Center for
National Truck Statistics

AN ASSESSMENT OF TRUCK DRIVER TRAINING ISSUES BASED ON PRECOLLISION EVENTS

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16. Abstract

This report is based on information from the 1991 State of Michigan Official Traffic Accident Report form, known as the UD-10, the Supplemental Truck and Bus Traffic Accident Report, the UD-10T, and information obtained by UMTRI in telephone interviews with drivers of trucks involved in reported accidents in Michigan. The overall project was conducted jointly with the Department of Civil and Environmental Engineering at Michigan State University (MSU). This report documents the methodology and results of the UMTRI portion of the research project. The objective of this study was to identify truck driver training issues.

Based on the collision typology used, the two most common collision situations for truck-tractors in Michigan were multi-vehicle, non-intersection, same direction accidents, and single-vehicle collisions. Together these account for nearly 55% of all tractor accident involvements in Michigan. Among the single-vehicle accidents, loss of control was the most common initiating event. Slippery roads and empty trucks were strongly over-represented in this group. Over 70% of the same direction accidents were classified as lane encroachment situations. Approximately two-thirds of these collisions involved encroachment into the truck's lane by the other vehicle. In the other third, the truck struck a vehicle in the blind spot while making a lane change to the right.

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BACKGROUND

In 1991, the State of Michigan's Official Traffic Accident Report form, known as the UD-10, was supplemented with a form that was to be completed when an accident involved a medium or heavy truck or bus. This form is called the Official Supplemental Truck and Bus Traffic Accident Report, also known as the UD-10T. One UD-10T form was to be filled out for each truck or bus involved in an accident. The specific reporting criteria called for UD-10Ts to be filed for any of the following types of vehicles involved in an accident:

1) any truck or truck-tractor having at least 2 axles and 6 tires on the power unit
2) any vehicle displaying a hazardous materials placard
3) any bus designed to transport 16 or more passengers including the driver
4) any yellow and black school bus.

The Department of Civil and Environmental Engineering at Michigan State University (MSU) and the University of Michigan Transportation Research Institute (UMTRI) jointly undertook a project to code and analyze the 1991 UD-10T data. The particular focus of this study concerned the mandate of the Michigan Truck Safety Commission to identify and address truck driver training issues. This report documents the methodology and results of the UMTRI portion of the research project.

THE 1991 MICHIGAN UD-10T DATA

As part of Task I of the joint project, the MSU research team obtained all 12,114 of the UD-10T forms that were submitted in 1991 and coded many of the data elements to create an electronic file. Much of the coded information consists of variables that do not appear on the UD-10 form, such as vehicle configuration, cargo body type, sequence of accident events for the vehicle, and CDL type. These variables potentially provide more detail on the trucks themselves and the accidents in which they were involved.

Merging the UD-10 and UD-10T Data

The MSU researchers subset all accidents involving at least one truck or bus from the Michigan Department of Transportation's (MDOT) UD-10 data file and matched these records with the coded UD-10T records by accident report number. The original UD-10 file was an accident-level file, meaning each record pertained to one accident. Summary information for up to three vehicles in an accident was part of each record. The UD-10T file produced by MSU was a vehicle-level file, since each record described one truck or bus involved in an accident. The resulting merged file contains accident-level, UD-10 information only for cases where no UD-10T match was found. Matched cases have UD-10T data for the truck or bus appended to the UD-10 record.

When more than one UD-10T record matched a UD-10 record, the UD-10 data were duplicated for each UD-10T record for that accident.

The file of merged UD-10 and UD-10T data contains 24,406 records. Of these, 11,002 cases have UD-10T data coded. Thus, no UD-10 match was found for 1,112 of the original 12,114 UD-10T cases. There are at least two possible reasons for this. The first concerns errors on the accident report number in either the UD-10 or the UD-10T file, either coding errors or otherwise. The second is related to the fact that only the first three vehicles in each accident were included in the version of the UD-10 file used for matching. Accidents involving a truck or bus with vehicle number 4 or higher could not be identified as potential UD-10T cases and, therefore, were not included in the original subset of the UD-10 file.

The number of cases in the merged file with more than one UD-10T record for the same accident is small. Of the 11,002 cases with UD-10T data, there are 10,599 unique accident record numbers. There are 386 accidents in the file for which more than one UD-10T was submitted. These 386 accidents have a total of 789 UD-10Ts associated with them.

No UD-10T match was found for 13,404 of the UD-10 cases known to have involved a truck or bus. Errors on the accident report number may account for a small portion of these unmatched cases, but the majority simply had no UD-10T form submitted. The next section compares the cases with UD-10T records to those cases where no UD-10T match was found.

Factors Associated with UD-10T Filing

As a preliminary analysis, the file of merged UD-10 and UD-10T data was examined for differences between the set of cases with UD-10Ts and those without. The objective was to determine if certain factors, such as investigating agency, crash location, or month of year, influenced the likelihood of a UD-10T report being filed. Overall, 45% of the cases in the merged file have UD-10T data, and 55% do not.

The first comparison was for investigating agency (Table 1). The percent of cases with a UD-10T shows little variation among the different branches of investigating agencies. Truck accidents investigated by city or village police, which comprised over half of the cases, were slightly less likely to have an accompanying UD-10T record.

Table 1 - UD-10T Status by Investigating Agency

UD-10T Status	Investigating Agency: Michigan State Police	County Sheriff	Township Police	City/Village Police	Total
10T Filed	1,889	2,149	1,011	5,953	11,002
Col. Pct.	47.3	46.7	47.2	43.6	45.1
No 10T Filed	2,107	2,454	1,129	7,714	13,404
Col. Pct.	52.7	53.3	52.8	56.4	54.9
Total	3,996	4,603	2,140	13,667	24,406
Col. Pct.	100.0	100.0	100.0	100.0	100.0

Each of Michigan's counties was classified according to the total number of truck or bus involvements the county reported in 1991. The categories were less than 100 truck or bus involvements, from 100 to 499 involvements, and 500 or more involvements. The percentage of cases with UD-10T reports was calculated for each of those three categories. Table 2 shows that counties reporting the fewest truck involvements overall had the lowest percentage of UD-10T reports. That group had a UD-10T filing percentage of just 37.5% compared with 45.1% overall. Each of the three groups showed some variability in UD-10T filing from county to county. For example, the nine counties in the state that reported at least 500 truck involvements in 1991 all had UD-10T filing percentages of 45% or higher, except for two counties (Genesee with 35.7% and Wayne with 38.9%).

Table 2 - UD-10T Status by Number of Truck or Bus Involvements per County

UD-10T Status	Number of Truck/Bus Involvements: <100	100-499	500+	Total
10T Filed	861	3,204	6,937	11,002
Col. Pct.	37.5	48.8	44.6	45.1
No 10T Filed	1,432	3,366	8,606	13,404
Col. Pct.	62.5	51.2	55.4	54.9
Total	2,293	6,570	15,543	24,406
Col. Pct.	100.0	100.0	100.0	100.0

Table 3 shows the percentages of UD-10Ts filed according to whether the accident took place in a rural or urban area. Virtually no difference in the likelihood of a UD-10T being filed was observed for this variable.

Table 3 - UD-10T Status by Land Use

UD-10T Status	Land Use Rural	Urban	Total
10T Filed	5,030	5,972	11,002
Col. Pct.	45.7	44.5	45.1
No 10T Filed	5,967	7,437	13,404
Col. Pct.	54.3	55.5	54.9
Total	10,997	13,409	24,406
Col. Pct.	100.0	100.0	100.0

The next comparison involved a three-level classification of the road class where the accident occurred. As Table 4 shows, crashes occurring on the interstate were the most likely to have a UD-10T report. The percentage declined for collisions on major arteries, and was the lowest for accidents on other roads.

Table 4 - UD-10T Status by Road Class

UD-10T Status	Road Class Interstate	Major Artery	Other	Total
10T Filed	1,859	3,946	5,197	11,002
Col. Pct.	56.8	47.9	40.3	45.1
No 10T Filed	1,415	4,294	7,695	13,404
Col. Pct.	43.2	52.1	59.7	54.9
Total	3,274	8,240	12,892	24,406
Col. Pct.	100.0	100.0	100.0	100.0

UD-10T reporting was tracked across months of the year to see if, for example, reporting began at low levels and then rose throughout the year. This particular trend did not occur, and in fact there was little change in UD-10T reporting from month to month. As Table 5 shows, the only noticeable variation is a drop-off in UD-10T filing during the summer months.

Table 5 - UD-10T Status by Month

Month	UD-10T Status 10T Filed	No 10T Filed	Total
January	1,138	1,250	2,388
Row Pct.	47.7	52.3	100.0
February	931	1,031	1,962
Row Pct.	47.5	52.5	100.0
March	742	817	1,559
Row Pct.	47.6	52.4	100.0
April	769	930	1,699
Row Pct.	45.3	54.7	100.0
May	880	1,098	1,978
Row Pct.	44.5	55.5	100.0
June	769	1,150	1,919
Row Pct.	40.1	59.9	100.0
July	813	1,097	1,910
Row Pct.	42.6	57.4	100.0
August	872	1,120	1,992
Row Pct.	43.8	56.2	100.0
September	851	1,094	1,945
Row Pct.	43.8	56.2	100.0
October	1,130	1,303	2,433
Row Pct.	46.4	53.6	100.0
November	1,060	1,255	2,315
Row Pct.	45.8	54.2	100.0
December	1,047	1,259	2,306
Row Pct.	45.4	54.6	100.0
Total	11,002	13,404	24,406
Row Pct.	45.1	54.9	100.0

Finally, UD-10T reporting was compared according to whether or not the accident resulted in at least one fatality. Fatal accidents were more likely to have a UD-10T filed, but the difference was not great (Table 6). Just under 52% of fatal accidents had a UD-10T filed, compared with 45% of nonfatal accidents.

