Improving the Safety of Older Truck Drivers:
Developing a Framework for Moving Forward

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ACKNOWLEDGEMENT

Technical Report Documentation Page

1. Report No. ATLAS-2016-17	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle Improving the Safety of Older Truck Drivers: Developing a Framework for Moving Forward		5. Report Date December, 2016
		6. Performing Organization Code
7. Author(s) Lisa J. Molnar, David W. Eby, Sharon Newnam, Jennifer Zakrajsek, Sjaan Koppel, Daniel Blower, Sharon Conklin, Daniel Crecca, Tian Tian		8. Performing Organization
9. Performing Organization Name and Address University of Michigan Transportation Research Institute (UMTRI) 2901 Baxter Rd. Ann Arbor, MI 48103		10. Work Unit no. (TRAIS)
		11. Contract or Grant No. DTRT13-G-UTC54
12. Sponsoring Agency Name and Address Advancing Transportation Leadership and Safety (ATLAS) Center 2901 Baxter Rd. Ann Arbor, MI 48109-2150 U.S.A		13. Type of Report and Period Covered Final Report, 2015-2016
		14. Sponsoring Agency Code
15. Supplementary Notes Supported by a grant from the U.S. Department of Transportation, OST-R, University Transportation Centers Program		

16. Abstract

The overarching goal of this project was to contribute to a reduction in crashes among older truck drivers. The project represents the starting point for developing a program that can be used by older truck drivers and trucking company management to keep older truck drivers on the road for as long as they can safely drive. The specific aims of this project were to: 1) conduct an analysis of truck crash data to identify risk factors that contribute to crashes among older truck drivers; 2) conduct a brief review of the literature to identify existing preventive strategies in the trucking industry; 3) conduct a series of group and individual structured interviews with older truck drivers and trucking company management; and 4) develop the conceptual framework for a needs assessment tool designed to improve the safety management of older drivers in the trucking industry. Results are discussed for each of the project aims. Collectively, results from the literature review, crash data analysis, and interviews with safety managers and drivers suggest that a tailored needs assessment tool could bring value to the trucking industry.

17. Key Words Older truck drivers, truck crashes, safety managers		18. Distribution Statement Unlimited	
19. Security Classification (of this report) Unclassified	20. Security Classification (of this page) Unclassified	21. No. of Pages 46	22. Price

Technical Report Form DOT F 1700.7 (8-72)   Reproduction of completed page authorized

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Introduction and Background

Road freight transportation represents a long-standing transportation safety and public health problem in the United States (US). In 2014, there were an estimated 438,000 large truck-involved crashes in the US, resulting in 3,903 people killed and approximately 111,000 injured. (National Center for Statistics and Analysis, 2016). These figures are likely to increase given a steadily increasing demand for both freight services and the requisite truck drivers (Short, 2014). One group of truck drivers found to be over-represented in crash statistics is the group comprised of drivers age 60 and older (Duke et al., 2010).

Research suggests that older adults, in general, are likely to experience some level of age-related functional decline in sensory, physical and cognitive functioning such as reduced visual acuity and slowed reaction time (Stelmach & Nahom, 1992). Of relevance to older truck drivers is how declines in these skills relate to the safe operation of a vehicle on the road and whether these skill degradations put them at increased risk of crash-related injury and/or death. The need for urgent attention was highlighted by a recent report by the American Transportation Research Institute (Short, 2014) that pointed to the aging employee base of the trucking industry, and projected significant growth in the percentage of trucking employees in the age ranges of 55-64 and 65 and older.

With the exception of a study conducted by Duke et al. (2010), there is little information related age-related risk factors that may contribute to crashes in older truck drivers. Further, there is little information about the unique safety issues faced by older truck drivers and existing preventive strategies to address these issues, or how to inform the development of new evidence-based preventive strategies.

However, some lessons can be learned from existing road safety programs designed for older drivers in the general population. One good example is the **S**elf-**A**wareness and **FE**edback for **R**esponsible **Driving (**SAFER) Driving self-screening instrument, developed by the University of Michigan Transportation Research Institute (UMTRI) (Molnar et al., 2010). SAFER Driving is a validated, web-based, self-screening instrument focused on 'health concerns' that affect driving – that is, the symptoms that people experience due to medical conditions, medications

used to treat them, and the general aging process. The development of the self-screening instrument was based on the assumption that while there are a myriad of medical conditions, medications, and age-related declines, they produce a relatively small number of health concerns that can vary in severity, and in turn affect driving. SAFER Driving provides older drivers with individualized information to help them make better decisions about driving. By linking the severity of health concerns to their effects on critical driving skills, the instrument provides feedback to increase knowledge and self-awareness, as well as recommendations for behavioral changes, further evaluation, and vehicle modifications. Users of SAFER Driving reported that they thought the tool would be useful for enhancing discussions between older adults and their families.

SAFER Driving offers one preventive approach for truck safety because of its potential to identify declines in abilities that can affect driving of trucks and enhance discussions between truck drivers and safety managers. However, in its current form, this tool does not align with the complexity inherent in the workplace system. More importantly, not enough is known about the unique challenges facing older truck drivers, current strategies, particularly from the perspective of drivers and safety managers, for addressing these challenges, and areas where more focus is needed. In addition, research has established that contributing factors at all levels of the road freight transportation system (i.e., drivers, management, other organizations, regulatory, and government bodies) play a role in influencing crash involvement (Newnam & Goode, 2015). Thus, preventive strategies designed for the workplace must consider interaction within and across system levels. Based on this logic, a preventive strategy that goes beyond a singular driver-level focus to one that considers the role of policy, procedure, regulation and beyond is more likely to be effective in managing the safety of truck drivers.

The overarching goal of this project was to contribute to a reduction in crashes among older truck drivers. The project represents the starting point for developing a program that can be used by older truck drivers and trucking company management to keep older truck drivers on the road for as long as they can safely drive. The specific aims of this project were to:

1. Conduct an analysis of truck crash data to identify risk factors that contribute to crashes among older truck drivers.
2. Conduct a brief review of the literature to identify existing preventive strategies in the trucking industry.
3. Conduct a series of group and individual structured interviews with older truck drivers and trucking company management.
4. Develop the conceptual framework for a needs assessment tool designed to improve the safety management of older drivers in the trucking industry.

Crash Data Analysis

Methods

Crash data from two national sets were analyzed to identify risk factors that contribute to crashes among older truck drivers age 60 and older. The crash analysis addressed the following questions:

1. What types of crashes were older drivers involved in and how do they differ from other truck drivers?
2. What environmental characteristics were associated with crashes involving older drivers and how do they differ from those involving younger drivers?
3. Given crash involvement, were older drivers more likely to be at-fault or to commit errors that precipitated crashes compared to younger drivers?
4. What types of actions by older drivers were identified in the data as contributing to the crash, as reported by investigators at the crash scene, and how did those actions differ from those of younger drivers?

Data Sources

Data were combined from two databases maintained by NHTSA: 1) the Fatality Analysis Reporting System (FARS); and, 2) the National Automotive Sampling System General Estimates System (GES). FARS was established in 1975 and is a census of all fatal motor vehicle crashes within the US and Puerto Rico. To be included in FARS, crashes must involve a motor vehicle traveling on a public roadway and must result in the death of a vehicle occupant or non-occupant within 30 days of the crash. FARS data are compiled from state records and the database

includes information at the crash-, vehicle-, and person-level. GES was established in 1988 and is a nationally representative probability sample of all police-reported crashes. GES crashes must have a police accident report, involve at least one motor vehicle traveling on a roadway, and result in property damage, injury, or death to be included in GES. GES is a stratified, hierarchical sample with an associated case weight used to estimate population totals.

FARS and GES data on crashes occurring from 2010-2012 were combined to create the dataset used for this analysis. FARS was used to obtain fatal crash data and GES was used to obtain non-fatal crashes. Combined in this way, FARS and GES provide the best estimate of the national crash experience.

Vehicles

All crashes involving a truck were included in the analysis. Trucks were defined as straight trucks (also known as single-unit or rigid in Australia) or combination trucks (such as tractor-semitrailers or articulated trucks), with a gross vehicle weight rating (GVWR) over 10,000 lbs. This is the customary size to identify medium and heavy trucks. This limit excluded pickup trucks, unless they had axles to boost their GVWR into the range specified above.

Drivers

Truck drivers of all ages were included in the analysis to allow comparison between older drivers and other drivers. Drivers were assigned to the following age groups: <21, 21-26, 27-59, and 60+. The 60 and older age group was considered the older driver group. The 27-59 year old age group was considered the primary reference group for comparisons.

