USDOT Comprehensive Truck Size and Weight Limits Study

Public Outreach Session #2
December 18, 2013
Webinar

CTSW Study Overview:

- MAP-21 Requirements
- Study Schedule
- Configurations and Networks to be Evaluated and Rationale for Selection
- Presentations by Sub-task Area:
  - Methodology, Data and Modeling
  - Desk Scan Findings

Comprehensive Truck Size & Weight Limits Study

MAP-21

- The "Moving Ahead for Progress in the 21st Century" (MAP-21) legislation requires the Secretary of Transportation to submit a Report to Congress by November 15, 2014;
- The Study directs that a comparative assessment be conducted between trucks operating at or within current federal limits to trucks that operate above those limits with regard to:
  - Highway Safety and Truck Crash Rates;
  - Pavement Service Life Consumption;
  - Impacts on Highway Bridges;
  - Impacts on the delivery of Effective Enforcement Programs;
  - Implications for Shifting Goods Movements between Modes, between Highways and between different Truck Configurations.

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- The Federal Highway Administration has been tasked with overseeing development and delivery of the "Report to Congress";
- FHWA has assembled a Multi-Modal USDOT Policy Oversight Group (POG) to assist in guiding the technical work included under this project;
- FHWA, FMCSA, NHTSA, MARAD, FRA, and OST have representatives on the POG.
- FHWA has also assembled a USDOT Technical Oversight Team (TOC) to assist in crafting the Statement of Work to procure contractor services and to assist in the oversight of the technical work.
- FHWA, FMCSA, FRA and NHTSA have representatives on the TOC.
- National Academy of Sciences has seated a Peer Review Panel that will review and comment on the Desk Scans and the Compiled Technical Report.

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Study Schedule:

Activity:	Description:	Date:
Complete Desk Scans and Project Plans	All five Sub-Task areas included in the Study (Safety, Pavement, Bridge, Enforcement, Modal Shift) will produce Desk Scan Reports and Project Plans/Schedules	Fall, 2013
Meet with National Academy of Sciences Peer Review Panel	USDOT meets with the Peer Review Panel that NAS has seated to address questions on Desk Scans.	December 5, 2013
2nd Stakeholder Input Meeting	National Webinar will be conducted presenting Desk Scan Reports and Project Plans/Schedules.	December 18, 2013
3rd Stakeholder Input Meeting	Site to be Determined.	Winter, 2013-2014
Draft Compiled Technical Report Completed	Technical work completed in each Sub-Task area will be compiled into a single Technical Report	Spring, 2014
4th Stakeholder Input Meeting	Site to be Determined.	Spring, 2014
Compiled Technical Report Review Completed by NAS Peer Review Panel	NAS Peer Review Panel completes their review of the Compiled Technical Report; USDOT meets with Panel to address questions.	Spring/Summer, 2014
Report Submitted to Congress	Final Report transmitted to Congress	Mid-November, 2014

Alternative Truck Configurations

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- Section 32801(a)(5)(A) directs that a six-axle truck configuration be included for analysis in the Study;
- Section 32801(a)(5)(A) also requires additional "alternative configurations of tractor-trailers" be included in the Study – Stakeholder Input was received and considered in identifying these additional configurations.

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Rationale for Alternative Configuration Selection

- Currently in use in the US, Canada, or elsewhere;
- Operationally practical for use in the US;
- Stakeholder input was considered;
- USDOT made final decision.

Configurations Included in Study

Configuration	# Trailers or Semi-Trailers	# Axles	Gross Vehicle Weight (pounds)
1) 5-axle vehicle [Control Vehicle]	1	5	80,000
	1	5	88,000
2) 6-axle vehicle	1	6	97,000
	1	6	91,000
3) Tractor plus two 28 or 28 ½ foot trailers [Control Vehicle]	2	6	80,000
4) Tractor plus twin 33 foot trailers	2	6	80,000
5) Tractor plus three 28 or 28 ½ foot trailers	3	7	105,500
6) Tractor plus three 28 or 28 ½ foot trailers	3	9/10	129,000

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Scenarios to be Evaluated

- Roadway Networks –
  – Interstate Highway System;
  – National Highway System (NHS);
  – National Truck Network (23 CFR Part 658 Appendix A.)
- Assess the impacts of running various Study Configurations on each of the Roadway Networks:
  – Configurations are run individually;
  – Configurations are run simultaneously;
  – Configurations are run in pairs.

