

APPENDIX A:

POLICE ACCIDENT REPORTS
ANNOTATION TABLE

This table is an expanded form of Table 4 in the main text. It identifies not only the number of PARs categorized in each cell, but also includes a code number indicating a particular report. The subsequent table lists every PAR in order where the key words that led to the categorization have been excerpted. The two letters in each code indicate the state that provided the report.

Table A-1. Reference Table of Contributing Factors Associated with the Unsafe Driver Acts Identified Across Crash Reports

Unsafe Driver Acts	Contributing Factors						
	Personal	Physio-logical	Attitudinal	Driver State	Organiza-tional	Info Gathering	None Specified
Too fast for conditions -Unsafe speed -uncontrolled speed -turning too fast				TX14, TX17, TX16, TX76 (4)		TX4, TX19, TX22, TX26, TX33, TX72, TX53 (7)	NY4, NY35 NY44 PA8, PA9, PA13, PA15 PA21 PA23 PA24 PA11 PA23 PA27 PA28 PA31 PA32 PA36 PA39 PA40 PA42 PA44 PA48 YX45 PA14 TX14 TX17 TX19 TX22 TX25 TX27 TX30 TX39 TX48 TX1 TX4 TX5 TX6 PA37 PA41 TX7 TX11 TX16 TX18 TX20 TX21 TX24 TX26 TX29 TX33 TX34 TX37 TX42 TX5 TX52 TX56 OK3 OK5 OK6 OK14 OK23 OK28 NY12 NY13 NY23 NY16 NY17 NY4 NY39 NY40 VA8 NY41 NY28 NY42 LA45 CO2 CO11 OK41 TX78 TX77 TX75 TX72 TX69 TX48 TX51 TX52 TX55 TX56 TX60 TX61 TX64 OK28 OK36 OK43 OK44 OK49 VA50 VA43 VA41 VA36 VA14 FL4 FL3 FL2 FL6 FL11 FL12 FL14 CO17, CO20, CO21, CO25, CO27
Too slow for traffic stream							
Following too closely -sudden slow/stop							PA8, PA39 VA35, VA38 CO26
False assumption of other road user's actions							VA7, TX63

Table A-1. Reference Table of Contributing Factors Associated with the Unsafe Driver Acts Identified Across Crash Reports (Cont.)

Unsafe Driver Acts	Contributing Factors						
	Personal	Physio-logical	Attitudinal	Driver State	Organiza-tional	Info Gathering	None Specified
Illegal maneuver/Improper turning -other improper driving action -turned when unsafe -wrong side -fail to yield	CO4 (1)	PA12 (1)				TX28 NY13, LA2 LA4 LA5 LA6 LA9 LA11 LA14 LA17 LA20 LA22 LA23 LA24 LA34 LA49 CO16 (17)	NY4, PA14 PA47 TX23 TX28 TX32 TX36 TX40 TX45 TX53 PA9 PA10 PA12 PA29 PA30 PA33 PA34 OK11 OK3 OK5 OK6 OK14 OK23 OK28 NY12 NY19 NY4 NY39 NY42 NY52 VA7 LA8 LA35 LA39 LA54 LA59 CO5 OK39 OK41 TX62 TX63 VA37 FL12 CO14, CO28
Failure to turn on head lamps -turning signal							OK1 OK31
Inadequate evasive action		TX46 TX59 (2)		TX58 TX68 (2)		TX22,TX31 TX4, TX19, OK19, NY36 NY45 VA10 (8)	NY2 NY4 TX4, TX19, TX22, TX31, TX46 TX54 TX58 VA13 VA14 VA31 TX51 TX54 TX58 VA49 FL10
Panic/freezing							
Overcompensation				TX66 (1)		PA18, TX53 OK19 NY38 NY45 VA10 (6)	PA4, PA9, PA13, PA18, PA36 PA37 PA44 TX38 TX45 CO8 TX61 TX64 VA53 VA48 FL8 FL13 CO23, CO24 NY15 NY24 NY29 NY51

Table A-1. Reference Table of (Cont.)

Unsafe Driver Acts	Contributing Factors						
	Personal	Physio-logical	Attitudinal	Driver State	Organiza-tional	Info Gathering	None Specified
Poor directional control (careless driving) -drifting -passing -veering -parking	PA7 (1)	NY8 NY27 NY31 VA23 LA55 (5)		PA2, PA5, PA19 PA46 TX49 TX12 TX58 TX47 CO12 TX67 TX49 OK46 OK48 (13)		PA3, PA16,TX31, TX49 OK2 OK16 OK9 TX8 TX12 TX33 OK19 OK20 OK26 NY11 NY32 NY36 NY45 VA10 LA25 LA10 LA26 LA28 LA30 LA3 LA37 LA41 LA42 LA43 LA46 LA50 LA51 CO6 OK40 TX49 OK26 CO16 (36)	NY2, PA6 VA1 VA5 TX38 PA25 PA10 PA35 OK17 NY7 NY6 NY9 NY10 NY14 NY18 NY21 NY16 NY22 NY26 NY37 NY47 NY50 NY49 NY30 NY1 NY3 VA11 VA12 VA17 VA21 VA25 VA26 VA28 VA30 VA31 VA34 LA1 LA12 LA18 LA19 LA31 LA19 LA31 LA36 LA38 LA44 LA53 LA57 LA58 CO7 CO8 CO9 TX69 TX70 TX52 TX57 VA52 VA51 VA50 VA47 VA56 VA45 VA44 VA43 VA41 VA36 FL1 FL3 FL6 FL8 FL11 FL13 FL14 CO13, CO17, CO18, CO19, CO20, CO21, CO22, CO23, CO28
Failed to take heed to signage -road signs -yield signs -traffic lights						TX26, TX43 LA48 (3)	TX24, TX26, OK17, TX35, TX43, NY42, OK39
Unknown							PA26, PA47, NY46
Total	2	8	0	20	0	77	

*The crash ID from each data record is indicated in each cell.

Table A-2. Annotation Table of Contributing Factors Associated with the Unsafe Driver Acts Identified Across Crash Reports

[CB] = Check Box [Cit] = Citation issued

Case	Unsafe Act	Contributing Factor	Comment
CO2	Too fast for conditions	None specified	[CB] – Exceeded safe speed
CO4	Illegal maneuver	Personal	“...attempted to make a right hand turn...” [CB] – Careless driving [CB] – Driver inexperience
CO5	Illegal maneuver	None specified	[CB] – Improper turn [Cit] – Careless driving
CO6	Poor directional control	Info gathering	[CB] – Careless driving [CB] – Distracted/Cell phone [Cit] – Failed to drive in designated lane
CO7	Poor directional control	None specified	[CB] – Exceeded safe speed [CB] – Drove improperly on mountain highway
CO8	Poor directional control Overcompensation	None specified	“...driver attempted to correct to the left but was unable to break free of the sloped shoulder.” [CB] – Lane violation [Cit] – Careless driving
CO9	Poor directional control	None specified	“The driver drifted off of the right side of the road and lost control.” [Cit] – Careless driving
CO11	Too fast for conditions	None specified	“...lost control on the snow packed/icy roadway.” [CB] – Exceeded safe speed [CB] – Other factor [CB] – Drove improperly on mountain highway
CO12	Poor directional control	Driver state	“...ran off the side of the road.” [CB] – DUI [Cit] – Drove vehicle while under influence of alcohol or drugs or both
CO13	Poor directional control	None Specified	[Cit] – Careless Driving (...slid into the northbound lane...)
CO14	Illegal maneuver	None Specified	[CB] – Improper turn [CB] – Aggressive driving
CO16	Poor directional control Illegal Maneuver	Info-gathering	[Cit] – Failed to drive in designated lane [CB] – Improper Turn [CB] – Distracted
CO17	Poor directional control Too fast for conditions	None Specified	[Cit] – Careless Driving [CB] – Exceeded safe speed

Table A-2. Annotation Table of Contributing Factors Associated with the Unsafe Driver Acts Identified Across Crash Reports (Cont.)

Case	Unsafe Act	Contributing Factor	Comment
CO18	Poor directional control	None Specified	[Cit] – Careless Driving [CB] – Careless driving
CO19	Poor directional control	None Specified	[CB] – Lane violation (...went off left side...)
CO20	Poor directional control Too fast for conditions	None Specified	Cit – Careless driving [CB] – Exceeded safe speed
CO21	Poor directional control Too fast for conditions	None Specified	Cit – Careless driving [CB] – Exceeded safe speed
CO22	Poor directional control	None Specified	[CB] – Careless Driving
CO23	Poor directional control Overcompensation	None Specified	[CB] – Lane Violation
CO24	Poor directional control Overcompensation	None Specified	[CB] – Careless Driving [Cit] – Careless Driving
CO25	Too fast for conditions	None Specified	[Cit] – Careless Driving [CB] – Exceeded safe speed
CO26	Following too closely	None Specified	[Cit] – Careless Driving [CB] – Followed too close
CO27	Too fast for conditions	None Specified	[Cit] – Careless Driving [CB] – Exceeded safe speed
CO28	Poor directional control Illegal Maneuver	Info-gathering	[Cit] – Careless Driving [CB] – Improper passing on the left
FL1	Poor directional control	None Specified	[CB] – Careless driving [Cit] – Fail to drive single lane
FL2	Too fast for condition	None Specified	(...failed to use due care and reduce his speed...roadway conditions...)
FL3	Poor directional control Too fast for condition	None Specified	[CB] – Careless driving (...make a left turn...lost control...)
FL4	Too fast for condition	None Specified	(...turned his tanker...too fast...)
FL6	Poor directional control Too fast for condition	None Specified	[CB] – Careless driving (...speed that was too fast for the load...)
FL8	Poor directional control Overcompensation	None Specified	[CB] – Careless driving (...drifted...attempted to steer back...)
FL10	Inadequate evasive action	None Specified	(...took evasive action in attempt to avoid collision...)
FL11	Poor directional control Too fast for conditions	None Specified	[CB] – Careless driving (...significant heart disease...)

Table A-2. Annotation Table of Contributing Factors Associated with the Unsafe Driver Acts Identified Across Crash Reports (Cont.)

Case	Unsafe Act	Contributing Factor	Comment
FL12	Illegal maneuver Too fast for conditions	None Specified	[CB] – Improper turn (...he was moving too fast...)
FL13	Poor directional control Overcompensation	None Specified	[CB] – Careless driving (...careless driving...failed to maintain control of vehicle...)
FL14	Poor directional control Too fast for condition	None Specified	[CB] – Careless driving (...failed to use due care...)
LA1	Poor directional control	None specified	[CB] – Improper parking
LA2	Illegal maneuver	Info gathering	[CB] – Other improper turning [CB] – Inattentive
LA4	Illegal maneuver	Info gathering	[CB] – Made wide turn [CB] – Inattentive [CB] – Distraction inside the vehicle
LA5	Illegal maneuver	Info gathering	[CB] – Other improper turning [CB] – Inattentive
LA6	Illegal maneuver	Info gathering	[CB] – Careless operation [CB] – Distracted: outside vehicle
LA8	Illegal maneuver	None specified	[CB] – Careless operation [CB] – Making left turn
LA9	Illegal maneuver	Info gathering	[CB] – Inattentive [CB] – Making right turn
LA10	Poor directional control	Info gathering	[CB] – Inattentive [CB] – Crossed center line into opposing lane
LA11	Illegal maneuver	Info gathering	[CB] – Careless operation [CB] – Making left turn [CB] – Inattentive [Cit] – JPS 40352
LA12	Poor directional control	None specified	[CB] – Careless operation
LA14	Illegal maneuver	Info gathering	[CB] – Careless operation [CB] – Making left turn [CB] – Inattentive
LA17	Illegal maneuver	Info gathering	[CB] – Careless operation [CB] – Making right turn [CB] – Inattentive
LA18	Poor directional control	None specified	[CB] – Careless operation
LA19	Poor directional control	None specified	[CB] – Careless operation

Table A-2. Annotation Table of Contributing Factors Associated with the Unsafe Driver Acts Identified Across Crash Reports (Cont.)

Case	Unsafe Act	Contributing Factor	Comment
LA20	Illegal maneuver	Info gathering	[CB] – Careless operation [CB] – Making left turn [CB] – Inattentive
LA22	Illegal maneuver	Info gathering	[CB] – Careless operation [CB] – Making left turn [CB] – Inattentive
LA23	Illegal maneuver	Info gathering	[CB] – Careless operation [CB] – Making right turn [CB] – Inattentive
LA24	Illegal maneuver	Info gathering	[CB] – Other violation [CB] – Inattentive
LA25	Poor directional control	Info gathering	[CB] – Careless operation [CB] – Inattentive
LA26	Poor directional control	Info gathering	[CB] – Careless operation [CB] – Inattentive
LA27	Poor directional control	Info gathering	[CB] – Careless operation [CB] – Inattentive
LA30	Poor directional control	Info gathering	[CB] – Careless operation [CB] – Inattentive
LA31	Poor directional control	None specified	[CB] – Careless operation
LA33	Poor directional control	Info gathering	[CB] – Careless operation [CB] – Inattentive [CB] – Distraction: other inside vehicle
LA34	Illegal maneuver	Info gathering	[CB] – Careless operation [CB] – Making right turn [CB] – Inattentive [CB] – Distraction: other outside vehicle
LA35	Illegal maneuver	None specified	[CB] – Other violation [CB] – Making left turn
LA36	Poor directional control	None specified	[CB] – Careless operation [CB] – Crossed center line into opposing lane [CB] – Roadway condition: previous crash

Table A-2. Annotation Table of Contributing Factors Associated with the Unsafe Driver Acts Identified Across Crash Reports (Cont.)

