USDOT Comprehensive Truck Size and Weight Limits Study

Presentation of Study Technical Results
Public Meeting #4
June 18, 2015

U.S. Department of Transportation
Federal Highway Administration

Agenda

Study Overview

- What This Study Is Not
- What this Study Does
- Important Notes

Study Results by Subject Area

- Modal Shift Analysis
- Highway Safety Analysis
- Compliance Analysis
- Bridge Impact Analysis
- Pavement Impact Analysis

Study Next Steps

Questions and Answers

What This Study Answers

The Study provides estimates of the magnitude of the potential impacts if changes were made to current federal Truck Size & Weight (TS&W) limits:

- Assesses differences between trucks operating at or within federal truck size and weight limits and trucks legally operating in excess of federal limits;
- Estimates changes in freight movements by the introduction of alternative truck configurations;
- Estimates the potential impacts of alternative truck configurations;
- Identifies all Federal rules and regulations impacted by potential changes in size and weight limits.

Fundamental Truck Size and Weight Policy Question

Increases in allowable TS&W limits are presumed to impact highway safety, infrastructure condition, effectiveness of enforcement, shift of goods movement from other modes to truck, and overall productivity of the freight system.

Do the estimated "positive" impacts of a particular TS&W change outweigh the estimated "negative" impacts?

This study does not attempt to answer this question.

Specific Areas the Study Examined

Technical Areas:

- Modal Shift Analysis;
- Highway Safety Analysis;

Compliance Analysis;

- Bridge Condition Analysis;
- Pavement Condition Analysis.

Six Scenarios with Alternative Truck Configurations:

- Three heavier, single trailer trucks;
- Three longer combination trucks.

Important Notes

Reading the Study contents, certain considerations must be understood:

- Lack of data availability, data quality and models limited level of analysis in some areas;
- Freight volumes were held constant at 2011 levels to understand impacts of size and weight variables nationwide;
- Results from Modal Shift Analysis impact the results in other study areas;
- Did not attempt to get to a single statement or number that summarizes results, results are often not additive;
- Even with robust data, actual market responses to changes in TS&W are difficult to predict.

Advancements Since Prior Studies

The Study took advantage of improved models in a number of areas, data sets not available to previous Studies and undertook an analysis not previously performed in TSW Studies:

- Freight Analysis Framework – enabled a robust modeling regiment for modal shift analysis;
- Mechanistic-Empirical Pavement Design Guidelines – enabled the evaluation of impacts on pavements using state-of-the-art techniques;
- AASHTOWare VIRTIS – enabled state-of-the-art assessment of bridge structural impacts;
- Regional and Short-line Railroad Shift Railroad Modal Shift Analysis – enabled an assessment of shifts of freight from Class II and III railroads that was not addressed in previous Studies.

Comments Are Invited

You have two ways to submit comments:

- Docket: http://www.regulations.gov/#!docketDetail;D=FHWA-2014-0035

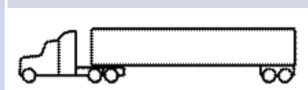
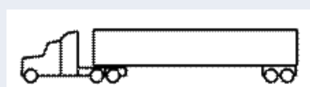
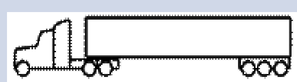
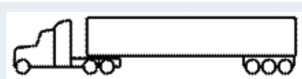
- E-Mail: CTSWStudy@dot.gov

We continue to monitor comments we receive.

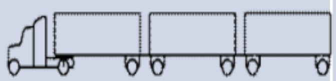
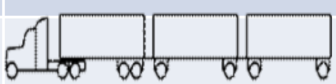
Comments will be considered as we prepare the Report to Congress.

Docket will remain open through the end of the calendar year (CY 2015).