Table 6 - UD-10T Status by Fatal Status

UD-10T Status	Fatal Status: Fatal	Fatal Status: Nonfatal	Total
10T Filed	115	10,887	11,002
Col. Pct.	51.8	45.0	45.1
No 10T Filed	107	13,297	13,404
Col. Pct.	48.2	55.0	54.9
Total	222	24,184	24,406
Col. Pct.	100.0	100.0	100.0

The comparison of truck and bus accidents that had a UD-10T report filed with those for which no UD-10T was filed revealed a few differences related to the likelihood of UD-10T submission. Accidents occurring in counties with fewer than 100 annual truck and bus involvements were less likely to have a UD-10T filed. Accident reports filed by city or village police were slightly less likely to include a UD-10T. The class of road where the accident occurred was also related to the likelihood of a UD-10T being filed, with accidents on the interstates having the highest percentage, followed by collisions on major arteries, and accidents on other roads having the lowest UD-10T filing percentage. No difference in the likelihood of a UD-10T submission was observed for accidents in urban areas versus rural areas. Accidents reported from June through September had a lower percentage of UD-10Ts compared with accidents taking place in other months. Fatal accidents were slightly more likely than nonfatal accidents to have a UD-10T filed.

COLLISION TYPOLOGY

UMTRI has previously conducted research on passenger car accident data for the purpose of evaluating opportunities for collision avoidance. This approach has focused on the precrash situation. A typology was developed to classify accidents based on roadway characteristics and the precollision positions and maneuvers of the vehicles. The same typology was used for the present project to determine the most common truck accident scenarios in Michigan and to provide a basis for selecting a sample of accidents for survey follow-up.

The collision typology is best suited to classifying accidents at the vehicle involvement level. Recall that the MDOT version of the UD-10 data used by MSU is an accident-level file. Additionally, the MDOT file has data for only the first three vehicles involved in an accident, so some trucks are excluded. For these reasons, the UMTRI version of the 1991 Michigan UD-10 file was used to prepare the collision typology. The UMTRI UD-10 file can be analyzed at the vehicle level, and all trucks, regardless of vehicle number, may be identified.

Since the emphasis of this study is on truck-driver training, buses were excluded from the data for the collision typology analysis. Furthermore, the decision was made to

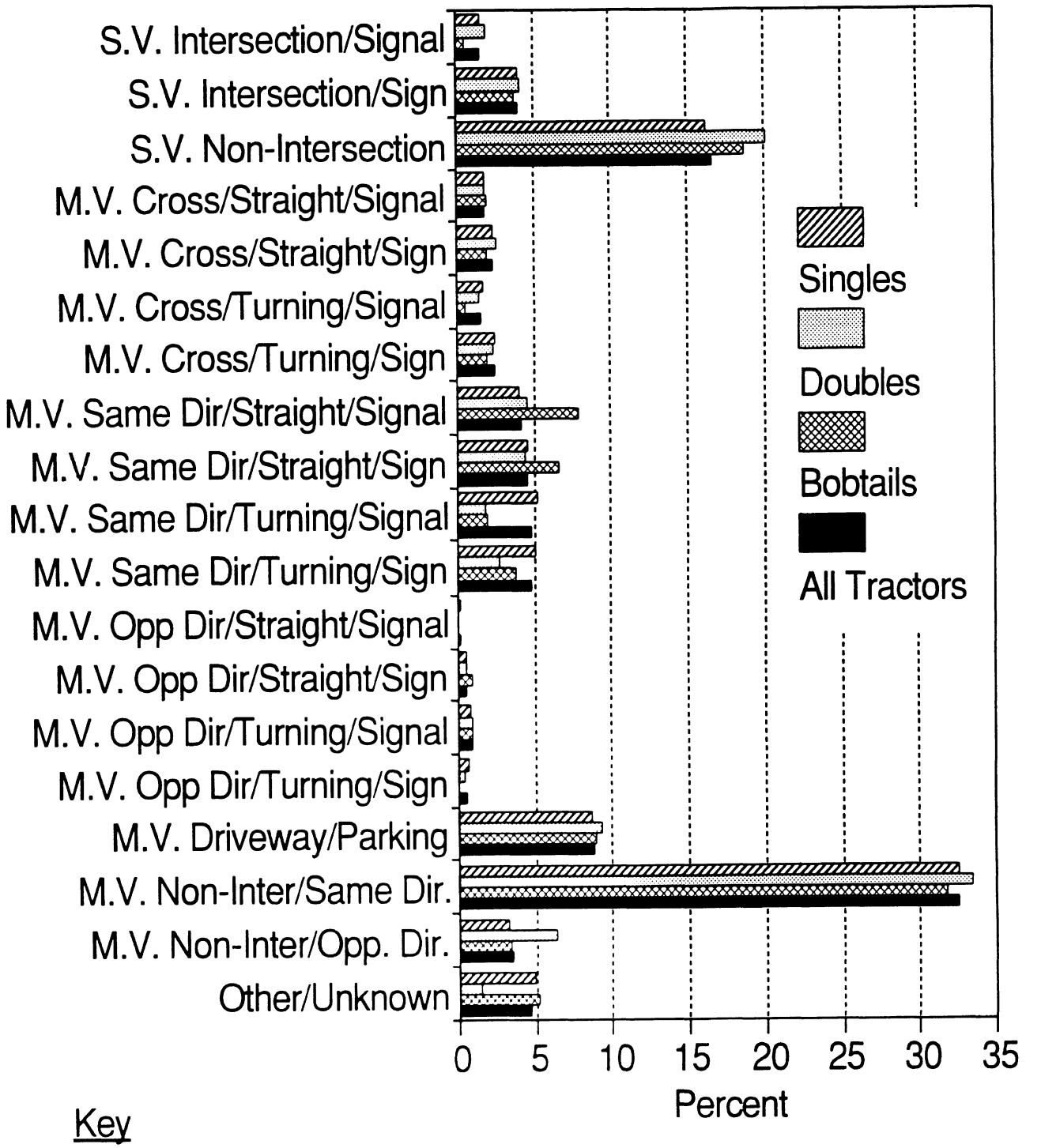
restrict the data to only truck-tractor accident involvements. One reason for this restriction was to ensure that only large trucks were analyzed. Vehicle type miscodings are more common among straight trucks; for example, pickups are sometimes classified as straight trucks. Also, commercial driving schools typically train people to drive truck-tractors. In addition, tractors account for nearly two-thirds of heavy truck mileage in the United States, and tractors are generally perceived as more of a safety hazard than are straight trucks.

The UMTRI version of the UD-10 file was subset to create a file of all truck-tractor accident involvements. Tractors hauling any number of trailers, or no trailers (bobtails), were included. This file contains 7,784 tractor involvements. Figure 1 shows the collision typology for all truck-tractor involvements, and separately for singles, doubles, and bobtails. The distribution of collision types is fairly stable among the different configurations of tractors. For all tractor categories the two most common collision types are multivehicle, nonintersection, same direction accidents at 32.6% of all tractor involvements and single-vehicle, nonintersection accidents at 16.6% of all tractor involvements (Table 7).

The file of 7,784 tractor involvements was merged with the UD-10T file of 24,406 cases described earlier. Cases eligible for matching from the latter file were truck-tractor involvements with UD-10T data, since only the UD-10T variables from that file were written to the new file. Cases were matched using accident record number and vehicle number. The new merged file describes accidents at the vehicle involvement level, and each record contains accident and vehicle variables from UMTRI's UD-10 file followed by UD-10T variables.

A total of 5,031 cases from the UD-10T file were eligible for matching, and 4,326 matches actually occurred between the two files. This means that UD-10T reports were filed and successfully matched for 55.6% of the tractor involvements in the UMTRI version of the UD-10 file, while no UD-10T record was found for 44.4% of the tractor involvements. The UD-10T match rate for tractor involvements is notably higher than the 45.1% match rate described earlier for all truck and bus accidents. However, 705 or 14.0% of the truck-tractor UD-10T records were not matched with the UD-10 file, which is higher than the 9.2% of all UD-10T records that were not matched with the UD-10 file earlier. This is probably at least partially due to matching on both accident number and vehicle number for the tractors, instead of just accident number as for the earlier file. Some UD-10T records have missing or incorrect vehicle number data.

Figure 1 - Collision Typology for Tractors, Michigan 1991



Key

S.V. = Single-Vehicle

M.V. = Multi-Vehicle

Non-Inter = Non-Intersection

Cross = Crossing Paths

Same Dir = Same Direction

Opp Dir = Opposite Directions

Table 7 - Collision Typology for Tractors, Michigan 1991

Frequencies

Collision Category	Singles	Doubles	Bobtails	All Tractors
S.V. Intersection/Signal	110	11	1	122
S.V. Intersection/Sign	282	23	8	313
S.V. Non-Intersection	1,140	111	40	1,291
M.V. Cross/Straight/Signal	125	10	4	139
M.V. Cross/Straight/Sign	157	14	4	175
M.V. Cross/Turning/Signal	116	8	1	125
M.V. Cross/Turning/Sign	176	13	4	193
M.V. Same Dir/Straight/Signal	280	25	17	322
M.V. Same Dir/Straight/Sign	318	24	14	356
M.V. Same Dir/Turning/Signal	360	10	4	374
M.V. Same Dir/Turning/Sign	351	15	8	374
M.V. Opp Dir/Straight/Signal	8	0	0	8
M.V. Opp Dir/Straight/Sign	36	3	2	41
M.V. Opp Dir/Turning/Signal	57	5	2	64
M.V. Opp Dir/Turning/Sign	42	2	0	44
M.V. Driveway/Parking	607	51	19	677
M.V. Non-Inter/Same Dir.	2,283	185	68	2,536
M.V. Non-Inter/Opp. Dir.	229	35	7	271
Other/Unknown	340	8	11	359
TOTAL	7,017	553	214	7,784

