

HB 2223 Study Stakeholder Workshop

Welcome!



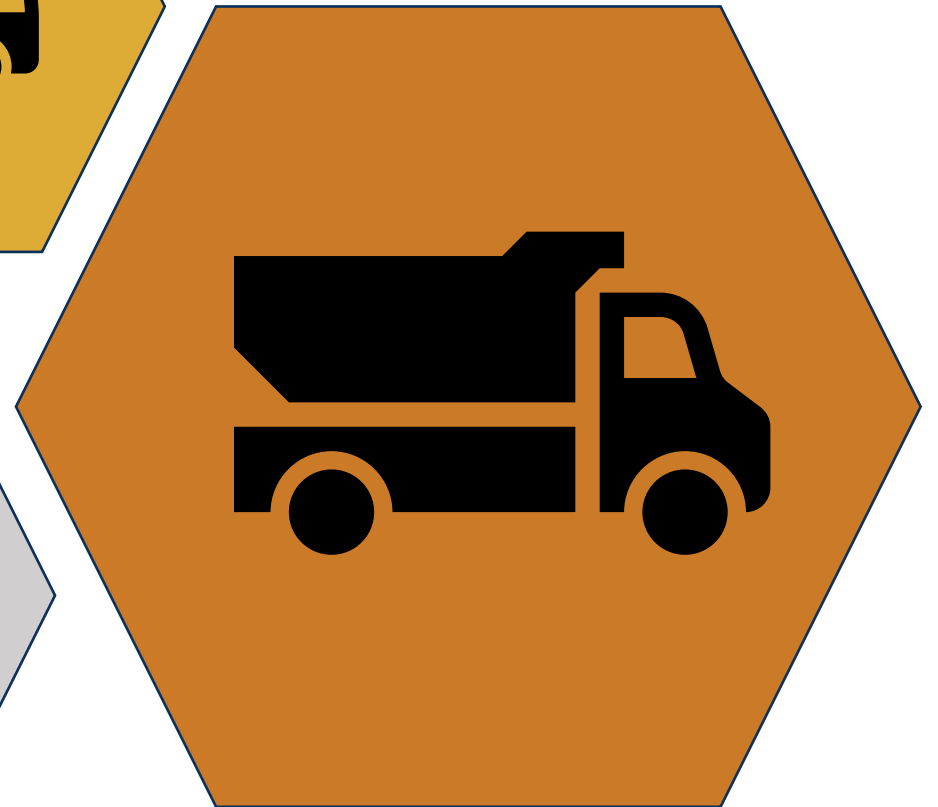
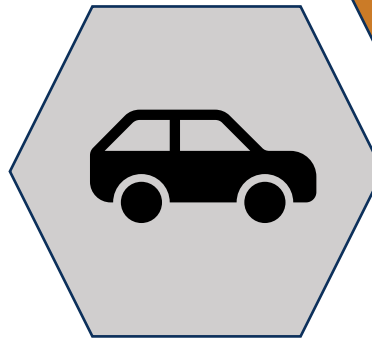
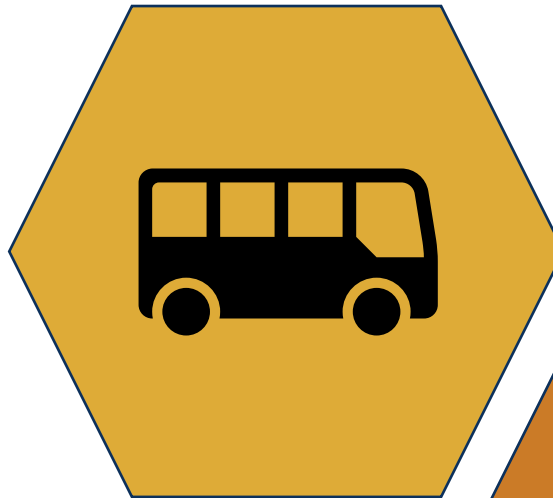
Agenda

9:00 – 10:00	Welcome, Introductions, Agenda, Overview, Workshop Objectives
10:00 – 10:15	Pavement Analysis Methodology Presentation
10:15 – 10:30	Bridge Analysis Methodology Presentation
10:30 – 10:45	Break
10:45 – 11:00	Congestions Analysis Methodology Presentation
11:00 – 11:15	Revenue Analysis Methodology/Cost Recovery Presentation
11:15 – 11:30	Economic Analysis Methodology Presentation
11:30 – 12:30	Lunch
12:30 – 3:00	Breakout Groups for Topical Discussion
3:00 – 3:00	Wrap Up

Overview

HB 2223 calls for the Texas Department of Transportation to conduct a study examining the “**impact on the roads and bridge of this state by motor vehicles classified as:**”

- **Passenger vehicles,**
- **Commercial motor vehicles, and**
- **Oversize or overweight vehicles.”**



Overview

The bill also directs the Texas Department of Transportation to conduct the study in consultation with:

- Texas A&M Transportation Institute,
- University of Texas Center for Transportation Research, and
- Transportation industry representatives.

The study is due to the legislature by December 1, 2022.

Overview

For each of the three vehicle categories, the study shall determine:



The number of vehicles that drive on the roads and bridges.



The number of miles driven on the roads and bridges.

Overview

For each of the three vehicle categories, the study shall determine:



The total revenue contribution from taxes and fees to the construction and maintenance of the roads and bridges.



The financial impact due to costs associated with construction and maintenance as well as congestion.



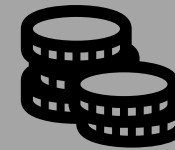
How much the total revenue contribution exceeds or falls short of the financial impact.

Overview

For each of the three vehicle categories, the study shall determine:



Assess the overall economic benefits to the economy of Texas of commercial motor vehicles and oversize or overweight vehicles.



Recommend one or more changes to existing tax or fee structures to ensure vehicle categories contribute revenue in an amount at least equal to their financial impact.

Overview



Congestion
analysis



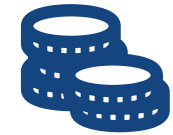
Pavement
analysis



Bridge analysis



Revenue
analysis/cost
recovery
scenarios



Economic
analysis

Workshop Objectives

- Stakeholder input on how we conduct this study
 - Analysis and methods used
- Stakeholder input on the data we use for the analysis

Your input is important!



Pavement Analysis

Jorge A. Prozzi
CTR



Impact on State Roads

Traffic Classification, Sample Selection and Routing

- Gather and process traffic data:
 - Pavement design traffic based on actual designs
 - Standard axle (reference axle: 18,000 lb. single axle = 1 ESAL)
 - Axle load spectra
 - Overweight traffic: select representative vehicles for each load group from DMV

SUBTASK 4.2: Traffic Classification, Sample Selection and Routing

Experimental design:

- Pavement type: rigid (4), flexible (12) and surface treatments (4).
- Traffic level: low (<100,000 ESAL); medium (100,000 to 1,000,000 ESAL); high (1 to 10 million ESALs), very high (>10,000,000 ESALs)
- Environmental conditions: dry-cold, wet-cold, dry-warm, wet-warm, and central.

Pavement Analysis

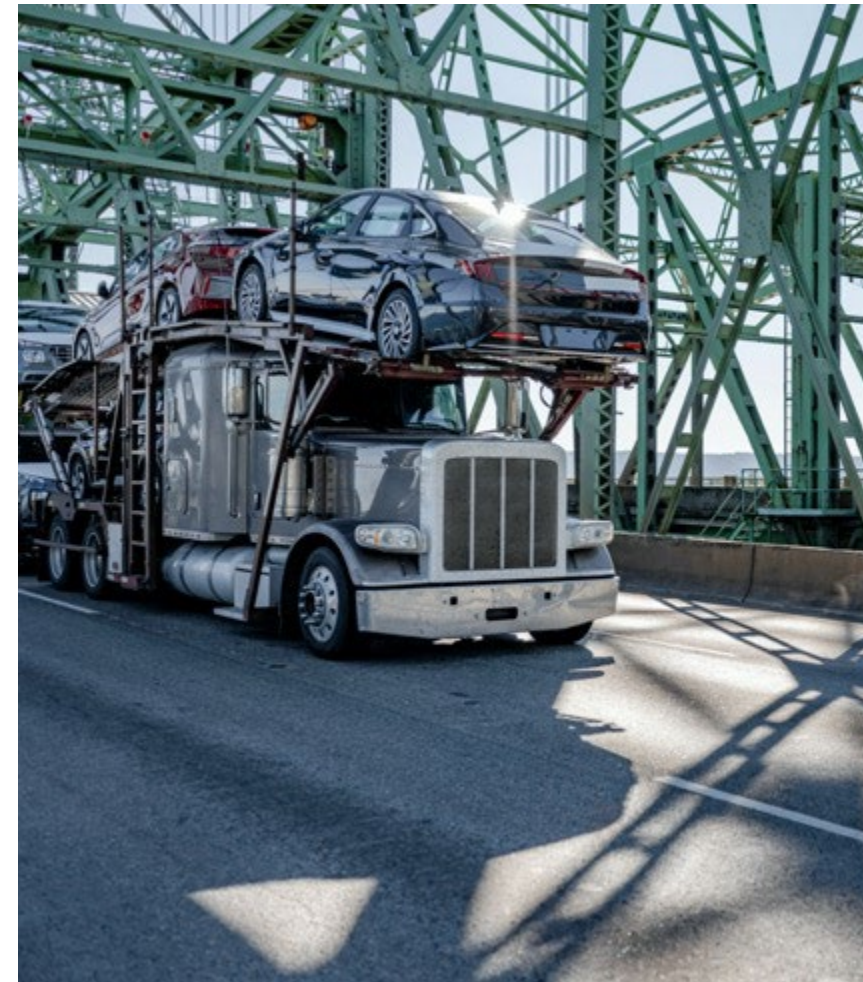
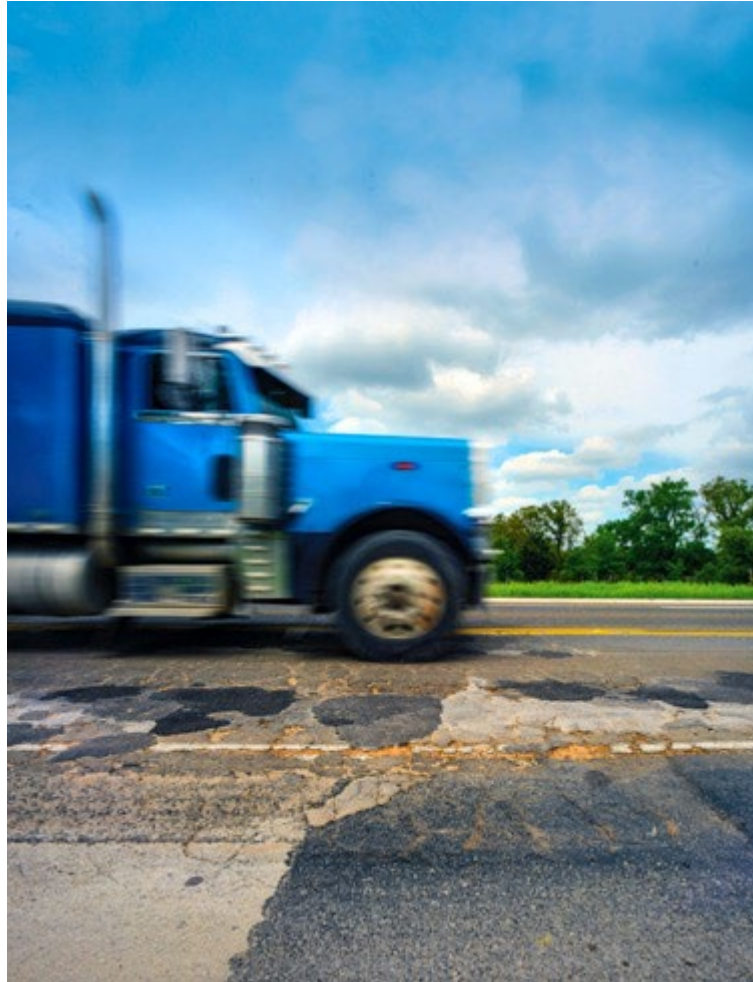
- Based on the experimental design we will run a series of mechanistic analyses covering: pavement types (20), environmental conditions (5), axle types (3) and loads (10).
- Results will be used to determine performance and impact of axle loads.