Single Trailer Truck Configurations and Weights Scenarios Analyzed in the Study

Scenario	Configuration	Depiction of Vehicle	# Trailers or Semi-trailers	# Axles	Gross Vehicle Weight (pounds)	Roadway Networks
Control Single	5-axle vehicle tractor, 53 foot semitrailer (3-S2)		1	5	80,000	Surface Transportation Assistance Act (STAA) vehicle; has broad mobility rights on entire Interstate System and National Network including a significant portion of the NHS
1	5-axle vehicle tractor, 53 foot semitrailer (3-S2)		1	5	88,000	Same as Above
2	6-axle vehicle tractor, 53 foot semitrailer (3-S3)		1	6	91,000	Same as Above
3	6-axle vehicle tractor, 53 foot semitrailer (3-S3)		1	6	97,000	Same as Above

Multi-Trailer Truck Configurations and Weights Scenarios Analyzed in the Study

Scenario	Configuration	Depiction of Vehicle	# Trailers or Semi-trailers	# Axles	Gross Vehicle Weight (pounds)	Roadway Networks
Control Double	Tractor plus two 28 or 28 ½ foot trailers (2-S1-2)		2	5	80,000 maximum allowable weight 71,700 actual weight used for Modal Shift Analysis	Same as Above
4	Tractor plus twin 33 foot trailers (2-S1-2)		2	5	80,000	Same as Above
5	Tractor plus three 28 or 28 ½ foot trailers (2-S1-2-2)		3	7	105,500	74,500 mile roadway system made up of the Interstate System, approved routes in 17 western states allowing triples under ISTEA Freeze and certain four-lane PAS roads on east coast
6	Tractor plus three 28 or 28 ½ foot trailers (3-S2-2-2)		3	9	129,000	Same as Scenario 5

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Modal Shift Analysis

How did we study it?

- Estimated current (base case) nationwide truck traffic by vehicle configuration (number of trailers, number and types of axles, etc.), operating weight, and highway functional class.
- Used the Freight Analysis Framework to determine origins and destinations of commodities.
- Used the Intermodal Transportation and Inventory Cost Model (ITIC) to estimate Total Logistics Cost (TLC).
- Intra- and Inter- modal traffic shifts occur where the Scenario Case TLC is lower than the Base Case TLC.
  - Intra-modal Shifts: Assessed changes in the distribution of freight traffic among truck configurations operating at various weights and freight traffic due to changes in truck size and weight limits
  - Inter-modal Shifts: Assessed 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 change in truck productivity.

Modal Shift Analysis

- Total Logistic Cost for each transportation alternative truck configuration are dependent on distance and volume shipped, travel-time reliability, commodity value, commodity physical attributes and highway networks available for different vehicle configurations.
- Energy and Emissions changes were estimated by truck configuration using latest tools developed by Southwest Research Institute.
- Traffic Operations impacts were estimated using latest Highway Capacity Manual methodologies and FHWA's Congestion Toolbox techniques.

Modal Shift Analysis Results

- All studied scenarios cause shifts from rail to truck and from existing trucks to scenario trucks. This is most pronounced for the 6 axle, 97,000 pound truck configuration.
- All studied scenarios result in temporary reductions in overall truck VMT if other factors are held constant. These reductions are most pronounced for 6 axle, 97,000 pound truck and the twin 33' trailer configurations. Increasing freight demands will eventually more than offset these temporary reductions.
- Temporary VMT reductions lead to commensurate temporary reductions in congestion, emissions and energy costs.
- All scenarios temporarily reduced total logistics costs as well as rail revenue (highest reduction for the 6 axle, 97,000 pound truck configuration).

Modal Shift Results

Scenarios	Truck VMT	Quantity of Freight Shifted (000s of tons)		Additional Ton-Miles Carried in Scenario Vehicles (millions)	Change in Railroad Contribution ($millions)
		From Truck	From Rail		
Scenario 1	- 0.6%	2,658,873	2,345	--	-197
Scenario 2	- 1%	2,622,091	2,311	407,000	-196
Scenario 3	- 2%	3,197,815	4,910	489,000	-562
Scenario 4	- 2.2%	578,464	1,473	237,000	-22
Scenario 5	- 1.4%	716,838	2,374	73,000	-17
Scenario 6	- 1.4%	716,838	2,363	74,000	-15

Modal Shift Analysis Results –
Energy, Emissions, and Traffic Operations Impacts (Millions)

Scenarios	Change in Fuel Consumption (gallons)	Change in CO_2 Emissions (kilograms)	Change in NOx Emissions (grams)	Change in Congestion Costs (millions)
Scenario 1	-107.0	-1086.2	-406.7	-$256
Scenario 2	-109.1	-1107.4	-414.6	-$358
Scenario 3	-309.2	-3138.7	-1175.1	-$857
Scenario 4	-244.7	-2483.5	-929.8	-$875
Scenario 5	-233.2	-2366.5	-886.0	-$505
Scenario 6	-230.9	-2343.2	-877.3	-$525

Highway Safety Analysis

How did we study this?