Results

Driver Factors and Types of Crashes

Drivers' Ages and Crash Severity

Table 1 shows the distribution of fatal, non-fatal, and total crashes by age. Fatal crashes accounted for 1.6% of the crash involvement of older drivers, compared with 1.3% for truck drivers in the 27-59 year range. There is a tendency observable in the table for older truck

drivers to have a higher proportion of fatal crashes. It is important to note that this difference may not be meaningful, given the standard errors in the dataset or operational differences in driving. For example, older drivers may drive more in long-haul trucking and on high-speed roads.

Table 1. Driver Age by Crash Severity

Age group	Fatal		Nonfatal		Total	
	N	%	N	%	N	%
<21	123	1.0	12,376	99.0	12,499	100
21-26	762	0.8	93,359	99.2	94,121	100
27-59	11,774	1.3	900,829	98.7	912,603	100
60+	1,962	1.6	118,203	98.4	120,165	100
Unknown	61	0.1	89,867	99.9	89,928	100
Total	14,682	1.2	1,214,634	98.8	1,229,316	100

Drivers' Truck Types

Table 2 shows the types of trucks driven by older and other drivers who have been in crashes. Truck type is of interest because it is tied to operational differences and there are differences in performance and handling. An SUT is a single-unit truck. A 'medium-duty' SUT is 10,001-26,000 lb. GVWR. A commercial driver's license is not required to operate a medium SUT. A 'heavy-duty' SUT is greater than 26,000 lb. GVWR. Approximately 11% of medium SUTs and 20% of heavy SUTs were pulling trailers. A Double or Triple is a tractor pulling two or three trailers. A Bobtail is a tractor with no trailer. When compared to all other age groups, the distribution of truck configurations driven by older drivers looked very similar to the distribution for drivers in the 27-59 age group.

Table 2. Percentage of Truck Configurations by Age, Crashes of All Severities

Truck type	<21	21-26	27-59	60+	Unknown	Total
Medium SUT	65.3%	51.5%	25.8%	20.7%	11.6%	26.7%
Heavy SUT	13.6%	14.8%	18.4%	20.7%	4.5%	17.3%
Bobtail	0.0%	0.4%	1.5%	2.5%	1.2%	1.5%
Tractor-Semi	6.5%	24.9%	42.0%	46.7%	38.4%	40.5%
Double, Triple	0.3%	0.4%	1.4%	1.1%	0.9%	1.3%
Other/Unknown	14.2%	7.9%	10.9%	8.3%	43.5%	12.8%

Drivers' Seat Belt Use

The distribution of seat belt use by age is presented in Table 3. Older drivers were reported as wearing a seat belt in most crashes (88.6%, with 5.3% unknown). These percentages may be biased toward higher use because there are incentives to misreport, given legal and company requirements to use seat belts, and the opportunity to misreport, since in most crashes the driver is not injured and is out of the truck when first responders arrive. However, the incentive to over-report belt use would be the same for each age group.

Table 3. Distribution of Safety Belt Use by Driver Age, Crashes of All Severities

Belt use	<21	21-26	27-59	60+	Unknown	Total
None	1.5%	3.0%	1.4%	1.9%	0.5%	1.5%
Shoulder and Lap Belt Used	91.6%	88.4%	85.6%	88.6%	13.5%	80.9%
Shoulder Belt Only Used	0.0%	0.1%	0.4%	0.2%	0.1%	0.4%
Lap Belt Only Used	0.3%	1.2%	2.3%	2.6%	0.4%	2.1%
Restrained, Unknown Type	1.0%	2.5%	3.4%	1.5%	0.7%	2.9%
Other/Unknown	5.5%	4.8%	6.9%	5.3%	84.8%	12.3%

Drivers' Injury Severity

Table 4 shows the distribution of truck driver injury by driver age. Injury severity is characterized using the KABCO scale, which is common on US crash reports. K-injury is fatal, A-injury is defined as incapacitating, B-injury is non-incapacitating but evident, C-injury means complaint of pain, but the injury is not evident and O means no injury-property damage only. Older drivers were somewhat more likely to be killed in crashes than those in younger age groups and were more likely to sustain no injury at all.

Table 4. Distribution of Driver Injury Severity by Age, Crashes of All Severities

Truck Driver Injury	<21	21-26	27-59	60+	Unknown	Total
K-Fatal Injury	0.2%	0.1%	0.2%	0.4%	0.0%	0.2%
A-Injury	1.3%	0.6%	0.7%	0.5%	0.0%	0.6%
B-Injury	7.3%	2.6%	2.1%	2.1%	0.1%	2.1%
C-Injury	6.0%	3.2%	2.7%	2.8%	0.4%	2.6%
Injured, Unknown Severity	0.9%	0.1%	0.2%	0.0%	0.0%	0.2%
O-No Injury	82.4%	93.3%	93.7%	94.1%	23.7%	88.5%
Other/Unknown	1.9%	0.1%	0.4%	0.1%	75.8%	5.9%

Crash Types

Table 5 presents the distribution of crash types by truck driver age. There appeared to be a tendency for older drivers to be involved in run off the road crashes at a somewhat higher rate than younger drivers. Older drivers were also more likely to be the encroaching vehicle in a same direction sideswipe crash. They were also somewhat more likely to turn across the path of another vehicle in a crash (note that right-of-way is not known in these crashes, just the basic geometry – position and relative movement – of the vehicles) compared to younger drivers. Finally, older drivers were more likely to be the striking vehicle in crossing paths crashes (straight into other) than other driver age groups. Right-of-way is not known for these crashes, so it is not known whether they were at fault.

Table 5. Distribution of Crash Type by Driver Age

Crash type	<21	21-26	27-59	60+	Unknown	Total
Truck went off road, under control or not under control	11.8%	8.1%	7.3%	9.4%	4.4%	7.4%
Truck hit object (often pedestrian, bicyclist or animal) in roadway	2.2%	7.4%	7.2%	7.0%	11.1%	7.4%
Truck struck another vehicle in the rear, on the same roadway	23.9%	14.7%	10.3%	9.7%	6.4%	10.4%
Other vehicle struck truck in rear (complement of above)	6.6%	10.2%	8.9%	8.6%	3.2%	8.6%
Other rear-end crash	2.0%	0.8%	0.9%	0.7%	0.4%	0.8%
Same direction sideswipe, truck encroached on other vehicle	7.5%	6.0%	7.7%	8.3%	21.1%	8.6%
Same direction sideswipe, other vehicle encroached on truck	0.3%	4.9%	8.2%	6.5%	5.6%	7.5%
Same direction sideswipe, some other situation	4.4%	3.2%	4.3%	4.1%	5.0%	4.3%
Head-on crash, truck crossed centerline into other vehicle	1.2%	0.3%	0.1%	0.0%	0.0%	0.1%
Head-on crash, other vehicle crossed centerline into truck	0.1%	0.3%	0.6%	0.5%	0.1%	0.5%
Head-on crash, some other situation	0.0%	0.0%	0.1%	0.3%	0.0%	0.1%
Opposite direction sideswipe, truck encroached into other vehicle	1.5%	2.0%	1.1%	1.0%	3.4%	1.3%
Opposite direction sideswipe, other vehicle encroached into truck	2.2%	2.4%	1.6%	1.6%	0.6%	1.6%
Opposite direction sideswipe, other situation	0.0%	1.4%	0.8%	0.8%	0.5%	0.8%
Truck turned across the path of the other vehicle	3.1%	6.8%	8.2%	10.8%	3.7%	8.0%
Other vehicle turned across the path of the truck	8.9%	5.3%	5.1%	5.2%	1.8%	4.9%
Some other turning crash	0.0%	5.1%	5.1%	5.6%	5.7%	5.1%
Both vehicles going straight, truck struck side of other vehicle	3.7%	1.4%	1.8%	2.6%	1.1%	1.8%
Both vehicles going straight, other vehicle struck side of truck	5.5%	3.9%	2.2%	2.1%	0.9%	2.3%
Both vehicles going straight, other situation	2.4%	0.2%	0.4%	0.1%	0.0%	0.3%
Truck backed into other vehicle	0.7%	4.2%	5.6%	3.9%	8.5%	5.5%

Other vehicle backed into truck	0.0%	0.9%	0.8%	1.1%	0.0%	0.8%
Some other accident type not in the above; most of these are crashes where the first harmful event involved other vehicles & the truck was involved later. An example is a vehicle struck another vehicle and pushed that vehicle into the truck.	9.6%	10.0%	11.2%	9.5%	13.2%	11.1%
Unknown crash type	2.4%	0.4%	0.5%	0.6%	3.1%	0.7%

Rollover Crashes

A rollover crash significantly increases the probability of truck driver fatality. When crashes of all injury severities were examined, older drivers rolled over at about the same percentage as all other age groups: 3.8% of involvements. Considering fatal crashes alone, the distribution is somewhat different and is presented in Table 6. Older drivers rolled a few percentage points more than drivers in the 27-59 year old age group. 'Tripped' rollovers typically follow collisions with other vehicles or objects (after running off the road). 'Untripped' rollovers typically occur while attempting to traverse a curve at too-high a speed or overcorrecting after running off the road.