Scope: Focus Areas for Study

Technical assessments and evaluations will be conducted in the following areas –

- Modal Shift
- Pavement
- Compliance
- Bridge
- Safety

Modal Shift Analysis - Overview

Purpose:

- Estimate freight shifts between trucks, and between truck and other modes due to introduction of alternative truck configurations to the fleet
- Determine other impacts from freight shifts including: energy, emissions, traffic operations

Methodology Overview:

- Use of existing models and databases

Modal Shift Analysis - Method

- To Provide Basis for Estimating Impacts of Increased Truck Sizes and Weights on Safety, Infrastructure, Economy and Environment
  - Intra-modal Shifts: Assess changes in the distribution of freight traffic among truck configurations operating at various weights and truck VMT due to changes in truck size and weight limits
  - Inter-modal Shifts: Assess changes in the volume of freight traffic moving on trucks as a result of changes in the competitive balance between trucks and other modes due to increased truck productivity

Modal Shift Analysis - Method

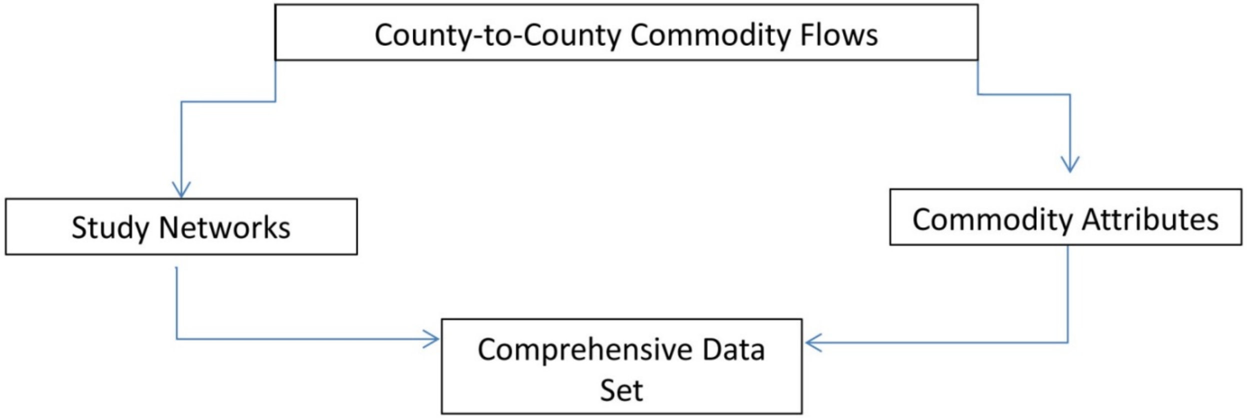
Example of an Approach –

- (1) Base Case is estimated truck activity under existing truck size and weight limits. Estimate Total Logistics Cost (TLC) for base case vehicles.
- (2) Scenario Case is estimated truck activity under the alternative truck configuration size and weight limits being studied. Estimate TLC for scenario case vehicles.
- (3) Intra- and Inter- modal traffic shifts occur where the Scenario Case TLC is lower than the Base Case TLC.

Modal Shift Analysis - Method

Example, *continued*

- (4) TLC for each transportation alternative are dependent on distance and volume shipped, travel-time reliability, commodity value, commodity physical attributes and highway networks available for different vehicle configurations.



Modal Shift Analysis - Models

- Mode shifts will be estimated using the Intermodal Transportation and Inventory Cost (ITIC) model.
- ITIC is very similar to the model used in USDOT's 2000 Comprehensive Truck Size and Weight Study
- Energy consumption and CO2/NOx emissions will be estimated using EPA's Greenhouse Gas Emissions Model
- Traffic operations impacts will be based primarily on updated estimates of passenger car equivalents for different vehicle configurations

Modal Shift Analysis - Data

- The FHWA's Freight Analysis Framework (FAF) will be the primary commodity flow data base used in the modal shift analysis. The Carload Waybill Sample will be used for rail diversion analysis
- The FAF is being disaggregated to the county level to allow impacts of restricting certain configurations to limited highway networks to be analyzed

Modal Shift Analysis - Desk Scan Results

- Modal shift analysis has been conducted at the federal, state and regional levels
- Different modal shift analysis methods have been used depending on such factors as study objectives and resources.
- Total logistics costs of shipments by different modes between different origins and destinations have been analyzed in recent USDOT truck size and weight studies
- Expert opinion has been the primary basis for estimates of modal shifts in some recent state studies
- Econometric techniques have been used in studies by some academics

