Predictive Modeling to Evaluate Carrier Safety Performance in Saskatchewan

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PROBLEM STATEMENT

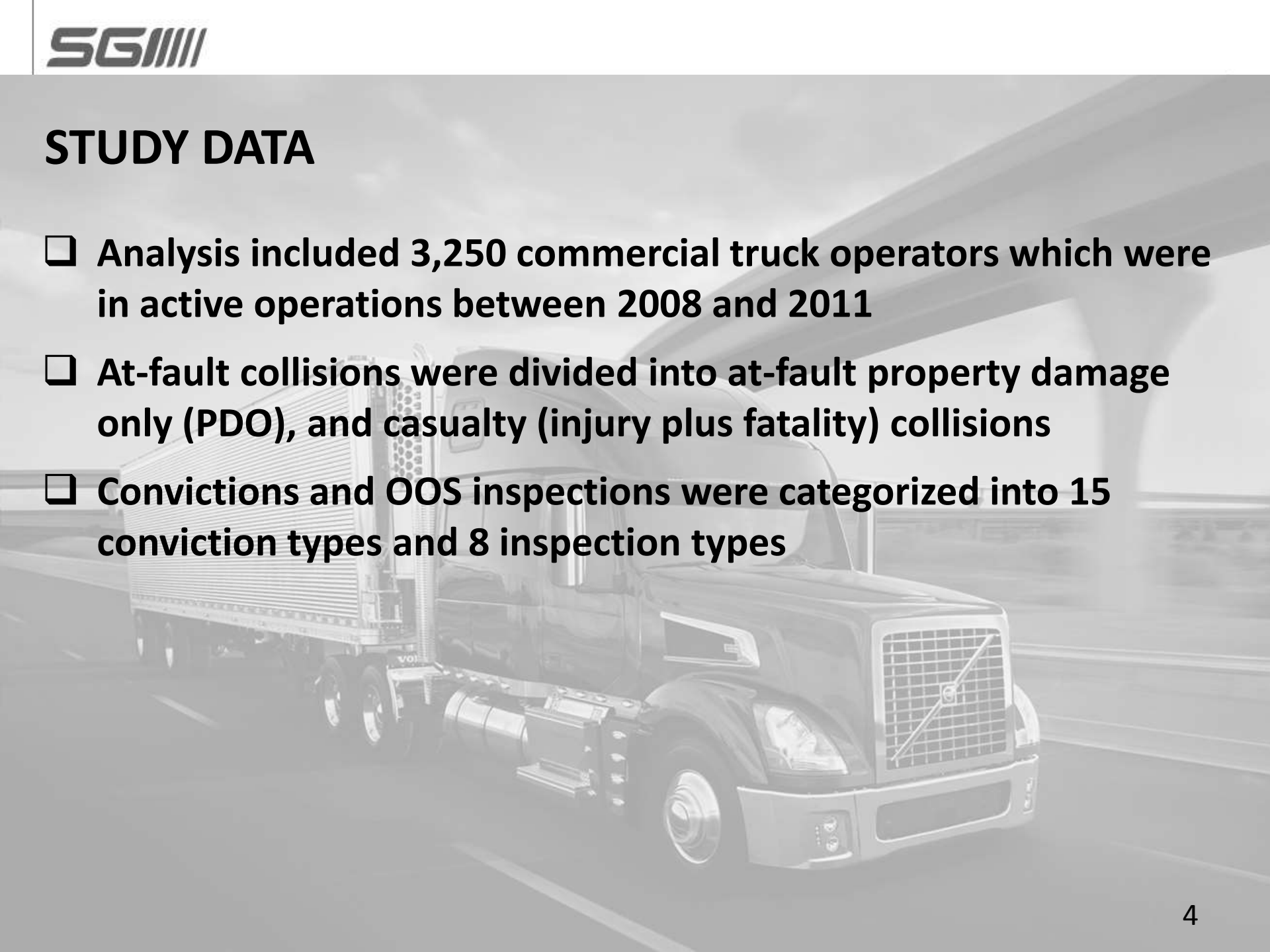
- In Canada, the rate of fatal collisions involving commercial trucks has been on the decline from 2001 to 2005
- Between 2001 and 2005, commercial trucks accounted for about 19 percent of all traffic fatalities
- In Saskatchewan, the rate of fatality involving commercial trucks is more than five times higher than the fatality rate involving passenger vehicles
- Saskatchewan's existing carrier safety rating system is not designed to predict a carrier's future safety performance

