Work-Stress Factors Associated with Truck Crashes

Alternative Compliance Subcommittee of the Truck and Bus Safety Committee
Transportation Research Board
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Research Supports Pay-Safety Link

- **Quinlan, Michael.** 2001. "Report of Inquiry into Safety in the Long Haul Trucking Industry," Sydney, NSW, Australia: Motor Accidents Authority of New South Wales, 353.
- **Rodriguez, Daniel A.; Marta Rocha; Asad J. Khattak and Michael H. Belzer.** 2003. "Effects of Truck Driver Wages and Working Conditions on Highway Safety: Case Study." *Transportation Research Record*, Freight Policy, Economics, and Logistics; Truck Transportation(1833), 95-102.
- **Rodriguez, Daniel A.; Felipe Targa and Michael H. Belzer.** 2006. "Pay Incentives and Truck Driver Safety: A Case Study." *Industrial and Labor Relations Review*, 59(2), 205-25.

Work Stress and Crashes

- Pay structures in trucking mainly piecework.
- Pay level has declined 50% during the last 40 years

  Belzer, Michael H. 2000. *Sweatshops on Wheels: Winners and Losers in Trucking Deregulation*. Oxford, UK and New York, NY: Oxford University Press.
- Lower pay leads drivers to work excessive hours, creating risk of fatigue.
  - **Panel on Research Methodologies and Statistical Approaches to Understanding Driver Fatigue Factors in Motor Carrier Safety and Driver Health; Committee on National Statistics; Board on Human-Systems Integration; Division of Behavioral and Social Sciences and Education; Transportation Research Board and Engineering National Academies of Sciences, and Medicine,.** 2016. *Commercial Motor Vehicle Driver Fatigue, Long-Term Health, and Highway Safety: Research Needs*. Washington: National Academies of Science.
  - **Belzer, Michael H. and Stanley A. Sedo.** 2017. "Why Do Long Distance Truck Drivers Work Extremely Long Hours?" *The Economic and Labour Relations Review*, (OnlineFirst).https://goo.gl/M5Xx47

Data

- Large Truck Crash Causation Study
  - FMCSA, NHTSA, NASS supervised collection
  - 49 data sets; 34 concatenated for this analysis
  - 1,000 variables; 967 crashes, including 1,127 large trucks, 251 fatalities, and 1,408 injuries
  - “Induced exposure” method analyzing “critical reason for the critical event”
- No valid compensation data recorded
- I created my own “work pressure” index

Model

$$\text{AssignedCriticalReason} = \alpha + \beta_1 + \beta_2 + \beta_3 + \beta_4 + \beta_5 + \beta_6 + \beta_7 + \beta_8 + \varepsilon$$

where β_1 = WorkPressureTotal, β_2 = AggressionCount, β_3 = Fatigue, β_4 = ClassYears, β_5 = ClassYearsSq, β_6 = SafetyBonus, β_7 = HoursDriving, β_8 = MileagePayThisTrip(Driver), and ε = error

Results: Work Pressure Index

GLM Analysis for WorkPressureTotal Index

Type of analysis: OLS ANOVA

Cases selected according to GVE CDL Truck

2284 total cases of which 1276 cases are missing (including non-trucks)

R^2: 99.6%*[1]

Source	df	Sums of Squares	Mean Square	F-ratio	P-value
Intercept	1	38.1111	38.1111	20207	≤ 0.0001
NewPosition	1	14.8675	14.8675	7882.8	≤ 0.0001
ShippingDeadline	1	1.49750	1.49750	793.98	≤ 0.0001
EXPWorkSchedule	1	14.4370	14.4370	7654.6	≤ 0.0001
Quotas	1	0.675007	0.675007	357.89	≤ 0.0001
ExtraLoads	1	4.31924	4.31924	2290.1	≤ 0.0001
Demoted	1	0.925434	0.925434	490.67	≤ 0.0001
SelfInducedIllegal	1	9.42254	9.42254	4995.9	≤ 0.0001
SelfInducedOther	1	22.6224	22.6224	11994	≤ 0.0001
OtherPressure	1	15.6562	15.6562	8301.0	≤ 0.0001
LoadPressureIndicator	1	23.8791	23.8791	12661	≤ 0.0001
ShortNoticeTrips	1	8.96493	8.96493	4753.2	≤ 0.0001
FillInTrips_m	1	3.93397	3.93397	2085.8	≤ 0.0001
UnpaidLoading_m	1	8.49207	8.49207	4502.5	≤ 0.0001
HurryingW	1	10.6460	10.6460	5644.6	≤ 0.0001
OtherRelations	1	17.3428	17.3428	9195.2	≤ 0.0001
Error	992	1.87097	0.001886		
Total	1007	381.889			

Results: Work Pressure Index

General Linear Model for Assigned Critical Reason

Type of analysis: Logistic; ANOVA

Cases selected according to GVE CDL Truck

2284 total cases of which 1574 cases are missing (including non-trucks)

R^2: 14.75%

Iteration	LogLikelihood	Convergence
1	-433.26054	————————
2	-430.86683	0.11826015
3	-430.81859	0.01815587
4	-430.81855	0.00055343
5	-430.81855	0.00000058

Source	df	Sums of Squares	Mean Square	F-ratio	P-value
Intercept	1	18.1651	18.1651	18.198	≤ 0.0001
AggressionCount*	1	15.1209	15.1209	15.148	0.0001
Fatigue**	1	30.4849	30.4849	30.539	≤ 0.0001
ClassYears*	1	9.04029	9.04029	9.0565	0.0027
IDRSafetyBonus**	1	8.74275	8.74275	8.7584	0.0032
HoursDriving*	1	12.0612	12.0612	12.083	0.0005
WorkPressureTotalD*	1	8.99809	8.99809	9.0142	0.0028
MileagePayThisTrip(Driver)**	1	5.37788	5.37788	5.3875	0.0206
Error	702	700.746	0.998213		
Total	709	786.266			

* Continuous ** Discrete

Results

Coefficients for the independent variables replace the betas in the equation.

AssignedCriticalReason for the critical event = 0.8318 + (0.5822)WorkPressureTotal

+ (1.484)AggressionCount + (0.9145)Fatigue + (-0.0231)ClassYears +

(-0.3187)IDRSafetyBonus + (-0.0974) HoursDriving +

(-0.2245) MileagePayThisTrip(Driver) + ε

Conclusion

- A conservative conclusion based on the LTCCS
- At least 15% of truck crash probability can be predicted from economic factors associated with the work process alone, independent of compensation.
- Work pressure's predictive value is higher than any other factors measured in the LTCCS.