Modal Shift Analysis - Desk Scan Results

- Larger, heavier trucks can affect several aspects of highway traffic operations including passing, merging and weaving, hill climbing, intersection clearance, and congestion
- Vehicle length and weight-to-horsepower ratio affect relative impact on traffic operations
- Engine size and efficiency, aerodynamics, rolling resistance and the driving environment affect the relative fuel efficiency and emissions of different vehicle configurations operating at different weights

Pavement Analysis - Overview

Purpose: Estimate pavement costs related to the introduction of alternative truck configurations to the fleet.

Methodology Overview:

- Use of sample pavements sections to understand cost impacts from alternative truck configurations
- Use of latest pavement models
- Use of existing databases

Pavement Analysis - Method

- (1) Select Locations in Each Climate Zone
  - Evaluate key environmental variable in wet freeze, dry freeze, wet no-freeze and dry no-freeze zones
  - Pick location that best represents entire zone
- (2) Select Sample Pavement Sections
  - Four pavement types: new Asphalt Cement Concrete (ACC), Flexible Pavement Overlay (ACC over ACC), Jointed Portland Cement Concrete (JPCC), Overlay Flexible Pavement over Rigid Pavement (ACC/JPCP);
  - Three traffic levels—high, moderate, and low truck volumes
  - Four locations—one in each climate zone

Pavement Analysis - Method

- (3) Apply *Pavement ME Design®* to Pilot Sample Section
  - Apply full analysis described below to a pilot section
  - Adjust analysis plan, if needed, based on pilot
- (4) Apply *Pavement ME Design®* to Base Case Traffic Conditions
  - Based on estimates of detailed current truck travel estimates

Pavement Analysis - Method

- (5) Apply *Pavement ME Design®* to Scenario Traffic Variations
- (6) Expand Sample Results Nationally

Pavement Analysis - Models

- *AASHTOWare Pavement ME Design®*
- FHWA's *RealCost (Life Cycle Cost Analysis)*

Pavement Analysis - Data

- Pavement and Loading Data from Long Term Pavement Performance Program (LTPP)
- *Pavement Mechanistic-Empirical (ME) Design*® Default Data
- FHWA Highway Performance Monitoring System (HPMS) Sample Section Data
- Travel and Axle Load Spectra from CTSW Traffic Data Sets

Pavement Analysis - Desk Scan Results

- Size and Weight Analysis Methods
  - Most previous studies assumed that ESALs from the AASHO Road Test adequately estimated relative truck impacts, so have no current relevance
  - Previous Federal studies used older pavement damage models
  - Only a few studies used analysis based on current pavement damage and deterioration models

Pavement Analysis - Desk Scan Results

- Application of Current Models
  - One FHWA-sponsored study applied MEPDG directly to simplified representation of shifts in axle weight spectra that might occur with size and weight changes
  - That study recommended a more systematic approach to applying MEPDG to allow generalized findings
  - Several subsequent studies applied MEPDG 1.0 in order to estimate the relative effects of various axle loads
  - No studies have yet applied *AASHTOWare Pavement ME Design®* in this manner

Pavement Analysis - Desk Scan Results

- Analysis Enhancements
  - Wide single tires may have an important pavement damage implications, but *Pavement ME Design*® cannot currently accommodate them, and there is no evidence that they would be used differently on scenario alternative configurations
  - Some sources have suggested enhancements to the models in *Pavement ME Design*®, but study constraints limit our ability to modify or enhance the model

Pavement Analysis - Desk Scan Results

- Pavement and Traffic Load Data
  - Several reports have compiled soils data, pavement design parameters, and other information that will help us develop representative pavement sections
  - Available reports and data files from the LTPP program will significantly enhance the quality of our analysis

Compliance Analysis Overview

Purpose:

- Estimate enforcement costs and effectiveness of enforcement related to introduction of the alternative truck configurations to the fleet
- Identify affected federal laws and regulations

Methodology Overview:

- Use of existing databases at the federal and state levels of government
- Use of existing enforcement community to understand current practices and trends

Compliance Analysis - Method

- (1) Gather and compare weighings, violations, and violation rates by type
  - CMVs not complying with federal TSW limits
- (2) Gather information about enforcement program resources, technologies, and activities
- (3) To determine enforcement costs and the effectiveness of the enforcement by analyzing:
  - Enforcement program outputs (*e.g.,* violation rates)
  - Compliance rates
  - Experience enforcing alternative configurations
- (4) A separate inventory of all federal laws and regulations that would be affected by a change in federal truck size and/or weight limits will be prepared.