Case	Unsafe Act	Contributing Factor	Comment
LA37	Poor directional control	Info gathering	[CB] – Careless operation [CB] – Inattentive [CB] – Crossed center line into opposing lane [CB] – Distraction: other inside vehicle
LA38	Poor directional control	None specified	[CB] – Careless operation [CB] – Crossed center line into opposing lane
LA39	Illegal maneuver	None specified	[CB] – Careless operation [CB] – Making right turn
LA41	Poor directional control	Info gathering	[CB] – Careless operation [CB] – Inattentive [Cit] – B9856297
LA42	Poor directional control	Info gathering	[CB] – Careless operation [CB] – Distracted [Cit] – 037381
LA43	Poor directional control	Info gathering	[CB] – Distracted [CB] – Distraction: other outside vehicle
LA44	Poor directional control	None specified	[CB] – Careless operation [CB] – Crossed center line into opposing lane
LA45	Too fast for conditions	None specified	[CB] – Exceeding safe speed limit [CB] – Animal in roadway
LA46	Poor directional control	Info gathering	[CB] – Careless operation [CB] – Distracted [CB] – Distraction: Other electronic device [Cit] – I9681589A
LA48	Failed to take heed to signage	Info gathering	[CB] – Disregarded traffic signal [CB] – Inattentive [Cit] – 9624250
LA49	Illegal maneuver	Info gathering	[CB] – Careless operation [CB] – Making right turn [CB] – Inattentive [Cit] – E9727131
LA50	Poor directional control	Info gathering	[CB] – Careless operation [CB] – Inattentive [CB] – Crossed center line into opposing lane [Cit] – G9821598A

Table A-2. Annotation Table of Contributing Factors Associated with the Unsafe Driver Acts Identified Across Crash Reports (Cont.)

Case	Unsafe Act	Contributing Factor	Comment
LA51	Poor directional control	Info gathering	[CB] – Careless operation [CB] – Inattentive [Cit] – 9867291
LA53	Poor directional control	None specified	[CB] – Careless operation [CB] – Proceeding straight ahead [Cit] – 7875494
LA54	Illegal maneuver	None specified	[CB] – Careless operation [CB] – Making left turn [Cit] – 9922742
LA56	Poor directional control	Physiological	[CB] – Driver condition: Illness
LA57	Poor directional control	None specified	[CB] – Crossed center line into opposing lane [Cit] – 9926179
LA58	Poor directional control	None specified	[CB] – Careless operation
LA59	Illegal maneuver	None specified	[CB] – Careless operation [CB] – Making left turn [Cit] – G1090328A
NY1	Poor directional control	None specified	“...lost control and started ‘fish-tailing’ as he descended the hill.”
NY2	Inadequate evasive action Poor directional control	None specified	“...tried to avoid an uninvolved vehicle which lost control in front of him.” [Cit] – 1180E
NY3	Poor directional control	None specified	“...stated he swerved to avoid unknown car that swerved in front of him.”
NY4	Too fast for conditions Illegal maneuver Inadequate evasive action	None specified	“...operator states that the air brakes failed and he was unable to downshift...truck picked up speed...unable to make the sharp corner...” [Cit] – 1229C3A
NY6	Poor directional control	None specified	“...moves over to make room for the plow...rolling vehicle 1 onto its side.”
NY7	Poor directional control	None specified	“...pulled to the right side of the roadway to allow another vehicle to pass, struck a culvert...”
NY8	Poor directional control	Physiological	“Driver of vehicle taken to Corning ER for complaint of neck pain.” [Cit] – 1180A
NY9	Poor directional control	None specified	“...loses control of MV. V1 starts to slide...”
NY10	Poor directional control	None specified	“...began to apply his brakes and lost control of his vehicle.”
NY11	Poor directional control Illegal maneuver	Info gathering	“...another driver called him on his truck to truck radio.” [Cit] – 1120A
NY12	Too fast for conditions Illegal maneuver	None specified	“...operator failed to negotiate curve in roadway due to speed...” [Cit] – 1180E
NY13	Too fast for conditions	None specified	“...travelling at an unreasonable speed and could not safely travel...”

Table A-2. Annotation Table of Contributing Factors Associated with the Unsafe Driver Acts Identified Across Crash Reports (Cont.)

Case	Unsafe Act	Contributing Factor	Comment
NY14	Poor directional control	None specified	"Driver traveled off of roadway, could not regain control..."
NY15	Overcompensation	None specified	"Driver reacted to an unknown type of animal..."
NY16	Too fast for conditions Poor directional control	None specified	"...travelling at unsafe speed...fails to negotiate a right curve in the roadway." [Cit] – 1180A [Cit] – 1120A
NY17	Too fast for conditions	None specified	"...climb incline in road on snow/ice covered roads. V-1 starts to spin and loses control..."
NY18	Poor directional control	None specified	"...missed gear while down shifting..."
NY19	Illegal maneuver	None specified	"...attempted to turn south...went up onto the curb."
NY21	Poor directional control	None specified	"...went off the right side of road..." [Cit] – 1180A
NY22	Poor directional control	None specified	"...right front tire went off pavement on right side of roadway..."
NY23	Too fast for conditions	None specified	"...due to speed unreasonable and prudent given roadway conditions..." [Cit] – 1180E
NY24	Overcompensation	None specified	"...swerved to avoid deer..."
NY26	Poor directional control	None specified	"...truck drifted to the right..." [Cit] – 1128a
NY27	Poor directional control	Physiological	"...crosses the double yellow dividing line and enters the northbound lane...wife of OPV1 reveals that OPV1 has an extensive medical history and has recently suffered from fainting episodes."
NY28	Too fast for conditions	None specified	"...upon entering the intersection vehicle #1 overturned...operator stated that he lost his brakes."
NY29	Overcompensation	None specified	"...swerved to miss a deer in the roadway..."
NY30	Poor directional control	None specified	"...lost control of vehicle and it started to slide..."
NY31	Poor directional control	Physiological	"...attempted to slow down for the stop sign...lost control...operator of V-1 stated back and head pain..."
NY32	Poor directional control	Info gathering	"...loses control of V-1 while reaching for a fallen object in the cab..." [Cit] – 1128D
NY35	Too fast for conditions	None specified	"V-1 lost control on snow/ice and spun out." [Cit] – 1180A
NY36	Poor directional control Overcompensation	Info gathering	"...his cell phone rang and he answered the phone." [Cit] – 1225C2A [Cit] – 1120A
NY37	Poor directional control	None specified	"...failed to negotiate the curve and drove off the west shoulder..."

Table A-2. Annotation Table of Contributing Factors Associated with the Unsafe Driver Acts Identified Across Crash Reports (Cont.)

Case	Unsafe Act	Contributing Factor	Comment
NY39	Too fast for conditions Illegal maneuver	None specified	"...failed to reduce speed for a corner..." [Cit] – 4011A [Cit] – 1180A
NY40	Too fast for conditions	None specified	"...driving down Ossian hill road when he lost his brakes..." [Cit] – 1402DII
NY41	Too fast for conditions	None specified	"...traveling too fast for conditions..." [Cit] – 1180E [Cit] – 14F
NY42	Illegal maneuver Too fast for conditions Failed to take heed to signage	None specified	"...attempted to make a left hand turn...lost control..." [Cit] – Speed reason prudent [Cit] – Disobey stop sign
NY44	Too fast for conditions	None specified	"...loses control due to the slippery road..."
NY45	Poor directional control Overcompensation	Info gathering	"Lost control due to inattention." [Cit] – 1128A
NY46	Unknown	None specified	"Accident investigation pending."
NY47	Poor directional control	None specified	"...rounded a corner and met a tractor traveling in the opposite direction...swerved to avoid other vehicle and lost control."
NY49	Poor directional control	None specified	"Veh#1 veered right and ran partly off the road."
NY50	Poor directional control	None specified	"...backing into a private drive...slid in the north ditch and overturned."
NY51	Overcompensation	None specified	"...swerved to avoid a deer..."
NY52	Illegal maneuver	None specified	"...while making the turn, driver 1 lost control of the vehicle...driver 1 stated he had no idea why the vehicle overturned."
OK1	Failure to turn on head lamps	None specified	[CB] – Failed to signal
OK2	Poor directional control	Info gathering	"Driver unit 1 said retrieving drink from floor and lost control." [CB] – Inattention: Other distraction inside vehicle
OK3	Too fast for conditions Illegal maneuver	None specified	[CB] – Unsafe speed: On curve/turn
OK5	Too fast for conditions Illegal maneuver	None specified	[CB] – Unsafe speed: On curve/turn
OK6	Too fast for conditions Illegal maneuver	None specified	[CB] – Unsafe speed: On curve/turn
OK9	Poor directional control	Info gathering	[CB] – Inattention: Distraction from outside vehicle
OK11	Illegal maneuver	None specified	[CB] – Other/Unknown improper act/movement

Table A-2. Annotation Table of Contributing Factors Associated with the Unsafe Driver Acts Identified Across Crash Reports (Cont.)

Case	Unsafe Act	Contributing Factor	Comment
OK14	Too fast for conditions Illegal maneuver	None specified	[CB] – Unsafe speed: On curve/turn
OK16	Poor directional control	Info gathering	“...he heard a ‘pop’ and was looking out the rearview window when he ran off of the road.” [CB] – Inattention: Distraction from outside vehicle
OK17	Failed to take heed to signage Poor directional control	None specified	“Both units disregarded a warning sign with flashing lights not to drive into the fog.” [CB] – Left of center: In meeting
OK19	Poor directional control Overcompensation Inadequate evasive action	Info gathering	“...became distracted by vehicle behind him.” [CB] – Inattention: Distraction from outside vehicle
OK20	Poor directional control	Info gathering	[CB] – Inattention: Other distraction inside vehicle
OK23	Too fast for conditions Illegal maneuver	None specified	[CB] – Unsafe speed: On curve/turn
OK26	Poor directional control	Info gathering	“Driver stated he obviously wasn’t paying too much attention.” [CB] – Inattention: Other distraction inside vehicle
OK28	Too fast for conditions Illegal maneuver	None specified	[CB] – Unsafe speed: On curve/turn
OK31	Failure to turn on headlamps	None Specified	[CB] – Unsafe vehicle Stop lights
OK36	Too fast for conditions	None Specified	[CB] – Unsafe speed rain or wet roadway
OK39	Illegal maneuver Failed to take heed to signage	None specified	[CB] – Failed to yield from stop sign
OK40	Poor directional control	Info gathering	[CB] – Other inattention
OK41	Too fast for conditions Illegal maneuver	None specified	[CB] – Unsafe speed: On curve/turn
OK43	Too fast for conditions	None Specified	[CB] – Unsafe speed in rain or wet roadway (...due to the wet and muddy roadway...)
OK44	Too fast for conditions	None Specified	[CB] – Unsafe speed
OK46	Poor directional control	Drivers State (Asleep)	[CB] – Apparently sleep (Driver of #1 apparently fell asleep...)

Table A-2. Annotation Table of Contributing Factors Associated with the Unsafe Driver Acts Identified Across Crash Reports (Cont.)

Case	Unsafe Act	Contributing Factor	Comment
OK48	Poor directional control	Drivers State (Asleep)	[CB] – Apparently sleep (...driver fell asleep...)
OK49	Too fast for conditions	None Specified	[CB] – Unsafe speed on curve/turn
OK50	Poor directional control	Drivers State (Asleep)	[CB] – Apparently sleep (...driver apparently fell asleep...)
PA2	Poor directional control	Driver state	“While entering into a right hand curve in the roadway, operator 1 fell asleep, causing unit 1 to travel into the grass median.” [CB] – Other improper driving actions [Cit] – Careless driving
PA3	Poor directional control	Info gathering	“He then reached over to the lower middle console to get his cup of soda and took his eyes off the road for a couple seconds....then struck the guardrails.” [CB] – Other improper driving actions [Cit] – Careless driving
PA4	Overcompensation	None specified	[CB] – Over/Under compensation at curve [Cit] – Careless driving/Overtaken vehicles
PA5	Poor directional control	Driver state	“The driver of the tanker truck did state that he had fallen asleep while operating his vehicle.” [CB] – Affected by physical condition
PA6	Poor directional control	None specified	[CB] – Other improper driving action [Cit] – Careless driving
PA7	Poor directional control	Personal	“...Oper#1 swerved to avoid a deer that entered the roadway and lost control of the truck. Oper#1 has a commercial driver's permit and was being trained by his passenger.” [CB] – Deer in roadway [CB] – Driver inexperienced
PA8	Following too closely Too fast for conditions	None specified	[CB] – Sudden slowing/stopping [CB] – Tailgating [CB] – Driving too fast for conditions [CB] – Other weather conditions [CB] – Other roadway factor
PA9	Overcompensation at curve Too fast for conditions Illegal maneuver	None specified	[CB] – Over/Undercompensation at curve [CB] – Driving too fast for conditions [CB] – Improper/careless turning [CB] – Other improper driving action [Cit] – Careless driving

Table A-2. Annotation Table of Contributing Factors Associated with the Unsafe Driver Acts Identified Across Crash Reports (Cont.)