OBJECTIVES

- Develop a set of predictive models to identify which past violation types, at the aggregate level (i.e., at-fault collisions, convictions, out-of-service (OOS) inspections), significantly predict a carrier's involvement in future at-fault collisions
- Identify the specific types of collisions, convictions and OOS inspections that warrant attention when reviewing a carrier's safety performance

STUDY DATA

- Analysis included 3,250 commercial truck operators which were in active operations between 2008 and 2011
- At-fault collisions were divided into at-fault property damage only (PDO), and casualty (injury plus fatality) collisions
- Convictions and OOS inspections were categorized into 15 conviction types and 8 inspection types



MODEL SPECIFICATION

Binary logistic regression technique

- **Aggregate level model (one model)**
  - Dependent Variable: Involvement in a future casualty collision – a binary variable (1 or 0)
  - Independent Variable: Numbers of all at-fault collisions, convictions, and OOS inspections
- **Disaggregate level model (three models)**
  - Dependent Variable: Involvement in a future casualty collision – a binary variable (1 or 0)
  - Independent Variable: At-fault PDO and casualty collisions; 17 conviction types; and 8 OOS inspection types

RESULTS

❑ Results for Aggregate Level Model

Parameter estimates

Predictors	Estimate (β)	Pr > ChiSq (p-value)	Odds Ratio
Intercept (α)	-4.6732	<.0001	N/A
Past At-Fault Collisions	1.2871	<.0001	3.622
Past Convictions	0.9638	0.0001	2.622
Past OOS Inspections	1.079	<.0001	2.942

RESULTS

❑ Results for Disaggregate Level Model

Parameter estimates for at-fault collisions

Predictors	Estimate (β)	Pr > ChiSq	(p-value)	Odds Ratio
Intercept (α)	-3.794	<.0001		N/A
Past At-Fault PDO Collisions	0.289	<.0001		1.335
Past At-fault Casualty Collisions	0.920	0.042		2.509

RESULTS

❑ Results for Disaggregate Level Model

Parameter estimates for 15 conviction types

Predictors	Estimate (β)	Pr > ChiSq (p-value)	Odds Ratio
Intercept	-3.979	<.0001	N/A
Brake Defects Conviction	1.221	0.003*	3.390
Dangerous Goods Conviction	0.389	0.444	1.476
Documents Conviction	0.202	0.606	1.224
Driver Qualification Conviction	-2.550	0.061	0.078
HOS Conviction	0.256	0.832	1.292
HOS Logs Conviction	0.452	0.060	1.571
Light Defects Conviction	0.446	0.283	1.562
Load Security Conviction	-0.357	0.425	0.700
Misc Driving Conviction	0.334	0.222	1.396
Misc Vehicle Defects Conviction	0.146	0.736	1.158
Seat Belt Conviction	0.309	0.205	1.363
Traffic Signal Conviction	0.482	0.036*	1.619
Speeding Conviction	0.346	0.004*	1.414
Trip Inspection Conviction	-3.665	0.001*	0.026
Vehicle Weights and Dimensions (VWD) Conviction	0.380	0.004*	1.461