Table 6. Distribution of Rollover in Fatal Crash Involvements

Type of rollover	<21	21-26	27-59	60+	Unknown	Total
No Rollover	78.0%	83.6%	86.7%	84.1%	96.7%	86.2%
Rollover, Tripped by Object/Vehicle	18.7%	13.4%	11.3%	12.7%	3.3%	11.6%
Rollover, Untripped	2.4%	2.5%	1.8%	2.8%	0.0%	2.0%
Rollover, Unknown Type	0.8%	0.5%	0.2%	0.4%	0.0%	0.2%

Environment Factors

Light Condition

Table 7 shows the distribution of light condition for truck-involved crashes by age group..
Crashes occurred predominately in daylight hours for all age groups. Dark-Lighted conditions
are typical of urban roads at night. Dawn and Dusk combined for about 3.3% of older driver
crashes, which is higher than other groups and is a nontrivial proportion.

Table 7. Light Condition by Driver Age, All Crash Severities

Light condition	<21	21-26	27-59	60+	Unknown	Total
Daylight	82.1%	83.8%	79.9%	82.5%	74.5%	80.1%
Dark - Not Lighted	6.5%	3.9%	7.4%	6.7%	8.3%	7.1%
Dark - Lighted	7.8%	9.4%	9.4%	6.9%	13.1%	9.4%
Dawn	0.5%	0.8%	1.9%	1.3%	1.1%	1.7%
Dusk	0.3%	1.6%	0.9%	2.0%	0.8%	1.1%
Dark - Unknown Lighting	2.8%	0.5%	0.3%	0.2%	0.6%	0.3%
Other/unknown	0.1%	0.0%	0.3%	0.5%	1.6%	0.0%

Roadway Alignment

Table 8 shows the distribution of roadway alignment of truck-involved crashes by age group. As
shown in Table 8, most crashes of older truck drivers occurred on straight road segments, which
is the common experience.

Table 8. Distribution of Roadway Alignment by Driver Age, All Crash Severities

Roadway alignment	<21	21-26	27-59	60+	Unknown	Total
Non-Trafficway or Driveway Access	1.8%	1.8%	1.9%	1.5%	2.1%	1.9%
Straight	80.6%	81.8%	83.0%	82.2%	82.1%	82.7%
Curve Right	3.2%	4.1%	3.3%	2.5%	2.8%	3.2%
Curve Left	2.5%	1.6%	3.3%	4.0%	1.4%	3.1%
Curve - Unknown Direction	6.8%	3.4%	2.7%	2.3%	1.9%	2.7%
Unknown	5.2%	7.3%	5.8%	7.5%	9.7%	6.4%

Road Surface Condition

Table 9 shows the distribution of road surface condition for truck-involved crashes by age group. Almost 80% of crash involvements occurred on dry roads. Older drivers were similar to those in the other age groups.

Table 9. Distribution of Road Surface Condition by Driver Age, All Crash Severities

Road surface condition	<21	21-26	27-59	60+	Unknown	Total
Non-Trafficway or Driveway Access	1.8%	1.8%	1.9%	1.5%	2.1%	1.9%
Dry	82.9%	82.5%	79.3%	79.6%	76.5%	79.4%
Wet	10.8%	10.8%	13.0%	12.7%	14.7%	12.9%
Snow/ice/frost/slush	1.9%	3.8%	4.6%	4.6%	4.4%	4.5%
Other condition	0.0%	0.2%	0.3%	0.6%	0.0%	0.3%
Unknown	2.6%	0.8%	0.8%	1.0%	2.2%	0.9%

<u>Driver Actions/Errors</u>

Speeding

The distribution of speeding-related truck crashes by age group is presented in Table 10. Older drivers were identified as speeding (combining all speeding types included in the table) in about 7.2% of crashes, a percentage that was not notably different from the 27-59 age group.

Table 10. Distribution of Speeding Related by Driver Age, All Crash Severities

Speed related?	<21	21-26	27-59	60+	Unknown	Total
No	84.6%	91.2%	92.1%	92.1%	39.6%	88.1%
Yes	12.3%	6.9%	5.2%	5.0%	2.9%	5.2%
Yes, Exceeded Speed Limit	1.9%	0.2%	0.1%	0.0%	0.0%	0.1%
Yes, Too Fast for Conditions	0.7%	0.9%	1.5%	2.1%	1.0%	1.4%
Yes, Specifics Unknown	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%
Unknown	0.4%	0.8%	1.1%	0.8%	56.4%	5.1%

Alcohol-related

Table 11 shows the distribution of truck-involved crashes by age group and whether or not the driver had consumed alcohol. Table 11 shows that the percentage of older drivers coded as having consumed alcohol prior to the crash was vanishingly small. It was low for all driver age groups, but considerably less for older drivers.

Table 11. Distribution of Driver Drinking, All Crash Severities

Driver drinking	<21	21-26	27-59	60+	Unknown	Total
No	96.8%	94.3%	93.7%	95.4%	20.3%	88.6%
Yes	0.1%	1.3%	0.4%	0.1%	0.1%	0.4%
Unknown	3.1%	4.3%	5.9%	4.5%	79.6%	11.0%

In summary, the data analysis stage provided an overview of the driver-level and environmental factors that need to be considered in the development of a program designed to better manage the safety of older truck drivers. The next stage of this project was to further explore the factors influencing the safety of older truck drivers by exploring where interventions have been focused and the alignment with the factors relevant to older drivers.

Review of Literature

Methods

The purpose of this task was to critically review studies published in the literature that focus on crash-prevention strategies related to truck drivers, including interventions, both in the US and in other countries. The review focused largely on studies conducted in the past 10 years. The search for relevant documents (e.g., journal articles, technical research reports, government reports) was conducted by first developing a set of selection criteria to yield literature on prevention strategies in the trucking industry. The set was developed with input from contacts the team has with trucking companies and the project teams' knowledge of the trucking industry. Databases searched included MEDLINE, PSYCINFO, TRID, NTIS, ProQuest, Scopus, and Google Scholar.

Results

All industrialized economies rely upon truck drivers to transport goods and keep products ready and available for the consumer. The trucking industry moves 9.2 billion tons of freight annually in the US alone, making up roughly 70% of all freight tonnage moved (American Trucking

Associations, n.d.). In May of 2015, there were over 1.6 million heavy truck and tractor-trailer truck drivers in the US (Bureau of Labor Statistics, U.S. Department of Labor, 2016a).

Decrease in New Driver Influx
Given the importance of the trucking industry for many countries' economies, it is especially concerning that the trucking industry is facing a crippling shortage of drivers. The current shortage of truck drivers ranges from 30,000-35,000 (Short, 2014) and is expected to reach 240,000 by 2022 (American Trucking Association, 2013). This shortage is largely due to a lack of influx of new drivers into the industry. Contributing to this is an age restriction that drivers must be at least age 21 to obtain a Commercial Driver License (CDL), thus preventing them from driving trucks with a GVWR over 26,000 lbs. As a result, potential new drivers may be discouraged from pursuing a career in trucking (Short, 2014).

Aging of the Truck Driver Workforce
Data shows that the truck transportation industry only relies on the ages of 20-24 for 4.9% of their drivers (Short, 2014). In contrast, 9.8% of the national workforce is comprised of workers ages 20-24. The trucking industry is comprised of only 15.6% of workers age 25-34 (Short, 2014), compared to about 22% for the overall workforce (Bureau of Labor Statistics, U.S. Department of Labor, 2016b). In the last decade, (1994-2013) the percentage of drivers age 25-35 has decreased from 30% to 15% while the percentage of drivers age 55-64 has increased from 8% to 20% and age 65 years and older has increased from 2% to 6% (Short, 2014). The aging of the trucking workforce creates new aging-related problems that must be addressed if the industry is going to meet the needs of a continuously growing economy.

Aging Related Health Risks
As drivers age, they are more likely to experience health conditions and that impact driving abilities (Eby, Molnar & Kartje, 2009). The three main abilities associated with driving are cognition, vision, and psychomotor abilities. Psychomotor abilities that can decline include reaction time, flexibility, coordination, and strength. Several visual abilities can also decline including: eye movements, sensitivity to light, dark adaptation, glare recovery, acuity, spatial contrast sensitivity, visual field, space perception, and motion perception. Common declines in

cognitive abilities include: attention, memory, problem solving, and spatial cognition (Eby, Molnar, & Kartje, 2009).