Case	Unsafe Act	Contributing Factor	Comment
PA10	Illegal maneuver Poor directional control	None specified	[CB] – Other improper driving action [CB] – Careless parking/unparking [CB] – Slippery road conditions (Ice/Snow) [Cit] – Careless driving
PA11	Too fast for conditions	None specified	[CB] – Driving too fast for conditions [CB] – Slippery road conditions (ice/snow)
PA12	Illegal maneuver	Physiological	[CB] – Affected by physical condition [CB] – Other improper driving action [Cit] – Careless driving
PA13	Too fast for conditions Overcompensation at curve	None specified	[CB] – Driving too fast for conditions [CB] – Failure to maintain proper speed [CB] – Over/undercompensation at curve [Cit] – Careless driving
PA14	Illegal maneuver Too fast for conditions	None specified	[CB] – Improper entrance into highway [CB] – Failure to maintain proper speed [Cit] – Careless driving
PA15	Too fast for conditions	None specified	[CB] – Driving too fast for conditions [Cit] – 3361
PA16	Poor directional control	Info gathering	“He looked down at a message on his Blackberry...wasn’t paying attention and went off the right side of the road.” [CB] – Driver was distracted [Cit] – Careless driving
PA18	Overcompensation	Info gathering	“...he was talking to his wife via cell phone...The operator attempted to correct and return truck to roadway. He apparently over compensated.” [CB] – Driving using hands free phone [CB] – Driver was distracted [CB] – Other improper driving action [Cit] – Careless driving
PA20	Poor directional control	Driver state	“Laporte (witness) stated that he thought the operator fell asleep....It is my (officer) opinion that the operator of unit#1 fell asleep and traveled off the roadway.” [CB] – Affected by physical condition
PA21	Too fast for conditions	None specified	[CB] – Driving too fast for conditions [Cit] – 3361
PA22	Too fast for conditions	None specified	[CB] – Driving too fast for conditions [CB] – Slippery road conditions (ice/snow) [Cit] – Driving on roadways laned for traffic

Table A-2. Annotation Table of Contributing Factors Associated with the Unsafe Driver Acts Identified Across Crash Reports (Cont.)

Case	Unsafe Act	Contributing Factor	Comment
PA23	Too fast for conditions	None specified	"...Oper#1 lost control of his fuel truck when it struck a patch of ice on the roadway." [CB] – Slippery road conditions (ice/snow) [CB] – Too fast for conditions
PA24	Too fast for conditions	None specified	[CB] – Driving too fast for conditions [CB] – Failure to maintain proper speed
PA25	Poor directional control	None specified	[CB] – Careless passing or lane change [Cit] – 3309
PA26	Unknown	None specified	[CB] – Windy conditions [CB] – Unknown
PA27	Too fast for conditions	None specified	[CB] – Driving too fast for conditions [Cit] – 3361
PA28	Too fast for conditions	None specified	[CB] – Driving too fast for conditions
PA29	Illegal maneuver	None specified	[CB] – Other improper driving action
PA30	Illegal maneuver	None specified	[CB] – Other improper driving action [CB] – Unknown vehicle failure
PA31	Too fast for conditions	None specified	[CB] – Driving too fast for conditions [Cit] – Driving too fast for conditions
PA32	Too fast for conditions	None specified	[CB] – Driving too fast for conditions [CB] – Slippery road conditions (ice/snow) [Cit] – 3361
PA33	Illegal maneuver	None specified	[CB] – Other improper driving action [Cit] – Careless driving
PA34	Illegal maneuver	None specified	[CB] – Other improper driving action [Cit] – Careless driving
PA35	Poor directional control	None specified	[CB] – Careless parking/unparking
PA36	Too fast for conditions Overcompensation	None specified	"...the driver over-corrected and the vehicle rolled onto its right side..." [CB] – Driving too fast for conditions [CB] – Other improper driving action [Cit] – 3361
PA37	Too fast for conditions Overcompensation	None specified	[CB] – Speeding (over) [CB] – Over/undercompensation at curve
PA39	Too fast for conditions Following too closely	None specified	[CB] – Driving too fast for conditions [CB] – Sudden slowing/stopping [CB] – Slippery road conditions (ice/snow) [CB] – Unknown vehicle failure

Table A-2. Annotation Table of Contributing Factors Associated with the Unsafe Driver Acts Identified Across Crash Reports (Cont.)

Case	Unsafe Act	Contributing Factor	Comment
PA40	Too fast for conditions	None specified	[CB] – Driving too fast for conditions [CB] – Speeding (over)
PA41	Too fast for conditions	None specified	[CB] – Speeding (over) [Cit] – 3361
PA42	Too fast for conditions	None specified	[CB] – Driving too fast for conditions [Cit] – 3361
PA43	Overcompensation at curve	None specified	[CB] – Over/undercompensation at curve [Cit] – 3309
PA44	Too fast for conditions	None specified	[CB] – Driving too fast for conditions [Cit] – 3361
PA45	Poor directional control	Driver state	“...it appeared the operator of the tractor trailer fell asleep as there was a gradual path from the roadway.” [CB] – Affected by physical condition
PA46	Too fast for conditions	None specified	[CB] – Driving too fast for conditions [Cit] – 3361
PA47	Unknown	None specified	[CB] – Unknown
PA48	Too fast for conditions	None specified	[CB] – Driving too fast for conditions [Cit] – 3361
TX1	Too fast for conditions	None specified	[CB] – Speeding unsafe (under limit) [Cit] – Unsafe speed
TX4	Too fast for conditions Inadequate evasive action	Info gathering	[CB] – Speeding unsafe (under limit) [CB] – Driver inattention [CB] – Faulty evasive action [CB] – Animal on road – Wild [Cit] – Unsafe speed
TX5	Too fast for conditions	None specified	[CB] – Speeding unsafe (under limit)
TX6	Too fast for conditions	None specified	[CB] – Speeding unsafe (under limit) [Cit] – Unsafe speed
TX7	Too fast for conditions	None specified	[CB] – Speeding unsafe (under limit) [Cit] – Unsafe/improper turn
TX8	Poor directional control	Info gathering	[CB] – Driver inattention
TX9	Too fast for conditions	None specified	[CB] – Speeding unsafe (under limit) [Cit] – Unsafe speed

Table A-2. Annotation Table of Contributing Factors Associated with the Unsafe Driver Acts Identified Across Crash Reports (Cont.)

Case	Unsafe Act	Contributing Factor	Comment
TX11	Too fast for conditions	None specified	[CB] – Driver inattention [CB] – Speeding unsafe (under limit) [Cit] – Unsafe speed
TX12	Poor directional control	Driver State Info gathering	“Driver of unit#1 was fatigued, drifted off roadway to the right.” [CB] – Fatigued or asleep [CB] – Failed to drive in single lane [CB] – Driver inattention [Cit] – Failed to drive in single lane
TX14	Too fast for conditions	Driver State	[CB] – Failed to control speed [CB] – Fatigued or asleep [Cit] – Fail to control speed to avoid accident
TX16	Too fast for conditions	Driver State	[CB] – Speeding unsafe (under limit) [CB] – Fatigued or asleep
TX17	Too fast for conditions	Driver state	“...medical records showed a serum reading of 177...which indicated a BAC of 0.15.” [CB] – Failed to control speed [CB] – Had been drinking [Cit] – Driving while intoxicated
TX18	Too fast for conditions	None specified	[CB] – Speeding unsafe (under limit) [Cit] – Unsafe speed
TX19	Too fast for conditions Inadequate evasive action	Info gathering	[CB] – Driver inattention [CB] – Failed to control speed [CB] – Faulty evasive action [Cit] – Driving comm vehicle without C.D.L. [Cit] – Driving comm vehicle without proper endorsements
TX20	Too fast for conditions	None specified	[CB] – Speeding unsafe (under limit) [Cit] – Speeding – unsafe (under limit)
TX21	Too fast for conditions	None specified	[CB] – Speeding unsafe (under limit) [Cit] – Unsafe speed
TX22	Too fast for conditions Inadequate evasive action	Info gathering	“...he looked down at his map and the right rear tires dropped off the roadway.” [CB] – Failed to control speed [CB] – Faulty evasive action [CB] – Driver inattention [Cit] – Failed to control speed
TX23	Illegal maneuver	None specified	[CB] – Turned when unsafe [Cit] – Turned when unsafe

Table A-2. Annotation Table of Contributing Factors Associated with the Unsafe Driver Acts Identified Across Crash Reports (Cont.)

Case	Unsafe Act	Contributing Factor	Comment
TX24	Too fast for conditions Failed to take heed to signage	None specified	[CB] – Speeding unsafe (under limit) [CB] – Failed to heed warning sign [Cit] – Unsafe speed
TX25	Too fast for conditions	None specified	[CB] – Failed to control speed
TX26	Failed to take heed to signage Too fast for conditions	Info gathering	[CB] – Disregard stop sign or light [CB] – Speeding unsafe (under limit) [CB] – Driver inattention [Cit] – Disregard stop sign
TX27	Too fast for conditions	None specified	[Cit] – Fail to control speed to avoid accident
TX28	Illegal maneuver	Info gathering	[CB] – Turned when unsafe [CB] – Driver inattention [Cit] – Turned when unsafe
TX29	Too fast for conditions	None specified	[CB] – Speeding unsafe (under limit)
TX30	Too fast for conditions	None specified	[CB] – Failed to control speed [Cit] – Failed to control speed
TX31	Poor directional control Inadequate evasive action	Info gathering	“...driver was trying to get a porkchop from between the seats and was not paying attention to the roadway.” [CB] – Driver inattention [CB] – Failed to drive in single lane [CB] – Faulty evasive action [Cit] – Failed to drive in single lane
TX32	Illegal maneuver	None specified	[CB] – Turned improperly – cut corner on left [Cit] – Cut corner left turn
TX33	Too fast for conditions Poor directional control	Info gathering	[CB] – Speeding unsafe (under limit) [CB] – Failed to drive in single lane [CB] – Driver inattention [Cit] – Unsafe speed
TX34	Too fast for conditions	None specified	[CB] – Speeding unsafe (under limit) [Cit] – Unsafe speed
TX35	Failed to take heed to signage	None specified	[Cit] – Ran red light
TX36	Illegal maneuver	None specified	[CB] – Turned when unsafe
TX37	Too fast for conditions	None specified	[CB] – Speeding unsafe (under limit) [Cit] – Unsafe speed

Table A-2. Annotation Table of Contributing Factors Associated with the Unsafe Driver Acts Identified Across Crash Reports (Cont.)

Case	Unsafe Act	Contributing Factor	Comment
TX38	Poor directional control Overcompensation	None specified	“...took faulty evasive action by overcorrecting back to the left...” [CB] – Failed to drive in single lane [CB] – Faulty evasive action [Cit] – Failed to drive in single lane
TX39	Too fast for conditions	None specified	[CB] – Failed to control speed
TX40	Illegal maneuver	None specified	[CB] – Turned when unsafe [Cit] – Turned when unsafe
TX42	Too fast for conditions	None specified	[CB] – Speeding unsafe (under limit) [Cit] – Unsafe speed
TX43	Failed to take heed to signage	Info gathering	[CB] – Driver inattention [CB] – Disregard stop sign or light [Cit] – Disregard red light
TX44	Too fast for conditions Overcompensation	None specified	“...traveling too fast for the road conditions...Unit 1 then overcorrected to the right...beginning to spin sideways.” [CB] – Speeding unsafe (under limit) [Cit] – Unsafe speed
TX45	Illegal maneuver	None specified	[CB] – Turned when unsafe [Cit] – Turned when unsafe
TX46	Inadequate evasive action	Physiological	“Driver stated that he blacked out...he had not been feeling well.” “Driver failed to take evasive action...” [CB] – Ill [Cit] – Ride – not secure by safety seatbelt – driver
TX47	Poor directional control	Driver state	“Driver stated that he fell asleep while driving.” [CB] – Fatigued or asleep [CB] – Failed to drive in single lane [Cit] – Failed to drive in single lane
TX48	Too fast for conditions	None specified	[CB] – Failed to control speed [Cit] – Failed to control speed
TX49	Poor directional control	Drivers State (Asleep) Info-gathering (Distraction)	[CB] – Distraction in vehicle [CB] – Fatigue or asleep
TX50	Too fast for conditions	None specified	[CB] – Speeding unsafe (under limit) [Cit] – Unsafe speed

Table A-2. Annotation Table of Contributing Factors Associated with the Unsafe Driver Acts Identified Across Crash Reports (Cont.)