Determination of Pavement Consumption Cost

- Develop and apply a mechanistically-based methodology for the determination of pavement impact due to “OW Traffic” relative to “Design Traffic”. Outputs:
 - Step-by-step methodology for **determine relative pavement impact (RPI)**
 - Estimated RPI for common vehicles in Texas.

Pavements Feel Axle Loads, Bridges Feel Trucks

Impact on State Pavements



STEP 1:

Traffic characterization and classification

Pavement design traffic (in ESALs)

Standard axle (18 kips single axle
= 1 ESAL)

Single, tandem and tridem axles

OS/OW traffic

STEP 2:

Determination of traffic routing and representative pavement structures

1

Select representative traffic sample

2

Identify routes and quantify VMT

3

Select representative pavement structures

Step 3:

Mechanistic-Empirical Pavement Analyses

Axle configurations

Reference axle +
single, tandem,
tridem

“Pavement Life”

Number of ESALs
to fail a pavement

Relative Pavement Impact (RPI) =

Number of
ESALs to fail a
pavement /
number of other
axle to fail same
pavement

Step 3:

Mechanistic- Empirical Pavement Analyses

Pavement performance in terms of several distresses:

Flexible: Rutting, Cracking and Roughness (Ride)

Rigid: Punchouts, Cracking and Roughness



Step 3:

Mechanistic- Empirical Pavement Analyses

AASHTOWare Pavement ME Design

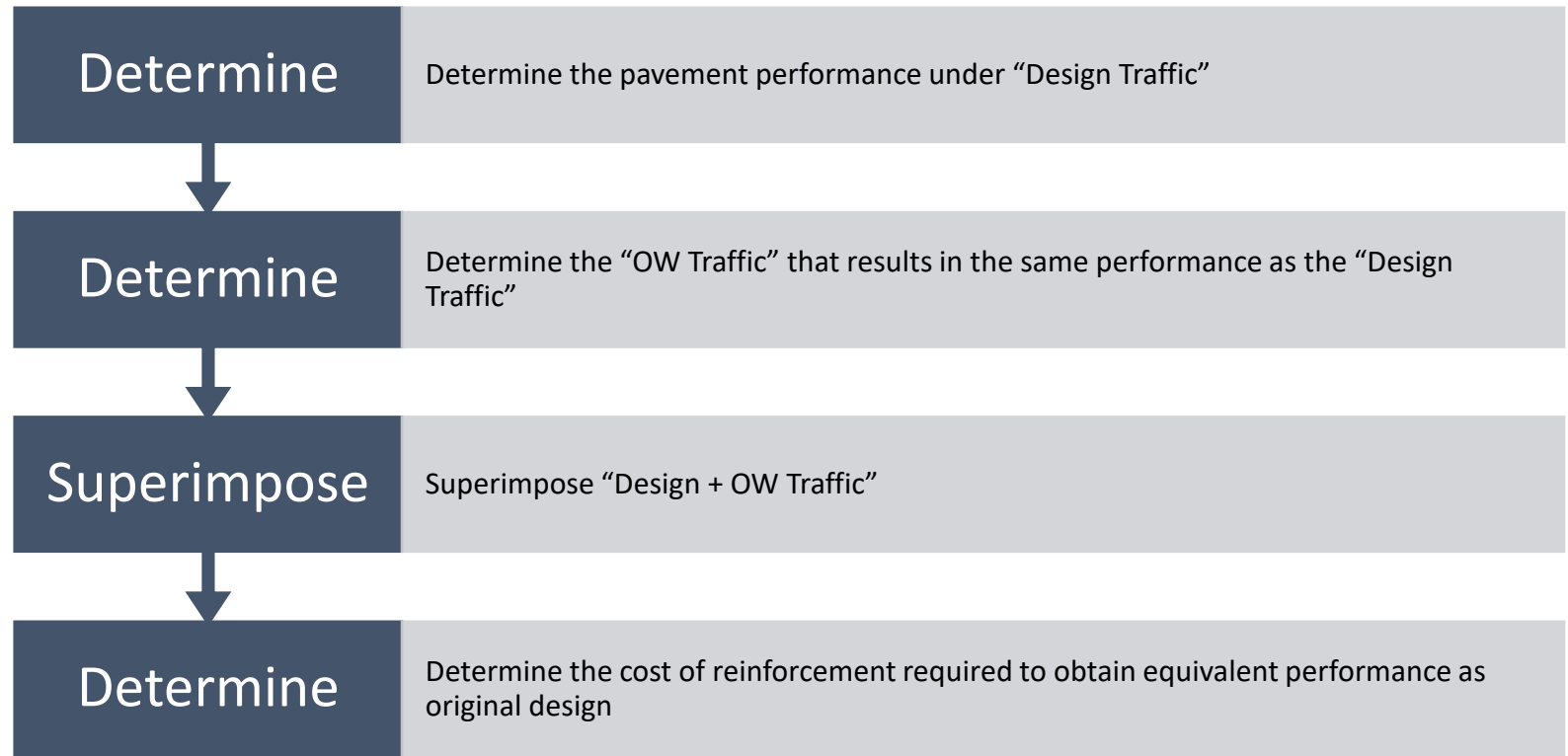
Supported by FHWA

National consensus



STEP 4:

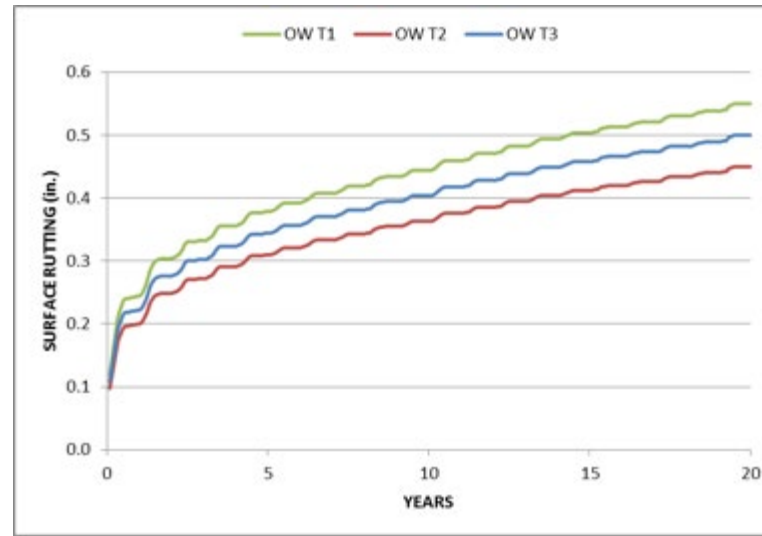
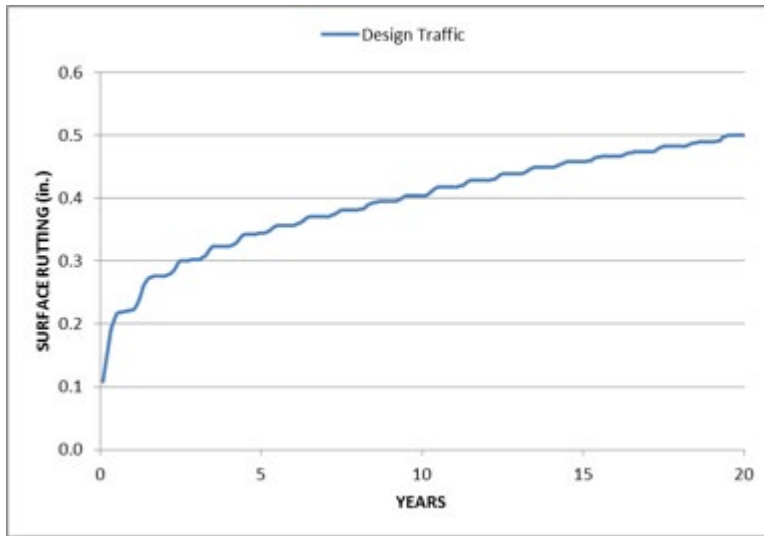
Determination of OW Traffic to produce equivalent pavement impact



STEP 4:

Determination of OW Traffic to produce equivalent impact (e.g., OW Traffic = 10 ESALs)

Design Traffic

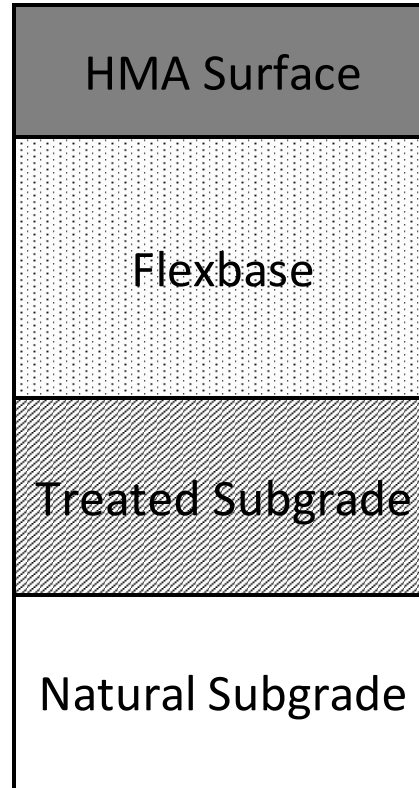


OW Traffic 1 = 300,000 vehicles
 OW Traffic 2 = 200,000 vehicles
 OW Traffic 3 = 250,000 vehicles

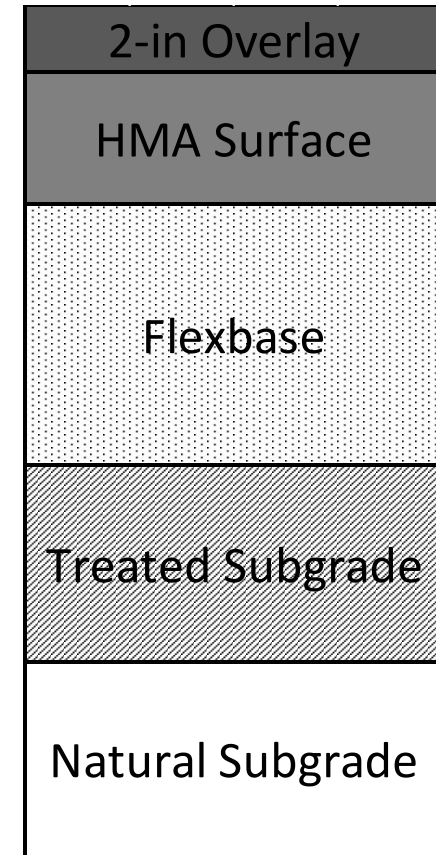
STEP 4:

**Determination
of OW Traffic to
produce
equivalent
impact**

Original Design



Design to Accommodate OW Traffic
(e.g. \$250,000/ lane . mile)

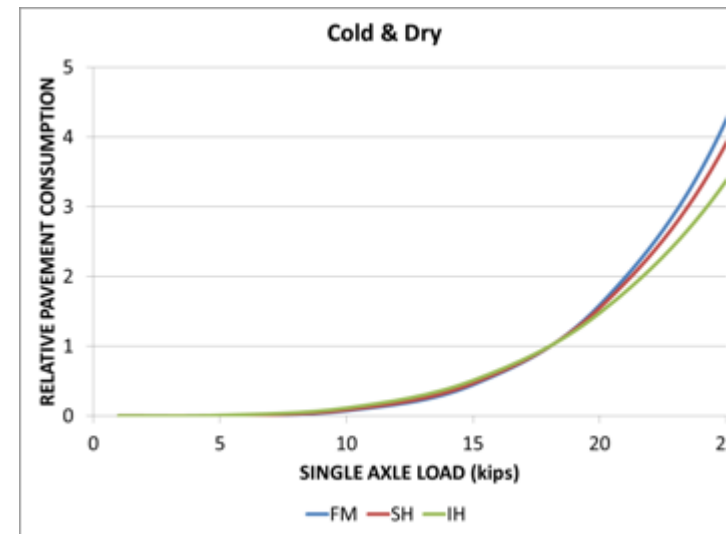
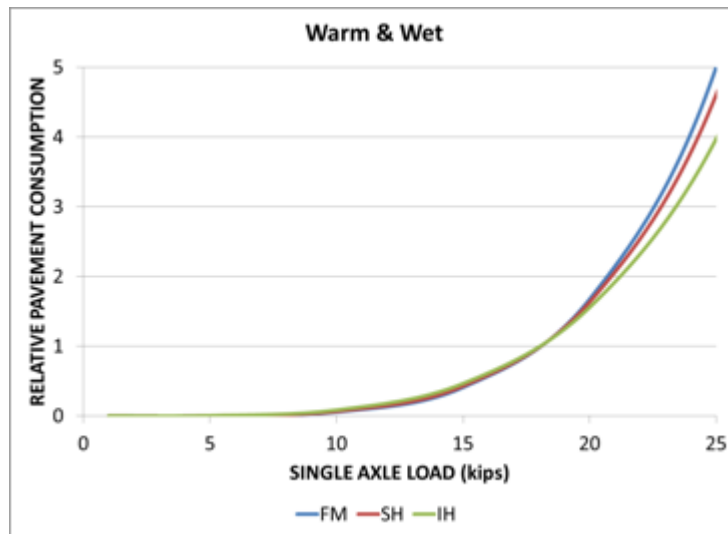


Final Metric: e.g. 10 cents/mile.ESAL

STEP 5:

Determination of RPI for standard axle configurations for different facility types

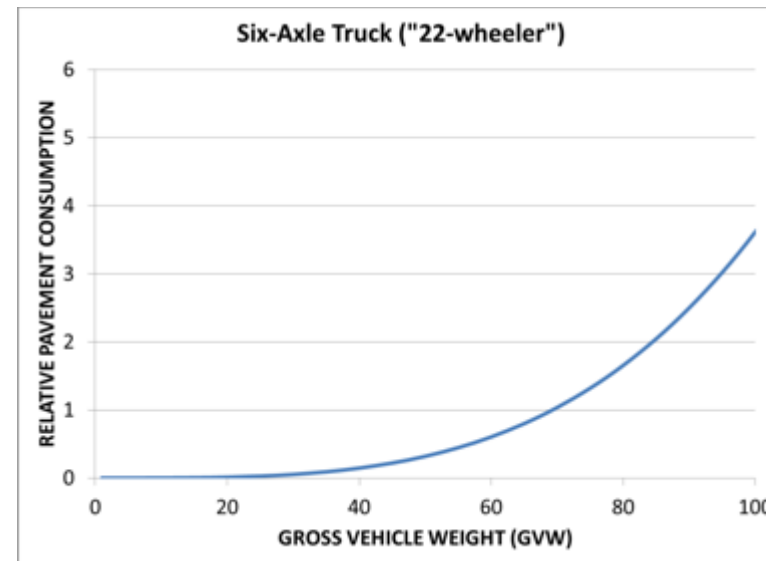
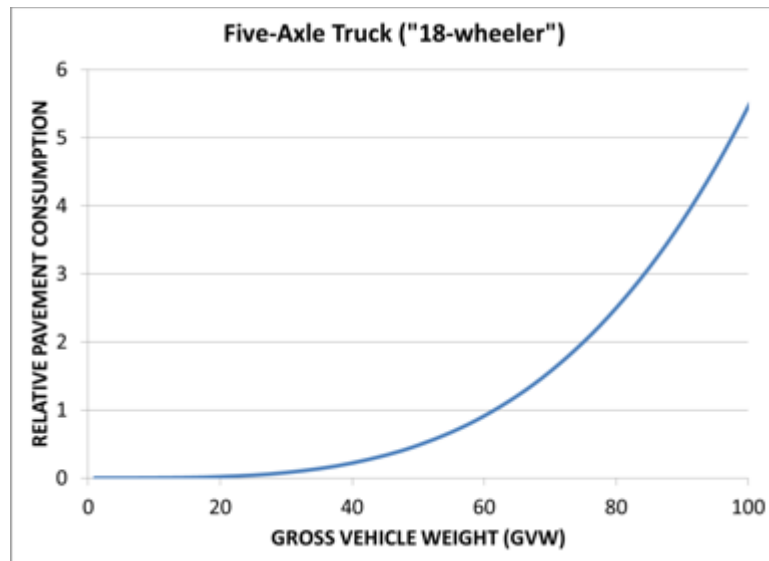
- Average RPI for different types of axle, facilities, pavements and environmental conditions



STEP 6:

Determination of RPI for representative vehicles for Texas

Average RPI for representative vehicles weighted according to typical routing in terms of VMT



In Summary

- **At the end, we will provide:**
 - Step-by-step methodology that can be used to determine RPI of common vehicle configurations.
 - Estimated RPI for common axle configurations and facility types that can be combined to estimate the impact of specific vehicles on specific routes.
 - Average RPI for typical vehicles in Texas that can be used for planning and programming purposes.

In Summary

- **What does our approach mean?**
 - We will quantify the impact of axle loads on the Texas road network
 - Benefit/cost analysis
 - Basic cost
 - Marginal cost
 - Marginal cost expressed in dollars per ESAL per mile per facility type, traffic level, region, etc.

Questions?



**CENTER FOR
TRANSPORTATION
RESEARCH**

Pavement Consption Analysis

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UTSA.Engineering

Bridge Consumption Analysis

Jose Weissmann and
Angela Weissmann

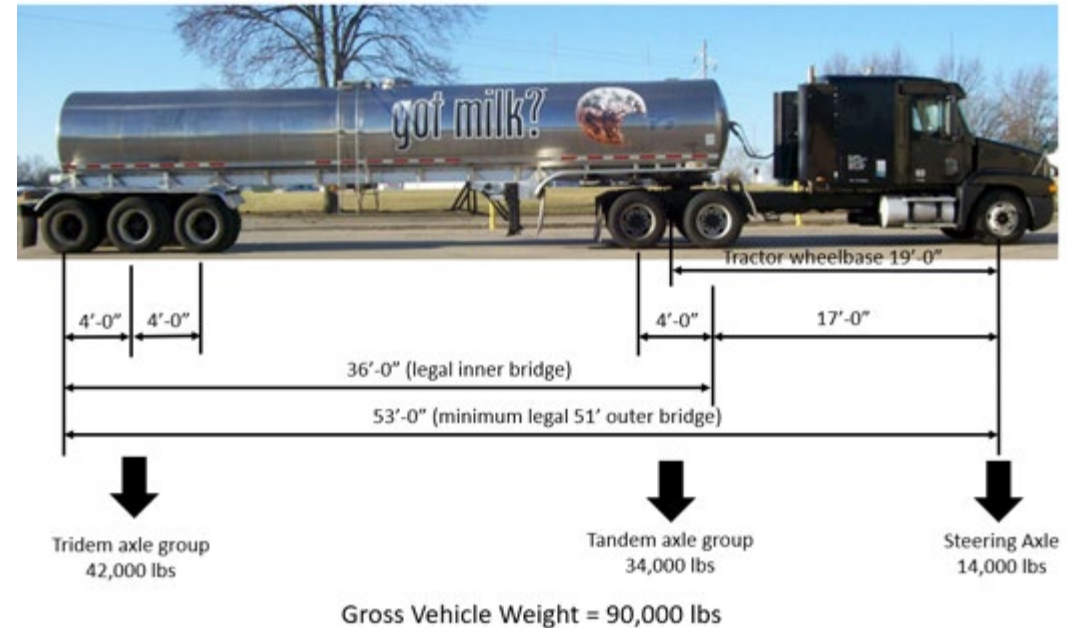
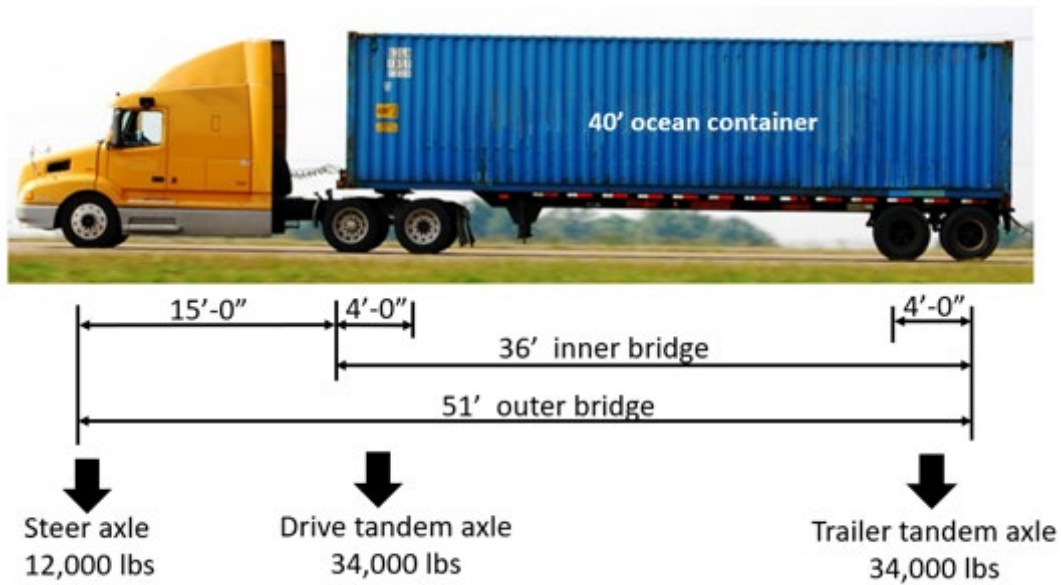
UTSA