Column Percentages

Collision Category	Singles	Doubles	Bobtails	All Tractors
S.V. Intersection/Signal	1.6	2.0	0.5	1.6
S.V. Intersection/Sign	4.0	4.2	3.7	4.0
S.V. Non-Intersection	16.2	20.1	18.7	16.6
M.V. Cross/Straight/Signal	1.8	1.8	1.9	1.8
M.V. Cross/Straight/Sign	2.2	2.5	1.9	2.2
M.V. Cross/Turning/Signal	1.7	1.4	0.5	1.6
M.V. Cross/Turning/Sign	2.5	2.4	1.9	2.5
M.V. Same Dir/Straight/Signal	4.0	4.5	7.9	4.1
M.V. Same Dir/Straight/Sign	4.5	4.3	6.5	4.6
M.V. Same Dir/Turning/Signal	5.1	1.8	1.9	4.8
M.V. Same Dir/Turning/Sign	5.0	2.7	3.7	4.8
M.V. Opp Dir/Straight/Signal	0.1	0.0	0.0	0.1
M.V. Opp Dir/Straight/Sign	0.5	0.5	0.9	0.5
M.V. Opp Dir/Turning/Signal	0.8	0.9	0.9	0.8
M.V. Opp Dir/Turning/Sign	0.6	0.4	0.0	0.6
M.V. Driveway/Parking	8.7	9.2	8.9	8.7
M.V. Non-Inter/Same Dir.	32.5	33.5	31.8	32.6
M.V. Non-Inter/Opp. Dir.	3.3	6.3	3.3	3.5
Other/Unknown	4.8	1.4	5.1	4.6
TOTAL	100.0	100.0	100.0	100.0

Key
S.V. = Single Vehicle
M.V. = Multi-Vehicle
Non-Inter = Non-Intersection
Cross = Crossing Paths
Same Dir = Same Direction
Opp Dir = Opposite Directions

SELECTION OF CASES FOR THE DRIVER SURVEY

The primary objective of the UMTRI portion of this project is to use Michigan accident data to identify truck driver training issues. To help meet this objective a sample of UD-10 reports was obtained for a set of the truck-tractor accidents. Hardcopy police reports contain the officer's scene diagram and accident narrative. These provide details on both the precollision situation and the accident itself. This information is essential for any assessment of the potential for avoiding the collision, and the nature of the intervention necessary. In addition, the hardcopy reports provide the only means of locating involved drivers, since identifying information is not coded in the electronic files. The hardcopy UD-10 reports provide drivers' names, addresses, and often phone numbers, and the hardcopy UD-10T reports have carriers' names, addresses, and identification numbers.

After obtaining a sample of police reports, follow-up telephone interviews with the involved truck drivers were conducted. Each interview focused on the driver's perception of the precollision sequence, any evasive actions that were initiated, and relevant training issues. The purpose was to use the interviews as a tool to establish links between the precrash situation, driver training, and driver errors in specific crashes.

The collision types chosen as the focus of UMTRI's survey of accident-involved truck drivers were multivehicle, nonintersection, same direction accidents, and all single-vehicle crashes (both at and away from intersections). Together these account for nearly 55% of all tractor accident involvements in Michigan. Involvements in any of these collision types were subset from the file of 7,784 tractor involvements described above. The multivehicle, same direction group was restricted to trucks that sustained only front or side damage. These accidents were primarily rear-end collisions with the truck as the striking vehicle, or sideswipe accidents. The research team decided that interviews with truck drivers whose vehicles had been struck in the rear would probably not yield much information relevant to precollision circumstances. Also, for all types of collisions, the cases were restricted to accidents where no truck occupants were killed.

The sampling universe consisted of 1,723 single-vehicle cases and 1,346 same direction involvements. Prior to sampling, the cases were sorted according to three variables to ensure the sample would be representative in terms of these variables. The sort variables were number of trailers, quarter of year, and tri-county area (Oakland, Wayne, and Macomb) versus the rest of the state. Cases were sampled according to an interval selection procedure with a random start. For each of the two accident categories, 25 pilot cases and 300 actual survey cases were selected and hardcopy police reports were obtained from Lansing. A copy of the UD-10 report was made for every case, and copies of UD-10T reports were made whenever they were present.

SURVEY OF DRIVERS

After the 650 police reports were obtained, UMTRI researchers reviewed them in order to develop subtypes of collision categories. The subtypes are listed below:

Single-vehicle collisions:

Animal and pedestrian - The critical event is the truck making contact with an animal or pedestrian. The majority of these cases in the Michigan sample involve deer.

Roadside object - The critical event is the truck striking an inanimate object alongside, or more rarely above, the roadway. Many of these cases involve offtracking while making a turn and hitting a sign or other object on a corner. Some cases involve parked cars or overhead objects, such as bridges and wires.

Loss of control - In these cases, the driver lost control of the truck, whether because of poor road conditions, speeding, inattention, making an avoidance maneuver, or some other reason. While the end result sometimes involved hitting a roadside object, the difference between this subtype and the roadside object subtype concerns control of the vehicle.

Same direction collisions:

Lateral encroachment - These cases involve one vehicle moving into another vehicle's lane. Some involve lane change attempts when another vehicle was alongside the vehicle initiating the lane change. Others involve one vehicle moving suddenly in front of another vehicle such that the driver of the second vehicle cannot stop in time to avoid a collision.

Truck following - The precollision situation is the truck following another vehicle down the road, and the critical event involves the truck striking that vehicle. These are typically rear-end collisions. The reverse situation, another vehicle striking the truck in the rear, was excluded from the survey sample because the truck driver would usually not be aware of an impending collision until it had occurred.

Interview Questionnaires

The next step was to develop questionnaires to use for the telephone interviews with the truck drivers (see Appendix C). All interviews began by confirming the accident date and identifying information for the truck. The initial questions concerned the make and model year of the truck, power unit type, configuration, trailer body style, number of axles, and load status of the truck at the time of the accident, and whether the carrier was for-hire or private and whether it operated interstate or intrastate. Some case vehicles turned out to be non-sample vehicles (i.e., not tractors), and in those cases the interview was terminated as soon as this determination was made.

The next set of questions concerned route familiarity. The idea was to establish whether the route the driver was taking at the time of the accident was new to him or one he had driven many times before. If the route was unfamiliar, the interviewer tried to establish if the lack of familiarity contributed to the accident. If the route was familiar, the interviewer asked if something unusual or unexpected occurred prior to the accident, such as road construction or traffic delays. Inquiry into the accident began with the route familiarity questions in order to encourage the driver to recall the time immediately before the collision took place. The expectation was that this might assist the driver in remembering details about the accident sequence itself.

At this point the questions diverged depending on accident subtype. Three main forms were developed, one for all the single-vehicle collisions, one for same direction/lateral encroachment cases, and one for same direction/truck following cases. The single-vehicle form had particular questions for each accident subtype. The questions for all the subtypes dealt with the precollision scenario from the truck driver's point of view. The particular questions for each subtype will be discussed later when the results are analyzed.

Each interview concluded in the same manner. First, the driver was asked about the sequence of accident events for his truck. This information was also coded on the UD-10T, so the results may be compared. The final set of questions concerned driver experience and training. These included the age of the driver, number of years driving tractor combinations, length of time driving for the carrier, and length and type of formal driver training.

Survey Methodology

Telephone interviews for the 50 pilot cases were carried out in March of 1994. The purpose of making pilot calls was to give the interviewers a practice period and to discover questions that should be added, deleted, or modified. Calls on the actual 600 survey cases began on March 22, 1994. Most cases were completed by the end of April, although a few drivers did not return phone calls until May.

The interviewers went through a brief period of training before initiating phone calls. They were instructed about the purpose of this study and were told to encourage the survey respondents to provide as many details as possible about the accident itself and the precrash situation. Interviewers were provided with an opening statement (see Appendix A) that introduced the study and informed the respondents that their cooperation was voluntary. A longer statement (see Appendix B) was also written that interviewers could read to respondents who were uncomfortable with extensive questioning about an accident in which they were involved. This statement stressed the need for reliable precollision information and noted that professional drivers could provide this type of data.

The only respondents sought for this survey were drivers of the involved truck-tractors. Drivers of other involved vehicles, police officers, tow-truck operators, and

other personnel at the carriers were not targets of the survey. Interviewers attempted to reach the truck drivers by calling their home phone number, which was usually on the police reports, or by calling their company. Sometimes the company phone number was also on the police reports. Phone numbers of companies regulated by the Interstate Commerce Commission could also be obtained through ICC listings of motor carriers. If direct approaches to locating a driver were unsuccessful, interviewers would call other people with the same last name in the city or town listed on the police report in hopes of finding a relative who knew the driver's current phone number. This method was feasible only if the number of people with that last name was small.

Due to the nature of their work schedule, it is not always easy to get in touch with truck drivers. Interviewers would leave messages at home or work for the drivers and would regularly call back to renew the messages if the drivers had not returned the calls. Some drivers were never located. Most of these no longer had the phone number listed on the police report and were no longer working for the company that they were with at the time of the accident.

RESULTS OF THE SURVEY

Table 8 shows the outcome of the 600 survey cases according to collision type. Complete interviews were achieved for 241, or about 40%, of the 600 cases. Partial interviews were obtained for seven cases (1%). Partial interviews generally resulted when a respondent declined to answer further questions part way through an interview. There were 186 cases (31%) where the interview staff was unable to obtain a phone number for the driver. In 62 cases (10%) interviewers left messages for the drivers with another person or on a machine but never succeeded in talking to the driver despite repeated attempts. In 13 instances (2%) contacted drivers refused to be interviewed. There were 10 cases (2%) where it was determined that the truck was a non-sample vehicle (NSV) once the interview began. Finally, there were 81 cases (13.5%) where no interview call was attempted. Most of these were part of an entire category of accidents that were never assigned to a collision subtype, as described in the next section. The rest were single-vehicle cases where phone-calling efforts were halted after sufficient data had been collected on the subtypes.

Response rates were calculated by dividing the number of completed interviews by the number of cases for which calls were attempted, minus the number of NSVs. Overall the response rate was 47%. The response rate for single-vehicle crashes was 51%. Animal and pedestrian crashes had the highest rate with 78%, while loss of control and roadside object cases each had a response rate of about 45%. The same direction cases had a response rate of 44%, with lateral encroachment cases at a rate of 46% and truck following cases with the lowest response rate at 41%.