Case	Unsafe Act	Contributing Factor	Comment
TX51	Too fast for conditions Inadequate evasive action	None Specified	[Cit] – Unsafe Speed [Cit] – Safety Belt [CB] – Unsafe Speed [CB] – Faulty evasive action
TX52	Too fast for conditions Illegal maneuver	None specified	[CB] – Failed to control speed [CB] – Turned when unsafe
TX53	Overcompensation	Info-gathering (Distraction)	[Cit] – Driver inattention [CB] – Driver inattention [CB] – Faulty evasive action [CB] – Distraction in vehicle [CB] – Animal on road Domestic [CB] – Unsafe speed (...he was taking a drink from his beverage when he couldn't find the cup-holder..)
TX54	Inadequate evasive action	None Specified	[CB] – Loose gravel steep embankment (...a vehicle came onto his lane of travel, and caused him to veer off..)
TX55	Too fast for conditions	None Specified	[CB] – Unsafe speed [CB] – Turned when unsafe
TX56	Unsafe speed	None specified	[CB] – Speeding unsafe (under limit) [Cit] – Unsafe speed
TX57	Poor directional control	None Specified	[CB] – Driver Inattention (...study of the skid marks...could not have been traveling over 40mph...posted speed limit for that road 55mph...)
TX58	Poor directional control Inadequate evasive action	Driver state	[CB] – Failed to drive in single lane [CB] – Faulty evasive action [CB] – Fatigued or asleep [Cit] – Failed to drive in single lane [Cit] – Safety belt, child required to be secured <17
TX59	Inadequate evasive action Poor directional control	Physiological factor (driver health)	[CB] – Ill [CB] – Disregard stop and go signal [CB] – Failed to drive in a single lane (...distracted by his nose bleeding...attempted to pull to the shoulder but lost consciousness...)
TX60	Too fast for conditions	None Specified	[CB] – Turn improperly
TX61	Too fast for conditions Overcompensation	None Specified	[CB] – Unsafe speed [Cit] – Unsafe Speed

Table A-2. Annotation Table of Contributing Factors Associated with the Unsafe Driver Acts Identified Across Crash Reports (Cont.)

Case	Unsafe Act	Contributing Factor	Comment
TX62	False assumption of other road user's actions Illegal maneuver	None specified	[CB] – Other: Failed to yield row crossing marked roadway
TX63	Illegal maneuver	None Specified	[Cit] – Changed lane when unsafe
TX64	Too fast for conditions Overcompensation	None Specified	[CB] – Unsafe speed [CB] – Impaired visibility
TX66	Overcompensation Inadequate evasive action	Drivers State (Asleep)	[CB] – Fatigue or asleep [CB] – Faulty evasive action (Path of travel is consistent with driver asleep or fatigued.)
TX67	Poor directional control	Drivers State (Asleep)	[CB] – Fatigue or asleep [CB] – Failed to drive in a single lane (Manner in which the vehicle traveled off the roadway indicated...fell asleep.)
TX68	Too fast for conditions	None Specified	[CB] – Failed to control speed [CB] – Turned improperly
TX69	Poor directional control	None Specified	[CB] – Driver inattention
TX70	Poor directional control	None Specified	[CB] – Animal on road domestic [CB] – Failed to drive in signage lane
TX71	Too fast for conditions	None Specified	[CB] – Unsafe Speed
TX72	Too fast for conditions	Info-gathering	[CB] – Distraction in Vehicle [CB] – Driver inattention [CB] – Impaired Visibility [Cit] – Unsafe Speed (Raining hard that day driver could not see the end of the road)
TX74	Too fast for conditions	None Specified	[CB] – Unsafe Speed (Witness states he was traveling to fast for the turn)
TX75	Too fast for conditions	Drivers State (Asleep)	[CB] – Unsafe Speed [CB] – Fatigue or Asleep [Cit] – Unsafe Speed (The driver stated he fell asleep.)
TX76	Too fast for conditions	None Specified	[CB] – Unsafe Speed [Cit] – Unsafe Speed
TX77	Too fast for conditions	None Specified	[CB] – Unsafe Speed [Cit] – Unsafe Speed
VA1	Poor directional control	None specified	[CB] – Fail to maintain proper control

Table A-2. Annotation Table of Contributing Factors Associated with the Unsafe Driver Acts Identified Across Crash Reports (Cont.)

Case	Unsafe Act	Contributing Factor	Comment
VA5	Poor directional control	None specified	[CB] – Fail to maintain proper control [Cit] – 46.2-853
VA7	False assumption of other road user's actions	None specified	[CB] – Did not have right of way [Cit] – Failure to yield emerging highway
VA8	Too fast for conditions	None specified	[CB] – Exceeded safe speed
VA9	Too fast for conditions	None specified	[CB] – Fail to maintain proper control
VA10	Poor directional control Overcompensation	Info gathering	"...then overcorrected striking Veh#2." [CB] – Other driver distraction [CB] – Other driver distraction
VA11	Poor directional control	None specified	[CB] – Improper or unsafe lane change [Cit] – Reckless driving
VA12	Poor directional control	None specified	[Cit] – Fail to maintain proper control
VA13	Inadequate evasive action	None specified	[CB] – Avoiding other vehicle
VA14	Inadequate evasive action	None specified	[CB] – Avoiding other vehicle
VA17	Poor directional control	None specified	[CB] – Fail to maintain proper control
VA21	Poor directional control	None specified	[CB] – Fail to maintain proper control
VA23	Poor directional control	Physiological	"...he had a seizure..." [CB] – Fail to maintain proper control
VA25	Poor directional control	None specified	[CB] – Improper or unsafe lane change
VA26	Poor directional control	None specified	[CB] – Fail to maintain proper control
VA27	Poor directional control	None specified	[CB] – Fail to maintain proper control
VA28	None	None	None
VA29	Poor directional control	None specified	[CB] – Improper passing
VA30	Poor directional control	None specified	[CB] – Improper or unsafe lane change
VA31	Inadequate evasive action	None specified	[CB] – Avoiding other vehicle
VA33	Poor directional control	None specified	[CB] – Improper or unsafe lane change
VA35	Following too closely	None specified	[Cit] – Following too close
VA36	Poor directional control Too fast for condition	None Specified	[CB] – Failure to maintain proper control (...lost control ran off road...)
VA37	Illegal Maneuver	None Specified	(Vehicle 1 ran the red light.)
VA38	Following too closely	None Specified	[CB] – Exceeded safe speed (...struck #2 from behind...)
VA40	Too fast for condition	None Specified	[CB] – Exceeded safe speed
VA41	Poor directional control Too fast for condition	None Specified	[CB] – Failure to maintain proper control (...lost control ran off road...)

Table A-2. Annotation Table of Contributing Factors Associated with the Unsafe Driver Acts Identified Across Crash Reports (Cont.)

Case	Unsafe Act	Contributing Factor	Comment
VA43	Poor directional control Too fast for condition	None Specified	[CB] – Failure to maintain proper control [CB] – Roadway alignment grade (...went off right edge of road...)
VA44	Poor directional control Too fast for condition	None Specified	[CB] – Failure to maintain proper control [CB] – Roadway alignment curve (...went off right edge of road...)
VA45	Poor directional control	None Specified	[CB] – Failure to maintain proper control
VA46	Poor directional control	None Specified	[CB] – Failure to maintain proper control
VA47	Poor directional control	None Specified	[CB] – Failure to maintain proper control
VA48	Overcompensation Inadequate evasive action	None Specified	[CB] – Overcorrection Cit – (...swerved to miss deer...)
VA49	Poor directional control Too fast for conditions	None Specified	[CB] – Failure to maintain proper control (... exceeded the safe speed limit....)
VA50	Poor directional control Too fast for conditions	None Specified	[CB] – Failure to maintain proper control (... lost traction on the ice...)
VA51	Poor directional control	None Specified	[CB] – Failure to maintain proper control
VA52	Poor directional control	None Specified	Cit – Failure to maintain proper control
VA53	Overcompensation	None Specified	Cit – (...rightside, overcorrected...)

Appendix B:

Detailed Findings from TIFA on Rollover Causes

TIFA, Trucks Involved in Fatal Accidents, is maintained by the University of Michigan Transportation Research Institute (UMTRI) for the Federal Motor Carrier Safety Administration (FMCSA). It is a census file on the fatal accident experience of medium and heavy trucks nationwide and is essential to any evaluation of truck safety issues. The database compilation begins from the files in the Fatality Analysis Reporting System (FARS) database. Information on any fatal truck accident in FARS is extracted and then enhanced by UMTRI by calling the carriers, medical institutions, and the law enforcement organizations to confirm information reported in FARS and in PARs generated as a result of the accident. UMTRI extensively supplements the information obtained from FARS using supplemental fields in the TIFA database. TIFA is the only accident database administered by the government that follows up on the drug and alcohol tests administered and records the results of these tests. While the TIFA identifies only fatal crashes, it is a good source for information to identify potential causes. TIFA provided some indications of driver-related factors that contributed to the fatal crash.

The research team conducted a thorough analysis of crash records in TIFA from 2006 to 2008. While the focus of this assessment is cargo tank crashes, a subset of the crashes reported in TIFA, it is useful to analyze a broader set of reports for comparison. Parameters that might contain driver factors were identified, and then the database was queried to identify the driver factors for three cases.

1. All fatal truck crashes for four vehicle configurations: trucks with three or more axles, trucks with a trailer, tractors and semitrailers, and doubles.
2. Fatal truck crashes involving cargo tank trucks.
3. Fatal truck crashes involving cargo tank trucks where a rollover occurred as part of the crash sequence.

This appendix contains the results of detailed analyses capturing 6570 records in the first case, 599 records in the second case, and 163 records in the third. The first case was analyzed to provide a set of data that might identify differences between fatal truck crashes and fatal cargo tank crashes. Rather than use the entire TIFA dataset for case 1, by using the subset of vehicle configurations that contain cargo tanks, accurate differences might be identified.

Different numbers of fatal truck crashes might be evaluated for each of the factors listed, because each of the fields has an entry for *Unknown* or *None* and those crashes were not considered in the analysis.

DRIVER AGE

TIFA contains a field that records the driver age for most crashes. The distribution of drivers' ages was developed for all three cases, the vehicle configurations containing cargo tanks as a subset, cargo tanks, and cargo tank rollovers. These distributions were compared to the distribution of truck drivers in the United States and the age distribution of the working population in the United States from Jarrossi (2009). There were slight differences, indicating that the cargo tank drivers over age 65 were slightly over represented in fatal crashes. Based upon our interviews, cargo tank truck drivers are likely to be older than the U.S. truck driver

general population. Therefore, without knowing the age distribution of cargo tank truck drivers, no clear conclusions can be drawn.

SPEEDING

TIFA provides the speed limit for all the crashes but the vehicle speed is often not reported. The percentage of speeding vehicles and the number of vehicles for which a determination of speeding can be made is shown in Table B-1.

Table B-1. Number of Vehicles and Percentage Speeding

Parameter	Trucks in Multiple Vehicle Crashes			Trucks in Single Vehicle Crashes		
	All Trucks	Cargo Tanks	Cargo Tank Rollovers	All Trucks	Cargo Tanks	Cargo Tank Rollovers
Vehicle Count	4,166	300	39	656	70	44
Percent Speeding	7%	8%	23%	18%	29%	25%

Speeding is present in approximately one fourth of all fatal cargo tank rollover crashes. When comparing all trucks to cargo tank trucks involved in fatal crashes, the percentages of the trucks speeding are much lower when considering multiple vehicle crashes involving cargo tanks and are more than a factor of three higher for all single vehicle cargo tank crashes. In comparing multiple vehicle and single vehicle crashes, the cargo tank rollover crashes were the only class of crashes that are high for both single and multiple vehicle crashes.

Note that this analysis concerns vehicles that were exceeding the legal posted limit at the time of the crash. This is a different question than whether the vehicle was going too fast for conditions.

OVERALL HEALTH

The relationship between body mass index and the prevalence of sleep apnea in drivers has been the subject of many recent studies and notices from the Federal Motor Carrier Safety Administration. While the Centers for Disease Control states that the relationship is by no means certain, it is clear that body mass index is an important indicator of health or the alternative, the potential for a decrease in driver alertness from acute sleep deprivation, a common consequence of severe sleep apnea. There is a simple formula for calculating the body mass index:

$$BMI = 703 * \left[\frac{Weight}{Height^2} \right]$$

In the above equation the weight is to be expressed in pounds and the height in inches. The constant 703 is needed because the BMI was initially defined in metric units, meters and kilograms. If the BMI is less than 18.5, the adult is judged to be under weight, from 18.5 to 25, normal, 25 to 30 overweight 30 to 40 obese, and greater than 40 extremely obese. Ogden et al. (2010) report that, in the 2007-2008 time period, 6.0 percent of the adult population aged 20 to 74 are extremely obese, 34.3 percent are obese, and 33.6 percent are overweight. These

percentages are shown on the first line in Table B-2. These percentages need to be compared to the TIFA percentages. In comparing the numbers in Table B-2 with the national average obesity rates for adults aged 20 to 74, the 33.6 percent of the US population that is overweight is slightly lower than the rate for all accident categories shown in Table B-2. The rates for the obese category are all below the national average for US adults aged 20 to 74 by almost 5 percent. However in the extremely obese category, the data is driven by the single vehicle cargo tank and cargo tank rollover data, which are a factor of two above the national average for adults aged 20 to 74, 6 versus 9 and 10 percent respectively. Since every extremely obese driver in rollover crashes is also included in the cargo tank and all vehicle crashes for both single and multiple vehicle crashes, an elevation in the percentage associated with cargo tank rollovers will also elevate the percentages in the other categories. Among the Single Vehicle Crashes, the contribution from the cargo tank rollovers to all cargo tank crashes involving extremely obese drivers is significant. From the raw data, there were 12 single vehicle cargo tank rollover crashes involving extremely obese drivers and in the all single vehicle cargo tank crashes, there were only 17. Thus about 70 percent of the total cargo tank crashes involving extremely obese drivers resulted in a rollover. The percentage for all other weight categories is around 40 percent for single vehicle crashes and less than 20 percent for multiple vehicle crashes. Thus, while there are not many crashes, 12, extremely obese drivers are over represented in single vehicle rollover crashes. When all vehicle configurations are considered, the percentage of extremely obese drivers is about the CDC norm. The contribution of extreme obesity to single cargo tank crashes, the 11 percent number, when compared to the mean value of 6 percent, is statistically significant at close to the 95 percent confidence level.