Driver Fatigue

One study concluded that driver fatigue is a significant risk in about 10% of drivers on the road today, for both commercial and non-commercial drivers (Adams-Guppy & Guppy, 2003). Because of the general lack of younger truck drivers, the aging truck drivers are often required to drive longer routes. Declining health can also lead to a higher susceptibility to the effects of fatigue while driving. Older individuals have a harder time maintaining circadian function and are therefore fatigued more easily (Di Milia, Smolensky, Costa, Howarth, Ohayon & Philip, 2011). Because of the reliance of the US economy on trucking, it is important to understand the challenges it is facing with a quickly aging workforce and learn how to most effectively deal with these challenges.

Countermeasures and Strategies for Improving the Safety of Older Truck Drivers

Truck-involved crashes tend to be more severe than other crashes, resulting in more life and property losses despite constituting a relatively small proportion of all crashes. Therefore, improving truck industry safety remains an important goal and focus of many researchers and professionals.

A number of countermeasures and strategies have been developed to improve the safety of older truck drivers. Among these are classroom courses and hands-on training programs that help older drivers learn more about their declining abilities and the influence of these declines on driving performance. Other countermeasures include special license testing procedures, as well as changes to road and vehicle design that are beneficial for older drivers (Elliott, Elliot & Lysaght, 1995). Although older drivers in the general driving population may be able to adapt their everyday driving habits as their abilities decline (e.g., by driving less, driving at lower speeds, or avoiding driving at night; e.g., Molnar et al., 2013), the compensatory strategies of value to truck drivers may need to be more complex. For example, among the strategies proposed in one study to overcome the declining abilities of older truck drivers were the application of an auditory navigational system, automatic transmissions, training on visual search and scanning patterns,

and an on-board advanced auditory warning system (Llaneras, Swezey, Brock, Rogers & Van Cott, 1998). An added challenge is that for older truck drivers, compensatory strategies for declining abilities need to be coupled with other considerations such as reducing burden and making changes to the operation of the larger system.

<u>Countermeasures and Strategies for Truck Drivers of All Ages</u>

Because countermeasures and strategies specifically targeted at older truck drivers are limited, more general countermeasures and strategies for truck drivers of all ages are worth examining. The general countermeasures and strategies fall into four general categories that capture the unique characteristics and demands of the trucking industry in terms of driver tasks, vehicle types, and system management. These four categories are driver-related, vehicle-related, technology-related, and other kinds of strategies. These categories are explained in more detail in the following sections.

Driver-related Strategies

Knipling, Hickman, and Bergoffen (2003) provided a comprehensive overview of driver-related strategies for improving truck driver safety. The strategies mapped to several driver-related areas including: driver recruiting, selection, or training; management-driver communications; driver-performance evaluation; safety incentives; improved driver scheduling and dispatching; fatigue management; or carrier-based medical provision. The authors reported results from a survey of commercial motor vehicle safety managers asking about effective methods for improving safety. The top six responses were:

1. Regularly scheduled vehicle inspection and maintenance;
2. Hiring based on criteria related to driver crash, violation, or incident history;
3. Continuous tracking of drivers' crashes/incidents/violations;
4. Requiring that new hires meet or exceed a minimum number of years of driving experience;
5. Crash and incident investigation by carrier management; and
6. Standardized training for all new hires.

Strengthening the Commercial Driver License (CDL) program by addressing issues of cheating and fraud has also shown promise for improving the safety performance of truck drivers. To this end, Blower and Kostyniuk (2013) identified several methods for discouraging cheating and fraud including improving administration and using computer software for the test, as well as overt surveillance on examiners. In addition, considerable attention has been given to reviewing the training of truck drivers, especially the content of instruction and instructional technology, to identify opportunities for expanding training programs to better meet driver need and improve training quality (Brock, McFann, Inderbitzen, & Bergoffen, 2007).

Vehicle-related strategies

Regularly scheduled vehicle inspections and maintenance have been identified by safety managers as one of the most effective strategies for improving truck safety (Knipling, Hickman, Bergoffen, 2003). The reason for this is that mechanical defects of the vehicles make operating a commercial motorized vehicle more challenging for drivers. Some common defects relate to braking, lighting, and steering system problems. Small fleets have been found to experience more problems with vehicle maintenance than large fleets (Blower & Kostyniuk, 2013).

Blower and Kostyniuk (2013) have proposed four specific strategies to improve the vehicle inspection and maintenance process. First, targeted enforcement should be used to maximize the effects of limited enforcement resources, with resources allocated to the areas with the most crash costs. Second, preventive maintenance should be mandated rather than implemented by fleets on a voluntary basis. This, however, would not only require new legislation but also additional enforcement resources, when existing resources are already limited. Third, proactive approaches should be used instead of punishment to encourage fleets to improve deficiencies in compliance. For example, problem carriers could write a letter to the state outlining their plans to improve identified deficiencies in operation. Finally, educational, training, and consultation programs should be used to improve the process of vehicle maintenance and inspection.

Technology-related strategies

Although the Federal Motor Carrier Safety Standards (FMCSS) specify the minimum standard that trucks must meet, innovative vehicle design and advanced assistant technology could be

effective in increasing the safety of truck drivers. For example, electronic braking systems, higher performance tires, conspicuity lighting, and convex and fender-mounted side mirrors can reduce safety risks and make operation easier. Some other advanced technologies like radar-based collision avoidance systems, adaptive cruise control, back-up camera systems, electronic vehicle speed regulation and so on, can help to prevent crashes (Blower & Kostyniuk, 2013). New technology is an effective way to improve safety, however, these technologies can increase the cost of vehicles, maintenance, and management, and may be resisted by drivers, especially older drivers. Therefore, their introduction may require strategies to encourage their use (Blower & Kostyniuk, 2013).

Other strategies

In addition to these direct strategies to help improve truck driver safety, some indirect countermeasures, which may take longer to impact truck driver safety, have also been proposed. Blower and Kostyniuk (2013) identified some countermeasures in this group. For example, increasing knowledge of other drivers on the road about how to share the road with trucks and how to drive safely around trucks has been proposed as a strategy, such as the Ticketing Aggressive Cars and Trucks (TACT) program (see e.g., Kostyniuk et al., 2014) Another element that is important to developing long-lasting and effective safety management is the maintenance of high-quality crash data. Reliable, clean, and unambiguous data are essential for identifying CMV safety problems systematically. However, some problems like incomplete data and complicated recording methods create obstacles for researches. Strategies for improving the utility of crash data are necessary.

In summary, the interviews provided an overview of interventions in the trucking industry. The review identified limited literature targeting older truck drivers. While some intervention is relevant to the factors influencing the safety of truck drivers, there is opportunity to better target strategies to this unique population. To better understand the unique issues influencing truck drivers, beyond driver and environmental factors, interviews were conducted with safety managers and older truck drivers.

Interviews with Safety Managers and Older Truck Drivers

Methods

Separate interviews were conducted with fleet/safety managers within trucking companies and with older truck drivers to better understand the complexities of trucking company management and truck driver relationships. The structured interview questions were based on Newman and Goode's (2015) system-based Heavy Vehicle Accident Analysis Method framework and included six primary discussion areas:

1. Unique positives older drivers bring to the job;
2. Concerns about older drivers;
3. Current strategies to help older drivers;
4. Challenges with current strategies;
5. Strategies participants want to try but have not yet; and
6. Desired additional help from others.

Specific question wording varied for fleet/safety managers and older drivers. The discussion guides can be found in Appendix A (fleet/safety managers) and Appendix B (older truck drivers). The interview protocol and questions were reviewed and approved by the University of Michigan's Health Sciences and Behavioral Sciences Institutional Review Board (IRB) and the study was determined to be exempt from IRB oversight.

Interview Format

The researchers originally planned to conduct all interviews as structured group interviews but during the recruitment process learned that it was not feasible to conduct group interviews with older truck drivers due to the demands of their work schedules and lack of sufficient overlapping availability to assemble a group. As a result, the fleet/safety manager interviews were conducted via two structured group interviews and the older truck driver interviews were conducted via individual telephone interviews. The group interviews lasted approximately two hours and were facilitated by a trained moderator with three members of the research team serving as note-takers. The telephone interviews lasted approximately 30 minutes and were facilitated by a trained interviewer who also served as the note-taker.

<u>Participants</u>

In all, 19 individuals participated in the interviews which was within the research team's target range of 16-20 participants. Each participant received $50 as compensation and light refreshments were served at the group interview sessions.