Table 8 - Outcome of Survey Cases by Collision Category

Collision Category	Comp. I/V	Par. I/V	Unable to Locate	No Resp.	Refused	NSV	No Call Made	Total
No Call	0	0	0	0	0	0	62	62
Single-Vehicle	118	2	84	20	7	6	19	256
Animal/Ped.	32	0	9	0	0	2	16	59
Roadside Obj.	41	1	34	10	3	2	3	94
Loss of Control	45	1	41	10	4	2	0	103
Same Direction	123	5	102	42	6	4	0	282
Lat. Encroach.	93	3	72	32	4	0	0	204
Truck Following	30	2	30	10	2	4	0	78
Total	241	7	186	62	13	10	81	600

When the telephone interviews with the drivers were complete, the data were coded and entered into Paradox databases. All coding forms for the data are included in Appendix D. The results of analyzing the interview data for each accident subtype are discussed below.

No-Call Cases

After the initial review of cases it became clear that there were certain instances where an interview with the driver about precollision circumstances would either be impossible or unproductive. The decision was made to not attempt phone calls on these cases, hence the name "no-call." An example of "impossible" interviews were accidents involving hit and run drivers. In the first batch of police reports obtained from Lansing, there were three cases of hit and run truck drivers. In such cases information about the vehicle that fled the scene is scant, and it is certainly insufficient to locate the driver. Other hit and run cases in the sample were identified, and the police reports for these cases were not obtained.

The other no-call cases were accidents where the initial event was some type of vehicle mishap. These included equipment failure, lost load, separation of units, and fire. While some of these may indicate a need for better vehicle maintenance, they did not seem relevant to the driving task per se.

A total of 62 of the 600 survey cases were assigned to the no-call group. Table 9 shows the reason that no survey call was made by collision type. At first glance it might seem odd that nearly half of the hit and run cases are single-vehicle accidents. Based on the three reports obtained and an analysis of the UD-10 variables for the other cases, these accidents involved a truck hitting a parked car or an object. The incident was witnessed by someone else and reported. Most of the other no-call cases are single-vehicle accidents, but there are four in the same direction category. Two of these

involved pieces of truck equipment coming off and striking another vehicle, one involved a trailer that became separated and hit another vehicle, and the other will be described below with the miscellaneous cases.

Table 9 - No-Call Cases: Reason by Collision Type

Reason	Collision Type: Same Direction	Collision Type: Single-Vehicle	Total
Hit and Run	15	11	26
Equipment	2	9	11
Lost Load	0	9	9
Separation of Units	1	7	8
Fire	0	4	4
Other	1	3	4
Total	19	43	62

UD-10 reports were obtained for all of the no-call cases except the hit and run accidents. While no driver interviews took place, the no-call cases were reviewed, coded, and entered into a Paradox database. A summary of each type of the no-call cases follows.

Equipment - The eleven cases of equipment failure included three cases of parking brake failure leading to the truck rolling; two cases of tire blowouts; two cases of the rear axle assembly falling off the trailer after braking; and one case each of a broken axle, fuel tank falling off, drive shaft falling off, and brake failure while driving.

Lost load - Eight of the nine cases of lost load involved cargo shifting or breaking loose followed by spillage. Four of these occurred when the driver was making a turn, one occurred during sudden braking, one during a lane change, and the other two apparently took place during normal, straight-ahead driving. The ninth case took place on a ramp and involved cargo shift, followed by the vehicle rolling over, and then the cargo spillage.

Separation of units - These eight cases involved a trailer coming unhitched. In one case the driver was decelerating and turning left, one took place while rounding a curve on a ramp, and one occurred when the driver was changing lanes. There was no mention of any particular driving maneuver for the other five cases. Specific reasons for the uncoupling included one case of a broken cable that controlled the rear of a pole trailer and three cases of defective fifth-wheel mechanisms.

Fire - The four fire cases included two instances of a tire on fire; one case of flames in the cab because of the tractor leaking fluid; and one case of a broken oil line spraying the engine and igniting.

Other - There were four miscellaneous cases that did not fit any of the other categories, but where a survey phone call did not seem worthwhile. In one case an object struck and broke the truck's windshield. In another the driver had stopped his truck on railroad tracks to wait for traffic to clear on the road when the truck was struck by a train. In the third case the driver of interest had parked his truck and was unloading it when another truck drove through the alley and scraped the side of the case truck. The fourth case involved an object that came off the road and struck and punctured the truck's gas tank, causing fuel to leak.

Animal and Pedestrian Cases

Phone interviews were completed for 32 animal and pedestrian cases. The collision involved an animal in 31 cases and a pedestrian in one case. In the pedestrian case, the truck was turning right on red when it struck a pedestrian who was crossing in front of it. The animal cases included 29 deer collisions, one case of a flying goose striking a truck's windshield, and one case of a truck colliding with a cow in the right lane of an interstate. Since collisions with deer comprised over 90% of the animal and pedestrian collisions, the rest of the discussion will focus on those 29 cases.

Typical deer accident

A typical setting for a truck-deer accident in Michigan has a driver traveling down a rural, high-speed road one night in October or November. The route is one the driver has traveled many times before. Suddenly a deer appears just a few feet ahead on the road. The driver has no chance to avoid the deer and strikes it.

Specifics of deer accidents

The information in the UD-10 file for the 29 deer cases indicates that all of the accidents occurred in rural areas. All but 4 occurred from August to December. The light condition was dark/unlit in 23 cases, daylight in 5 cases, and dawn in one case. Thirteen of the deer collisions occurred between midnight and 6 AM, six took place between 7 AM and noon, and ten occurred between 6 PM and midnight. The road type was limited access in 14 deer collisions, a major artery in 12 cases, and a surface street in 3 cases. One deer collision resulted in injury to the truck driver and the other 28 were property damage only.

In 17 of the 29 accidents the deer was in the road itself when the driver first saw it, in 9 cases it was on the shoulder, and in 3 cases the driver never saw it. In 23 of the cases, the truck driver stated that the truck struck the deer, while in 6 cases the deer ran from the side of the roadway into the truck. In 9 of the cases there were two or more deer in or alongside the roadway, while in the other 20 cases there was just a solitary deer. When there were multiple deer in the vicinity the truck driver usually hit only one. The drivers were asked the traveling speed of the truck and the distance between the truck and the deer when the deer was first seen. According to the drivers,

the speed was 25-40 mph in 6 cases, 45-50 mph in 9 cases, and 55-60 mph in 14 cases. The distance was reported as 10 feet or less in 12 cases, 11-50 feet in 8 cases, 60 feet to a quarter-mile in 5 cases, and in one case the deer was first seen at the moment of impact. All but one of the drivers were familiar with the route they were driving at the time of the collision, and most had driven it many times. None of the drivers mentioned any equipment problems with their trucks or any impairment of their own condition, such as fatigue, as contributing to the accident in any way.

The drivers in the deer accidents were asked about any avoidance attempts they made. Sixteen drivers made no attempt to avoid the deer, often because there was no time or because traffic conditions would not permit sudden maneuvers. Twelve drivers made some avoidance attempt. Eight drivers braked, two decelerated, one braked and steered, and one changed lanes. In one case it was unknown if the driver made an avoidance attempt.

The drivers were also asked about the sequence of collision events. In all 29 cases, the first event was striking an animal. In 26 of the accidents there were no subsequent events. The three cases with subsequent events included one where the truck ran off the road and then jackknifed, one where the truck jackknifed, and one where the truck struck a fixed object and then jackknifed.

Recommendations for driver training

Michigan has a substantial deer population. In 1991 in Michigan there were 297 accidents involving truck-tractors colliding with animals, the vast majority of which were deer. Based on the review of the police reports and the survey of drivers involved in deer accidents, there is probably nothing a driver can do in terms of the driving task per se that can reduce his chance of being in a deer accident. Deer tend to appear so suddenly that there is no time to avoid a collision, particularly when one is driving a heavy truck. Based on the drivers' estimates of their travel speed and their distance to the deer when they first saw it, in 26 of the 29 cases the deer was less than one second away from the truck at the speed the truck was going when the driver first saw the deer.

While drivers probably cannot avoid deer accidents, they may be able to mitigate the consequences. The best advice for drivers is to make no avoidance attempt when a deer suddenly appears on the road. In one of the survey cases a deer jumped directly in front of a driver's windshield as he was traveling down an interstate. The driver braked, the deer hit the truck, the truck pulled left and hit the median wall, broke through the wall, and jackknifed in the westbound lanes. The driver suffered B-level injuries. In another case a deer suddenly ran in front of the truck from a corn field on the right. The driver braked to avoid the deer and jackknifed. Generally, the consequences of the avoidance maneuver are much worse than the deer collision.

Roadside Object Cases

One partial and 41 complete phone interviews were made for the roadside object cases. For the other 50 cases of a truck-tractor hitting a roadside object, some information was coded off the police reports. The type of object struck was classified into four categories. The pole/building category, with 47 cases, includes such items as a tree, fire hydrant, curb, fence, telephone pole, light pole, street sign, building overhang or awning, bridge railing, and toll booth. The 24 cases in the overhead object category include power lines, phone lines, tree branches, bridges, overpasses, railroad viaducts, railroad crossing arms, overhanging signs, and overhead traffic signals. The third category includes 17 cases of parked vehicles. The final category includes four cases of an object in the roadway, specifically a ladder across the road, a deer carcass, a large piece of metal in the road, and a sewer grate.

Typical roadside object accident

A typical accident in the roadside object category involves a truck making a right turn on a city street in the daytime. The truck makes the turn at a speed less than 5 mph but strikes an object, such as a street sign or light pole, located on the corner. Usually the driver sees the object before striking it and either misjudges the clearance or is forced to turn more sharply than he wants to because of other traffic.

Specifics of roadside object accidents

Information in the UD-10 file on the 92 roadside object cases indicates that 76% of the accidents occurred during daylight. This high percentage of daylight accidents holds for all the subtypes except the object in the roadway group, where 3 out of 4 accidents took place when dark. For the entire roadside object group, 38% of the accidents took place between 7 AM and noon, 40% between noon and 6 PM, 12% between 6 PM and 11 PM, and 10% between 11 PM and 7 AM.