Table B-2. BMI Classification of Truck Drivers Involved in Fatal Truck Crashes

Category	Under-weight	Normal	Over-weight	Obese	Extremely Obese	Total Crashes
National Average	Not reported		33.6%	34.3%	6.0%	N/A
Multiple Vehicle Crashes						
All Crashes	0.4%	20%	42%	33%	5%	7,028
Cargo Tank Crashes	0.2%	19%	44%	30%	7%	610
Cargo Tank Rollovers	0.0%	26%	40%	25%	9%	96
Single Vehicle Crashes						
All Crashes	0.2%	19%	42%	31%	7%	1,385
Cargo Tank Crashes	0.4%	20%	40%	31%	8%	567
Cargo Tank Rollovers	0.0%	21%	41%	28%	10%	104

ALCOHOL INVOLVEMENT

A strong correlation has been made between drug and alcohol use and safe driving. TIFA is the only accident reporting database where the results of drug and alcohol testing are presented. All the other databases list only whether a drug or alcohol test was administered. The results are shown in Table B-3. These data show that the alcohol involvement is much higher for single vehicle crashes, about 2 percent, compared to about 0.2 percent for crashes involving multiple vehicles. There are not enough data on alcohol testing for single vehicle cargo tanks and single vehicle cargo tank rollovers, 4 and 3 cases respectively, to conclude that the alcohol

involvement is different from the alcohol involvement in all single vehicle crashes. The difference in alcohol involvement in single and multiple vehicle fatal truck crashes is significant.

Table B-3. Alcohol Test Results for Truck Drivers Involved in Fatal Crashes

Parameter	All Crashes	All Cargo Tanks	Cargo Tank Rollovers	All Crashes	All Cargo Tanks	Cargo Tank Rollovers
	Multiple Vehicle Crashes			Single Vehicle Crashes		
Total Accidents	7,030	616	86	1,386	203	142
None, refused, or Unknown if Given	4,230	376	43	536	71	45
Total Tests Administered	2,800	240	43	850	132	97
Tested, Results Unknown	322	26	4	72	12	9
No Measured Alcohol	2,436	209	37	739	114	83
Less than Legal Limit	25	4	2	16	2	2
Legally Drunk	16	1	0	23	4	3
Tested, Results Positive	1					
Drivers Drunk % of Acc.	0.2%	0.2%	0.0%	1.7%	2.0%	2.1%

DRUG INVOLVEMENT

In the analysis of drug involvement, for each fatal truck accident, TIFA contains fields that specify when the individual was tested for drugs and when so tested, the type of drug found. TIFA has provision for collecting data on 3 drug tests per accident. The results for cargo tank crashes involving multiple vehicles are summarized in Table B-4.

Table B-4. Total Drug Involvement in Fatal Multiple Vehicle Cargo Tank Crashes

Drug Involvement	Counts		
	All Crashes	All Cargo Tanks	Cargo Tank Rollovers
Total Crashes where no tests performed, no drugs found, or unknown for drugs	6,860	600	83
Total Crashes where Drugs found	168	16	3
Total Crashes	7,028	616	86
Percentage Drug Test Positive	2.39%	2.60%	3.49%

It can be seen from the three drug test columns that the multiple vehicle cargo tank crashes are quite similar to all multiple vehicle crashes and that the cargo tank rollover crashes involving multiple vehicles are slightly elevated. There are only three crashes shown, so that elevation is quite uncertain. While not shown, tests are made for multiple types of drugs and it is not uncommon for multiple drugs to be detected in the driver's system, e.g. a stimulant drug and two depressant drugs or two narcotic drugs and a depressant drug. Overall, in about 2.5 percent of the fatal multiple vehicle cargo tank crashes, the driver tested positive for being under the influence of one or more drugs. While not shown, in 2 of these crashes, alcohol was also involved.

The same analysis can be performed for single vehicle cargo tank rollover crashes. These results are shown in Table B-5. The format is the same as was used for single vehicle cargo tank crashes. The results from up to three drug tests were reported.

Table B-5. Drug Test Results for Single Vehicle Fatal Cargo Tank Rollover Crashes

Drug Involvement	Counts		
	All Crashes	All Cargo Tanks	Cargo Tank Rollovers
Total Rollovers where no test performed, no result or results unknown	1,257	181	126
Total Drug Test Positive	128	22	16
Total Cargo Tank Rollovers	1,385	203	142
Percentage Drug Test Positive	9.2%	10.8%	11.3%

Like with the multiple vehicle cargo tank crashes, there are several cases where multiple drugs are found in a driver's body after the fatal rollover. By separating the single and multiple vehicle crashes in Table B-5, it can be seen that the percentage of crashes in which the driver has a positive drug test is much higher than the results for multiple vehicle crashes shown in Table B-4. For the single vehicle rollover crashes there were 16 positive drug tests out of 142 crashes, a percentage that is more than a factor of 2 above the highest drug involvement rate for multiple vehicle cargo tank crashes. The positive drug test percentage, about 10 percent, was true for all single vehicle crash categories, all trucks, all cargo tanks and all cargo tank rollovers. Interestingly, no extremely obese individuals tested positive for drugs. They were pretty equally divided, having BMIs that placed them in the normal, overweight, and obese categories. So it might be concluded that the individuals were not on drugs to control their weight, more likely to keep them alert or to counter boredom while driving. The alcohol involvement is around 1 percent and its effect on driver performance is well understood. Perhaps more study is needed on the effect of drugs on driver performance. For example, is it safe to take stimulants and if so how much?

AVOIDANCE MANEUVER

In TIFA the avoidance maneuver field provides a means of listing the braking, steering, or other maneuver prior during the course of the crash. Table B-6 provides a summary of the listed avoidance maneuvers for various categories of crashes.

It can be seen from Table B-6 that the two middle columns, where no avoidance maneuver is reported, represents between 60 and 70 percent of the crashes for all crashes and all cargo tanks for multiple vehicle crashes and for all single vehicle accidents. For the single and multiple vehicle cargo tank rollover accidents, these percentages are lower and the probability that the driver will use a steering avoidance maneuver is higher. While the trend is present, additional study would be needed to draw any conclusions regarding the effect of human factors on this class of accidents – single and multiple vehicle cargo tank rollovers.

Table B-6. Avoidance Maneuver Percentages for Classes of Crashes

Type of Accident	Braking (no skid marks, driver stated)	Braking (other reported evidence)	Braking (skid marks evident)	No avoidance maneuver reported	In- conclusive or not reported by police	Other avoidance maneuver	Steering (evidence or stated)	Steering and braking (evidence or stated)	Total Crashes
Multiple Vehicle Crashes									
All Crashes	2%	2%	7%	42%	27%	1%	10%	9%	9,162
Cargo Tank	1%	2%	9%	31%	34%	1%	12%	10%	740
Cargo Rollover	1%	3%	7%	22%	33%	0%	20%	13%	98
Single Vehicle Crashes									
All Crashes	1%	2%	6%	42%	30%	0%	13%	7%	1,861
Cargo Tank	0%	3%	7%	30%	32%	0%	20%	8%	237
Cargo Rollover	0%	3%	9%	26%	29%	0%	26%	7%	162

VIOLATIONS

The violations were tabulated for the cargo tanks involved in multiple vehicle and single vehicle crashes. The violation rate, using the total population of vehicles from Table B-3 was approximately 3 percent for all but the single vehicle rollover, where the violation rate was 1 percent. It is not known why this violation rate is lower than the other categories of crashes. Later in this evaluation, in the Driver Fraction section, a listing of miscellaneous factors was developed (Table B-8). This table lists driving too fast for condition as a frequent driver factor for single vehicle rollovers. Therefore it is somewhat a mystery why that finding does not translate into police citations.

DRIVER-RELATED FACTORS

In TIFA, nine categories of driver-related factors are considered and for each accident, four different driver-related factors can be listed. As only three factors are given in 95 percent of the cases, only three are listed in Table B-7. The table lists each of the nine categories of factors and tabulates the percentage of occurrence of the factors for classes of cargo tank accidents, single and multiple vehicle accidents. Each of these classes of accidents is then further broken down into non-rollover and rollover accidents. The table then tabulates the percentage of occurrence of each of the nine categories of driver factors entered as the first, second or third driver-related factor. The result is twelve columns of probabilities, three for each of the two classes of accidents and then under each, separate columns for non-rollover and rollover accidents.

The real insight in Table B-7 is shown in the first and the third lines. The first line shows that driver-related factors are listed in more fatal single vehicle cargo tank rollover accidents than multiple vehicle accidents, 150 single vehicle rollovers and only 98 in rollover accidents involving multiple vehicles. As shown in Table B-7, there are many more multiple vehicle accidents. The third line shows the percentage of accidents in which a driver-related factor is listed. For multiple vehicle non-rollover fatal cargo tank accidents, driver-related factors are listed for only 21 percent of the crashes. In multiple vehicle rollover accidents, this factor increases to 41 percent. For single vehicle non-rollover cargo tank accidents, at least one driver-related factor is listed in 61 percent of the accidents and for single vehicle cargo tank rollover accidents, at least one driver-related factor is listed for 93 percent of the single vehicle cargo tank rollover crashes. There is often a second and third factor listed for these crashes and as would be anticipated, the percentage of crashes where two driver-related factors is listed is lower than the percentage having one driver-related factor listed. For the single vehicle cargo tank rollover crashes, a second driver-related factor is listed in 47 percent of the 150 crashes, and a third driver-related factor is listed in 16 percent of these accidents. That percentage is about the same as the 20 percent shown as having one or more driver-related factor listed for multiple vehicle non-rollover accidents. Of all the factors, the Miscellaneous Factor is by far the most common factor listed. This factor includes numerous improper driving situations, the most common being failure to keep in the proper lane.

Table B-7. Driver-Related Factors for Fatal Cargo Tank Crashes

Driver Factor #	Multiple Vehicle						Single Vehicle					
	No Rollover			Rollover			No Rollover			Rollover		
	1	2	3	1	2	3	1	2	3	1	2	3
Total Crashes	135	53	14	40	19	8	46	22	9	140	71	24
Total Driver Factors	637	637	637	98	98	98	75	75	75	150	150	150
Percent Driver Factors	21%	8%	2%	41%	19%	8%	61%	29%	12%	93%	47%	16%
Miscellaneous Factor %	65%	57%	57%	70%	63%	50%	50%	59%	44%	65%	75%	63%
Physical/Mental Condition %	10%	8%	14%	15%	5%	13%	20%	18%		27%	11%	4%
Possible Distractions in Vehicle %	12%	9%		3%	5%	13%	7%	5%			6%	13%
Special Circumstances %	6%	4%	14%	3%			9%		11%	1%	3%	
Skidding, Swerving, Sliding %	1%	11%		5%	16%	13%	2%	5%	11%	4%		
Visual Obstruction %	6%	9%	7%	3%	5%	0%	7%	14%		1%	6%	4%
Unknown %	1%	2%	7%	3%	5%	13%	7%	0%	33%	3%	0%	17%

Table B-7 also shows that physical or mental condition was listed as the first driver factor in 15 percent of the fatal multiple vehicle cargo tank rollover crashes and in 27 percent of the fatal single vehicle cargo tank rollover crashes. Even in the non-rollover multiple and single vehicle fatal cargo tank crashes, driver factors are listed as 10 and 20 percent respectively, numbers not that different from the values shown for rollover crashes. Clearly driver physical and mental condition is an important driver-related factor to consider. The Miscellaneous Factor category is the dominant driver factor category listed. Table B-8 lists the Miscellaneous Factors for the fatal single vehicle cargo tank rollover crashes. Since from Table B-7 the total number of single vehicle cargo tank rollover crashes totals 150, driving too fast or in excess of the posted speed is a factor in about a third of the fatal single vehicle cargo tank crashes. In Table B-1, excess speed was listed as a factor in 25 percent. Thus excess speed is probably the major contributor to the listing, “driving too fast for conditions/in excess of posted maximum.”