Fleet/safety managers were recruited with assistance from the Michigan Trucking Association, a statewide trade association for motor carriers, which sent email invitations to the members of its Eastern Michigan Safety Council and Western Michigan Safety Council. The councils' membership consists primarily of motor carrier safety and maintenance management personnel. Two group interview sessions were conducted, one in eastern Michigan and one in western Michigan. There were a total of 15 participants between the two sessions. Participants included 10 safety managers/directors, 1 transportation director, 1 service center director, 1 vocational rehabilitation specialist, 1 transportation staffing company director, and 1 driver certification support service representative. The participants represented motor carriers with a range of characteristics: small (15 drivers) and large (15,000 drivers) carriers; fleets comprised of varying distributions of company employees, union members/non-members, and independent owner-operators; and, percentages of older drivers ranging from 1% to 15% of fleets.

Drivers were recruited with assistance from fleet/safety managers that had participated in the group interviews. Fleet/safety managers forwarded interview invitations to their drivers aged 60 years and older. Drivers interested in being interviewed contacted the research team to schedule an interview. Four drivers completed interviews. Two drivers were company employees and two were independent owner-operators, all of the participants had been heavy truck drivers for twenty years or longer, and all of the drivers worked for carriers with fleet sizes of 100 drivers or smaller.

Results

Themes Emerging from Fleet/Safety Manager and Older Driver Interviews

Unique positives older drivers bring to the job

Safety managers and drivers described several assets of older drivers and were consistent in their responses. Participants praised older drivers' work ethic, reliability, maturity, knowledge, and experience. Specifically, participants observed that older drivers were more likely than younger colleagues to:

- Arrive for the start of a shift/trip on time;
- Be more detail-oriented;
- Know how to operate the vehicle properly and drive safely;
- Make better decisions;
- Have a better sense of when something is wrong (e.g., when to push and when to hold back in bad weather);
- Detect when a vehicle is not operating properly, and
- Conduct pre- and post-trip checks more thoroughly.

Several noted that older drivers were valuable mentors to younger drivers, when younger drivers were receptive. Multiple participants described the respect and care older drivers have for their equipment and vehicles and that older drivers have considerable pride in their vehicles and in their own maintenance of their vehicles. Participants related several examples of older drivers' superior trip planning skills. Older drivers were more likely than their younger colleagues to research and select the most efficient and safest routes, to monitor road and weather conditions frequently, and adjust routes and/or departure times accordingly. One participant described how an older driver will monitor weather forecasts and depart several hours earlier than planned to get ahead of an approaching snow storm, whereas, a younger driver will check the weather when he leaves his house and walks into the snow and then will call dispatch to delay his delivery. Another participant said that older drivers are more likely to interact with fellow drivers at truck stops and ask about road conditions ahead, while younger drivers are less likely to interact with colleagues and more likely to engage with personal electronic devices during truck stop visits. In addition to taking pride in their vehicles, older drivers were noted for demonstrating pride in

doing their job well and for accumulating miles that were crash- and incident-free. Finally, participants noted that older drivers often have greater loyalty to their employers than younger drivers. They explained that the older drivers recognize and appreciate employment characteristics that contribute to a "high quality of work life" and they remain with those employers for long periods of time. Younger drivers are more likely to "chase a dollar an hour more here or there" and change employers more frequently.

Concerns about older drivers

Participants also described concerns about older drivers. The most frequently reported concern by safety managers and older drivers was the physical demand of loading and unloading. Drivers are generally responsible for loading and unloading their cargo and almost unanimously the participants described older drivers' increasing difficulty completing this task without help. Participants were concerned that older drivers are more likely to fall during loading/unloading, that the stress on their bodies from lifting heavy cargo and equipment could lead to injuries, and that they may not be strong enough to "tie things down" effectively enough to secure loads. Older drivers tend to take longer to complete loading and unloading their trucks. This contributed to another frequently mentioned concern, that older drivers have a longer delivery time per load/trip. Slower loading and unloading times contribute to longer overall delivery times as does a tendency by older drivers to plan routes based on route familiarity, preferred road characteristics and conditions, and safety as opposed to the fastest route possible. Multiple fleet/safety managers noted that they had noticed memory and other cognitive declines for some older drivers. None of the drivers interviewed mentioned this concern but some of the safety managers mentioned that they have had drivers approach them for help.

Another related concern expressed by fleet/safety managers, but not mentioned directly by older drivers, was concern about the general mental and physical health of older drivers after decades of working on the road. It is difficult for drivers of all ages to maintain healthy diet and exercise habits on the road and a career as a driver can be socially isolating, which can lead to an increased likelihood of mental health issues. One safety manager noted, "the sad reality of the trucking industry is that many drivers don't go home to families. It's hard to build relationships over a 30-40 year career. By the time they hit 70 they don't know what to do and may keep

driving longer than they should." By contrast, drivers did not express concern about their own health but expressed frustration about being required to pass physical examinations and that they could lose their medical certification if something "comes up" during the physical. Older drivers were particularly frustrated that being diagnosed with sleep apnea could prevent them from being certified because they do not see how it relates to driving and do not feel it is "something that should take away my livelihood."

Some safety managers noted conflicts between older drivers and younger co-workers. One manager described problems between older drivers and dispatch operators (who tended to be younger at that company) due to their opposing communication styles. Dispatch operators conducted all communication (including job assignments) with drivers electronically. This created a problem for some as older drivers preferred to communicate directly. When older drivers received an email or text message from a dispatcher the older driver would immediately call the dispatcher to obtain the information by phone. Dispatchers did not want to interact with the drivers and were frustrated by the telephone call while drivers were frustrated by the lack of personal interaction with dispatchers. Older drivers expressed frustration with younger drivers' laziness, short attention spans, and need for instant gratification. They did not attribute this to a lack of experience or maturity among younger drivers but to a generational difference present for the younger generation.

Safety managers and older drivers had concerns about the increasing integration of technology into the job, particularly electronic log books. Drivers expressed frustration with being forced to use valuable time to learn something new at this point in their career and that many feel is not needed. Further they were concerned that electronic log books brought "Big Brother into my cab" and would eliminate some of their freedom and decision-making and they were confident their decisions would be better because it would not be possible to get a computer to truly understand all the factors a veteran driver would consider. Safety managers were concerned about resistance from older drivers to learn, accept, and adopt technology particularly with pending federal requirements for all drivers to use electronic log books. In addition to resisting change in general, they have found that older drivers require more "hands-on" time to learn how to use the technology and require more explanation about the purpose of using the technology to

obtain their buy in. All of the safety managers had experience with older drivers moving to new companies to avoid using technology being adopted by their current employer. They anticipate a cohort of older drivers will continue moving to new companies to avoid using technology until they are eventually forced out of the industry.

Finally, safety managers pointed out that a significant overriding concern regarding older driver safety is that there are a wide range of differences among older drivers in every aspect of aging and driving performance/safety. This makes it challenging for them to anticipate, recognize, and address older drivers' needs.

Despite the concerns addressed, safety managers and older drivers clearly felt that older drivers are a valuable and even essential part of the industry. One safety manager said, "My main concern is that I need more of them!"

Current strategies to help older drivers
Safety managers described several strategies they were currently using to help older drivers and one noted that, "The littlest things make a difference." Overwhelmingly, safety managers said that building relationships and rapport with drivers was essential and the most effective strategy to recognizing when older drivers needed help and determining how to help them. Safety managers felt that if they were able to establish respect and trust with their drivers, their drivers would be more likely to discuss their concerns.

Resulting strategies managers have used included:
- Providing portable steps/stairs and straps for drivers to use during loading and unloading;
- Asking another employee to help drivers load and unload;
- Allowing drivers more time to complete jobs without adding "time pressure" (this includes trying to protect drivers from pressure from dispatchers, customers, and others);
- Giving older drivers trips that were easier or that they were more comfortable with or assigning them to dedicated runs that would be consistent and familiar to drivers;
- Tailoring technology training to the needs of older drivers;

- Providing wellness programs that ranged from comprehensive and tailored content and coaching from third party providers (more likely among the largest motor carriers) to making a library of self-guided literature available to drivers (more likely among the smallest motor carriers), and
- Some companies have workplace gyms or pay a portion of drivers' costs for gym memberships.

The drivers were aware of many of these strategies but did not consistently recognize their purpose. They were, however, very aware and appreciative of equipment and other assistance provided to help with loading and unloading.

All of the older drivers had noticed some declines in their performance and compensated for them in both their preparation for trips and in their driving itself. Drivers said that they carefully planned their routes to take "the best roads" and monitored weather forecasts to avoid driving in bad weather when possible. Several drivers had noticed that they become fatigued quicker than when they were younger and tried to increase their sleep the night before trips. On the road, drivers "really slowed down" during bad weather and drove at a speed where they felt comfortable. Also, some drivers had noticed that their reaction time was slower than when they were younger and have adapted by leaving more space between themselves and other vehicles.