The roadside object accidents more commonly took place in urban areas. Overall, 64% of the cases were urban accidents and 36% were rural accidents. This approximate distribution held for all the subtypes except the object in the roadway group, where 3 out of 4 accidents occurred in rural areas. For all roadside object accidents, just 6.5% occurred on a limited access road, 33% took place on a major artery, and the majority, 61%, took place on a surface street. The road condition in these accidents was generally good. Over three-quarters took place on dry roads, 18% on wet roads, and 5% on snowy or icy roads. All 92 accidents in the sample resulted in property damage only.

The 42 drivers who were contacted by phone were asked if they were familiar with the route they were driving at the time of the accident. Overall, 23 drivers were familiar with the route, and 19 were not. The percentage of drivers familiar with the route was lowest among those who struck a pole or building, with 35%, and increased to 67% for the parked vehicle cases, 73% for overhead objects, and 100% for objects in the roadway. The 19 drivers who were not familiar with the route were asked if that was a

factor in the accident. Ten responded affirmatively, and nine said that lack of familiarity was not a factor. In some cases where lack of familiarity was cited as a factor, it was a matter of the driver not being aware of potential pitfalls for large trucks, such as narrow roads or tight corners. In other cases, the driver was devoting so much attention to navigating that the driving task was compromised. One example is a driver who was looking for a sign that indicated his pickup place. He failed to follow the curve in the road and ended up striking a bridge railing.

Nearly 60% of the 42 drivers interviewed said that they noticed the object they hit prior to the collision. This was true in 80% of the pole/building cases, 55% of the overhead objects, 50% of the objects in the roadway, but just 22% of the parked vehicle cases. Occasionally the driver did not see the object until the last moment, but usually the driver saw the object well in advance and underestimated how much clearance he had. Drivers who struck an object while making a right turn frequently mentioned that the presence of traffic on the left side of the road restricted how far they could swing out. Of the 25 drivers overall who noticed an object prior to striking it, 20 made no avoidance attempt. Three drivers steered and two drivers braked.

Table 10 shows the maneuver the truck was making when the object was struck for each of the subtypes of roadside object accidents. Right turns dominate the pole/building subtype, accounting for nearly 70% of the cases. In the overhead object subtype, the truck was moving straight ahead in two-thirds of the cases. The types of maneuvers were more varied in the parked vehicle subtype. A few cases were similar to the pole/building group, in that a parked vehicle was struck as the truck was rounding a corner. Others involved trucks in parking situations. In three out of four of the object in the roadway cases, the truck was proceeding straight ahead.

Table 10 - Roadside Object Cases: Truck Maneuver by Type of Object Struck

	Type of Object				
Truck Maneuver	Pole/ Building	Overhead Object	Parked Vehicle	Object in Roadway	Total
Straight	3	16	3	3	25
Right turn	32	1	3	1	37
Left turn	5	0	2	0	7
U-turn	4	0	0	0	4
Starting up	0	6	0	0	6
Backing	1	1	6	0	8
Entering parking	0	0	1	0	1
Leaving parking	0	0	2	0	2
Avoidance attempt	2	0	0	0	2
Total	47	24	17	4	92

Table 11 gives the speed of the truck when the object was hit, as estimated by the driver. The speed was unknown in the 50 cases where no phone interview took

place. Among the 42 interview cases, the truck was moving at less than 5 mph in 26 cases (62%). Low speeds were very common in the pole/building and parked vehicle subtypes, while there was a broader range of speeds among overhead object accidents.

Table 11 - Roadside Object Cases: Truck Speed by Type of Object Struck

	Type of Object				
Truck Speed (mph)	Pole/ Building	Overhead Object	Parked Vehicle	Object in Roadway	Total
<5	13	4	8	1	26
5-10	6	3	0	0	9
20-56	1	4	1	1	7
Unknown	27	13	8	2	50
Total	47	24	17	4	92

No mention was made of any equipment problems with the truck itself during any of the 42 interviews with the drivers. There was one case of a driver citing fatigue as a contributing factor to the accident. The sequence of events in the 92 roadside object accidents included 69 cases of striking a fixed object as the first event, 17 cases of striking a parked vehicle as the first event, and 5 cases of striking a non-fixed object. Only one accident included more than one event. In that instance the first event was "ran off the road" and the second event was "struck a fixed object."

Recommendations for driver training

Roadside object collisions generally are not serious accidents. No injuries were reported in any of the 92 cases reviewed here. The accidents typically occur at very low speeds, involve just one vehicle, and do not involve loss of control of that vehicle. However, these collisions are relatively common. An estimated 528 of these accidents involving a truck-tractor are reported to the police in Michigan each year. In some cases there is substantial property damage and traffic congestion as a result of the collision.

The obvious recommendation for driver training is for drivers to be aware of the dimensions of the vehicle they are driving, particularly when they are driving in a new area. Several of the overhead object cases involved a truck hauling construction equipment or a mobile home and hitting an overpass or viaduct. One pole/building accident involved a driver who usually drove a 24-foot trailer, but was driving a 48-foot trailer on the day of the accident. He said he was not paying attention while making a right turn and struck a pole on the corner. Other pole/building accidents involved trucks with cargo overhanging the trailer, or extra-wide loads. A few drivers were accompanied by escort vehicles, who failed to warn the drivers of potential hazards.

Striking an object while making a right turn was the most common roadside object accident, and drivers often commented that the corner was too tight for a large truck and that the presence of traffic restricted their movement. While it may often be

better to strike a fixed object than another vehicle, if drivers could wait for traffic to clear or encourage other vehicles to move to give them space, fewer of these collisions would result. Also, many drivers saw the object they struck prior to hitting it and misjudged the clearance. This may indicate a need to practice more driving in tight situations so that drivers learn to more accurately estimate distances.

Some of the parked vehicle cases occurred right after the driver had made a delivery. A vehicle pulled in front of or behind the truck while the driver was in the store or after he had gotten back in the truck. The driver was unable to see the vehicle despite checking his mirrors and trying to look over the cab. The first recommendation in this case is for the driver to circle the vehicle prior to leaving the parking area, which some but not all drivers did. The second does not have to do with driver training, but there is a need for better visibility from the cab. Visibility may be enhanced through the use of more sophisticated mirrors. Also, implementing obstacle detection devices that will warn drivers when they are approaching an object while backing up would help overcome the visibility deficit.

Loss of Control Cases

One partial and 45 complete interviews were made for the loss of control cases. Some data elements were coded from the police reports for the four drivers who refused the interview and the remaining 51 cases where no contact was made. The loss of control accidents were divided into five subgroups: weather-related (43.6%), avoidance maneuvers (29.7%), driver error (12.9%), vehicle-related (8.9%), and road defect (5.0%). The weather-related cases include skidding on icy or snowy roads, or high winds catching the empty trailer(s). The avoidance maneuvers include cases of swerving to avoid a previous accident or a car cutting in front of the truck. Driver error cases include instances of falling asleep at the wheel or in-vehicle distractions taking the driver's attention from the road. The majority of the vehicle-related cases were caused by a cargo shift or imbalance; the remainder were instances of brake failure, tire blowouts, and a lift axle failure. The roadway defect cases include accidents caused by soft shoulders, ruts, potholes, and bumps.

Typical loss of control accident

A typical loss of control accident on Michigan roads occurs on a rural, limited access, snow- or ice-covered road on a winter morning. The truck driver brakes for traffic, slides into the median, and jackknifes.

Specifics of loss of control accidents

The UD-10 data indicate that 74 (73%) of the loss of control accidents took place in rural areas. The majority (61) occurred on limited access roads. The major artery and other type road classes each had 20 occurrences. The road surface was snowy or icy

in 48 of the cases, wet in 26 cases, and dry in 27. The weather condition was coded clear or cloudy for 50 accidents, snowing for 36, raining for 13, and foggy for 2 accidents.

Just over half of the loss of control accidents (52) occurred in the three-month period from December through February. In contrast, only 12 loss of control accidents took place over the four-month period of June through September. December had the most accidents with 20 and July the fewest with just two. The loss of control accidents were fairly evenly distributed over the hours of the day. Twenty-five accidents occurred between midnight and 6 AM, 32 between 6 AM and noon, 25 between noon and 6 PM, and 19 between 6 PM and midnight. The cases were almost equally divided between those that occurred during daylight (49) and in the dark (46). Six accidents happened during dawn or dusk. Sixty-four of the accidents involved property damage only, while 37 resulted in an injury.

Some differences emerge when looking at the subcategories of loss of control accidents. Overall, 73% of the loss of control accidents occurred in rural areas, but this percentage was 86% for weather-related accidents and 92% for driver error accidents, as shown in Table 12. In contrast, only 57% of the avoidance maneuver accidents took place in rural areas. As mentioned earlier, the overall number of daytime and nighttime accidents was nearly equal. However, all nine of the vehicle-related accidents occurred during daylight, while only 23% of the driver error accidents occurred in the daytime. The majority (60%) of loss of control accidents took place on limited access roads, but only 20% of the road defect accidents and 33% of the vehicle-related collisions occurred on limited access highways. Overall 37% of the accidents resulted in an injury, but half of the avoidance maneuver accidents were injury cases. Just 25% of the weather-related accidents involved an injury.

Table 12 - Loss of Control Cases: Accident Subtype by Land Use

Type of Accident	Land Use		Total
	Rural	Urban	
Weather-Related	38	6	44
Avoidance Maneuver	17	13	30
Driver Error	12	1	13
Vehicle-Related	4	5	9
Road Defect	3	2	5
Total	74	27	101

Forty of the 46 drivers who were interviewed said they were familiar with the route they were on at the time of the accident, and 18 of those drivers reported they used that route at least once a week. For the weather-related cases where the driver estimated his precollision speed, almost a third of the drivers were traveling at speeds of 50 mph or more. In contrast, in the avoidance maneuver cases 40% of the drivers were traveling between 40 and 50 mph.