Table B-8. Listing of Miscellaneous Factors for Single Vehicle Cargo Tank Rollover Crashes

Miscellaneous Factor	Number of Crashes
Driving too fast for conditions or in excess of posted maximum	42
Failure to keep in proper lane	29
Overcorrecting	9
Making an improper turn	3
Operating vehicle in an erratic, reckless, negligent manner	2
Illegal driving on road shoulder, ditch, sidewalk or median	2
Following improperly	2
Failure to obey traffic signs, control devices, officer's, etc	1
Operating without required equipment	1

It can be seen from the Table B-8 entries that driving too fast is listed as the first driver-related factor in 42 of the fatal single vehicle cargo tank rollover crashes. The next most common is failure to keep in the proper lane followed by overcorrecting. Both of these might be quite connected, in that overcorrecting might easily follow close behind failure to keep in the proper lane, and the recorder felt that the most significant and therefore the first driver factor listed was overcorrecting, since that led directly to the overturn.

The second most common driver factor is physical or mental condition, which from Table B-7 is listed as the first driver factor in 27 percent of the 150 fatal single vehicle cargo tank rollover crashes. That translates into 38 of the 150 rollovers. The number of physical/mental condition driver factors is shown in Table B-9.

Table B-9. Listing of Physical or Mental Driver Factors in Fatal Single Vehicle Cargo Tank Rollovers

Physical or Mental Condition Driver Factor	Number of Crashes
Careless, inattentive	20
Drowsy, sleepy, asleep, fatigued	11
Under the influence of drugs or alcohol	4
Ill, passed out, blackout	3

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APPENDIX C:
INTERVIEW QUESTIONS

HM-13 List of Questions for Tasks 3 and 4

1. Please select your primary job title (check the most appropriate).
 - ☐ Federal Agency
 - ☐ Industry Association
 - ☐ Industry other than Cargo Tank Truck Operator
 - ☐ Safety Management
 - ☐ Fleet Operations
 - ☐ Compliance Manager
 - ☐ Corporate Executive
 - ☐ Maintenance Director
 - ☐ Consultant
 - ☐ Other (please specify):
2. Which sector of the trucking industry do you operate in? (check one)
 - ☐ For-hire
 - ☐ Private Fleet
 - ☐ Other (please specify)
3. What is your primary type of business? (check all that apply)
 - ☐ Truckload
 - ☐ Less-Than-Truckload
 - ☐ Bulk/Tanker
 - ☐ Hazmat
 - ☐ Specialized
 - ☐ Other (please specify)
4. How many power units does your fleet operate, including owner-operators? (check one)
 - ☐ Less than 50
 - ☐ 50 - 249
 - ☐ 250 - 999
 - ☐ 1,000 - 4,999
 - ☐ 5,000+

5. Optional: We would appreciate your contact information so that we can follow up for additional information as necessary. All information you provide will remain confidential.

Name/Title:	Company Name:
Phone:	Email:

Company Safety Culture & Policies

6. What are the key components of truck fleet safety culture *at your company*?
7. What safety management areas could the industry could improve in?
8. Please rate the importance of each of the following components in creating an effective safety culture

	LEVEL OF IMPORTANCE			
Safety Culture Component	Very Important	Important	Somewhat Important	Not Important
Employee Compensation				
Monetary Rewards				
Non-Monetary Rewards and Recognition				
Communication from Company Leadership				
Safety Policies				
Safety Meetings and Education				
Safety Incentives				
Discipline for Unsafe Behaviors				
Safety Monitoring and Measurement Systems				
Safety Equipment				
Hiring Practices				
Training				
Performance Monitoring				
Other (Specify)				

9. How often is the process for reviewing the corporate risk assessment reviewed?
10. How do people at any level strike the balance between safety and efficiency?

11. How are safety problems communicated up the chain of command?
12. How are driver safety behaviors monitored and evaluated? How effective is this monitoring system?
13. How is safety culture highlighted outside your company:
 - a. to contract carriers or drivers
 - b. to customers,
 - c. to the surrounding community
14. What role does benchmarking play in your company?
15. In describing your company's safety policies:
 - a. What percentage, or which of these, are proactive (i.e., aimed towards preventing unsafe behaviors from occurring)?
 - b. What percentage, or which of these, are reactive (i.e., occur after unsafe behaviors have already occurred)?
 - c. Do safety policies at your company mostly reward good behavior or punish bad behavior?
16. How are safety policies communicated and reviewed (e.g., written, oral, electronic reinforced with posters, handbooks)?
17. What steps are taken to ensure drivers understand safety policies?
18. Describe key components of your safety meetings.
19. What are your company's procedures for handling non-routine or unplanned events (e.g., road closures, weather, unusual type of load or product, unable to deliver)
20. Do you have a policy regarding drivers' authority to stop a work process or delivery due to unsafe conditions?
21. How do you involve driver families involved in your company's safety missions?

Hiring & Training

22. When hiring drivers, what innovative steps does your company take beyond the minimum pre-employment requirements? What practices are in place to ensure that the minimum pre-employment requirements are being satisfied?
23. What are minimum requirements for hiring cargo tank truck drivers? What flags are "deal killers" when evaluating driver candidates?
24. Do you offer any health and wellness training? How important is this to your company's safety culture?
25. Are drivers required to pass any tests as a part of training to evaluate training effectiveness? If so, what do the tests entail?

Operations

26. What truck components are most important to safety?
 - a. What effect do these have on driver safety and performance?
 - b. Do you purchase any truck OEM special options as Standard Operating Procedures?
27. Which, if any, Onboard Safety Systems do you use? In general, how effective do you find these systems to be? Which is the most effective? Which is the least effective?
28. What types of real-time driver and vehicle monitoring is in place, if any? How effective are these monitoring systems?
29. What is the average age of your trucks?
30. Do you have a Fatigue Management Program in place? If so, what are the specific components of the program?

Fitness for Duty

31. How do you monitor a driver's day-to-day fitness for duty (FFD)?
32. What do you do for FFD monitoring that exceeds regulatory requirements?
33. What is your company's approach or policy toward driver illness?

APPENDIX D:

CASE STUDY 1

OUTLINE OF AN OVERALL
SAFETY PROGRAM

An overall safety program spans nearly everything a company does. This checklist focuses on rollovers. It only briefly mentions other aspects of an overall program, though it is certainly true that safety is an attitude that must permeate the whole operation. If you train for safety on the road but do not practice safety on the lot, the mixed message seriously erodes the value of the on-road training.

This checklist was produced from interviews with tank truck carriers and with experts in other safety-critical industries. Most carriers are probably familiar with most of this. Maybe one or two points will be something new and worth considering. The main part of the report has more to say on most of these points.

Recruiting and hiring

- Ask for years of prior tanker experience
- Take a drug tests. Urine is the norm; hair tests show history and are becoming common.
- Look at the applicant's driving and criminal record. Some carriers have automatic deal-killers; others will consider mitigating circumstances or the passage of time.
- Some carriers look for non-driving evidence of risk-taking attitudes. A lot of hirers, not just in the tank truck industry, for example, look at a Facebook page to see what an applicant is like away from the job.

Initial training

- Ride along with trainees before letting them go solo. Even an experienced recruit needs to learn the peculiarities of different equipment, customers, and routes.
- Don't preach against rollovers; teach how to avoid the situations.
- Describe what to do if a bad situation suddenly arises.

Recurrent training

- Keep the message in front of them and keep it fresh. Don't show the "same old song and dance."
- Talk about rollovers in the company or the competition. A rollover on the news will increase attention.

Recurrent observation (including Behavior-Based Safety as in Case Study 2)

- When a manager occasionally rides in a cab, it tells the driver that the boss understands the workload and that the boss is truly interested in safety. And the manager has a chance to see little lapses before they become engrained bad habits or big problems.
- Electronic behavior monitoring (cameras or statistical measures) also detect problems before they become bad habits. If everybody understands the purpose and benefit, there will be fewer "big brother" objections.
- Peer-to-peer observation makes everybody involved. Small, friendly, constructive observations do not need to be threatening. No one wants a bad apple in their organization.

Fitness for Duty (scheduling, training, and all that Case Study 3 involves)

- Tell the drivers about healthy sleep habits. Don't be afraid to mention the obvious—a quiet, dark place is best.
- Tell the family about healthy sleep habits.
- Exercise, nutrition, and hydration count for a truck driver just like they do for an athlete.
- Hobbies are good for taking the mind off the road for a day off. Do not let them get in the way of a good sleep cycle.

Safety Culture

- Safety culture is best if it involves the whole operation, not just the drivers. Include the back office, the mechanics, everybody.
- Customers can help by understanding the legal limitations and safety constraints of the carrier.
- Dispatch schedules have to account for realistic traffic conditions and loading times. They have to recognize the Hours of Service regulations. They have to recognize that drivers are human and need sleep.
- Specify safe equipment. Safety devices pay for themselves. (Do not let drivers use them as a crutch.)
- Be patient. Visible improvements in other companies have taken three or more years after practices were implemented.

Continuous Improvement

- Learn from mistakes. Push statistics lower, learn lessons from mishaps.
- If you have electronic monitors, try to make next year's numbers lower than last year's. If you can't afford electronic monitors and all you have are the CSA BASICS, they can be tracked and improved.

Driver Retention

- Recruiting is expensive, and experienced drivers know the company's procedures and customers. Treating drivers with respect will help with retention, and that helps with safety.

APPENDIX E:

CASE STUDY 1

INVESTIGATION REPORT
FOR A FICTITIOUS ROLLOVER

This is a fictional report, but it is based on a combination of real events. The first page of text is what management would expect to see in an initial report of a serious incident. It has key points and not much detail, because the investigation is not yet started. The initial description suggests several plausible causal scenarios that could be surmised. Investigators could easily jump to conclusions. The diagram on the second page graphically shows the critical sequence of events and the contributing factors. A thorough analysis would include the reasons why the no new wheel seals were in the warehouse, and it would list causes that had been ruled out, such as a negative result from the post-incident drug screening. The diagram conveys the idea that several factors contribute to an incident. The form of a real report would be more than the single page in this simplified example.

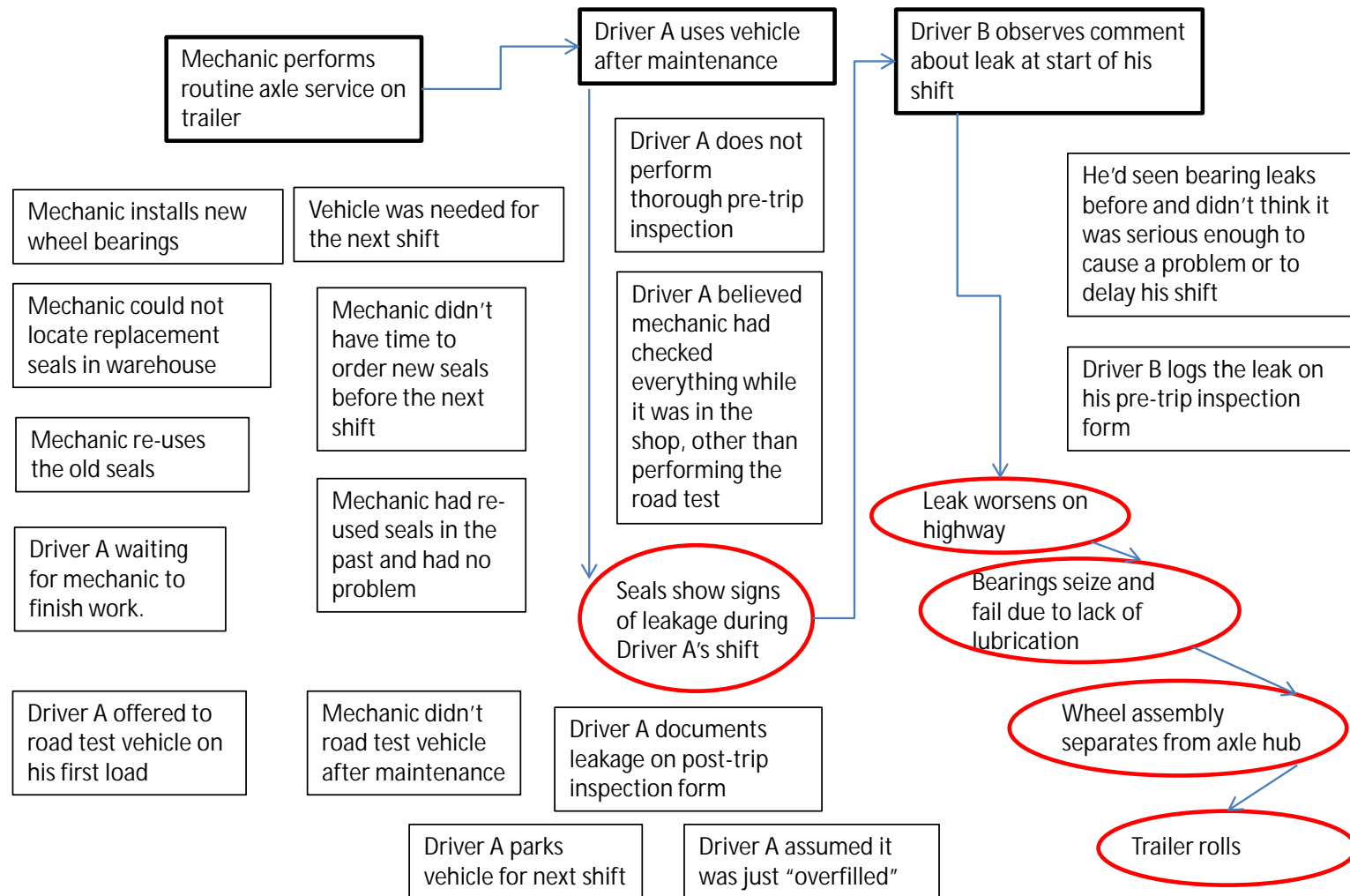
Preliminary Report

At approximately 20:40 on Wednesday, Oct 28, the pull trailer of unit 68-123 rolled onto its right side. There were no reported injuries and no other vehicles were involved. On scene responders report that all product seems to be contained in the vehicle. Initial internal and agency notifications have been made. The State Highway Patrol is acting as the incident commander.