Some drivers had made various attempts at eating healthier on the road by choosing restaurants with healthy options and taking snacks in a cooler. With an alternative approach, one driver said that he was very strict with diet and exercise at home to make up for sitting all day and eating truck stop food on the road.

Challenges with current strategies
Safety managers discussed several challenges to their efforts for older drivers. First, they must be careful to avoid discriminating based on age even when their intentions are to help. All strategies they adopt at their companies must be applicable to all of their drivers. Companies with a combination of company drivers and owner-operators or a combination of union members and non-members must be aware of federal and other regulations that may limit what strategies they

are allowed to offer to some drivers and what strategies they are allowed to require some drivers to participate in.

The safety managers' responsibilities are to keep the drivers, equipment, and cargo safe. That can often conflict with other employees within their own companies. Dispatchers, for example, are responsible for making sure loads are delivered on time and are often under pressure from the customers and their own company's ownership/management. As a result, safety managers sometimes have difficulty getting strategies approved and/or must overcome interference with strategies in use. They too often must advocate to protect their drivers even within their own company.

Multiple safety managers said that they've encountered more resistance to the wellness program activities by older drivers than from younger drivers. One safety manager said that he was so concerned about the health of his older drivers that he considered the advantages of older drivers (reliability, experience, etc.) to be nearly cancelled out by the increased risk of their unhealthy lifestyle (e.g., unhealthy diet, lack of exercise, limited social network/emotional support).

As expected, there were some difference in the challenges faced by safety managers at small carriers compared to their counter-parts at large carriers.

Drivers mentioned several challenges as well. Most commonly, they acknowledged that many of their strategies to be safer during loading/unloading and while driving led them to have slower delivery times than their younger counterparts. Drivers felt they were constantly being pushed by dispatch and the business office to be faster at all aspects of their job. One noted that they really had to resist the pressure if they wanted to stay at a pace where they felt comfortable. Those that attempted to eat healthier on the road had not yet been able to sustain the change. Finally, despite the efforts described by safety managers to establish bonds with drivers, most drivers expressed reluctance to reveal some physical, mental, and/or functional declines with anyone at the company due to a perceived risk that the information could be used to "fast track me right out of here."

Strategies participants want to try but have not yet

Several safety managers said helping drivers who were struggling with memory problems was one challenge they feel unequipped to manage. They said there are no DOT guidelines for memory or dementia. Other than closely tracking drivers with demonstrated memory issues, most had not yet implemented any strategies to help drivers.

Safety managers also expressed a wish to increase their older drivers' "buy in" for healthy living. Though not a strategy per se, multiple safety managers agreed that they wished they did not have to worry so much about their company's bottom line and could focus on the safety part of their job instead.

Finally, some safety managers semi-jokingly said that one strategy they would like to try is to talk their older drivers out of retiring. More seriously, one clarified "You want them to stay longer…how do you make their time the easiest it can be?"

Desired additional help from others

Specific assistance that safety managers wanted included resources to help them address drivers' memory problems and more frequent driver medical assessments, without penalty or risk of losing medical cards, to encourage more utilization of preventive care by older drivers. Additionally, they wanted medical examinations to be more comprehensive and to include cognitive assessment. Safety managers would like to have access to mobile simulators for assessments and/or training. They would like a change in focus, for all aspects of older driver safety, from an incident-based approach to prevention. Finally, safety managers would like to see a higher public value placed on truck driving careers to help them recruit and retain good drivers to the field and to allow truck drivers to be proud of their profession.

Truck drivers addressed this issue from a different perspective. They wanted everyone in the system from their managers, to the doctors that perform their medical examinations, to the "feds" to value what the older drivers bring to the job and leave them alone to do their job.

Conceptual Framework for Program Development

One of the original aims of this study was to develop a conceptual framework that could be used to guide management practices that support older truck driver safety. Consistent with the systems approach (Rasmussen, 1997), we envisioned a framework that would take into account factors relevant to the road freight transportation system and older truck drivers. To this end, we decided to draw upon the 'heavy vehicle accident analysis method', a system-based framework designed to better understand the factors contributing to crashes in the road freight transport system (Newnam & Goode, 2015). The framework includes six system levels: government policy and budgeting; regulatory bodies; other organizations and clients; road freight transportation companies; drivers and other actors at the scene of the crash; and equipment, environment and meteorological conditions (see Figure 1).
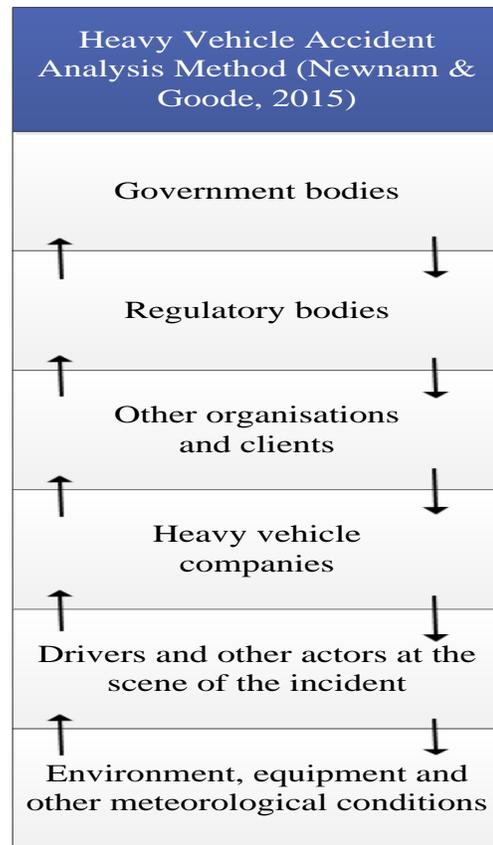
Figure 1: Heavy-Vehicle Accident Analysis Method

Underlying this framework is the understanding that crashes are caused by the decisions and actions of all actors within the system, not just front line workers alone (i.e., truck drivers). Safety is maintained through a process referred to as 'vertical integration,' by which decisions at higher levels of the system (i.e., government, regulator, company bodies) are reflected in practices occurring at lower levels of the system, while information at lower levels informs decisions and actions at the higher levels of the hierarchy (Cassano-Piche, Vicente & Jamieson, 2009; Svedung & Rasmussen, 2002).

Based on results from the analysis of truck crash data, review of the literature, and interviews with safety managers and older truck drivers, the research team identified factors within each system level of Newnam and Goode's framework that should be taken into account in establishing management practices that support the needs of older truck drivers. The level of other organizations and clients was not addressed separately as it was determined that relevant organizations were already picked up in the regulatory and government levels. Factors that were identified are discussed below by the level of the system to which they best fit.

Environmental, Equipment and Other Conditions
Factors at this level are associated with the vehicle and equipment (e.g., in-vehicle technology), the physical road environment (e.g., road conditions) and to the extent possible, meteorological conditions. These factors are important because of the effects they can have on safe driving when conditions are not optimal. For example, as noted in the review of the literature, equipment defects (e.g., with brakes, lighting, and steering systems) make operating a truck much more challenging. We were primarily interested in factors that affected older truck drivers in particular rather than truck drivers in every age group; however, some factors were determined to have more universal benefit and were therefore included.

The identification of factors at this level of the model come primarily from the crash analysis which provide several insights about environmental, equipment, and other conditions that could be used to inform the practices of safety managers with respect to older truck drivers. First, there appeared to be several conditions under which older truck drivers performed worse or had worse

outcomes than younger truck drivers. Among these were an overrepresentation of the following for older truck drivers versus truck drivers of other age groups:

- Crashes occurring at dawn or dusk (represented about 3.3% of total crashes among older truck drivers);
- Run off the road crashes;
- Being the encroaching vehicle in a same direction sideswipe;
- Turning across the path of another vehicle in a crash (based on position and relative movement of the vehicles);
- Being the striking vehicle in crossing paths crashes (straight into other; possibly due to running through a stop sign or traffic light at an intersection).

Second, there were a number of conditions under which older drivers performed the same as drivers of other ages or had similar outcomes. These included:

- Crashes occurring on straight road segments (most crashes);
- Crashes occurring on dry roads (representing about 80% overall);
- Incidents of speeding — of all types, including both exceeding the speed limit and too fast for conditions;
- Rollover crashes (about 3.8% of crashes overall; however, when restricted to fatal crashes, the risk is elevated for older drivers). As noted in the crash analysis, rollover is a very significant event because it increases the probability of truck driver fatality by up to 30 times. Rollover accounts for slightly over half of truck driver deaths in traffic crashes.