Compliance Analysis - Data

- Annual Certifications of TSW Enforcement Activities
- Enforcement Costs and Resources
- State Permit Data
- WIM Data

Compliance Analysis - Desk Scan Results

- Studies on compliance
  - Nationwide estimates of non-compliant trucking and its' impacts are generally unavailable.
  - States like Arizona and Minnesota have done detailed research on compliance.
  - FMCSA is developing a method to link overweight trucking and safety.
  - Compliance team will work closely with Commercial Vehicle Safety Alliance (North American TSW law enforcement organization) to develop the necessary methodology.

Compliance Analysis - Desk Scan Results

- Impacts of Regulatory Change
  - The impacts of change on compliance are not well researched
  - Several documents state that regulatory complexity hinders TSW enforcement and compliance
    - Carson 2011 study on compilation of TSW research for NCHRP
    - Cambridge Systematics 2006 study for Minnesota
- Enforcement Costs and Benefits
  - Benefits are most often established in terms of pavement damage savings
  - Costs of enforcement technologies are well-researched
  - Australia’s National Transport Commission (NTC) has done analysis at national level

Compliance Analysis - Desk Scan Results

- Enforcement Effectiveness
  - Studies related to violation rates
    - Not best measure of effectiveness
  - Few studies on compliance rates
  - Lack of reliable evidence to link enforcement activities and compliance (NCHRP 2001 review by Carson)
  - Some studies conclude that effectiveness is impacted by the probability of detection and severity of penalties
  - Measures of effectiveness are not standardized

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Compliance Analysis - Desk Scan Results

- Enforcement Technologies
  - Technologies have been well catalogued (*e.g.,* by OECD 2011 study and Cambridge Systematics 2009 study)
  - Weigh-in-Motion (WIM) is a key technology
    - Can be combined with cameras, communication networks and other supporting technology to create virtual weigh scales
- Alternative Compliance Approaches
  - Accreditation programs
  - Chain-of-responsibility policies (*e.g.,* in Australia)

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Bridge Structure Analysis - Overview

Purpose:

- Estimate the bridge structural impacts related to the introduction of alternate truck configurations to the fleet
- Determine the likelihood that bridges will require load posting as a result of the new configurations
- Estimate costs associated with additional maintenance, strengthening, or replacement due to accelerated bridge deck damage or steel superstructure fatigue

Methodology Overview:

- Use ~400 representative bridges from the National Bridge Inventory to determine structural demands
- Use AASHTOWare Bridge Rating program (ABrR)
- Conduct an axle-load based cost allocation approach to estimate costs related to the alternative truck configurations

Bridge Analysis - Desk Scan Results

Structural Analysis:

- Use the National Bridge Inventory System Database to Screen and Select 400 representative bridges on the Interstate, NHS or National Truck Networks
- Use AASHTOWare Bridge Rating Program (formerly known as VIRTIS) to structurally analyze the 400 real bridges used by 38 states
- More rigorous analysis programs are beyond the scope of this project
- Use the methodology in the AASHTO Manual for Bridge Evaluation & NCHRP Report 12-76 to select appropriate LRFR load factors
- Load rate base condition truck and the alternate truck configurations as listed by USDOT CTSW web site

Bridge Analysis - Desk Scan Results

Bridge Cost Allocation:

- Previous studies use different cost allocators mostly driven by pavement type cost allocation studies
- Number of states have used axle load based cost allocations for bridge costs.
- The goal is to assign bridge cost responsibility by vehicle class.