RESULTS

❑ Results for Disaggregate Level Model

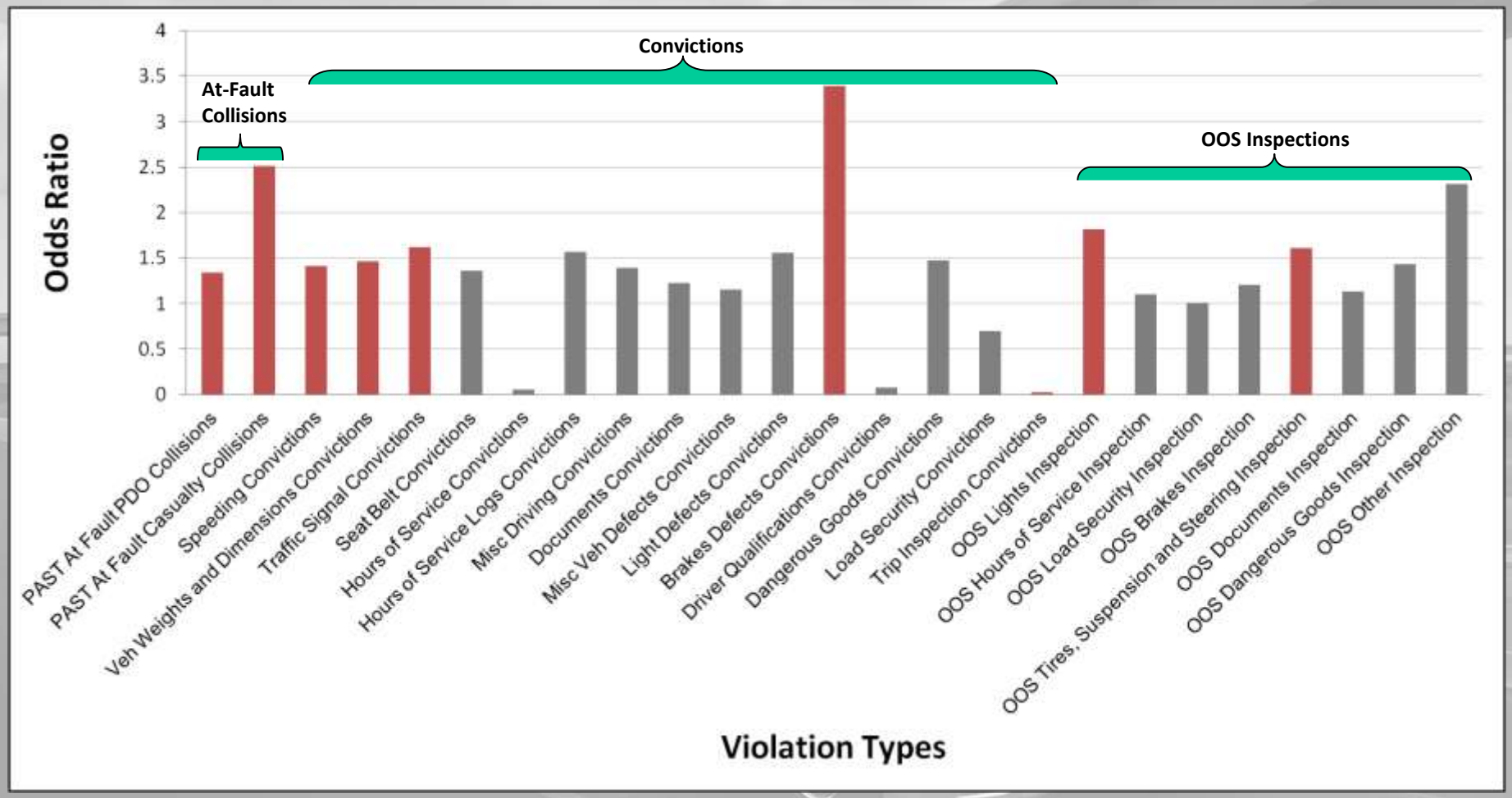
Parameter estimates for eight OOS inspection types