Data Sources

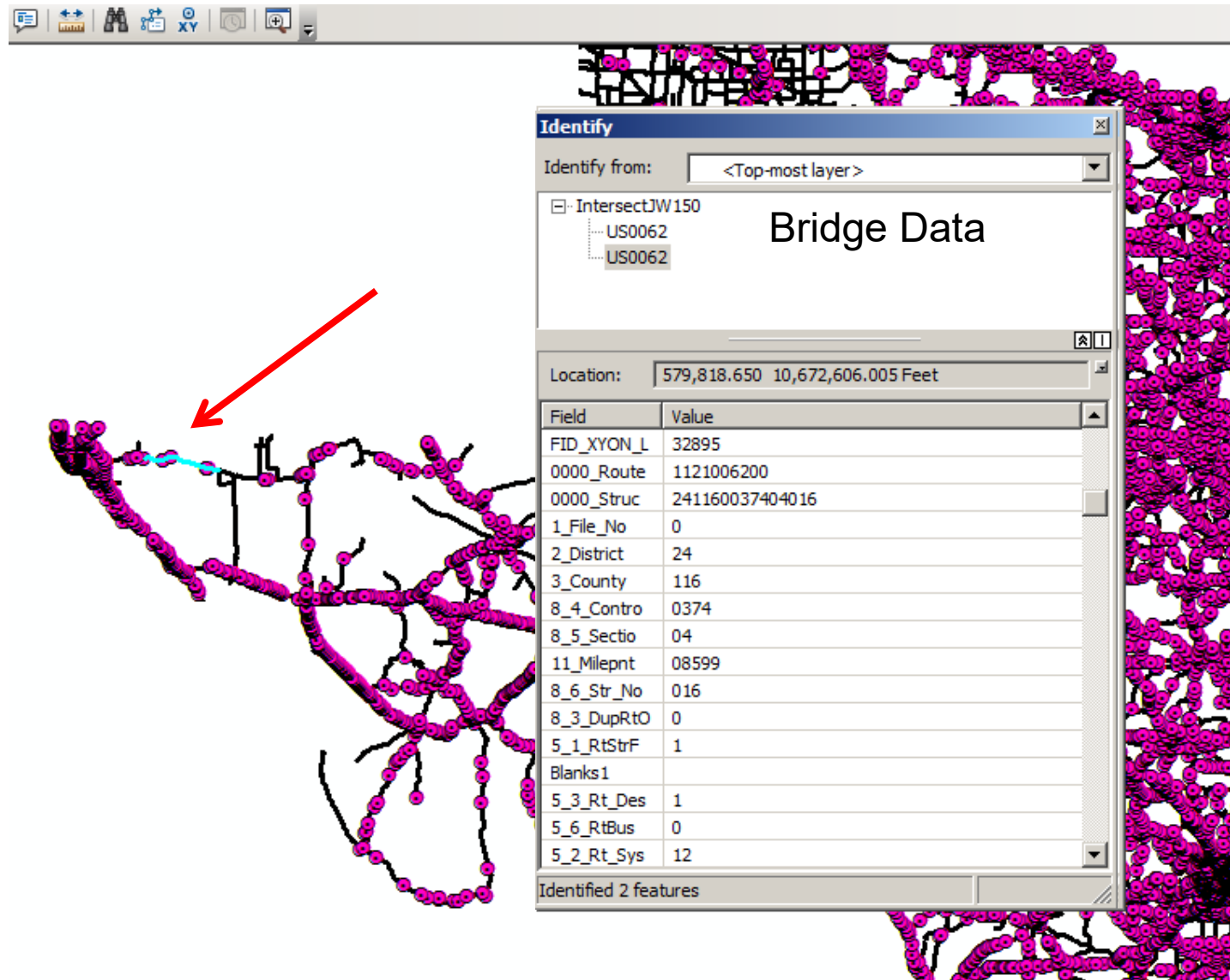
- Bridge Inventory and Inspection data
- Route alignment RHINO
- GIS data spatially combined with ArcMap
- Data cleaning using SAS
- Truck Configurations, Routes and Annual Mileage

Example Truck Configurations



GIS Data Analysis

(Bridges per Mile)



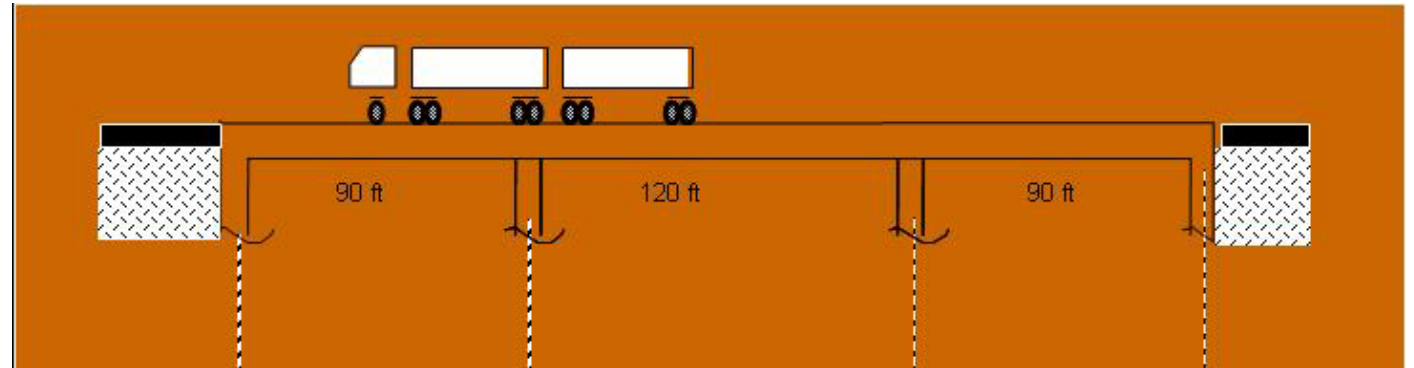
Bridge Consumption Concepts

$$Consumption_{TC} = (Area)(A_v)(0.11) \left(\frac{M_{TC}}{M_{Inventory}} \right)^m \div (2,000,000)$$

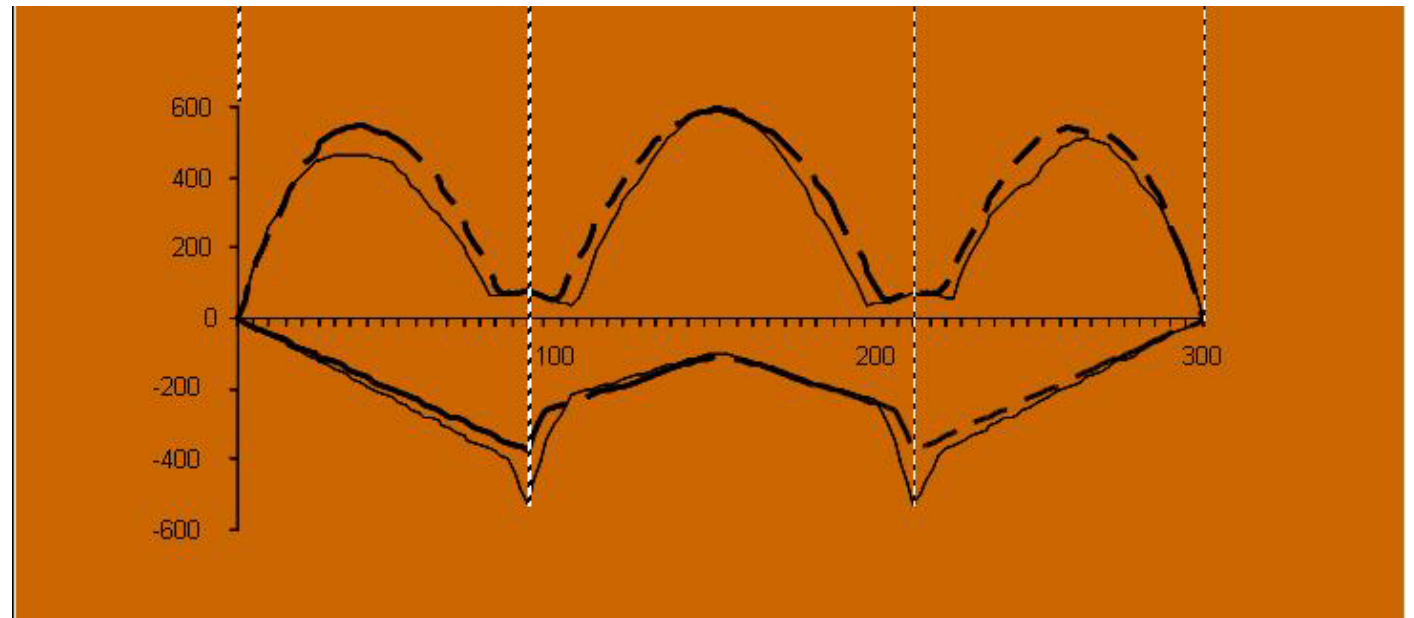
- ❑ $M_{inventory}$, M_{TC} — Live load moments for the Inventory Rating load and Truck Configuration
- ❑ $Consumption_{TC}$ — Consumption of one passage of the Truck Configuration
- ❑ m — Constant dependent on bridge material type
- ❑ A_v - Asset unit value of the bridge (dollars per squarefoot)
- ❑ Area – Deck area in sqft
- ❑ 0.11 – 11% portion of the Asset Value that is responsibility of Heavy Trucks
- ❑ 2,000,000 – Number of Design Load applications AASHTO

Computerized Bending Moment Envelopes

(Calculation of M_{TC} and $M_{inventory}$)



$$Consumption_{TC} = (Area)(A_v)(0.11) \left(\frac{M_{TC}}{M_{Inventory}} \right)^m \div (2,000,000)$$



m Values and Bridge Inventory Codes

$$\frac{N_{Inventory}}{N_{TC}} = \frac{S_{TC}^m}{S_{Inventory}^m} = \frac{M_{TC}^m}{M_{Inventory}^m}$$

$$Consumption_{TC} = (Area)(A_v)(0.11) \left(\frac{M_{TC}}{M_{Inventory}} \right)^m \div (2,000,000)$$

Structure Type	m value
Concrete Slab 101	4.1
Concrete Girders 102	3.5
Concrete T Beam 104	4.1
Concrete Box Beam 105	4.1
Concrete Continuous Slab 201	4.1
Concrete Continuous T Beam 204	4.1
Steel Girder 302	3.0
Steel Continuous Girders 402	3.0
Steel Continuous Girder 403	3.2
Steel Continuous Box Beam 405	3.2
Steel Continuous Box Beam 406	3.2
Prestressed Concrete 500	3.5
Prestressed Concrete Slab 501	3.5
Prestressed Concrete Girder 502	3.5
Prestressed Concrete Box Beam 505	3.5
Prestressed Concrete Continuous 601	3.5
Prestressed Concrete Continuous 602	3.5