Drivers were asked in the telephone interviews to pinpoint the triggering event in the accident sequence. For the weather-related accidents, 68% of the drivers responded that icy roads were the triggering event, and 26% reported high and/or gusting winds (one driver cited the combination of ice and winds as the triggering event). In the avoidance maneuver category the two events mentioned most often, 47% each, were a vehicle entering the truck's lane (either from the oncoming traffic lane or from an adjacent lane in the same direction) or the truck swerving to avoid an out of control or disabled vehicle, or a previous accident. In the one other avoidance maneuver case the driver swerved to avoid a deer. The most frequent cause of driver error accidents was falling asleep at the wheel. The vehicle-related accidents were most often triggered by a load shift, but also included faulty brakes and a lift axle failure. The roadway defect cases were caused by various problems with the road surface or soft shoulders.

Table 13 illustrates the sequence of accident events as coded on the interview form. For the cases where the driver was not contacted, this information was coded from the police report narrative by UMTRI researchers. Sixty-seven of the 101 accidents in the loss of control group had "ran off the road" coded as one of the events. Typically this was coupled with a jackknife, overturn, or striking a fixed object. In 51 of the cases the truck jackknifed. The jackknife was twice as likely to be a first event as a subsequent event. The opposite was true for overturns, which were a subsequent event three times as often as the first event. Striking a fixed object was over three times more common as a subsequent event than the first event. The column headed "Total" in Table 13 represents the total number of cases that included each particular event. Some accidents had no subsequent event, while others had multiple subsequent events.

Table 13 - Loss of Control Cases: First and Subsequent Accident Events

	Sequence		
Accident Event	First Event	Sub. Event	Total
Ran off Road	47	20	67
Jackknife	34	17	51
Overturn	6	18	24
Hit Fixed Object	8	27	35
Hit Parked Vehicle	2	2	4
Cargo Loss/Shift	4	3	7
Total	101	87	188

Drivers were asked if they were hauling cargo at the time of the accident. Their responses are shown according to accident subtype in Table 14. Overall, 61% of the trucks had a full or partial load, and 39% were empty at the time of the accident. An UMTRI survey of truck travel conducted several years ago found that on average 71% of truck-tractors on the road are hauling cargo at any given time and 29% are empty. This suggests that trucks involved in loss of control accidents were slightly more likely to be

empty than all trucks on the road. This is especially true for the weather-related subtype, where 63% of the trucks in the sample were empty at the time of the accident and only 37% were hauling cargo. Most of the empty trucks in the weather-related subgroup lost control on ice; high winds were also involved in some cases.

Table 14 - Loss of Control Cases: Accident Subtype by Load Status

Type of Accident	Load Status Full/ Partial	Empty	Total
Weather-Related	7	12	19
Avoidance Maneuver	9	6	15
Driver Error	3	0	3
Vehicle-Related	5	0	5
Road Defect	4	0	4
Total	28	18	46

Recommendations for driver training

An estimated 580 truck-tractors were involved in single-vehicle loss of control accidents in Michigan in 1991. The injury potential for these accidents is high. Of the cases considered in our sample, over one-third resulted in personal injury. Since these are single-vehicle accidents, it is almost always the truck driver who suffers the injury.

It would appear that driver training programs could address some of the conditions and situations the truck drivers encountered in the loss of control accidents. Since the weather-related accidents occurred primarily on ice- and snow-covered roads, training specifically focused on driving in adverse weather and road conditions would be beneficial. According to the drivers, many of the accidents were precipitated by a braking or turning maneuver. Perhaps these road conditions could be simulated to give new drivers experience driving in winter road conditions. Drivers also need to know how to handle an empty trailer under dangerous weather conditions.

Similarly, skills needed to maintain control of the vehicle during an avoidance maneuver should be addressed in the driver training curriculum. These kinds of skills are covered in the Michigan Decision Driving Course. Avoidance maneuver accidents often occur in bad weather as a car is passing the truck and loses control, spinning out in front of the truck. The sudden steering and braking required to avoid a collision while maintaining control require a knowledge of the reaction of the vehicle and a certain amount of practice. Driver training programs should include instruction on when it is best to brake only or steer only or both brake and steer, and the difference in the handling of the truck depending on road conditions and amount of cargo.

The training implications for the three remaining accident subcategories in the loss of control group are clear. The most frequent (38%) cause of the driver error

accidents is truck driver inattention due to fatigue or actually falling asleep. Training courses could include information on strategies for recognizing signs of fatigue and for staying alert, such as stopping to stretch or taking a short nap. While the pressure for timely delivery often falls on the driver, the precedence of safety over schedule considerations should be stressed. Just over 55% of the vehicle-related accidents involved a load shift or, rarely, an unbalanced load. The importance of checking the securement and distribution of the load as part of a thorough pre-trip safety inspection might prevent some of these types of single-vehicle accidents. The most common road defect accident occurred when soft shoulders caused the truck to roll over. As with many of the single-vehicle loss of control accidents, the speed of the truck is often too high for the road condition. Driver training, through instruction and on-the-road experience, should illustrate to student drivers that the posted speed is often not feasible for large trucks, particularly on exit ramps.

Lateral Encroachment Cases

Lateral encroachment cases are the largest accident category considered in this study. Three partial and 93 complete phone interviews were conducted, and some information was coded off police reports for the 108 other lateral encroachment cases. As the name suggests, lateral encroachment accidents involve one vehicle moving into another vehicle's lane. This may occur through an intentional lane change, drifting, or loss of control. Some lateral encroachment collisions occur when two vehicles are alongside each other in adjacent lanes, while others involve one vehicle "cutting off" another vehicle.

The cases were split into two main subtypes according to the lane in which the accident occurred. In 135 cases the accident took place in the truck's lane, generally meaning that another vehicle encroached on the truck. In 64 cases the accident took place in the lane of the vehicle that collided with the truck, most of these due to the truck changing into their lane. Two cases involved both vehicles simultaneously changing into the lane that was between them. Three cases were indeterminate because no interview was obtained, and on the UD-10 each driver said the other driver came into their lane. It is interesting to note that while the majority of the cases occurred in the truck's lane, the percentage varied according to whether the truck driver was interviewed or the information was derived from the police report. As Table 15 indicates, 76% of the truck drivers said that the accident took place in their lane, and only 22% said it took place in the hit vehicle's lane. In contrast, when the UD-10 was the only source of information, 57% of the accidents occurred in the truck driver's lane, and 40% occurred in the hit vehicle's lane.

Table 15 - Lateral Encroachment Cases: Interview Status by Lane Where Collision Occurred

Interview Status	Whose Lane? Truck Driver's	Hit Vehicle's	Other	Indeterminate	Total
Complete	72	19	2	0	93
Partial	1	2	0	0	3
No interview	62	43	0	3	108
Total	135	64	2	3	204

Typical lateral encroachment accidents

In a typical lateral encroachment accident occurring in the truck's lane, the truck driver is driving down an urban interstate highway on a route he has driven many times before. It is late afternoon on a winter's day. The truck is proceeding straight ahead in the right lane, and the road is slippery because of snow or ice. Another vehicle attempts to pass the truck in the left lane, loses control on the slick road, and spins out into the truck's lane. The other vehicle either collides with the trailer or ends up in front of the tractor and is then hit.

In the other subclass of lateral encroachment accidents the collision takes place in the hit vehicle's lane. A typical scenario again finds the truck driver driving on a familiar urban interstate in the late afternoon. The road surface is dry. The truck is in the left lane, and the driver wishes to change to the right lane. Before making the lane change, the driver checks his mirrors but ends up striking a vehicle in the right lane that was in his blind spot.

Specifics of lateral encroachment accidents

The UD-10 file indicates that 75% of the 204 lateral encroachment involvements occurred during daylight, 17% in dark/unlit conditions, 5% in dark/lit conditions, and 3% during dawn or dusk. Twenty-two percent of the involvements took place between 7 AM and noon, half between noon and 6 PM, and 14% each between 6 PM-11 PM and 11 PM-7 AM. The single most common hour of the day for lateral encroachment collisions was between 3 and 4 in the afternoon, with 27 involvements.

The land use split for the lateral encroachment involvements was 64% in urban areas and 36% in rural areas. The accidents most commonly took place on limited access roads, with nearly 71% of the involvements. Another 18% occurred on major arteries and 12% on surface streets. Road surface condition was a factor in a sizable portion of the lateral encroachment involvements. The roads were snowy or icy 20% of the time, wet in 13% of the cases, and dry in the remaining two-thirds of the cases. The majority of the lateral encroachment cases involved property damage only (78%), but 43

cases involved at least one injured party (21%), and there was also one fatal involvement.

The 96 drivers contacted by phone were asked if they were familiar with the route they were driving when the accident occurred. Nearly all of the drivers, 91 of them, were familiar with the route. Three were not familiar with the route, and it was unknown in two of the partial interview cases whether the driver was familiar with the route.

For all of the cases, both interview and non-interview, it was determined if a lane departure by the truck was the initiating event in the accident. Lane departures included both intentional lane changes, as well as drifting or jackknifing; merging was included as a separate category. If a truck left its lane in order to avoid a lane encroachment by another vehicle, the action was not counted as an initial lane departure. As Table 16 shows, if the truck made a lane departure or merged, the accident generally took place in the other vehicle's lane. One exception was a case where both the truck and another vehicle were merging at the same time into one lane on an entrance ramp, and the accident was coded as taking place in the truck's lane. Conversely, most of the accidents where the truck did not depart its lane or merge took place in the truck's lane, although there were six exceptions. These were cases of the truck being forced out of its lane by a vehicle other than the one with whom the truck collided. Generally, the other vehicle suddenly changed into the truck's lane, cutting it off, and forcing it into the adjacent lane. In these cases, the accident was initiated by the vehicle that suddenly changed into the truck's lane, not by the truck's subsequent lane departure.

Table 16 - Lateral Encroachment Cases: Whether Truck Departed Lane by Lane Where Collision Occurred

Initial Lane Departure?	Whose Lane? Truck Driver's	Hit Vehicle's	Other	Indeterminate	Total
Yes	0	54	2	0	56
Merging	1	4	0	0	5
No	134	6	0	0	140
Unknown	0	0	0	3	3
Total	135	64	2	3	204

Drivers were asked when they first saw the vehicle with which they collided. Their responses were grouped into three categories—prior to impact, at the moment of impact, and after the impact. Table 17 shows that, of the known cases, nearly three-quarters of the truck drivers saw the hit vehicle before the collision. Drivers who made a lane departure saw the hit vehicle before the collision about half the time, while drivers who did not depart their lane saw the hit vehicle before the collision about 80% of the time.

