 963 crashes including 1128 vehicles
- 113 Rollover relevant
- 46 Loss of control relevant
- Provides detailed information about crash events
  - Scene diagram
  - Detailed narrative
  - Detailed coded crash events
  - Physical configuration of the vehicle (weights, lengths, axle count, cargo weight and type, etc.)
- 22 crash cases selected for HIL simulation
- Remainder of cases reviewed by an expert panel

Determining Effectiveness of RSC/ESC

- RSC and ESC effectiveness (%) was determined separately for all relevant LTCCS cases
- Rollover
  - For rollovers that occurred after 100 m into the curve - effectiveness of 95% was assigned
  - Rollovers that occurred before 100 m into the curve - evaluated by HIL simulation
  - Rollovers that occurred near the start of the curve - evaluated by expert panel
- Loss of Control
  - All cases - evaluated by expert panel

Determining Effectiveness by HIL

- Critical Speed (V_c) - highest speed for which no rollover occurs
- V_c was determined for ABS, RSC, and ESC
- Effectiveness calculated from a distribution of V_c from field data.

Determining Effectiveness by Expert Panel

- Panel members observed test track handling maneuvers to gain insight into behavior of the RSC/ESC for tractor semitrailers
- Systematic process of scoring 15 factors from the case including:
  - Vehicle speed / road surface / weather conditions
  - Driver braking and steering inputs, and physical condition
  - Indication of oversteer / understeer
  - Would the event trigger the system algorithm?
- Upon review of all factors - final effectiveness was assigned

Linking Effectiveness to Potential Safety Benefits

- Scenarios classified by:
  - Road alignment (straight, curve)
  - Road surface condition (dry, not dry)
- RSC and ESC effectiveness calculated separately for each scenario
- GES/TIFA Crash populations associated for each scenario
- Benefits = Crash Population x Effectiveness

Potential Crash Benefit of RSC

Scenario	Crash Population*	Estimated Effectiveness (%)	Benefit (Crash Reduction)
Roll, curve, dry	3783	71.15	2692
Roll, curve, not dry	403	45.56	184
Roll, straight, dry	2480	16.36	406
Roll straight, not dry	207	0	0
LOC, curve, dry	572	14.00	80
LOC, curve, not dry	767	11.54	89
LOC, straight, dry	1207	0.56	6
LOC, straight, not dry	1802	1.76	32
*Source: GES, TIFA 2000-2004		**Total**	**3,489**

Potential Crash Benefit of ESC

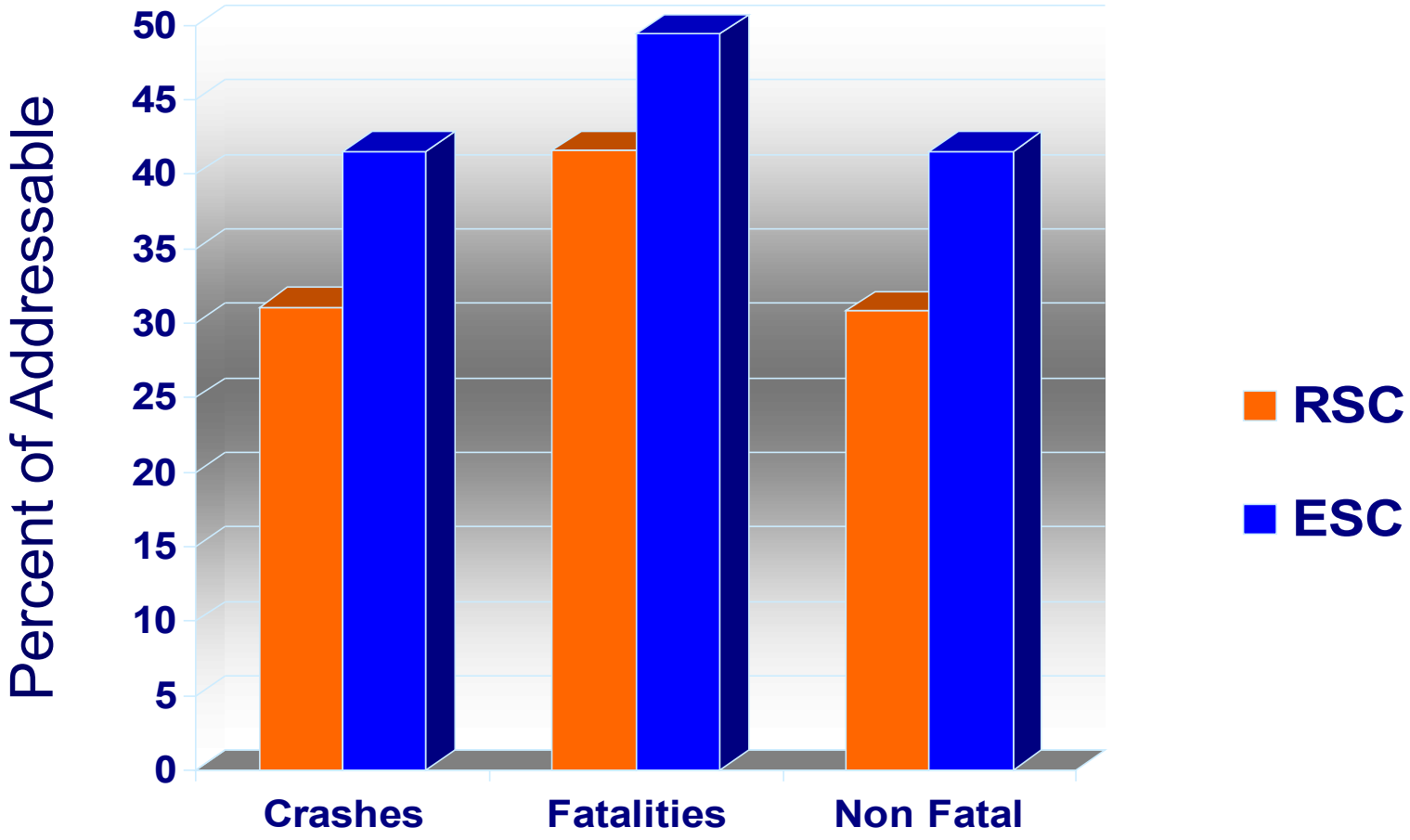
Scenario	Crash Population*	Estimated Effectiveness (%)	Benefit (Crash Reduction)
Roll, curve, dry	3783	75.05	2840
Roll, curve, not dry	403	55.56	224
Roll, straight, dry	2480	21.14	524
Roll straight, not dry	207	0	0
LOC, curve, dry	572	31.57	181
LOC, curve, not dry	767	39.62	304
LOC, straight, dry	1207	17.78	215
LOC, straight, not dry	1802	20.59	371
*Source: GES, TIFA 2000-2004		**Total**	**4,659**

Total Benefits For RSC and ESC

Total Annual Population Rollover and Loss of Control*		Potential Benefits	
		RSC	ESC
Crashes	11,224	3,489	4,659
Fatalities	255	106	126
Total Non Fatal	14,233	4,384	5,909

*Source: GES, TIFA 2000-2004

Percentage of Benefits Derived From RSC and ESC



Summary

- Study provided a means for determining safety benefits of RSC and ESC using available data
- Both RSC and ESC show positive net safety benefits
- ESC provides greater benefits than RSC
- Final report available on NHTSA website in October 2009

For Further Information

Website:

www.nhtsa.gov

Thank You

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