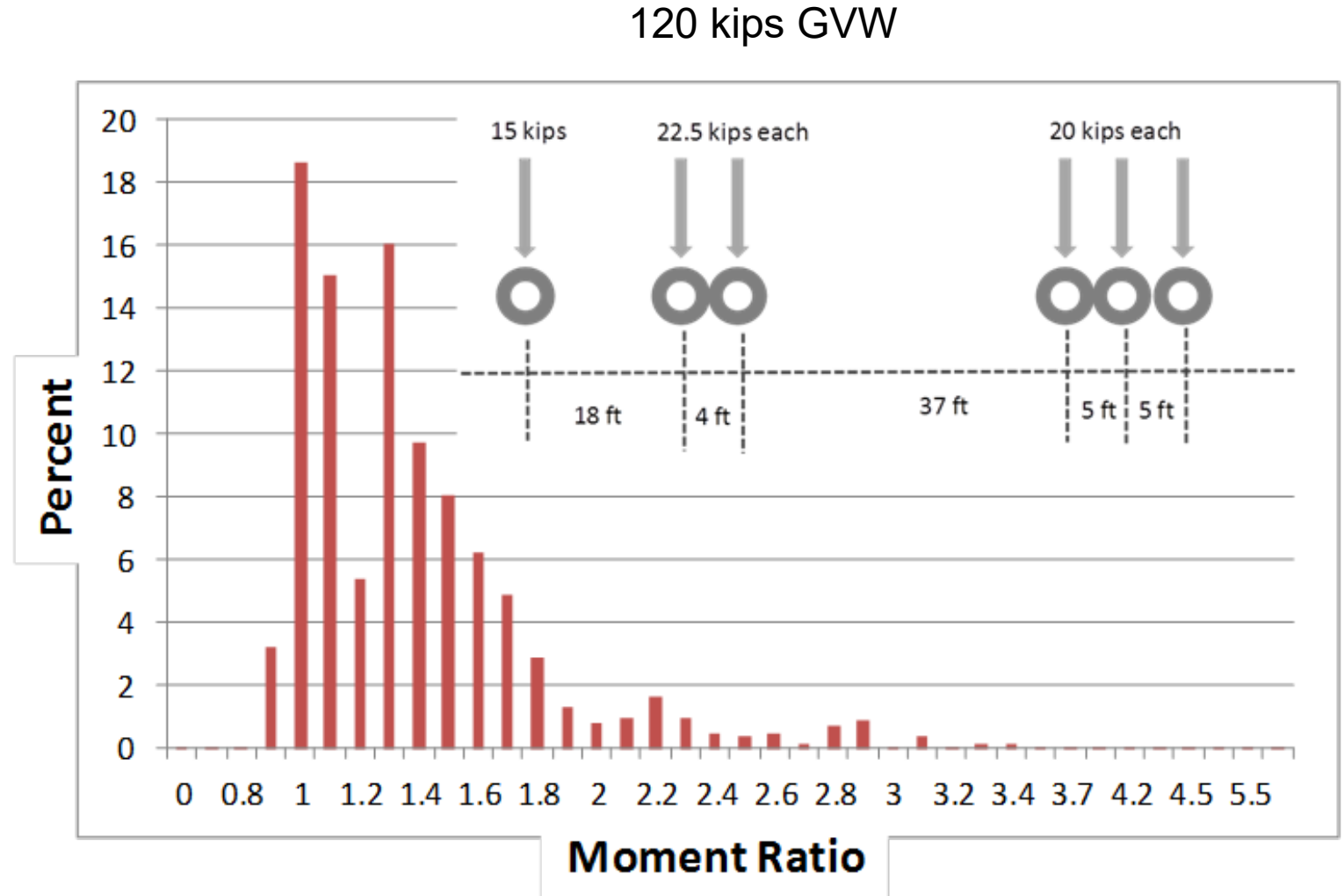
Bridge Consumption – Asset Value

- Bridge Asset Value = Deck Area x \$/sqft
- How much of the Asset Value is Heavy Truck responsibility ?
- Federal Highway Cost Allocation Study

$$Consumption_{TC} = (Area)(A_v)(0.11) \left(\frac{M_{TC}}{M_{Inventory}} \right)^m \div (2,000,000)$$

Vehicle Class	Percent Allocation
Passenger Vehicles	65.02%
Trucks	
Single Unit	7.67%
Combinations	
under 50 kips	2.68%
50 - 70 kips	5.15%
70 - 75 kips	8.41%
Over HS20-44 Loading	11.08%
TOTAL =	100.00%

Routed Permit Example (Rider 36)



Routed Permit Example (Rider 36)

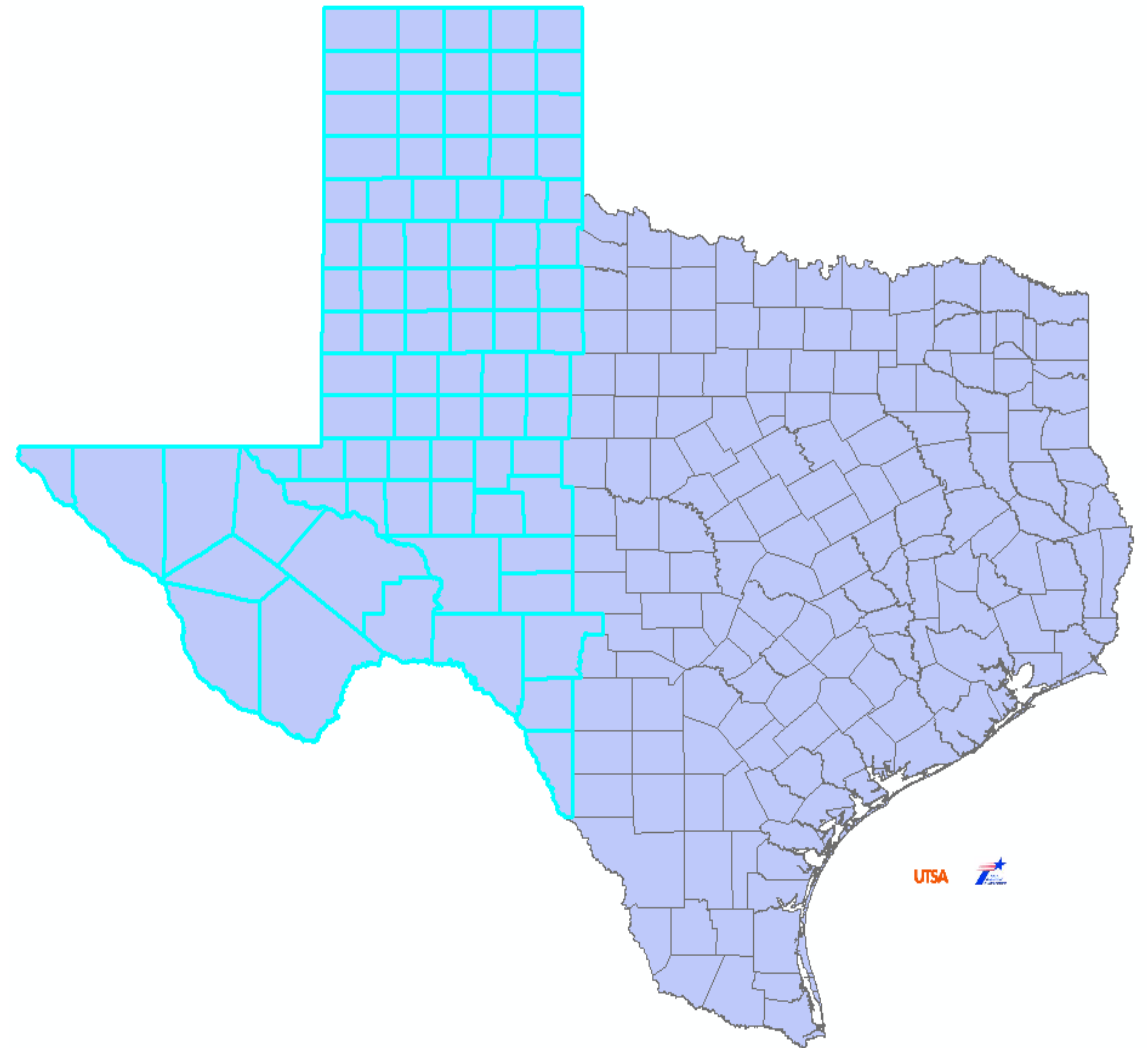
Structure ID	AREA sqft	GIS segment	Route#	# of 80_120 permits	Permit Mileage	Structure Type	Bridge Count	Moment Ratio	Bridge Consumption \$	Segment Miles
10600013604079	11,268	18787	SH0019	12	54.06	102	3	1.69	8.8	18.0
10600013604101	6,448	18420	SH0019	12	7.69	102	1	1.64	4.5	7.7
10600040001016	25,204	18416	SH0019	11	35.15	201	3	1.45	18.4	11.7
						404	1	2.06	19.2	
10750004520040	10,268	19123	FM1752	2	2.66	502				2.7
10750004520191	12,650	19089	US0082	71	71.56	502	2	1.33	23.2	35.8
10750004520219	13,110	19089	US0082	71	71.56	502	2	1.38	27.5	35.8
10750004520230	11,088	19110	US0082	93	466.71	502	1	1.33	26.7	466.7
10750020202028	2,493	18551	FM0151	29	44.6	102	1	1.79	5.8	44.6

Routed Permits Results

GVW category	Miles	Bridge Consumption (\$)	\$/mile
80-120k	3,939,917	909,968	0.23
120-160K	1,104,370	416,613	0.38
160-200k	534,260	259,374	0.49
200-254k	239,610	214,603	0.90

Non-Routed Permits

- Monte Carlo simulation (random GIS road segments)
- Each GIS road segment contains a number of bridges
- Simulation can be constrained by county basis and Functional Class
- East and West Texas Counties
- Different bridge/mile statistics



Non-Routed Permits Example

(Rider 36)

Legal: Up to 20,000 lbs.
Exemption: Up to 23,000 lbs.

Up to 34,000 lbs.
Up to 46,000 lbs.



Legal: Total Vehicle up to 54,000 lbs. GVW
Exemption: Total Vehicle up to 69,000 lbs. GVW

TTC 622.011 - .017 Ready Mix concrete and pump trucks

Non-Routed Permits Example

(Rider 36)



Randomly Assigned Miles	Total Bridge Consumption (\$)	Counties	\$/mile
22,453	2,058	West	0.092
20,837	2,511	East	0.120
Average			0.106

Questions?

UTSA[®]

Bridge Consumption Analysis

Jose Weissmann Ph.D., P.E.

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School of Civil & Environmental Engineering and Construction
Management

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Traffic Congestion in Texas

Where Are We Going?