Multi-Track Approach:

- Truck Crash Analysis:
  - State Level Truck Crash Data Analysis
  - Corridor Level Truck Crash Analysis
  - Fleet Level Truck Crash Records Analysis
- Vehicle Stability and Control Analysis
- Violations and Citations Analysis

Highway Safety Analysis

	Crash Analysis	Vehicle Stability and Control	Citations and Violations
Assumptions	• No change in driver skills or requirements; for example, current requirement for LCV level license for triples assumed • No change in management practices of firms	• Dry van trailers with fixed, rigid loads • Steer axles with two tires, all others with duals on both ends • Multi-trailer combinations modeled with pintle hitch • Air ride suspension, not leaf spring • Simulations on dry pavement except brake in curve • Three braking conditions simulated.	• Majority of MCMIS inspection data comes from roadside inspections at both fixed and roadside facilities • WIM is widely used as pre-screening tool but there is no indicator in MCMIS identifying the source of the GCVW values in the database (measured weight, manufacturer's weight rating, official's opinion, etc.)
Limitations	• Vehicle weight not included as element of crash data; severely limits analysis of on-road safety • Vehicle weight and configuration are not elements of state-collected exposure data; must rely on WIM data estimates • Few triple carriers currently operating	• Electronic stability control not included • No exposure data available to relate the results to crash rates on network	• North American Standard Inspection (NASI) Level 1 inspections were insufficient to compare twin-trailers to triple-trailer in any state • MCMIS does not include exposure data

Note: Longer Combination Vehicle (LCV).
Motor Carrier Management Information System (MCMIS)

Safety Analysis Results – General

- Lack of truck weight information on crash reports inhibited any meaningful analysis of truck weight as contributing factor to crash frequency or severity.
- Analysis process led to inclusion of data from very few states - results presented at national level are not possible.
- Data limitations prevented **any** crash analysis for 5 axle, 88,000 pound truck or twin 33' trailer configuration.
- Crash analysis used state weight limit and number of axles as proxy for vehicle weight in the four states with useful data (MI, WA, ID and KS Turnpike).

Safety Analysis Results – Heavier Single Semitrailer

Crash Analysis Results

- In the three states where tractor-semitrailer data could be analyzed (MI, WA, ID), the crash involvement rate for the six-axle alterative truck configuration is consistently higher than the rate for the five-axle control truck.
- No difference was found in severity level of crash distribution.

Vehicle Stability and Control Analysis

- Results showed that 6-axle and 5-axle heavy trucks did not significantly differ in maneuvers modeled.
- FMCSA truck braking analysis conducted outside of this Study, showed slightly longer stopping distances for heavier trucks than simulated results.

Safety Analysis Results – Heavier Single Semitrailer

Inspection and Violation Analysis:

- Vehicle weight is not uniformly reported by inspectors, so meaningful analysis of truck weight and violation rates could not be completed.
- In comparisons of brake violations, truck configurations operating over 80,000 pounds had 18 percent more brake violations and a higher number of brake violations per inspection.
- Trucks with overweight violations also typically have more other types of violations per inspection.
- Trucks weighing over 80,000 pounds had higher overall violation and Out-of-Service (OOS) violation rates compared to those at or below 80,000 pounds.
- But, analysis also pointed out that vehicle weight was not a strong overall factor for predicting probability of a violation.

Safety Analysis Results – Longer Combination Vehicles

Crash Analysis Results:

- As a result of lack of data, one state (ID) and a single roadway in a second state (Kansas Turnpike) were used in LCV crash analysis.
- Analysis in ID and KS showed a lower crash involvement rate for the triple combinations compared to the Study's control vehicle.
- Overall, no difference observed in crash severity distributions for twin trailer combinations and triple trailer combinations in the analysis completed in two states.