Predictors	Estimate (β)	Pr > ChiSq (p-value)	Odds Ratio
Intercept	-3.760	<.0001	N/A
OOS Brakes Inspection	0.186	0.165	1.204
OOS Dangerous Goods Inspection	0.362	0.354	1.436
OOS Document Inspection	0.127	0.643	1.135
OOS HOS Inspection	0.095	0.358	1.100
OOS Lights Inspection	0.597	0.003*	1.816
OOS Load Security Inspection	0.010	0.928	1.010
OOS Tires, Suspension and Steering (TSS) Inspection	0.475	0.030*	1.608
Other Inspection	0.841	0.052	2.318

Other Inspection – OOS inspection of coupling devices, frame, exhaust system, fuel system, and windshield wipers

RESULTS

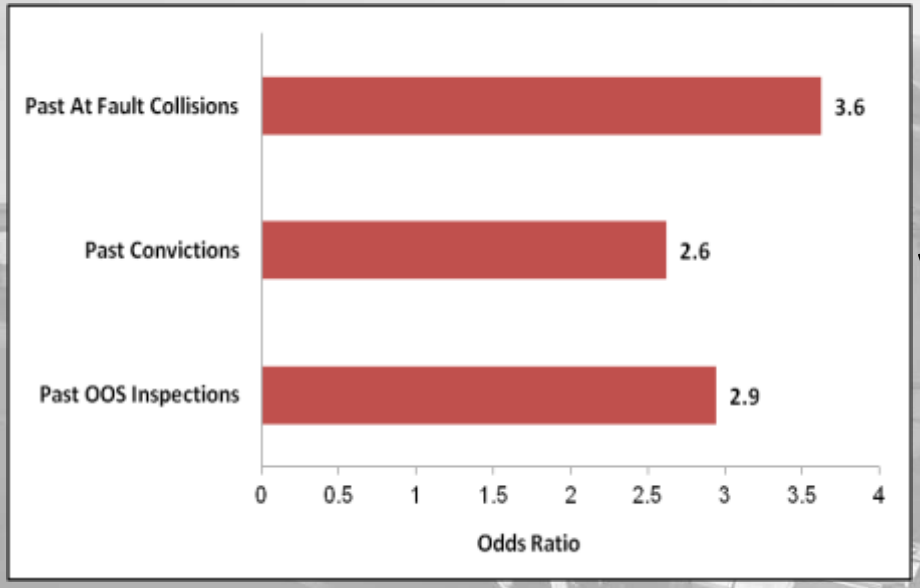
❑ Results for Disaggregate Level Model



CONCLUSIONS

❑ Aggregate Level Effects

Odds Ratios for Future Casualty Collisions – Aggregate Level Effects of Past at-fault Collisions, Convictions and OOS Inspections



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- ✓ **Carriers with a higher proportion of past at-fault collisions should be prioritized over past convictions/OOS inspections**
- ✓ **More weight be assigned to past convictions than at-fault collisions or OOS inspections**