David Schrank

TTI



Basis for Mobility Statistics

**15-minute
traffic volumes
on the road
segment map.**

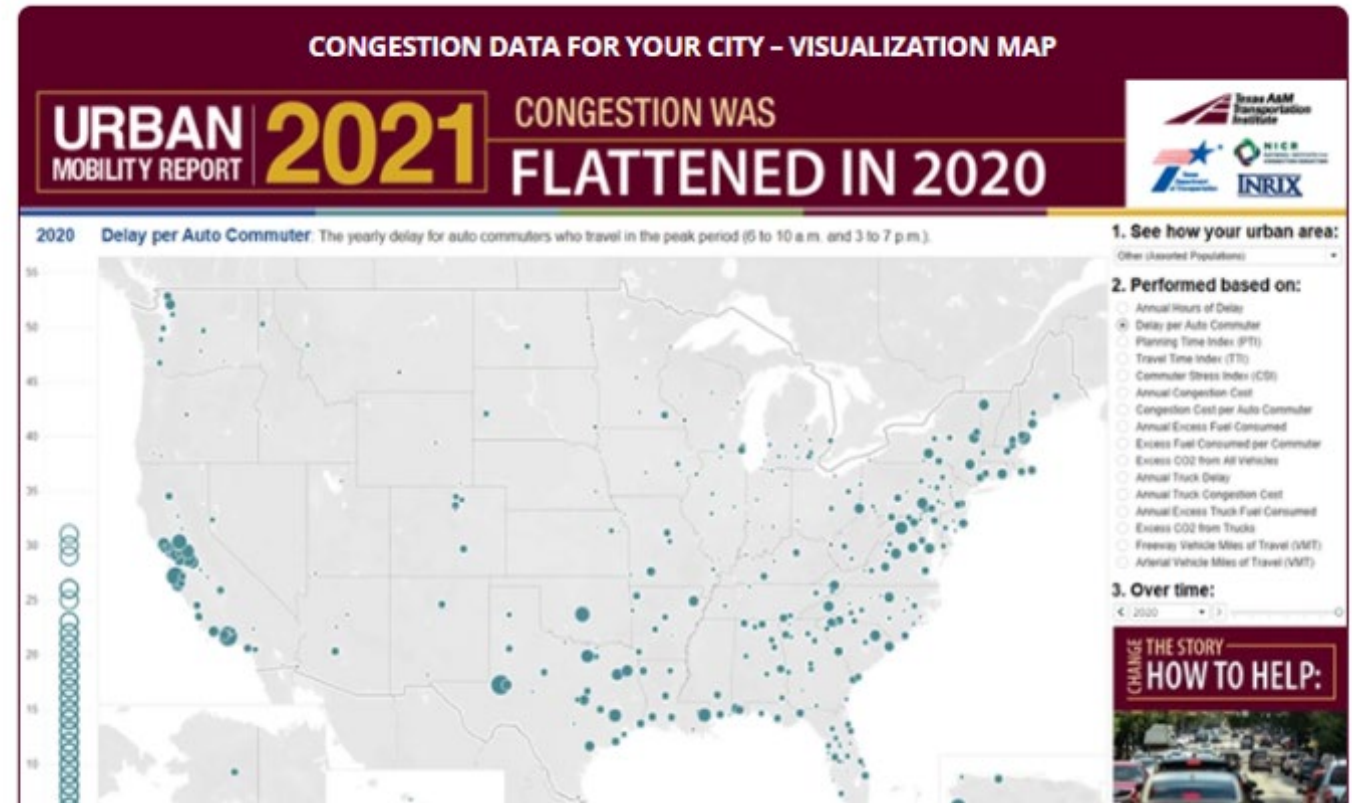
- All vehicles
- Trucks

**15-minute
speeds on the
road segment
map.**

**Combine these
two maps to
calculate
statistics.**

2021 Urban Mobility Report (UMR)

- 494 urban areas in the U.S.
- Data from 1982 to 2020.
- Texas:
 - Has 34 of the 494 urban areas in 2020.
 - Accounts for 8.9% of the population in the UMR.



2020 (COVID-19) in the UMR



- 4 congestion years in one.
- A 18% reduction in travel led to a 51% reduction in delay.
- Truck travel had a smaller decline than passenger cars.
- More of the delay is on streets, in the middle of the day, and on weekends.
- A majority of truck delay now happens in off-peak periods (53% in 2020 compared to 40% in 2019).

Texas in the UMR

- Texas had about 9.3% of the U.S. total delay in 2019 and 11.7% in 2020.
- For truck delay, Texas had about 9.9% in 2019 and 11.7% in 2020.
- Houston led Texas in delay and truck delay in both years, ranking 5th nationally in 2019 and 4th nationally in 2020 in both.
- DFW was also in the top 10 nationally in total delay and truck delay in both years.

Region	Total Annual Delay (Million Person-Hours) [Rank]		Total Annual Congestion Cost (\$bil) [Rank]		Total Annual Truck Delay (Million Person-Hours) [Rank]	
	2019	2020	2019	2020	2019	2020
U.S.	8,722	4,344	189.9	100.6	387.4	210.6
Texas	810	509	17.6	11.4	38.4	24.6
Houston	263.2 [5]	169.8 [4]	5.66 [6]	3.80 [4]	12.02 [5]	7.95 [4]
DFW	219.8 [9]	137.0 [5]	4.81 [9]	3.05 [5]	9.85 [8]	6.25 [6]
Austin	81.1 [22]	48.4 [18]	1.08 [22]	1.73 [18]	3.55 [25]	2.15 [20]
San Antonio	71.9 [25]	45.0 [22]	1.58 [26]	1.01 [22]	3.47 [27]	2.27 [18]

Texas in the UMR

- Texas was higher in delay per commuter and cost per commuter than the national average in both 2019 and 2020.
- All 4 Texas large metro regions ranked higher in 2020 congestion nationally than in 2019.
- Houston was in the top 10 for both measures in both years, ranking as high as 3rd in delay per commuter in 2020.
- Houston, Austin, and DFW were all in the top 10 in delay per commuter and congestion cost per commuter in 2020.

Region	Annual Delay per Commuter [Rank]		Annual Congestion Cost per Commuter (\$) [Rank]	
	2019	2020	2019	2020
U.S.	54	27	1,174	605
Texas	56	35	1,178	764
Houston	76 [9]	49 [3]	1,635 [9]	1,097 [5]
DFW	65 [16]	40 [8]	1,335 [18]	848 [10]
Austin	68 [12]	41 [7]	1,520 [14]	945 [6]
San Antonio	52 [36]	32 [21]	1,069 [40]	682 [23]

Texas 100 Most Congested Road Sections



- Legislative mandate in 2009.
- Road segments ranked annually for delay per mile.
- About 1,800 road sections (all Texas urban areas included).
- Almost 10,000 miles of road (freeway and streets).
- Updated annually since 2009.

How Does a Road Section Enter the Top 100?



Lots of traffic

Economic prosperity

Land use

Construction

Congestion outside peaks

Weather

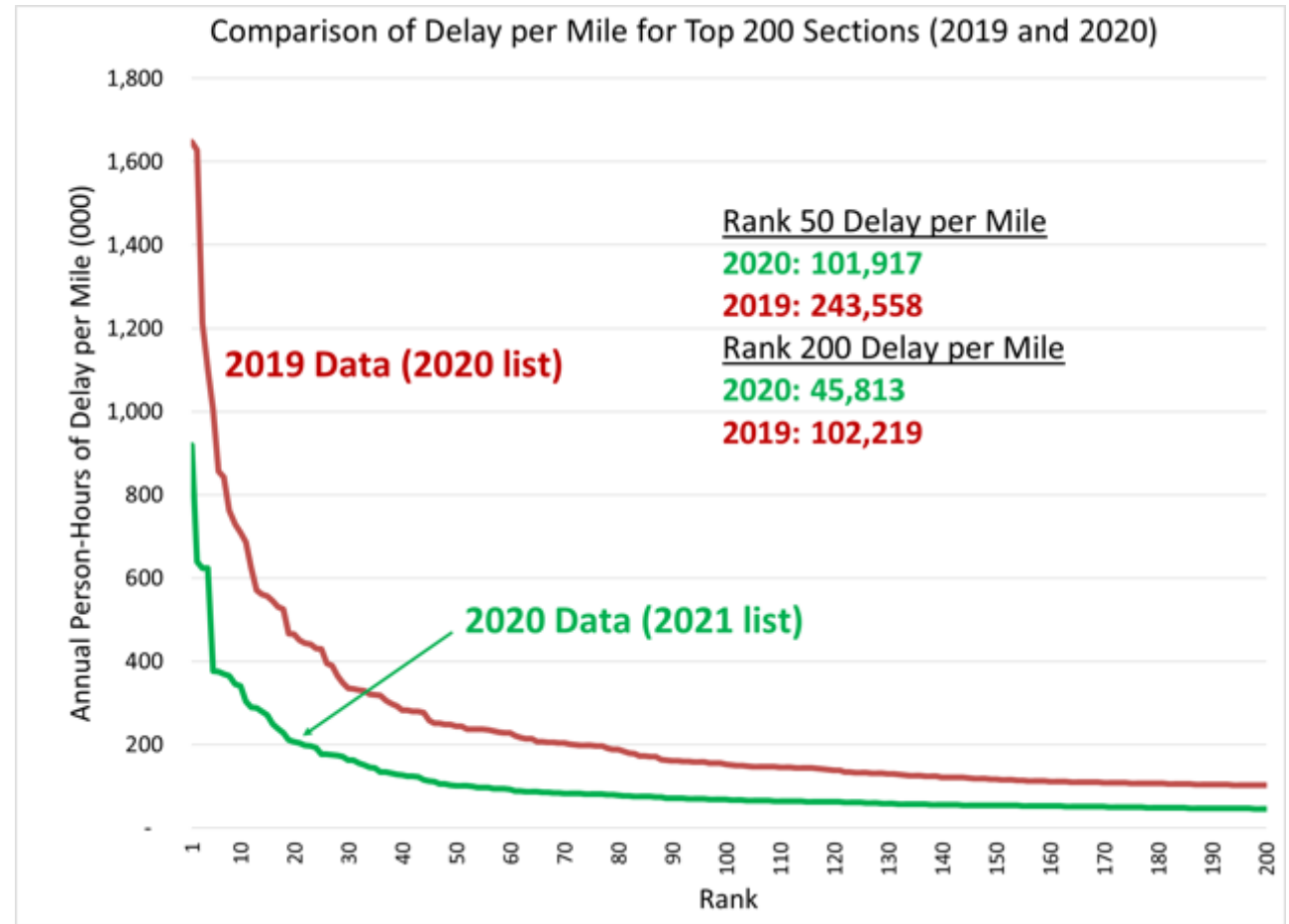
Texas 100 – 2020 All Vehicle Top 10

#1 and #2 in Texas (West Loop in Houston and I-35 through Austin) have been in the top 2 for much of TX100’s existence.