Bridge Analysis - Data

- National Bridge Inventory (NBI)
- Legal Weight Limits
- Weigh-in-Motion (WIM) Data
- Financial Management Information System (FMIS) for bridge project cost information

Bridge Analysis - Models

- AASHTOWare Bridge Rating Program (VIRTIS)
- Regional Bridge Deterioration Model
- Fatigue Analysis

Bridge Task – Climatic Regions

Regions to be Studied:

- For Bridge Purposes, the Three Regions are:
  - States that use Chlorides to melt ice and snow – generally the Northern States
  - State that use Chlorides and also allow heavier trucks to run on most highway systems, Michigan for instance
  - All other states

Bridge Structure Analysis - Method

- (1) Use the National Bridge Inventory (NBI) database to select 400 representative bridges, consisting of 13 bridge types, for structural analysis using the AASHTOWare Bridge Rating Program (ABrR) to determine structural demands associated with various trucks in the current fleet.
- (2) Assess the effects of the structural demands associated with the proposed alternative truck configurations.
- (3) Present the load rating results in tabular and graphical form

Bridge Task – Cost Allocation Method

- This study will use real WIM data, which applies the entire axle load spectra to the bridges
- Deterioration Model assumes axles loads as well as environmental factors incur damage on bridge decks and other bridge elements
- Chlorides used in cold/wet environments tend to magnify the effects of axle loads
- Bridge elements (decks in particular) damaged as a result of axle loads contribute to total bridge capital costs either linearly or exponentially with respect to the axel load and number of load cycles.

Bridge Task – Cost Allocation Method

- The standardized axle weight ratio raised to a composite exponential power, multiplied by the number of load cycles (from the WIM data) is the Relative Damage Share – RDS.
- The process is repeated for every truck classification and for each incremental axle weight.
- The WIM derived RDS values for each alternative truck configuration will be used to allocate the costs associated with the truck.
- A variant of this methodology was used in the 2010 D.C. District DOT Truck Size & Weight study.

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Bridge Cost Responsibility - Method

- (1) Use WIM Data to assess the cost effects for the existing fleet of trucks, and then for a future fleet based on the Modal Shift.
- Total bridge costs on a regional basis (climatic regions) will be estimated using a Bridge Deterioration Model.
- (2) Present findings with respect to relative cost impacts of the various truck types and configurations by allocating bridge costs by truck type via a net sum of the relative damage attributable to those vehicle classes based on axle load induced damage.

Bridge Task - Fatigue Method

- Conduct bridge fatigue in two main categories: load induced fatigue in steel and concrete fatigue in reinforced concrete bridge decks.
- Distortion induced fatigue analysis of specific bridges will not be conducted within the limited scope of this study.
- Conduct a study of the effects of greater and more numerous heavy axle loads on a typical bridge, based on an assessment for fatigue as documented in NCHRP Report 495.

Safety Analysis - Overview

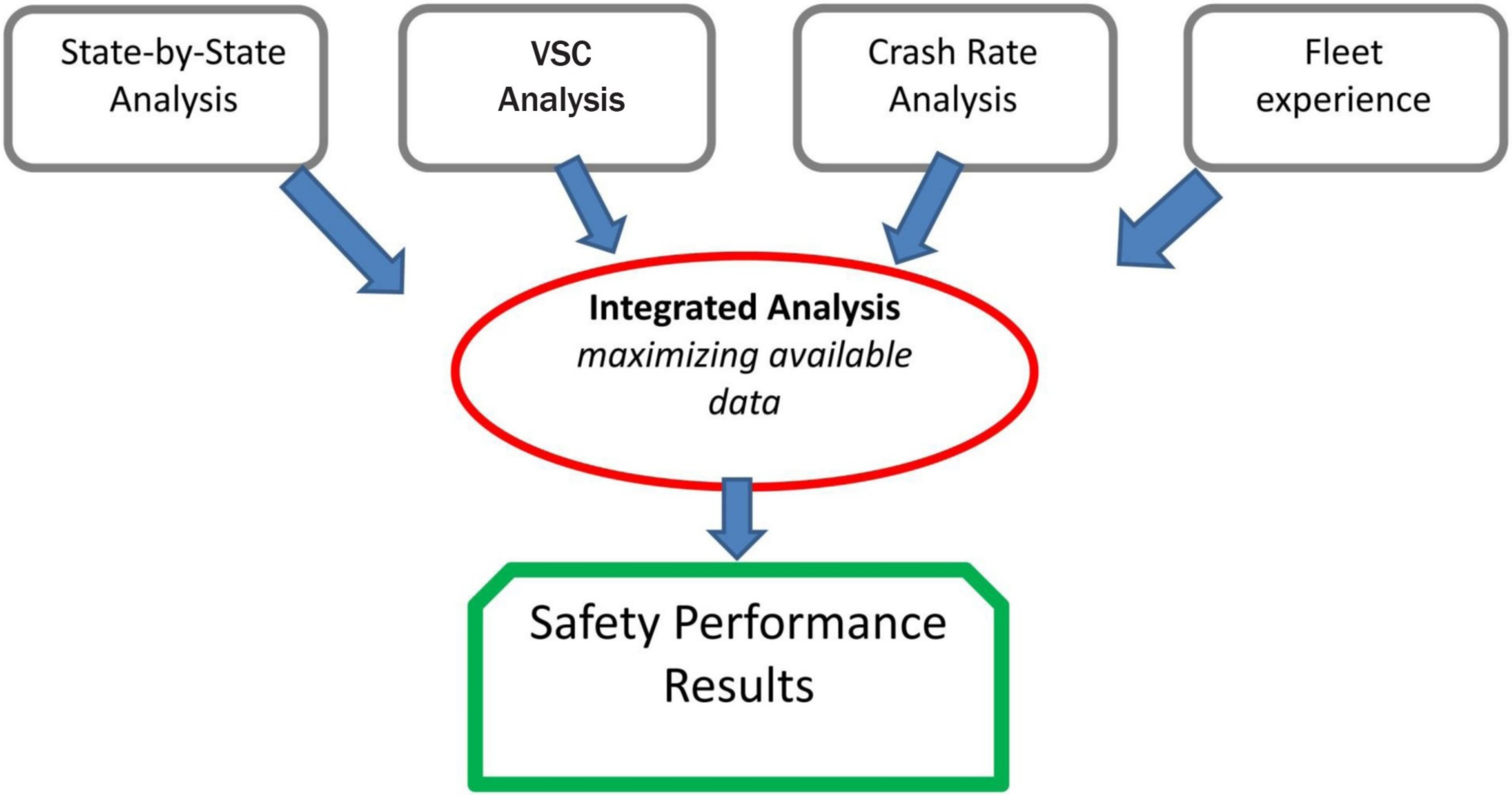
Purpose:

- Estimate safety impacts from introduction of alternative truck configurations to the fleet

Methodology Overview:

- Crash analysis using three methods (fleet, state by state, route)
- Vehicle stability and control analysis using existing models

Safety Analysis Multi-Level Approach



Safety Analysis - 3 Methods of Crash Analysis in Response to Safety Data Limitations

- Team proposes 3 crash analysis methods
  - Route-based method comparing the crash rates of routes with differing levels of legal heavies (*i.e.,* 80,000 pounds+)
  - Fleet-based method utilizes data from triples and legal heavy carriers in matched-pair analysis
  - State-based analysis using data elements that can be creatively combined to infer vehicle configuration
- WIM data for exposure estimation in all analyses
- Highway Safety Manual methods, if possible

Safety Analysis - Method

- (1) Determine safety performance results
- (2) Use safety inspections and violations analysis to identify Violation Patterns
- (3) Use vehicle simulation to evaluate performance measures, using 3-S2 and twin 28.5’ (80,000 pounds) as control vehicles
- (4) Prepare truck crash, truck stability and control, and safety inspection/violation findings

Safety Analysis - Model

- Vehicle Simulation - to evaluate performance measures, understand practical loadings, and combine metrics into single numeric ranking.

Safety Analysis - Data

- Commercial Motor Vehicle Inspection Records
- Highway Safety Information System (HSIS)
- Weigh-in-Motion Data
- Risk Factors
- Highway Performance Monitoring System (HPMS)
- Vehicle Stability Observations and Measurements
- Speed through highway geometric elements

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Safety Analysis - Desk Scan Results

- Availability of US-based crash and exposure data to support truck size & weight policy decisions is lacking.
  - These are essential data required by contemporary safety analysis methods
- Time-limited pilot studies in small states alone have insufficient crash data to assess safety performance.
  - Will aggregate findings from several states in one method to increase sample size

Safety Analysis - Desk Scan Results

- Impacts on the performance of roadside and median barriers in meeting crash test criteria will be assessed; currently the largest test vehicles used in such evaluations are 80,000 pound tractor semi-trailer combinations.

- The potential for heavier vehicles penetrating or overtopping current high performance level roadside and median barriers will be evaluated.

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Safety Analysis - Desk Scan Results

- Studies in Alberta, Canada of LCVs operating in a permit regime showed relatively good safety performance.
  – but implications for US unclear given differences in regulations concerning operations, driver qualifications and equipment.
- Different studies have found crash severity to be lower, higher or about the same for LCVs/doubles compared to tractor semitrailers

Questions from Webinar Participants