Table 17 - Lateral Encroachment Cases: Whether Truck Departed Lane by When Hit Vehicle Was First Seen

Initial Lane Departure?	First Seen: Prior to Impact	At Impact	After Impact	Unknown	Total
Yes	10	1	6	39	56
Merging	0	0	2	3	5
No	59	7	8	66	140
Unknown	0	0	0	3	3
Total	69	8	16	111	204

Drivers who made an initial lane departure were asked whether they checked their mirrors prior to leaving their lane. Of the 18 responses, 15 replied that they had checked their mirrors first. Of the three cases where the driver did not check the mirror, one was a jackknife, and one involved a bobtail that skidded when braking. The third involved a truck passing a snow plow when the driver's view became obstructed by blowing snow and he drifted into the plow's lane. The 15 drivers who checked their mirrors were asked if there was a problem with the hit vehicle being in their blind spot. Thirteen responded affirmatively. The two cases where the driver said a blind spot was not a factor included one case where both vehicles moved into the empty lane between them at the same time, and one case where the hit vehicle tried to pass the truck as the truck changed lanes. In five of the cases where a blind spot was a factor, the driver saw the hit vehicle before the impact. In four of these cases the driver passed the vehicle and thought he had cleared it or that the vehicle had turned. In fact the vehicle was in the truck's blind spot and was struck when the truck changed back to its original lane. The other case involved a truck making a lane change when the hit vehicle suddenly appeared and the driver saw it just before impact.

The interview cases were coded for the actions of the involved vehicles prior to the collision. Table 18 shows the truck's action and the encroaching vehicle's action for the 73 collisions that occurred in the truck's lane. Most of the trucks were proceeding straight ahead at the time of the collision, although a few were stopped in traffic. Five types of lane departure were identified for the encroaching vehicle—deliberate lane change; merging; lane departure through loss of control, usually on a slick road surface; contact with the truck while passing; and turning in front of the truck. Interestingly, loss of control cases were just as common as deliberate lane changes, each representing a third of the cases. Merging accounted for 16% of the cases, passing for 14%, and turning for 3%. In Table 18, the "encroaching vehicle" was the vehicle that hit the truck in all but four cases. In those four cases, another vehicle suddenly came into the hit vehicle's lane, and the latter vehicle subsequently was forced into the truck's lane.

Table 18 - Lateral Encroachment Cases in Truck's Lane: Truck Action by Action of Encroaching Vehicle

Encroaching Vehicle Action	Truck Action				Total
	Straight	Stopped	Braking	Merging Right	
Changing lanes to right	6	1	0	0	7
Changing lanes to left	15	2	0	0	17
Merging right	2	0	0	0	2
Merging left	9	0	0	1	10
Loss of control to right	15	0	1	0	16
Loss of control to left	9	0	0	0	9
Passed on left	4	4	0	0	8
Passed on right	2	0	0	0	2
Turned right	1	0	0	0	1
Turned left	1	0	0	0	1
Total	64	7	1	1	73

Table 19 shows the 21 interview cases that occurred in the hit vehicle's lane. In all but one of the cases the hit vehicle was going straight at the time of the accident. In about half the cases the truck made a lane change to the right. In 4 of the 21 cases the truck was proceeding straight when it was forced into the hit vehicle's lane by another vehicle.

Table 19 - Lateral Encroachment Cases in Hit Vehicle's Lane: Truck Action by Hit Vehicle Action

Truck Action	Hit Vehicle		Total
	Straight	Stopped	
Backing	1	0	1
Braking	2	0	2
Changing lanes to right	11	0	11
Changing lanes to left	1	0	1
Merging right	1	0	1
Passed on right	1	0	1
Straight	3	1	4
Total	20	1	21

It was known in 93 of the interview cases if the truck driver made an attempt to avoid the collision. In 50 of the cases (54%) no avoidance attempt was made. There were 23 cases of braking, 6 cases of steering, 5 of braking and steering, 3 of changing lanes, 1 each of decelerating and sounding the horn, and 4 cases of some other combination of avoidance maneuvers. In 39 of the 43 cases where an avoidance attempt was made, the truck was not the vehicle that made the initial lane departure.

In terms of the sequence of events in the accidents, in 187 of the 204 cases the only type of event was colliding with a moving vehicle. Most of the remaining cases included jackknifing and/or running off the road in addition to colliding with a motor vehicle. Two of these accidents involved truck rollovers as well. Among the 96 interview cases, there was no mention of any impairment of the driver's condition in any of the cases. There was only one mention of equipment problems, specifically brakes that were improperly adjusted. In that case, as the driver was stopping for a light, the bobtail tractor skidded into the next lane.

Recommendations for driver training

An estimated 915 truck-tractors are involved in lateral encroachment accidents in Michigan each year. Of the 204 such accidents reviewed for this study, nearly 22% resulted in at least one injured person. This figure is just slightly below the average for all police-reported accidents in Michigan. The fact that the closing speed between the involved vehicles is usually low probably reduces the probability of injury despite the great difference in mass between the vehicles and the fact that most of these accidents take place on high-speed roads. The greatest potential for injury in these lateral encroachment accidents appears to be when a passing driver loses control and ends up in the truck's lane. This was the scenario for the one fatal case in the sample.

In cases where the other vehicle loses control while passing the truck, there is usually not much the truck driver can do to prevent the collision. Similarly, when another driver suddenly changes lanes and cuts off the truck, all the driver can do is brake and try to stop before hitting the vehicle. The only accidents involving another vehicle coming into the truck's lane where the truck driver may have a chance to avoid an accident are those where the other driver is merging into the truck's lane. If the driver sees the merging vehicle and traffic conditions permit, the driver can assist the merging vehicle by changing lanes or decelerating. The difficulty is that in many of the merging cases that were reviewed, the other vehicle is merging on the right side of the truck and the driver does not see the merging vehicle before the impact.

For the other subtype of lateral encroachment accidents, those involving the truck entering the hit vehicle's lane, the most common scenario is the truck changing lanes to the right. This is much more common than the truck changing lanes to the left. The blind spot appears to be a much bigger problem on the right side of the truck than on the left. The best solution would probably be mirrors that give the driver a wider field of view. Truck drivers should realize that some car drivers will travel to the right of the truck in the blind spot, making no effort to move ahead of the truck. Interview responses suggest that truck drivers try to keep track of the vehicles they pass, but these efforts are not always successful.

Truck Following Cases

Two partial and 30 complete interviews were conducted for the truck following cases. No additional information was coded from police reports for the remaining cases. Three subgroups of truck following cases were created based on the circumstances of the accidents. The first subtype, with 15 cases, described collisions where the traffic ahead suddenly came to a halt and the truck was unable to stop in time. The second subtype, containing 11 cases, included accidents where the truck was cut off by another vehicle moving into its lane. In some of these cases a vehicle changed into the truck's lane and then either stopped or slowed abruptly. In a few cases a vehicle changed into the truck's lane one or more vehicles ahead of the truck, causing the other vehicles to brake, and resulting in the truck striking the vehicle directly ahead.

The third subtype of truck following accidents included six miscellaneous cases that did not fit either of the other two groups. These are briefly described below:

1) The first case in this group involved a truck backing up because the lane he was in to cross a bridge had closed. He struck a vehicle that had pulled behind him just as he started the backing maneuver. This case technically meets the criteria of a truck striking another vehicle in the same lane, but it is an anomalous case.

2) The second accident involved a delivery truck that was parked in a traffic lane without hazard lights. The case truck driver thought the delivery truck was moving. After checking his load in his rear-view mirrors the case truck driver was suddenly right behind the delivery truck and realized it was not moving.

3) The third accident involved a truck stopped behind a car at a red light. The truck driver was adjusting the radio when he let his foot slip off the brake, bumping the car ahead.

4) This accident involved a long-nose tractor stopped in traffic behind a small car that the driver could not see. The driver took his foot off the clutch and bumped the car.

5) This case involved a driver who had fallen asleep at the wheel. Upon awakening he found himself about to strike a truck ahead, which was moving at a slower speed.

6) The final case involved a truck following a car in the right lane. The car signaled left, then abruptly started to pull off on the right shoulder when it was hit by the truck.

Typical truck following accident

Now that the most unusual truck following accidents have been sketched, the following describes the scenario of a typical truck following collision. The truck driver is heading down an urban limited access road that he has driven many times. It is

daylight and the weather conditions are good. The traffic may be heavy. The driver is moving straight ahead, looking at the traffic in front of him, when the car he has been following suddenly stops. The truck driver brakes but cannot stop before hitting the stopped vehicle.

Specifics of truck following accidents

The UD-10 data show that the truck following cases generally took place in daylight. Of the 32 accidents, 27 occurred in the daytime, 2 under dark/lit conditions, 2 under dark/unlit conditions, and one at dawn. Ten of the involvements took place between 8 AM and noon, 17 between noon and 6 PM, and 5 between 11 PM and 7 AM.

Truck following accidents occurred about twice as often in urban areas as in rural areas (21 to 11 cases). Nearly half of the accidents took place on limited access roads, with 15 cases, followed by 11 collisions on major arteries, and 6 on other roads. The road surface was usually dry, although 5 collisions took place on wet roads and one on a snowy/icy surface. Most of the accidents resulted in property damage only (27 cases), while 5 resulted in at least one injured person.

Drivers in the 32 truck following accidents were asked if they were familiar with the route they were driving at the time of the crash. All but three replied that they were familiar with the route. Two drivers said they were driving an unfamiliar route, and in one of the partial interviews it was unknown if the driver was familiar with the route. Of the two drivers not familiar with the route, one said that the lack of familiarity was a factor in the accident.

Generally the truck drivers saw the vehicles with which they collided prior to the accident. There were three exceptions. One involved the truck that backed into another car, one involved the long-nose tractor stopped behind a car that the driver could not see, and the third involved a car coming off a ramp that pulled in front of a truck. It was unknown in both of the partial interviews if the truck driver saw the other vehicle before the accident.