2021 Report	County	Road Segment	From	To	2020 Report
1	Harris	W Loop Fwy/ IH 610	Katy Fwy / IH 10 / US 90	Southwest Fwy / IH 69 / US 59	2
2	Travis	IH 35	US 290 N / SS 69	Ben White Blvd / SH 71	1
3	Harris	Southwest Fwy / IH 69 / US 59	W Loop Fwy / IH 610	South Fwy / SH 288	3
4	Dallas	Woodall Rodgers Fwy / SS 366	US 75	N Beckley Ave	4
5	Harris	Eastex Fwy / IH 69 / US 59	SH 288	IH 10	5
6	Harris	Gulf Fwy / IH 45	IH 10 / US 90	S Loop E Fwy / IH 610	7
7	Dallas	US 75	LBJ Fwy / IH 635	Woodall Rodgers Fwy / SS 369	9
8	Dallas	Stemmons Fwy / IH 35E / US 77	John W Carpenter Fwy / SH 183	Tom Landry Fwy / IH 30	8
9	Tarrant	North Fwy / IH 35W / US 287	SH 183	IH 30	16
10	Dallas	LBJ Fwy / IH 635	Stemmons Fwy / IH 35E / US 77	US 75	18

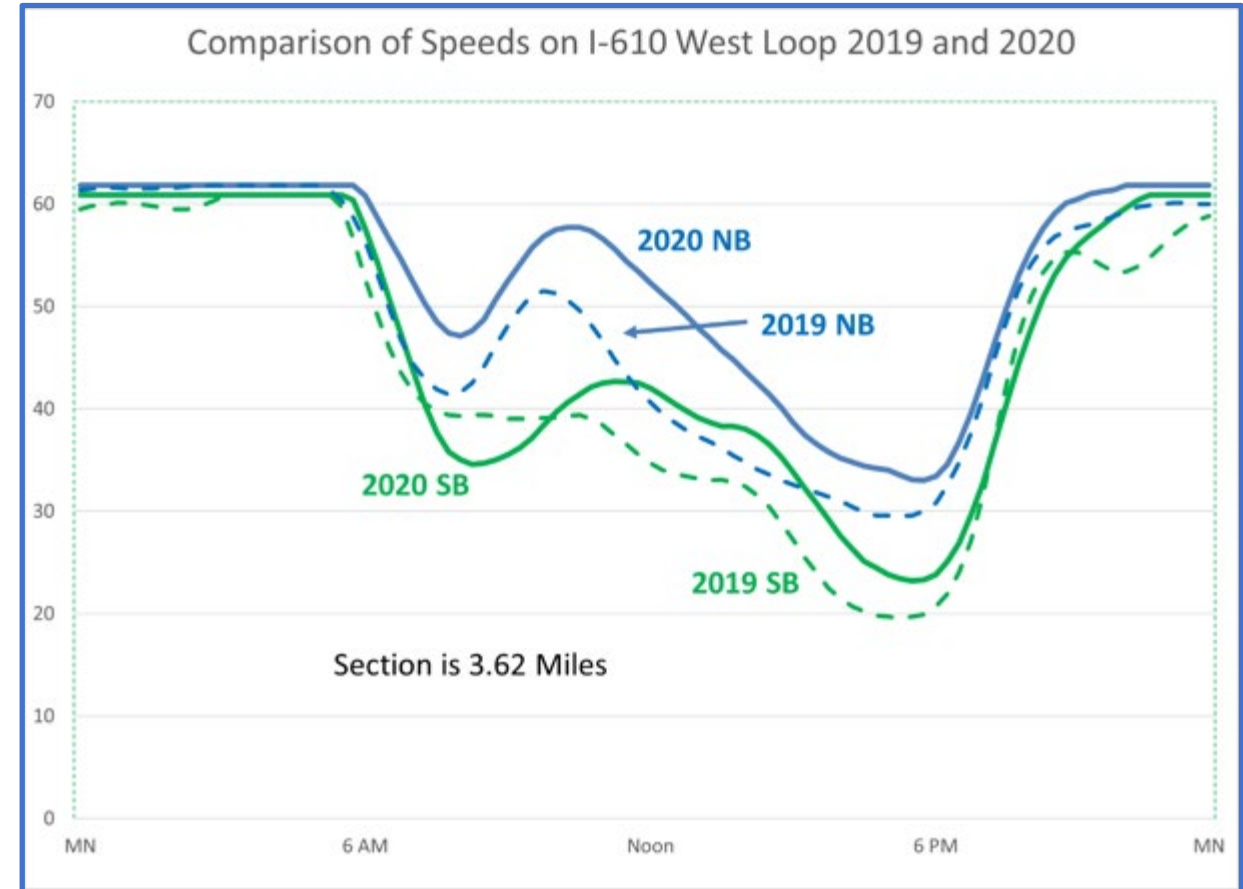
The Worst of the Worst

- The worst 10 ranks or so are still well above their peers for delay per mile.
- The curve flattens much sooner in 2020 at around rank 50 rather than closer to rank 100.



How Different Was 2020?

- West Loop (I-610 in Houston).
- Speeds were often 5-10 mph faster in 2020 than in 2019.
- The difference between 20 and 30 mph is about 1 minute per mile; between 30 and 40 is a half minute per mile.



Texas 100 – 2020 Truck Top 10

- #1 I-35 in Austin has been at the top of the list for years due to about 25,000 trucks per day in a top congestion location.
- New roads such as Mines Road in Laredo showed up in 2020.
- The ranks are shuffled a little when just looking at truck congestion.

2021 Report	County	Road Segment	From	To	2020 Report
1	Travis	IH 35	US 290 N / SS 69	Ben White Blvd / SH 71	1
2	Tarrant	North Fwy / IH 35W / US 287	SH 183	IH 30	8
3	Harris	W Loop Fwy / IH 610	Katy Fwy / IH 10/ US 90	Southwest Fwy / IH 69 / US 59	3
4	Harris	Eastex Fwy / IH 69 / US 59	SH 288	IH 10	2
5	Harris	Southwest Fwy / IH 69 / US 59	W Loop Fwy / IH 610	South Fwy / SH 288	10
6	Travis	IH 35	Ben White Blvd / SH 71	Slaughter Ln	11
7	Dallas	Stemmons Fwy / IH 35E / US 77	John W Carpenter Fwy / SH 183	Tom Landry Fwy / IH 30	7
8	Webb	Mines Rd / FM 1472	Pan American Blvd	Bob Bullock Loop / SL 20	110
9	Harris	South Fwy / SH 288	Gulf Fwy / IH 45	S Loop W Fwy / IH 610	16
10	Harris	N Loop W Fwy / IH 610	North Fwy / IH 45	Katy Fwy / IH 10 / US 90	6

What Does All of This Mean?

- Congestion was about half as bad in 2020 primarily due to work from home and remote learning.



What Does All of This Mean?

- We've already seen conditions looking more 2019-like in 2021.

Maybe not quite back to pre-pandemic levels.



What Does All of This Mean?

- Truck traffic will only continue to increase with a growing Texas population and more demand for home-based deliveries.



What Does All of This Mean?

- It will take time to figure out what work from home will contribute to our transportation system, but growth alone will require us to continue to add transportation systems at critical locations.
- It will take time to figure out how the shift in where businesses and people locate will affect people and goods movements.



Questions?



Traffic Congestion in Texas

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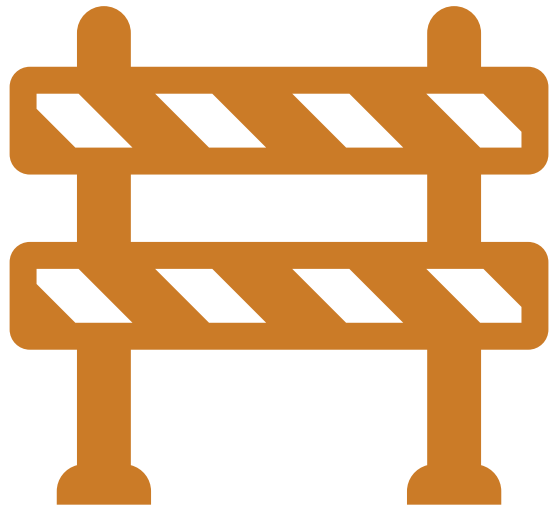
Revenue Analysis/ Cost Recovery

Brianne Glover
TTI

Total Revenues

Estimate the total transportation revenue contributed from:

- Passenger vehicles
- Aggregated commercial vehicles
- Oversized/overweight (OS/OW) vehicles



Total Revenues

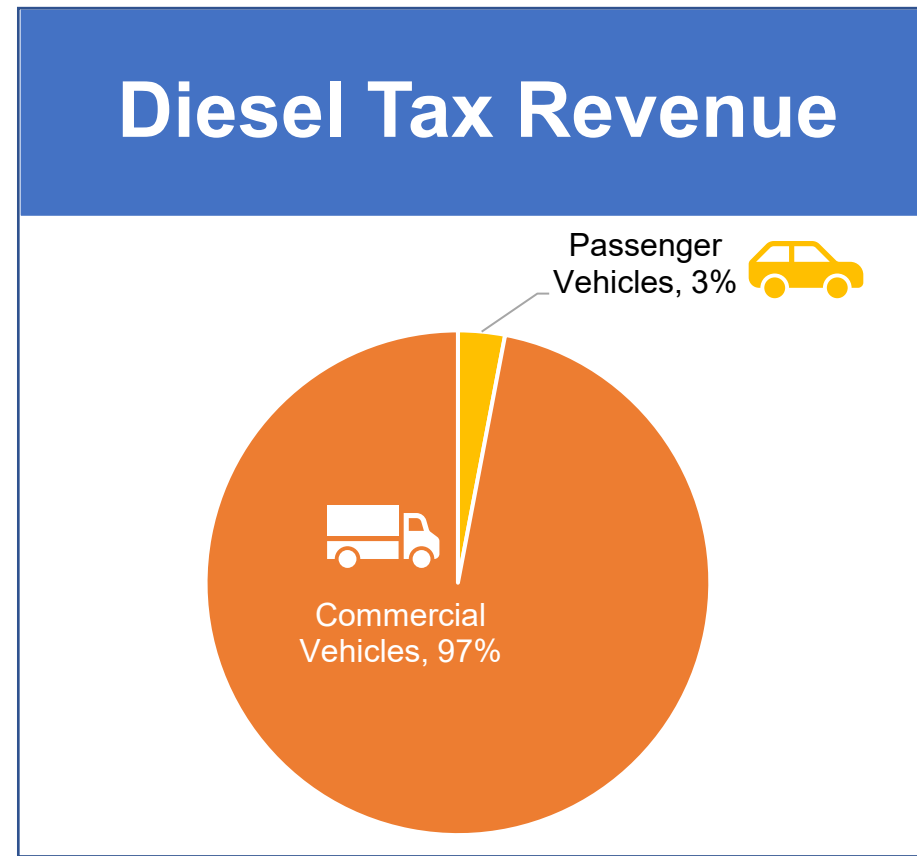
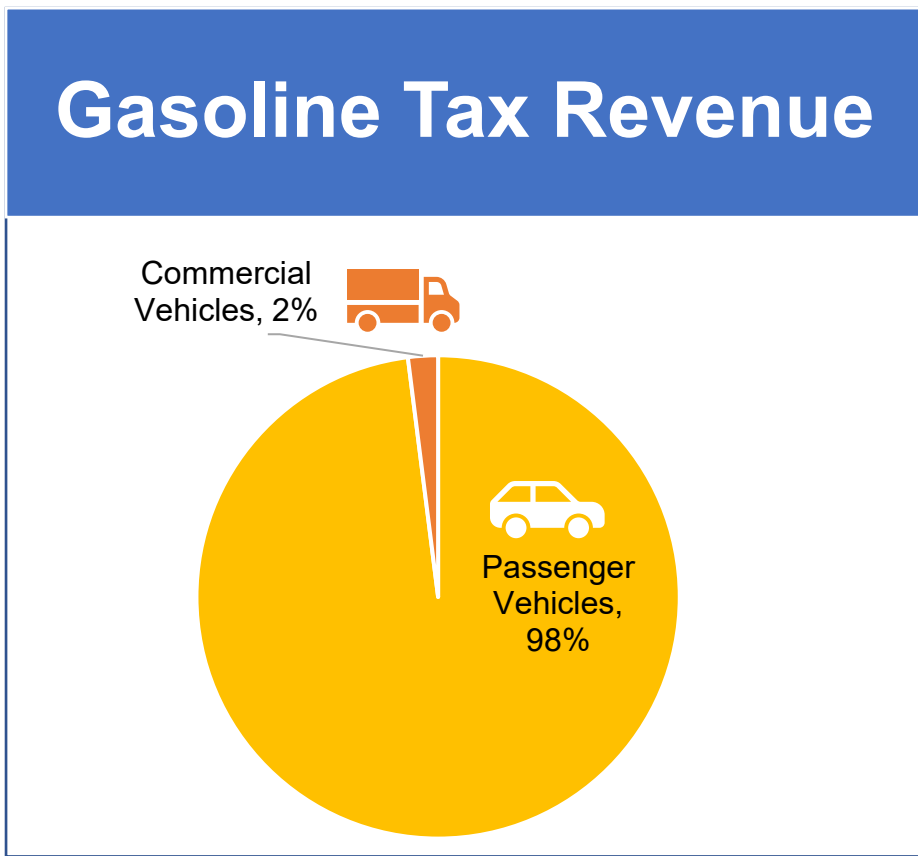
We will look only at the portion of each revenue stream that is attributable to construction and maintenance of roads and bridges.