Safety Analysis Results – Longer Combination Vehicles

Vehicle Stability and Control Analysis

- Both triple combinations modeled performed worse than the Study's control vehicle in the avoidance maneuver.
- Braking distances for each of triple combinations did not differ substantially from Study's control vehicle.
- Off-tracking, while somewhat greater, did not surface as a concern when comparing twin STAA combinations and two triple trailer combinations using simulation.

Inspection and Violation Results

- Comparative analysis of triple and twin trailer combinations was not successful due to data limitations.
- Some evidence was found in FMCSA MCMIS data reviewed that twin trailer combinations have higher violation rates compared to single trailer combinations.

Compliance Analysis

How did we study it?

- Gather and synthesize information about enforcement program methods and technologies.
- Determine enforcement program costs at national level and compare costs between states and for different truck configurations.
- Determine enforcement effectiveness by analyzing and comparing:
  - Enforcement program activities (*e.g.,* weighings, citations, citation rates); and
  - Compliance for various truck types.
- Prepare an inventory of all federal laws and regulations that would be affected by a change in federal truck size and/or weight limits.

Compliance Analysis Results

- Little difference was observed in enforcement costs or program effectiveness in 16 States that allow trucks to operate above federal limits compared to 13 States that don’t have such allowances.
- Temporary reductions in truck VMT under all scenarios would allow States to inspect a larger proportion of the truck population for as long as the VMT reductions last.

Compliance Analysis Results

Scenario	Change in Cost of Enforcement	Additional Trucks Weighed
Scenario 1	- 0.3 %	185,000
Scenario 2	- 0.4 %	266,000
Scenario 3	- 1.0 %	625,000
Scenario 4	- 1.1 %	653,000
Scenario 5	- 0.7 %	452,00
Scenario 6	- 0.7 %	446,000

Bridge Analysis

How did we study this?

- Used 490 representative bridges from the National Bridge Inventory to determine structural demands.
- Used AASHTOWare Bridge Rating program (ABrR).
- Conducted and researched bridge fatigue studies in two main categories: load induced fatigue in steel and concrete fatigue in reinforced concrete bridge decks.
- Estimated the bridge structural impacts related to the introduction of alternative truck configurations to the fleet.

(continued)

Bridge Analysis

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How did we study this?

- Determined the percentage of bridges that will require load posting, strengthening or replacement as a result of the new configurations.
- Estimated/Addressed costs associated with the predicted postings, strengthening or replacements.
- Assessed the impact of alternative truck configurations on structural fatigue.

Bridge Analysis

Assumptions:

- Impacts are quantified primarily based on the criteria of strength and service from the AASHTO Bridge design Guidelines
- A sampling of 490 bridges was selected and considered representative of the nationwide inventory
- Bridge capital costs based on 2011 Fiscal Management Information System (FMIS) cost summaries, including both State and Federal shares.
- Bridge Damage is equated to Repair and Replacement Costs.

Limitations:

- Little segregated cost data available for deck preservation and preventive maintenance.
- Limited fatigue analysis performed; supports a qualitative assessment.
- Load and Resistance Factor Rating (LRFR) capability not available for structural analysis of trusses and girder-floor beam bridges;
- No widely used tool or model is available to estimate the impact of heavy trucks on bridge decks.

Bridge Analysis Results

- All scenarios result in increases in NHS bridges requiring posting, strengthening or replacement (highest increases for six axle 91,000 and 97,000 pound trucks and triple trailers at 129,000 pounds).
- One time strengthening or replacement costs range from $400 million (5 axle, 88,000 pound truck) to $5.4 billion (triple trailer combination at 129,000 pounds).
- No analytical approach or tool measuring the magnitude of the impact of heavy trucks on bridge decks as a function of axle weight is currently available.