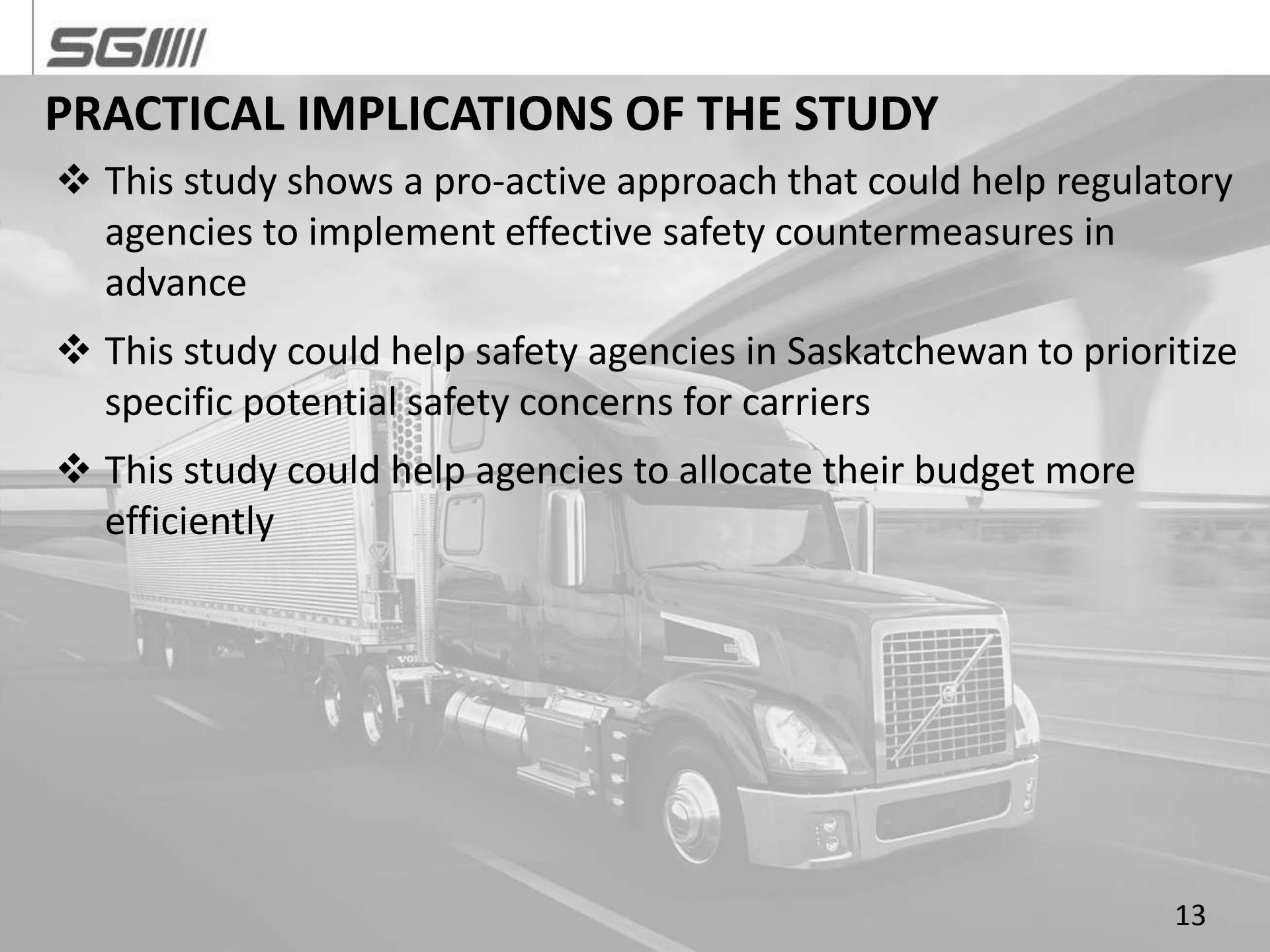
CONCLUSIONS

❑ Disaggregate Level Effects

- ❖ **At-fault collisions:** More weight should be assigned to prior involvement in casualty collisions than PDO collisions
- ❖ **Conviction types:** Brake defects related conviction should be given top priority followed by traffic signaling, vehicle weights and dimensions, speeding, and trip inspections related convictions
- ❖ **OOS inspection types:** OOS vehicle lights have been flagged as the most significant predictor for future collision involvement followed by the state of the tire, suspension and the steering assembly (TSS)

PRACTICAL IMPLICATIONS OF THE STUDY

- This study shows a pro-active approach that could help regulatory agencies to implement effective safety countermeasures in advance
- This study could help safety agencies in Saskatchewan to prioritize specific potential safety concerns for carriers
- This study could help agencies to allocate their budget more efficiently




THANK YOU!


QUESTIONS?