Revenue Sources

Revenues
directly
linked to
vehicle
use:

- State and federal motor fuel revenues
- Vehicle registration fees
- OS/OW permit fees

Motor Fuel Tax Revenue



Vehicle Registration Fees



Motorcycles/Mopeds	\$30.00
Passenger Vehicles	\$50.75
Trailers/Travel Trailers	\$45.00
All Vehicles 6k to 10k lb	\$54.00
10k to 18k lb	\$110.00
18k to 26k lb	\$205.00
26k to 40k lb	\$340.00
40k to 55k lb	\$535.00
55k to 70k lb	\$740.00
70k to 80k lb	\$840.00

Oversized/ Overweight Permit Fees

- Routed
- Non-routed



Per-Mile Basis

Revenue estimates for each vehicle category will be presented as revenue per mile using VMT estimates.



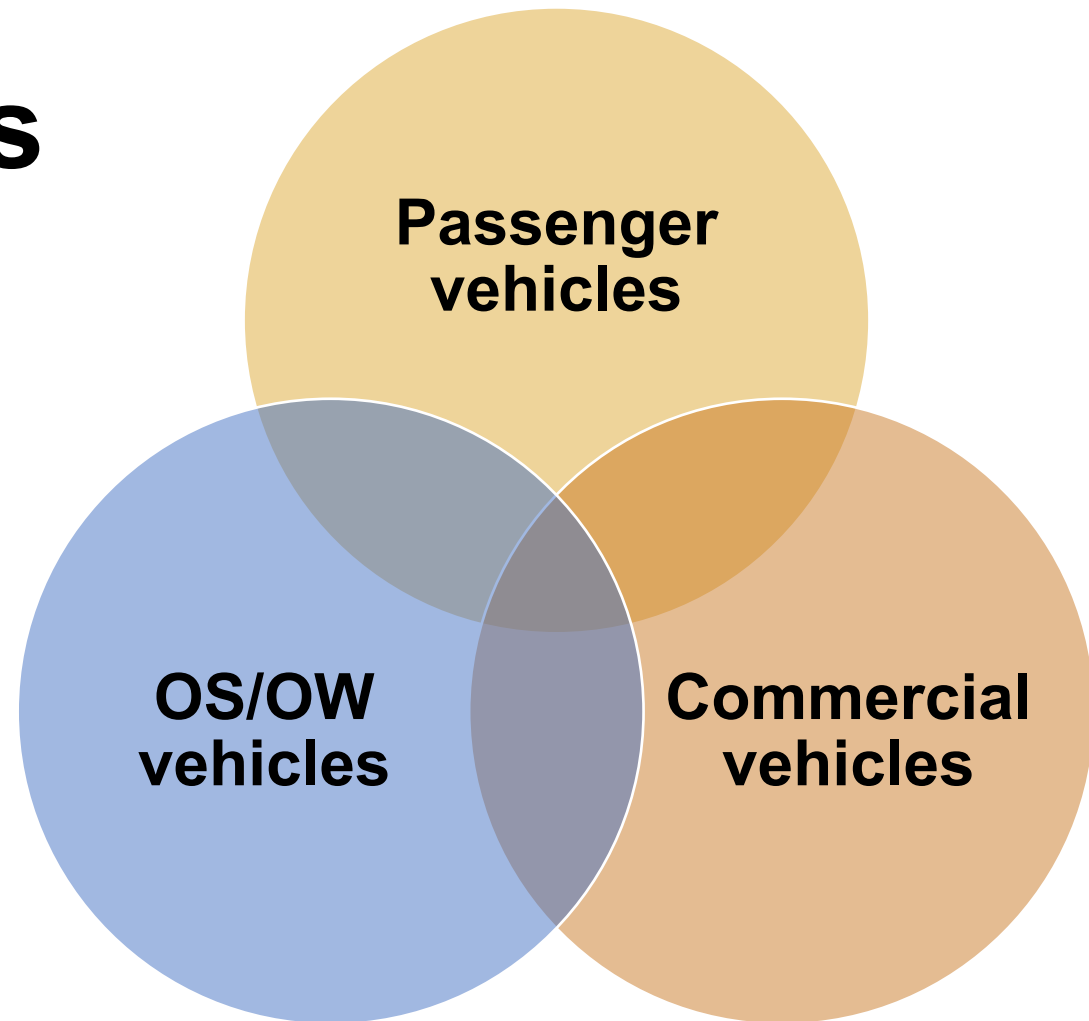
Revenue Analysis

Other
revenues
distributed
to vehicle
categories:

- **Proposition 1** — oil and gas severance taxes
- **Proposition 7** — sales and use taxes and taxes on motor vehicles
- Other applicable state and federal fees and taxes

Revenue Analysis

Compare the total cost responsibility to the revenue estimations for each of the three vehicle categories:



Develop Cost Recovery Scenarios



Cost Recovery Scenarios

Once the costs and revenues have been established, the research team will estimate potential changes to the existing tax and fee structure.

These scenarios will estimate the potential increases in revenue that could be produced from additional fees and taxes, or increases in certain fees and taxes.

Questions?



Revenue Analysis/ Cost Recovery

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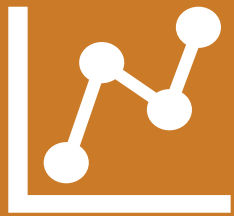


Economic Analysis

Jacki Kuzio
TTI



Objective



Determine the economic impact of commercial and oversize/overweight vehicles to the State of Texas.

Analysis

Two Components

- The contribution of the truck transportation industry to the economy.
- How truck transportation supports major industries in the state.

IMPLAN

Overview and
Review of Inputs
and Results



Overview

- IMPLAN is an economic analysis software that uses Input/Output Modeling and Social Accounting Matrices.
- IMPLAN can model the impact of an industry to the economy as well as an industry change or event.
- Results show the annual economic impact in terms of direct, indirect, and induced effects.

Inputs



Employment



Industry Sales



Industry Spending

Effects

Direct

- Immediate result of the direct spend.

Indirect

- Subsequent local purchases of goods and services from other local industries (related to direct spend).

Induced

- Household spending of labor income.

Benefit to the Economy

Contribution of
the trucking
industry



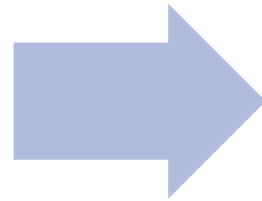
Economic Impact of Truck Transportation

- The first analysis will examine the contribution of the truck transportation industry to the state economy.
- The truck transportation industry contributes through employment and industry spending.
- Data from previous tasks will be used to form the inputs.

Methodology

Input: Industry Spending

- Transportation Costs
- Value of Time (calculated using VMT and Average Speed)



Outputs

- Direct, Indirect, and Induced effects
- Tax Impacts

Benefit to the Economy

Support to Major
Industries



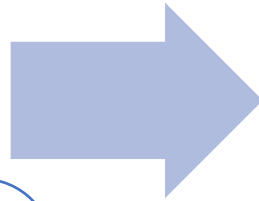
Supporting Major Industries

- Truck transportation is a key mode for the movement of freight. The second analysis will focus on the industries supported by truck transportation.
- The research team will use Freight Analysis Framework data to determine the value of goods being moved by truck within and to and from Texas.

Methodology

Input: Industry Sales

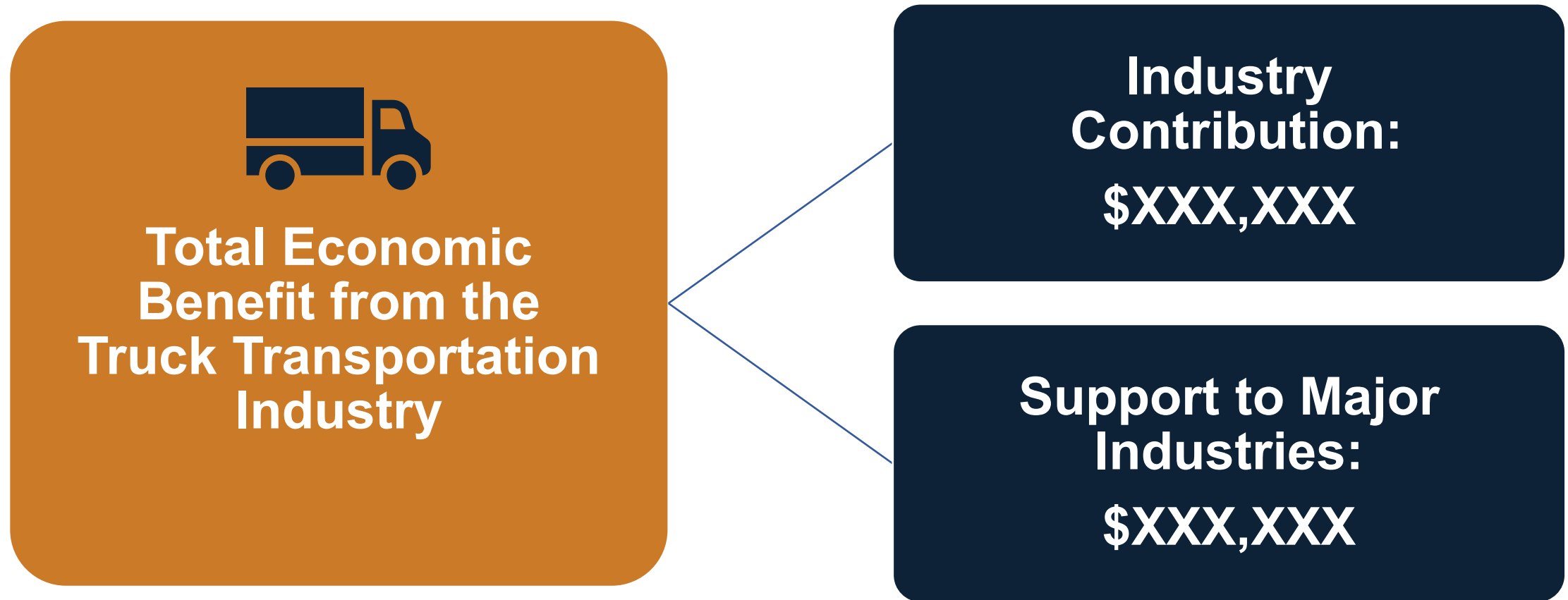
- Value of Goods moved by Truck



Outputs

- Direct, Indirect, and Induced Effects supported by the Truck Transportation Industry
- Supported Tax Impacts

Results



Questions?



Economic Analysis

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HB 2223 Study Stakeholder Workshop

Thank You!