Finally, several conditions were examined where the performance of older truck drivers appeared to exceed that of drivers of other ages. These included high rates of belt use among older truck drivers and significantly percentage of older truck drivers coded as drinking, although low for all truck driver age groups. It is important to note that based on the crash data available to us, it was not possible to determine the relative contributions of environment/equipment/meteorological conditions versus driver factors to the various crash types.

In summary, the results from the crash analysis highlight several conditions that can negatively affect the safety of older truck drivers as well as drivers of other ages. The implications of these conditions for truck driver behavior are addressed in the appropriate level-specific discussions that follow (e.g., compensatory strategies of truck drivers for driving in adverse weather conditions are addressed in the truck driver level).

Truck Drivers

Factors at this level are associated primarily with cognitive, perceptual, and psychomotor abilities that come into play during the operation of trucks and how these factors can be managed within the workplace context. The identification of factors at this level came primarily from the literature review and the interviews with safety managers and older truck drivers.

An important finding from the literature was that as people age, many will experience declines in cognitive, perceptual, and psychomotor abilities that can compromise safe driving. These declines make driving especially challenging when driving and road conditions are less than optimal. Thus, from the truck driver perspective, it is of interest to examine the ways in which older truck drivers try to overcome or compensate for these declines, particularly when faced with challenging conditions in the environment.

One set of conditions, as discussed earlier, has to do with vehicle equipment. Results of the literature review pointed to the important role that appropriate maintenance of equipment plays in maintaining safety. This is one of the areas where older truck drivers appear to excel. For example, safety managers interviewed for the project considered older truck drivers to outperform their younger counterparts on several dimensions related to vehicle maintenance including: knowing how to operate the vehicle; detecting when the vehicle might not be operating properly; conducting more thorough pre and post trip checks; and more generally, respecting and caring for their equipment and vehicles. The main concern raised by safety managers about older driver performance relative to equipment had to do with their ability to physically handle loading and unloading of cargo (e.g., greater risk of falling, injuring themselves over time due to the added physical stress, difficulty tying down to sufficiently secure, slower loading and unloading times).

Equipment upgrades in the form of new and emerging technologies could also lead to improvements in safety, although it appears that barriers may exist. For example, both safety managers and older truck drivers raised concerns about the need to integrate new technology (including learning how to use it, accepting it, and adopting it). While much of the discussion focused on electronic log books, more general concerns were expressed by safety managers

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about older truck drivers requiring more "hands on" learning and more explanation before they were willing to accept the new technology. All reported situations in which an older truck driver had left their company in order to avoid having to use a new technology.

A second set of conditions has to do with inclement weather. Safety managers thought that older drivers prepared better for adverse weather conditions than their younger counterparts by monitoring road and weather conditions earlier and more often, and adjusting their routes and driving times accordingly. Older truck drivers themselves reported noticing some declines in their performance and highlighted the role of careful trip planning and weather monitoring to avoid having to drive in inclement weather whenever possible. Drivers also reported driving more carefully (e.g., driving at slower speeds, leaving greater gaps between themselves and the vehicles ahead of them).

Other more general strengths of older truck drivers identified by safety managers included greater reliability (e.g., arriving on time), attention to detail, and loyalty, strong work ethics, better decision making. These qualities may not have direct implications for safety. More general concerns noted by safety managers included the general wear and tear on physical and mental health from working for years on the road (e.g., difficulty in maintaining healthy nutrition and exercise, social isolation). In addition, an overriding concern expressed by safety managers was that the heterogeneity of older drivers in terms of aging and driving performance makes it very challenging for them to anticipate, recognize, and address their needs.

The concerns raised by safety managers were not directly raised by the drivers themselves, although some reported that they tried to maintain a healthy diet on the road (e.g., by choosing healthy meals in restaurants or eating healthier at home). However, many drivers expressed concerns about feeling pressured from management (i.e., dispatchers and the business office) to perform all parts of their jobs faster, which they perceived to sometimes be at odds with improving safety. For example, several noted that their efforts to be safer during cargo loading and unloading resulted in slower cargo delivery times than younger truck drivers. Finally, while many drivers did acknowledge some declines in physical, mental, or other functioning, they were

reluctant to share information about these declines with anyone at the company because of the perceived risk to their continued employment.

Trucking Companies

Factors at this level are associated with strategies, practices, and policies at the supervisory and management personnel levels. The identification of factors at this level came primarily from the literature review and the interviews with safety managers and older truck drivers.

Results of the literature review pointed to a number of driver-, vehicle-, and technology-related strategies that have been or could be implemented by truck company managers/supervisors to improve truck driver safety. These included: employing strict criteria in hiring decisions including taking into account drivers crash, violation, and incident histories, and requiring a minimum number of years of experience; continuing to track crashes, violations, and incidents once drivers are hired; requiring regularly scheduled inspection and maintenance of trucks, using incentives to get drivers to address deficiencies, and making better use of education and training to improve the inspection and maintenance process; and providing standardized training for all newly hired drivers.

Results of the interviews with safety managers extended this set of strategies by including more nuanced and interpersonal approaches for helping older drivers. For example, a major focus of the strategies they employed was on building and sustaining relationships with older truck drivers, particularly by recognizing when drivers needed timely assistance, as well as establishing trusting and respectful relationships. Safety managers also recognized that their goal of keeping drivers, equipment, and cargo safe was sometimes in conflict with broader company goals, especially those related to fast or at least on-time deliveries. In addition, they noted that they were constrained by the need to make sure that the safety strategies they employ were applicable to all truck drivers and not just older drivers, to avoid any semblance of age discrimination, as well as the need to be responsive to various federal and other regulations that apply to certain workplace environments (e.g., mixed union and non-union membership).

Nevertheless, they did identify several strategies that they employ including: facilitating the process of loading/unloading cargo by providing portable steps/stairs and straps or having someone else provide assistance; adjusting job expectations by allowing more time to complete deliveries or assigning easier or more familiar trips; providing training on technology tailored to older drivers' needs; and providing various levels of wellness education, despite feeling that older drivers are more resistant to such education than younger drivers. One area they were not comfortable with was how to help older truck drivers who are experiencing memory problems or dementia. In fact, managers called for additional resources to assist them in this regard, as well as expanding medical examinations to include a cognitive assessment component. Other changes they thought would be beneficial included: greater emphasis on prevention (e.g., by increasing the frequency of driver medical assessments without penalty or risk of drivers losing their medical cards); greater value placed on truck driving as a career choice to improve recruitment and retention of good drivers; and more access to mobile simulators for assessment and training.

Government and Regulatory Bodies

This project did not involve direct interaction with government and regulatory bodies connected to the trucking industry. However, results from the literature review and interviews with safety managers and older truck drivers did provide some insights into the activities of these bodies and the gaps and opportunities relative to the development of safety strategies for older drivers, as well as the current government and regulatory frameworks.

One important focus for improving safety identified in this project was the vehicle inspection and maintenance process. While there are many actions that trucking companies could take to make this process more effective, some strategies either are not possible because of the current regulatory environment or fall outside the purview of truck company management. For example, One strategy identified in the literature for improving the vehicle inspection and maintenance process was to use targeted enforcement to maximize the effects of limited enforcement resources – this is an activity that would need to be initiated and carried out a government body (e.g., state police or state commercial vehicle regulators) rather than trucking companies. Another strategy – that of mandating rather than encouraging preventive maintenance would not

only require new legislation but also additional enforcement resources in an environment of scarcity.

Similarly, strengthening the Commercial Driver License (CDL) program through various efforts to reduce cheating and fraud would require changes at the regulatory level such as improving administration and using computer software for the test, as well as overt surveillance on examiners. Broader efforts to improve the CDL process such as expanding the criteria for completion or revamping training expectations, particularly to ensure adequate training on new technologies, would require major changes in how the program is structured and carried out.

Finally, results from the project suggest that at least some advanced vehicle technologies could help older truck drivers maintain safety. However, it is a government body – NHTSA – that sets the Federal Motor Carrier Safety Standards (FMCSS) that specify the minimum standards that trucks must meet. In addition, as noted earlier, these new technologies increase the cost of vehicles, maintenance, and management, and may be resisted by drivers. Therefore, the issues surrounding new vehicle technologies may start at the government/regulatory levels but have implications all the way down to the driver level where special training and education may be required to give older truck drivers a better understanding of these technologies and increase their acceptance of them.

Discussion

The end goal of this research was to develop a conceptual framework for a needs assessment tool designed to improve the safety management of older drivers in the trucking industry. The framework was informed through (1) an analysis of truck crash data, (2) review of the literature, and (3) a series of focus groups and interviews. This information can be used to guide the development of a system-based needs assessment tool that will assist the workplace to better manage the safety of older truck drivers and keep them on the road for longer.