The driver was on his first load of the night shift laden with gasoline. He was eastbound on a 4-lane section of Interstate 80 about two hours into the outbound leg of the delivery. Traffic was light. Weather was fair and the roads were dry. That road segment has a long radius left turn and is slightly banked.

Initial reports are that the straight truck is fully intact, other than possible pintle hook damage. The pull trailer suffered severe damage to its right side along the entire length, to the front right duals and drawbar. The right rear duals have been thrown into the adjacent field.

Sample Investigation Diagram



APPENDIX F:

CASE STUDY 2

SAMPLE DRIVER CHECK RIDE
EVALUATION FORM

Truck Driver Evaluation Report

Driver		<input type="checkbox"/> New Hire Evaluation	
<input type="checkbox"/> Driver Instructor <input type="checkbox"/> Driver Trainer		<input type="checkbox"/> Follow Up- 30- <input type="checkbox"/> -90 <input type="checkbox"/> 180 <input type="checkbox"/>	
Date _____ Shift _____		<input type="checkbox"/> Post Incident	
Terminal _____ Equipment _____		<input type="checkbox"/> Annual Review	
Date of Last Check Ride _____ <input type="checkbox"/> Instructor <input type="checkbox"/> Trainer		<input type="checkbox"/> Defensive Driver Training	
Road Condition _____		<input type="checkbox"/> Other _____	
License Number _____ Endorsements _____		Tank Chart Book <input type="checkbox"/> Yes <input type="checkbox"/> No	
Drivers License Expiration Date _____		Vehicle Shift Inspection Form Correct <input type="checkbox"/> Yes <input type="checkbox"/> No	
D.O.T. Medical Card Expiration Date _____		Back up Paper Log IN Possession <input type="checkbox"/> Yes <input type="checkbox"/> No	
EOBDR / Logbook (Correct) <input type="checkbox"/> Yes <input type="checkbox"/> No		F.M.C.S.R. IN Possession <input type="checkbox"/> Yes <input type="checkbox"/> No	
Accident Form <input type="checkbox"/> Yes <input type="checkbox"/> No		N.A.E.R.G. IN Possession <input type="checkbox"/> Yes <input type="checkbox"/> No	
Emergency Phone List <input type="checkbox"/> Yes <input type="checkbox"/> No		HAZ3 Card IN Possession <input type="checkbox"/> Yes <input type="checkbox"/> No	
Current Truck Registration <input type="checkbox"/> Yes <input type="checkbox"/> No		Spare delivery document IN possession <input type="checkbox"/> Yes <input type="checkbox"/> No	
		Off-Site Emergency- Response Procedures <input type="checkbox"/> Yes <input type="checkbox"/> No	
		Driver Utilizes Journey Plan <input type="checkbox"/> Yes <input type="checkbox"/> No	
		Truck Drivers Manual IN Possession <input type="checkbox"/> Yes <input type="checkbox"/> No	
Driving Operations & Functions (IN Ratings Require Explanation) <div style="display: flex; justify-content: space-between;"> <div> MR = Meets Requirements Pre-trip Inspection <input type="checkbox"/> MR <input type="checkbox"/> IN <input type="checkbox"/> NA Post- trip Inspection <input type="checkbox"/> MR <input type="checkbox"/> IN <input type="checkbox"/> NA Idle Away <input type="checkbox"/> MR <input type="checkbox"/> IN <input type="checkbox"/> NA Gear Shifting <input type="checkbox"/> MR <input type="checkbox"/> IN <input type="checkbox"/> NA Clutch Use <input type="checkbox"/> MR <input type="checkbox"/> IN <input type="checkbox"/> NA RPM Range <input type="checkbox"/> MR <input type="checkbox"/> IN <input type="checkbox"/> NA Smoothness <input type="checkbox"/> MR <input type="checkbox"/> IN <input type="checkbox"/> NA Railroad Crossings <input type="checkbox"/> MR <input type="checkbox"/> IN <input type="checkbox"/> NA </div> <div> IN = Improvement Needed Care of Equipment <input type="checkbox"/> MR <input type="checkbox"/> IN <input type="checkbox"/> NA Loading <input type="checkbox"/> MR <input type="checkbox"/> IN <input type="checkbox"/> NA Unloading <input type="checkbox"/> MR <input type="checkbox"/> IN <input type="checkbox"/> NA Lane Use <input type="checkbox"/> MR <input type="checkbox"/> IN <input type="checkbox"/> NA Chaining Up <input type="checkbox"/> MR <input type="checkbox"/> IN <input type="checkbox"/> NA Seat Belt Use <input type="checkbox"/> MR <input type="checkbox"/> IN <input type="checkbox"/> NA Speed <input type="checkbox"/> MR <input type="checkbox"/> IN <input type="checkbox"/> NA Brake Use <input type="checkbox"/> MR <input type="checkbox"/> IN <input type="checkbox"/> NA </div> <div> NA = Not Applicable Turn Signals <input type="checkbox"/> MR <input type="checkbox"/> IN <input type="checkbox"/> NA Right Turn <input type="checkbox"/> MR <input type="checkbox"/> IN <input type="checkbox"/> NA Left Turn <input type="checkbox"/> MR <input type="checkbox"/> IN <input type="checkbox"/> NA Backing <input type="checkbox"/> MR <input type="checkbox"/> IN <input type="checkbox"/> NA Safety Cones <input type="checkbox"/> MR <input type="checkbox"/> IN <input type="checkbox"/> NA Chock Block <input type="checkbox"/> MR <input type="checkbox"/> IN <input type="checkbox"/> NA EOBDR <input type="checkbox"/> MR <input type="checkbox"/> IN <input type="checkbox"/> NA Clearances (5) <input type="checkbox"/> MR <input type="checkbox"/> IN <input type="checkbox"/> NA </div> </div>			

Compliance					
Local & State Laws	<input type="checkbox"/> Yes	<input type="checkbox"/> No	Follows Terminal Security Plan	<input type="checkbox"/> Yes	<input type="checkbox"/> No
D.O.T. Regulations Part 172 & 177.816	<input type="checkbox"/> Yes	<input type="checkbox"/> No	Meets Uniform Standards	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Defensive Driving: (IN Rating Requires Explanation)					
MR = Meets Requirements		IN = Improvement Needed		NA = Not Applicable	
Looks Ahead	<input type="checkbox"/> MR	<input type="checkbox"/> IN	<input type="checkbox"/> NA	Gets eye contact	<input type="checkbox"/> MR <input type="checkbox"/> IN <input type="checkbox"/> NA
Aware of surroundings	<input type="checkbox"/> MR	<input type="checkbox"/> IN	<input type="checkbox"/> NA	Defensive Driving Classroom Trng	<input type="checkbox"/> Yes <input type="checkbox"/> No
Vigilant and observant	<input type="checkbox"/> MR	<input type="checkbox"/> IN	<input type="checkbox"/> NA	Training Date (Classroom)	_____
Avoids being boxed in	<input type="checkbox"/> MR	<input type="checkbox"/> IN	<input type="checkbox"/> NA	Following Distance (Secs)	_____
Additional Remarks:					

Driver Signature _____ Supervisor Signature _____ DTS Initial _____

Adapted from a Form, Courtesy of Chevron

APPENDIX G:

CASE STUDY 2

SAMPLE RIDE-ALONG DRIVER
OBSERVATION FORM

Terminal:

Driver Name : _____

Driver Type : ☐ Employee ☐ Contractor ☐ Owner-Operator

Driver's Supervisor _____

Observation Date & Time : _____

Observer: _____

Background Information

Summary of Observer's Comments

Follow-up

_____ Discuss comments with this driver

_____ Discuss recurring issues with all drivers

_____ Consider changes to Journey Plan, training, policies, etc.

Good Practice	Properly executed	Comments
BEFORE LEAVING		
Performs a self assessment of fitness for duty		
Reviews the appropriate Journey Plan		
Performs pre-trip inspection (tires, lights, hitch, hoses, suspensions, wires, maintenance records according to company policy)		
Checks placard and manifest if appropriate		
Enters cab using 3-point stance		
Fastens seat belt		
Closes all windows to reduce noise level		
Adjusts seat		
Adjusts mirrors		
Keeps log book up to date		
STARTING		
Checks in all directions for sufficient clearance and potential hazards.		
Selects the gear that will provide a smooth, easy start		
Increases vehicle speed with gradual progressive shifting until desired speed is reached.		
While not shifting gears, keeps both hands on wheel at 9 & 3 or 10 & 2 position.		
Assumes a proper sitting position		
SCANNING AHEAD		
Demonstrates eye lead time consistently in excess of 15 seconds		
Assesses traffic lights (fresh versus stale)		
Sees and evaluates relevant information from among distant objects		
Looks around bends before beginning to turn		

Good Practice	Properly executed	Comments
SITUATIONAL AWARENESS		
Following distance consistently appropriate for conditions		
Makes and executes decisions early		
Moves eyes at least every two seconds		
Scans mirrors every 5 - 8 seconds		
Checks mirrors before slowing and when stopping the vehicle		
Scans all intersections before entry (left, right, left)		
Avoids staring while evaluating relevant objects		
MAINTAINING SAFE DISTANCE		
Maintains proper space around the vehicle		
Speed is neither too fast nor too slow for conditions		
Avoids sudden decelerations		
Adjusts space to avoid unsafe intrusion by other vehicles		
Stops 10 feet behind crosswalks and behind other vehicles ahead to maintain tire-to-ground visual contact		
When stopped, allows vehicle in front to move 2 seconds before starting		
INTERACTION WITH VEHICLES		
Establishes eye contact with drivers of conflicting vehicles.		
Covers or uses horn when conditions suggest the need		
Effectively times the use of turn indicators (100 feet before lane change)		
Avoids sudden steering motions		
BRAKING		
Brakes early to activate brake lights		
Gradually slows down using brakes and downshifts as necessary		
Does not put the transmission in neutral to coast to a stop		
Engine brake use is limited to long descents when loaded and is not used on wet surfaces or in restricted areas		
Maintains foot on treadle when stopped		

Good Practice	Properly executed	Comments
BACKING		
Before backing walks completely around the truck looking for hazards, including overhead hazards		
Uses a minimum of three cones to barricade backing area or uses flagman		
When using a flagman, ensures the flagman is visible at all times		
When flagman is used, makes sure hand signals are understood		
Before backing, taps horn and turns on four way flashers		
Backs slowly so stops can be made quickly if necessary.		
Uses mirrors and backs immediately		
Backs only as far as necessary		
Retrieves cones		
SPECIAL SITUATIONS		
Follows restricted speed in construction zones.		
Follows restricted speed in school zones		
Follows state law for stopped school buses		
Uses four-way flashers 100 feet before approaching non-exempt railroad crossings to alert other drivers		
Makes a complete stop at all non-exempt railroad crossings (as far to the right as is safe) not less than 15 feet or more than 50 feet from the nearest rail		
DOES NOT shift gears while crossing tracks		
After crossing tracks, uses four way flashers or left turn signal to re-enter the flow of traffic		

Good Practice	Properly executed	Comments
AT THE DELIVERY LOCATION		
Evaluates for sufficient clearances, e.g., parked cars, pumps, posts, canopy		
Observes movement of other vehicles and pedestrians		
Enters the location according to the Journey Plan		
Makes continuous forward movement to fills		
Properly positions vehicle according to the Journey Plan and in a way that does not compromise safety when offloading		
Ensures sufficient space for safe exit from facility		
Ensures equipment is stowed and vehicle is clear before leaving.		
Keeps log book up to date		
Observes movement of other vehicles and pedestrians		
FINISHING THE SHIFT		
Puts transmission in gear and shuts engine down		
Applies the parking brake		
Keeps log book up to date		
Exits cab using 3 point stance		
Reports maintenance needs as necessary		

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APPENDIX H:

CASE STUDY 2

PERFORMANCE DASHBOARD REPORTING

Incidents


Reports

Administration

Incidents


Vehicle ID

Start date


 mm/dd/yyyy

Driver ID


End date

 mm/dd/yyyy

Use filter

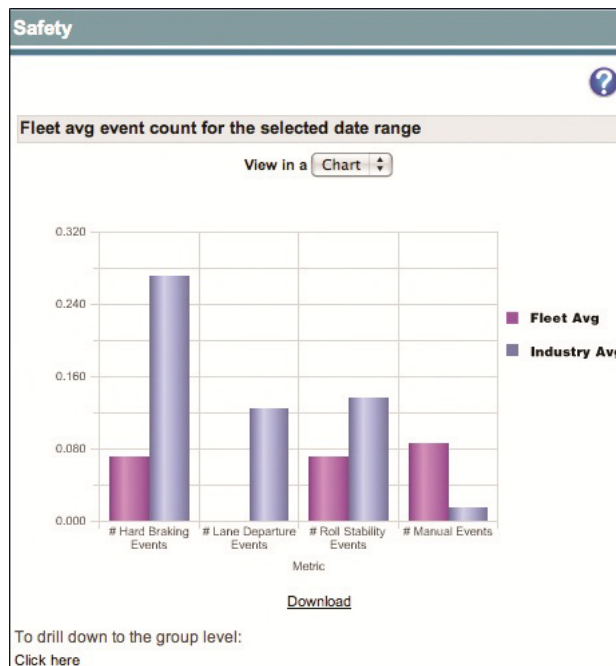


Vehicle group



Search

Vehicle	Driver	Time	Occurred near	Trigger	Trigger data	Speed	Reviewed
1301	3924	02/23/2010 03:53:00 PM PST	6 miles E of Beverly Hills, FL	Hard braking	11.0 MPH/sec	29.5 MPH	<input type="checkbox"/>
1974		02/23/2010 03:26:33 PM PST	2 miles ENE of Echo, UT	Stability control	2 messages	53.5 MPH	<input type="checkbox"/>
1946		02/23/2010 03:04:49 PM PST	4 miles NE of Herndon, KY	Lane departure	1 Left/2 Right	63.5 MPH	<input type="checkbox"/>
1946	9821	02/23/2010 03:02:49 PM PST	2 miles WSW of Harrisonville, MO	Hard braking	9.0 MPH/sec	27.5 MPH	<input type="checkbox"/>
1974		02/23/2010 02:54:41 PM PST	6 miles SW of Wolf Creek, MT	Stability control	5 messages	52.0 MPH	<input type="checkbox"/>
1942	4658	02/23/2010 02:50:02 PM PST	2 miles E of Fairchild, WI	Hard braking	10.0 MPH/sec	49.0 MPH	<input type="checkbox"/>
7058		02/23/2010 02:46:12 PM PST	21 miles SSW of Socorro, NM	Manual		0.0 MPH	<input type="checkbox"/>



Courtesy of ATRI

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APPENDIX I:

CASE STUDY 2

QUESTIONS TO ASK IN SELECTION OF IN-CAB CAMERA SYSTEMS

Costs include initial capital and installation, as well as ongoing subscription rates. Both long- and short-term costs should be analyzed. Insurance providers should be contacted to determine if purchase assistance or reduction in premiums are offered.

Many other factors should be considered when exploring a camera system investment:

- How are installation, replacements, spares, and warranties handled?
- What is the video quality (min 640x480) and night vision capability?
- Who has ownership and access to videos?
- If internally controlled, can the company support the program?
- If hosted by the provider, what level of support is provided?
- Are camera or software upgrades included?
- Is the camera data (speed and location) compatible with on-board computers?
- What is the maximum recording length after trigger?
- What reports are available?
- Are the communications devices compatible with existing systems? Are they redundant or can they be shared?
- Are events mapped individually, or are there maps showing concentrations of similar events (e.g., all lateral acceleration triggers over a certain G-force)?
- What file formats are offered? Are they tamper resistant for use in court? Is there edit capability for use in training?
- What is the capture rate (frames per second, or fps)? Can video be viewed frame-by-frame?
- How many cameras can be placed in the vehicle?

Note:

Some states have laws against placing objects on or near the windshield that might obscure the driver's line of sight. Local regulations should be checked before installing a camera system.

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APPENDIX J:

CASE STUDY 3

**FATIGUE MANAGEMENT PROGRAM
GUIDELINE AND SCORING WORKSHEET**

FMP GUIDELINE AND SCORING WORKSHEET

As an aid in deploying an effective FMP, the following guideline and scoring worksheet has been developed for potential use by cargo tank truck carriers. It contains a list of recommended program components and a basis for measuring progress towards instituting a mature FMP.

The worksheet is patterned after a similar approach devised by Transport Canada in its study on rail safety. It is comprised of the following categories: 1) education and training, 2) scheduling practices, 3) dealing with emergencies, 4) alertness strategies, 5) rest environments, 6) implementation policies and 7) evaluation of FMP effectiveness. Within each category are several program elements, some of which are marked with the letter “C”, denoting that the element is considered a core program component and therefore should be included in any FMP.

In the worksheet, each category is assigned a certain number of points, reflecting its relative importance, and apportioned among the program elements within that category. The maximum possible overall worksheet score is 100, a convenient metric against which to benchmark the current status of a carrier’s FMP program and to measure progress over time. The discussion below introduces the worksheet and offers additional information on its contents.

Education and Training

Employees expected to function effectively must be fully aware of the effects of fatigue and how to properly prepare for fatigue-related situations. The education and training components of a fatigue management program should consist of, at a minimum, information on sleep hygiene, body clock, sleep disorders and the relationship between sleep and performance. A more comprehensive program would include additional information on diet health and lifestyle, definitions of fatigue and alertness, stress management, various sleep schedules, countermeasures and individual and age differences.

Sleep hygiene focuses on a person’s readiness to obtain sleep, covering factors affecting sleep quality and duration (e.g., light, noise). *Diet and lifestyle* should provide awareness of how various foods and food groups that are consumed at key times can affect the body’s readiness for sleep. *Body clock* emphasizes the importance of circadian cycle and rhythms, the corresponding arousal and recovery cycles, and how these affect sleep, alertness and ultimately work performance. *Definitions of sleep and alertness* enhance understanding of the differences between physical fatigue that might come from muscular exertion and fatigue that is associated with sleep loss. *Sleep disorders* focuses on the propensity for sleep apnea as well as other conditions, such as restless leg syndrome and narcolepsy, which can cause deficiencies in operational performance. *Stress management* is intended to raise awareness that persons who are experiencing high levels of stress can experience either lack of sleep, early awakening, or sometimes even excessive sleep. *Sleep and performance* emphasizes the relationship between lack of sleep and decreases in cognitive and work performance, including thresholds beyond which levels of optimal performance are exceeded. *Sleep schedules* should describe those types of sleep patterns that lead to the development of a sleep debt over time. *Countermeasures*

introduces various fatigue mitigation strategies, such as napping, sleeping, exercise, activity, short breaks, judicious use of caffeine, and preventive anchor sleep. Finally, *individual and age differences* acknowledges that each individual will react differently to fatigue risk factors; therefore, it is important to monitor one's own sleep needs and schedule so as to allow for appropriate recuperation.

Education and Training			Score	Observed
C	1	Sleep hygiene	3	
	2	Diet, health & lifestyle	1	
C	3	Body clock	3	
	4	Definitions of fatigue and alertness	1	
C	5	Sleep disorders	3	
	6	Stress management	1	
C	7	Sleep and performance	3	
	8	Various sleep schedules	1	
	9	Countermeasures	1	
	10	Individual and age differences	1	
		Sub-Total	18	

Scheduling Practices

Scheduling practices can include up to ten components, of which five are considered part of a FMP core: 1) complying with the regulations concerning individual shift driving and on-duty limits, 2) ensuring that off-duty times permit reasonable recuperation, 3) complying with the regulatory prohibition on driving after 60 hours on duty in any 7 consecutive days (or 70 hours in 8 days), 4) attempting to structure work schedules that are highly predictable and 5) providing sufficient opportunity for sleep when periods of wakefulness exceed 19 continuous hours. Other beneficial scheduling practices include minimizing work schedules that require being on duty between the hours of midnight and 6:00 a.m., allowing for recovery periods that provide opportunities to obtain rest when obtaining less than six hours of continuous sleep in a 24-hour period, providing recovery periods that permit two consecutive nights of sleep, scheduling twenty-minute break periods approximately every four hours, and creating opportunities for napping.

Scheduling Practices			Score	Observed
C	1	Comply with the regulations concerning individual shift driving and on-duty limits	3	
	2	Minimize work schedules that require being on duty between the hours of midnight and 6:00 a.m.	1	
	3	Allow for recovery periods that provide opportunities to obtain rest when obtaining less than six hours of continuous sleep in a 24-hour period	1	
C	4	Ensure that off-duty times permit reasonable recuperation	3	
C	5	Comply with the regulatory limits for hours of driving over 7/8 consecutive days	3	
	6	Provide recovery periods that permit two consecutive nights of sleep	1	
	7	Schedule twenty-minute break periods approximately every four hours	1	
C	8	Structure work schedules that are highly predictable	2	
	9	Create opportunities for napping	1	
C	10	Provide sufficient opportunity for sleep when periods of wakefulness exceed 19 continuous hours	3	
		Sub-Total	19	

Dealing with Emergencies

A section of the FMP should be devoted to how management expects to address emergency situations or unexpected deviations from planned schedules. This should include a definition of what constitutes an emergency and include procedures that manage fatigue for persons performing emergency duties. Specific attention should be devoted to situations in which individuals are encroaching on the maximum allowable hours of service limits or when emergency work would occur between the hours of midnight and 6:00 a.m.

Dealing with Emergencies			Score	Observed
C	1	Definition of emergency situations	4	
C	2	Provision of specialized considerations for extra duty	4	
		Sub-Total	8	

Alertness Strategies

The most important component of this aspect of a FMP is to provide information on fatigue alertness strategies that can be used in an operational environment. The primary solution is to avoid fatigue. While **there is no direct substitute for sleep** [bold lettering added by the research team for emphasis], when this is not possible, studies have shown that there is benefit in remaining physically active as a means of warding off sleep. Short breaks with some light exercise can counteract fatigue for a brief period. Use of technological aids (in-cab alarms) can also help stimulate alertness. Additionally, selective use of legal, natural stimulants is an option, as is the appropriate use of napping. The types of light, sound and temperature environments conducive to alertness can also be important. Creating a social environment where it is possible to talk to others or listening to the radio can also enhance attentiveness.

Alertness Strategies			Score	Observed
C	1	List of recommended and approved alertness strategies	5	
	2	Technological aids (alerts)	1	
	3	Napping strategies	1	
	4	Breaks	1	
	5	Checklists to stay alert	1	
	6	Other communication strategies as needed	1	
	7	Appropriate use of exercise	1	
	8	Use of light, sound, and temperature	1	
		Sub-Total	12	

Rest Environments

As rest plays a critical role in managing fatigue risk, providing opportunities to obtain quality rest becomes important. FMPs should include the following core items to achieve that objective: 1) having a standard policy for review of the adequacy of facilities for promoting rest, 2) creating a comfortable sound, light and temperature environment, and 3) establishing appropriate wake-up policies. Other desirable features include certifying lodging as meeting rest standards, the availability of sleep aids, providing adequate exercise and eating facilities, and having rest environments located in reasonable proximity to the transportation system. In general, scheduling of breaks periodically during the workday is considered an effective fatigue countermeasure.

Rest Environments			Score	Observed
C	1	Standard policy for facility review	2	
	2	Certified lodging	1	
	3	Sleep aids	1	
C	4	Light reduction	2	
C	5	Sound reduction techniques	2	
C	6	Temperature controls	2	
	7	Exercise facilities	1	
	8	Eating facilities	1	
C	9	Wake up policies	2	
	10	Proximity to transport network	1	
		Sub-Total	15	

Implementation Policies

Overall, an FMP should have a format and content that is easily discernible. The program should include a statement of principles and corporate commitment, as well as a complete description of program policies and procedures. The discussion of policies and procedures should describe each program component at both a general and more detailed level. In addition, the FMP should identify responsible parties and include a protocol for how risks are assessed and controlled.

Implementation Policies			Score	Observed
C	1	Statement of principles	5	
C	2	General plan description	5	
	3	Detailed plan description	1	
	4	Use of risk assessment	1	
C	5	Commitment to FMP	3	
		Sub-Total	15	

Evaluation of FMP Effectiveness

An important aspect of an effective FMP is a process for monitoring program performance. This is a reflection of a commitment to adhere to FMP policies and procedures, and to strive to continually improve the management of fatigue in the workplace. Performance monitoring is most effective when both management and operations personnel are involved in the process. Central to performing the evaluation is a need to define appropriate fatigue measurements and metrics, and to devise a reliable method for collecting the corresponding data. A successful FMP will also include a provision for examining the extent to which fatigue was a factor in reported accidents. Lastly, the program should include a systematic evaluation of the level of overall fatigue in the organization, where the problems reside, and how they can best be mitigated. This may require the involvement of outside experts familiar with the science of sleep and fatigue, as well as the deployment of behavioral models.

Evaluation of FMP Effectiveness			Score	Observed
C	1	Specification of fatigue metrics	2	
C	2	Specification of data gathering methods	2	
C	3	Systematic review of crew scheduling	2	
C	4	Accident analysis	2	
C	5	Opportunity for consultation (e.g., employee representatives; health and safety committees)	2	
	6	Systematic review of plan measurement data	1	
	7	Use of behavioral models	1	
	8	Utilization of outside experts	1	
		Sub-Total	13	
		Overall Score	100	

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