Bridge Analysis Results

Number of Bridges In The National Bridge Inventory		Load Rating Results					Projected Number Of Bridges W/ Posting Issues For Entire Inventory	
# of IS Bridges in the NBI	# of Other NHS Bridges in the NBI	# of IS Bridges Rated	# of Other NHS Bridges Rated	Vehicle Config-uration	IS Bridges Rated w/ RF < 1.0 (percent)	Other NHS Bridges Rated w/ RF < 1.0 (percent)	# of IS Bridges w/ Posting Issues	Other NHS Bridges w/ Posting Issues
45,417	43,528	153	337	Scenario 1	3.3	5.0	1,485	2,194
				Scenario 2	3.3	7.7	1,485	3,360
				Scenario 3	4.6	9.5	2,080	4,135
				Scenario 4	2.6	3.0	1,185	1,293
				Scenario 5	2.0	0.9	890	387
				Scenario 6	6.5	5.6	2,970	2,455

Bridge Analysis Results

Scenario	Projected One-Time Strengthening or Replacement Costs (2011 US Dollars)
Scenario 1	0.4 Billion
Scenario 2	1.1 Billion
Scenario 3	2.2 Billion
Scenario 4	1.1 Billion
Scenario 5	0.7 Billion
Scenario 6	5.4 Billion

Pavement Analysis

How did we study this?

- Selected Four locations – one in each climate zone (wet freeze, dry freeze, wet no-freeze and dry no-freeze zones)
- Selected Model Sample Pavement Sections
  - Two pavement surface types used: new Asphalt Cement Concrete (ACC) and Jointed Portland Cement Concrete (JPCC)
  - Three traffic levels – high, moderate, and low truck volumes defined through analysis of traffic data
- Applied *Pavement ME Design® Model* to Pilot Sample Section
- Expanded the results to national level.

Pavement Analysis Assumptions and Limitations

Assumptions

- Models intended for new design can analyze differential effects of various axle loads
- Small number of pavement sections can be extended to national system

Limitations

- Not all scenario vehicles in current use. Have to assume axle load distributions
- Design models do not include all load-responsive distresses
- Predict impacts to new pavements due to limitation of **Pavement ME Design Model**
- Impacts on overlay pavements (asphalt on concrete and asphalt on asphalt) are not assessed because M-EPDG is not capable of performing this area of assessment.

Pavement Analysis Results

Studied scenarios resulted in relatively small changes in 50 year pavement lifecycle costs – reductions for the two 6-axle trucks (91,000 and 97,000 pound) and increases for the others.

- The two 6-axle configurations (91,000 and 97,000 pound) were estimated to decrease LCC by a range of approximately -2.5 to -4 percent compared to the base scenario.
- The twin 33' trailer configuration was estimated to increase overall life cycle costs (LCC) by a range of 1.8 to 2.7 percent compared to the base scenario.
- The two triple trailer configurations were estimated have very minimal impacts on LCC.

Pavement Analysis Results

	Scenario	Weighted Average Change in Service Intervals	Weighted Average Change in Life Cycle Costs
1	88,000-lb., five-axle single-semitrailer combinations	- 0.3%	+0.4% to +0.7%
2	91,000-lb., six-axle single-semitrailer combinations	+2.7%	-2.4% to -4.2%
3	97,000-lb., six-axle single-semitrailer combinations	+2.7%	-2.6% to -4.1%
4	five-axle double-trailer combinations with 33-ft. trailers	-1.6%	+1.8% to +2.7%
5	105,500-lb., seven-axle triple-trailer combinations	0.0%	+0.1% to 0.2%
6	129,000-lb., nine-axle triple-trailer combinations	-0.1%	+0.1% to +0.2%

Note: Individual pavement sections were weighted based on the number of lane-miles of pavement of each type, thickness range, and highway type.

Study Next Steps

- Steps Leading to Submittal of Report to Congress:
  - National Academy of Sciences' Peer Review Panel Completes Their Review;
  - Public Meeting #4 (Today);
  - Prepare and Submit Report to Congress;
- You have two ways to submit comments:
  - Docket: http://www.regulations.gov/#!docketDetail;D=FHWA-2014-0035
  - E-Mail: CTSWStudy@dot.gov

Thank you for your Attention.

Questions?