Collectively, results from the literature review, crash data analysis, and interviews with safety managers and drivers suggest that a tailored needs assessment tool could bring value to the trucking industry. First, from the literature review, we learned that that there are age-related

health risks in cognition, vision, psychomotor abilities, and fatigue susceptibility that can negatively affect driving safety. Although strategies tried at the company and government/regulatory level have included training drivers about declining abilities and their impact on driving performance, skill training (e.g. visual searching and scanning patterns), new technologies, special licensing procedures, and changes to road and vehicle design, these are fragmented. From the crash analysis, we learned that there are situations in which older drivers have worse outcomes/performance and various environmental, equipment, meteorological, and driver-related factors played a role. From the interviews, we learned that safety managers and drivers are aware of declines among older drivers and of adjustments that older drivers make to minimize those declines.

Safety managers also make adaptations for their older drivers (e.g., preferred route assignment, equipment and staff help with loading/unloading, allowing slower delivery time). However, despite the strategies reported by safety managers and drivers, gaps in knowledge and practice were evident with implications for all levels. Drivers reported fewer declines than safety managers and did not fully understand the safety implications of some health issues (e.g. sleep apnea). Some were also resistant to programs they felt were forced on them or that could result in their losing their job. There may be potential there for intervention at the driver level of the framework to increase understanding and buy-in from older drivers. Safety managers also face resistance from owners and management in parts of the company more focused on delivery time and keeping customers happy. There may be potential intervention at the company level to increase understanding and buy-in from the safety manager's bosses and managerial colleagues such as cost-benefit training to help them understand the potential benefit of keeping older drivers healthy. Safety managers have a very tough role and may need the most complex help from an intervention or tool (e.g. how to advocate for their drivers with the levels above them in the framework and how to effectively connect with and help their drivers). Drivers also seemed hesitant to engage in any strategy, regardless of its good intent or potential helpfulness, if they felt that their certification or job status might be jeopardized in any way. This will need to be addressed at all levels, perhaps through protections implemented by government/regulators and companies and clearly communicated and demonstrated to drivers.

The nature of the trucking industry itself, especially current trends in the industry highlight the importance of finding suitable educational interventions to help keep aging truck drivers safely on the road. Trucking is a demanding career - physically, mentally, and emotionally. Drivers have a strong desire to remain on the job as long as possible and safety managers are motivated to keep them on the road as long as possible given the driver shortage and the positive qualities older drivers bring to the job.

Further, we know from the literature review that there is a heavy reliance on the trucking industry to transport goods (70% of the US freight tonnage) that is not likely to decrease. At the same time, there has been a decreasing influx of new, young drivers into the trucking workforce. The lack of new drivers paired with the increasing demand for truck transport are contributing to the aging of the truck workforce and an over-representation of older drivers in the trucking industry compared to same-aged counterparts in the overall workforce.

The driver shortage was also mentioned during the interviews. Those discussions suggest that there is not only pressure to keep older drivers on the job longer, there is also a cascading workload pressure while they are on the job which is experienced at multiple levels. Carriers' business management needs to keep customers happy and make deliveries on time. The number of deliveries is increasing while the number of drivers is not; thus trucking companies need (existing) older drivers to maintain and even increase their workload, which is not sustainable. At the same time, safety managers have to balance their responsibility to ensure driver safety with pressure from business management to complete jobs quickly. Finally, the drivers themselves are highly motivated to stay on the job as long as possible and feel pressure to meet workload demands from their carriers without showing weakness, but at the same time are noticing age-related changes in their performance. All of these stakeholders seem motivated to keep older drivers (who are already trained and highly experienced) on the job as long as possible. Balancing those pressures with the health-related best interests of older drivers is something that will need to be addressed at multiple levels (i.e., organizations/clients, truck companies, and drivers) by a needs assessment tool. Further, separate needs assessments and interventions are likely needed within companies (e.g. ownership versus dispatchers versus safety managers).

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APPENDIX A: SAFETY MANAGER DISCUSSION GUIDE

1. **Icebreaker: Roughly what percentage of your drivers are age 60 and older?**

2. **Icebreaker: What are some of the positives they bring to the job that are unique to older truck drivers?**

3. **Now let's think about any concerns you might have about older truck drivers. This can include challenges that older truck drivers face in any part of their job, unique needs for older truck drivers compared to younger truck drivers, safety risks they face, or any other concerns you have for older truck drivers.**

a. *We'll start by focusing on the vehicle and equipment (like in-vehicle technology). Are there concerns you have about older truck drivers related to that?*

b. *Now think about older truck drivers and road conditions or road characteristics. What concerns do you have?*

c. *Next think about older truck drivers and weather conditions. What concerns do you have?*

d. *Next think about older truck drivers and other road users. What concerns to you have?*

e. *Do you have any concerns about older truck drivers physically or mentally?*

f. *Probe for any additional concerns not yet covered (for example, hours of service).*

4. **What strategies do you use to help older truck drivers? (If further explanation/clarification needed: 1) "strategies" can be any policies, procedures, practices, etc.; 2) "strategies" can be intended for groups and/or individuals)**

a. *Probe for strategies about vehicle and equipment concerns.*

b. *Probe for strategies about road conditions/characteristics concerns.*

c. *Probe for strategies about weather conditions.*

d. *Probe for strategies about other road users.*

e. *Probe for strategies about physical and/or mental factors.*

f.   *Probe for additional strategies*

g.   *Probe to learn if any strategies employed are different for older truck drivers than for other age groups: Are any of these strategies different from what you do for other age groups? In what way?*

5. **What are the positives you've seen from those strategies?**

a.   *Probe for benefits to older truck drivers (from the safety managers' perspective)*

b.   *Probe for benefits to older truck drivers (from the safety managers' perceptions of the older truck drivers' perspective)*

c.   *Probe for benefits to company*

6. **What negatives and/or challenges have you had with those strategies?**

a.   *Probe for any setbacks or barriers faced in implementing strategies.*

b.   *Probe for resistance from older truck drivers.*

c.   *Probe for resistance from any others.*

d.   *Probe for challenges regarding planning and/or budgetary factors*

7. **What would you like to do for older truck drivers that you haven't been able to yet?**

a.   *Probe for what has prevented from doing this.*

b.   *Probe for what would help to do this.*

8. **What additional strategies do you think older truck drivers would like to see?**

a.   *Probe for what has prevented this.*

9. **Are you aware of efforts others are taking to improve the safety of your older truck drivers?**

a.   *Probe for programs, policies, etc. from other organizations and clients.*

b.   Probe for programs, policies, etc. from government and regulatory bodies.

10. **What additional help would you like to have from others to improve the safety of your older truck drivers?**

a.   Probe for help from other organizations and clients.

b.   Probe for help from government and regulatory bodies.

11. **Is there anything else we should be talking about or be aware of?**

APPENDIX B: OLDER DRIVER INTERVIEW GUIDE

1. **Icebreaker: What are some of the best things about being a professional truck driver?**

2. **Icebreaker: What are some of the positives drivers your age bring to the job compared to younger truck drivers?**

3. **Now let's think about any concerns you might have about driving on the job. These can be things you've noticed about any professional truck drivers around your age. Concerns can be related to challenges drivers your age face in any part of the job, unique needs for truck drivers around your age, safety risks, or any other concerns you have for truck drivers around your age.**

a. *We'll start by focusing on operating the vehicle and equipment (like in-vehicle technology). Are there concerns you have about that?*

b. *Now think about truck drivers your age and road conditions or road characteristics. What concerns do you have?*

c. *Next think about truck drivers your age and weather conditions. What concerns do you have?*

d. *Next, think about truck drivers your age and other road users. What concerns do you have?*

e. *Can you describe any challenges truck drivers your age might have physically or mentally?*

f. *Probe for any additional concerns not yet covered (for example, hours of service).*

4. **What strategies do carriers have in place to meet the needs of truck drivers your age? (If further explanation/clarification needed: 1) "strategies" can be any policies, procedures, practices, etc.; 2) "strategies" can be intended for groups and/or individuals)**

a. *Probe for strategies about vehicle and equipment concerns.*

b. *Probe for strategies about road conditions/characteristics concerns.*

c. *Probe for strategies about weather conditions.*

d. *Probe for strategies about other road users.*

e. *Probe for strategies about physical and/or mental factors.*

f. *Probe for additional strategies*

5. **What are the positives you've seen from those strategies?**

a. *Probe for benefits to older truck drivers*

b. *Probe for benefits to company*

6. **What negatives and/or challenges have you had with those strategies?**

7. **What would be helpful for truck drivers your age?**

a. *Probe for carrier-level strategies.*

b. *Probe for help from other organizations and clients.*

c. *Probe for help from regulatory bodies.*

d. *Probe for help from government bodies.*

8. **Is there anything else we should be talking about or be aware of?**