The truck drivers were asked about the event that triggered the accident. In the traffic suddenly stopped subgroup, the triggering event was usually the vehicle ahead stopping. Reasons for the lead vehicle stopping included for a traffic light, to make a turn, for congestion, for a previous accident, and to avoid a dog in the road. In the truck was cut off subgroup, the triggering event was usually a lane change or merging maneuver by the vehicle that was hit or by a vehicle further ahead in the traffic stream. A few cases involved an unexpected turn by a vehicle.

The truck drivers were asked what they were looking at, or doing, just before the vehicle they hit stopped, or slowed down, or appeared in front of them. This was a way to identify driver inattention as a factor in the accident. Based on the interviews, seven of the 32 accidents involved driver inattention on the part of the truck driver. Three of these cases were in the traffic suddenly stopped subtype, two of which involved a driver

picking up something from the floor of the cab, and one that involved a driver trying to locate his exit. One case was in the truck was cut off subtype. In this accident the driver was looking at a woman walking down the street. The other three cases of driver inattention were in the "other" subgroup. One involved the driver who was asleep at the wheel, one the driver who let his foot slip off the brake while waiting at a traffic light, and the third involved the driver who was checking his load in his rear-view mirrors. This last case might better be considered misplaced attention rather than inattention. While the accident may have been avoided if the driver had been looking ahead rather than at the mirrors, the driver's attention was still focused on part of the driving task. In most of the other 25 cases, the driver was looking at the traffic ahead prior to the accident.

Three drivers mentioned equipment failure as a factor in the accident. One said he experienced brake failure when he applied the brakes, another said that several of the axles on his rig had poor brakes, and the third stated that the tractor he was driving was too light for the trailer. All three of these accidents were part of the traffic suddenly stopped category.

When asked about environmental factors that may have contributed to the accident, several drivers mentioned that it was raining or snowing and that the road was wet or icy. Several others cited heavy traffic or road construction. One driver mentioned a railroad overpass that prevented him from seeing that the traffic light was red. This driver had driven this route five times daily for three years and knew that truck drivers could not see the color of the light until they passed under the bridge. This driver was following another truck who stopped for the light after coming under the overpass, but the interviewed driver was unable to stop.

Table 20 shows the avoidance attempts made by the truck drivers according to accident subtype. Overall, close to 70% of the drivers braked, steered, or both to try to avoid the collision. The pattern of avoidance attempts is similar between the traffic suddenly stopped and the truck was cut off subtypes. In the "other" subtype, only one of the six drivers made an avoidance attempt.

Table 20 - Truck Following Cases: Avoidance Attempt by Accident Subtype

	Accident Subtype			
Avoidance Attempt	Traffic Stopped	Cut Off	Other	Total
Braked	8	6	0	14
Braked and Steered	1	0	0	1
Steered	3	3	1	7
None	2	2	5	9
Unknown	1	0	0	1
Total	15	11	6	32

The load status of the truck is shown according to accident subtype in Table 21. Of the known cases, 30% were empty and 70% were hauling cargo at the time of the accident. This is virtually the same distribution of load status found in the national survey of truck travel conducted by UMTRI several years ago. Thus, load status does not seem to be a predictor for truck following accidents, based on the trucks included in this sample.

Table 21 - Truck Following Cases: Load Status by Accident Subtype

	Accident Subtype			
Load Status	Traffic Stopped	Cut Off	Other	Total
Full/partial	10	6	5	21
Empty	4	4	1	9
Unknown	1	1	0	2
Total	15	11	6	32

Drivers were asked to estimate their speed, the speed of the vehicle they hit, and the distance between their truck and the vehicle they hit when that vehicle first stopped or slowed down or appeared in front of them. Table 22 shows the drivers' estimates. Cases were excluded if any of the following were true: (1) the truck driver did not see the lead vehicle prior to the collision; (2) the lead vehicle was not braking or stopped prior to the collision; (3) any of the speed or distance estimates were unknown; and (4) the case was the accident where the driver's foot slipped off the brake. Table 22 also shows the estimated braking distances for the trucks and the lead vehicles based on their initial speeds. For the purposes of this exercise, the lead vehicle was assumed to be a car. Different coefficients of friction were applied depending on whether the road was dry, wet, or icy. The last column in the table shows the difference between the estimated braking distances for the truck and the lead vehicle.

Table 22 - Braking Estimates for Truck Following Cases

Truck Speed (mph)	Braking Distance (ft)	Lead Vehicle Speed (mph)	Braking Distance (ft)	Inter-vehicle Distance (feet)	Braking Distance Difference (ft)
50	208	0	0	150	208
55	504	0	0	65	504
32.5	88	0	0	10	88
25	104	0	0	30	104
45	338	0	0	30	338
56.5	266	52.5	115	20	151
50	208	20	17	35	192
25	52	0	0	20	52
15	19	0	0	20	19
27.5	63	2.5	0	35	63
30	75	12.5	7	15	68
32.5	88	17.5	13	900	75
50	208	40	67	50	142
45	169	0	0	80	169
25	52	0	0	30	52
22.5	42	5	1	20	41
55	252	50	104	80	148
41	560	40	267	25	294
25	52	0	0	45	52
37.5	117	0	0	50	117

In all but two of the 20 cases in Table 22, the difference in the braking distance between the truck and the lead vehicle is greater than the distance between the truck and the lead vehicle when the lead vehicle first braked. In other words, even if the truck driver applied his brakes as soon as the lead vehicle did, he would be unable to bring the truck to a stop before hitting the lead vehicle. For various reasons, not all of the truck drivers braked right away or even at all, further reducing the likelihood of avoiding a collision. In one of the two exceptions there is only a one-foot difference in the estimates, and in the other exception the truck driver's estimate of 900 feet between the two vehicles when the lead vehicle started to brake is probably greatly exaggerated.

In all of the truck following accidents the first event was striking another motor vehicle. Two of the 32 cases featured a subsequent event. In one case the truck overturned, and in the other case the truck ran off the road.

Recommendations for driver training

An estimated 332 truck-tractors are involved in truck following accidents in Michigan each year. The review of the police reports and the interviews with truck drivers point to two potential areas of improvement for truck drivers. The first area is

driver inattention. About one out of five of the truck following accidents was found to include inattention or distraction on the part of the truck driver as a contributing factor to the accident. Causes of inattention varied and some seem more preventable than others. For example, most truck drivers presumably know that they should not try to pick up items from the floor of their cab while driving a big truck down the road, yet this very action led to two of the accidents that were reviewed. Perhaps more emphasis in training about the potential consequences of taking your eyes off the road would help combat this instinctive behavior. A more difficult and potentially more dangerous situation is driver fatigue, as represented by the case of the driver who fell asleep at the wheel. Driver fatigue is a recognized area of concern in the trucking industry, and possible areas of treatment include changes in hours of service regulations or scheduling, and implementation of driver vigilance monitors. Other cases, such as the driver trying to find his exit or the driver checking his load in his mirror, feature drivers averting their attention from the traffic ahead in order to concentrate on other parts of the driving task. Remedies for these situations are still more complex.

The other area to target for the prevention of truck following accidents is following distance. In the earlier discussion about deer accidents, it was argued that there was little truck drivers could do to avoid those collisions, given the speed of the truck and the distance to the deer when the deer first appeared. On the surface, Table 22 concerning braking distances in the truck following accidents seems to support the same conclusion. The difference is that, while a deer will suddenly appear in front of a truck, the vehicle struck in a truck following accident has often been in front of the truck for some time. What Table 22 really suggests is that the trucks that were involved in truck following accidents were following the lead vehicle so closely that they had almost no chance of avoiding a collision if the lead vehicle suddenly braked. If the involved truck drivers had been following the lead vehicle at a greater distance, they would have given themselves a better chance of avoiding a collision due to a sudden stop.

DRIVER AGE AND TRAINING

The drivers who were interviewed were asked if they had received any training before starting to drive trucks professionally. The interviewers recorded the responses verbatim and these responses were later categorized. The categories that emerged are: formal training at a truck driving school or community college, which included both classroom instruction and on-the-road training; learning from a family member or while growing up on a farm; training when serving in the military; a company training or apprentice program; learning by driving straight trucks or an unspecified training program, i.e. not enough detail to categorize the response; and no training.

Table 23 compares the type of driver training with the age of the truck driver. In this table, and the two others in this section, only those cases where at least one data element is known are included. This group comprises all of the complete and some of the partial interviews. Within each age category and overall, the most common

response to the training question was that the driver had no training. Overall, 40% of the drivers reported no driver training. Over half of the drivers 60 and older had no training, while only 32% of the drivers aged 30-39 had no training. For drivers reporting some type of training, formal training or learning from a relative or while growing up on a farm were the two most common responses, each representing about 20% of all drivers. Not surprisingly, the younger drivers were more likely to have attended a formal driver training course. The percentage of drivers who received formal training drops in each successively older group, declining rapidly for drivers 50 and older. Smaller numbers of drivers reported receiving training from a company program or while serving in the military.

Table 23 - Type of Training by Driver Age

Type of Training	Age Group 20-29	30-39	40-49	50-59	60+	Total
None	13	28	28	19	10	98
Col. Pct.	41.9	31.8	41.2	46.3	55.6	39.8
Formal Training	8	21	13	3	1	46
Col. Pct.	25.8	23.9	19.1	7.3	5.6	18.7
Relative/farm	4	21	11	10	5	51
Col. Pct.	12.9	23.9	16.2	24.4	27.8	20.7
Military	2	3	9	1	0	15
Col. Pct.	6.5	3.4	13.2	2.4	0.0	6.1
Company	2	13	5	5	0	25
Col. Pct.	6.5	14.8	7.4	12.2	0.0	10.2
Other	0	1	0	2	2	5
Col. Pct.	0.0	1.1	0.0	4.9	11.1	2.0
Unknown	2	1	2	1	0	6
Col. Pct.	6.5	1.1	2.9	2.4	0.0	2.4
Total	31	88	68	41	18	246
Col. Pct.	100.0	100.0	100.0	100.0	100.0	100.0

Comparisons were also made between the type of training the driver reported and the accident type (Table 24). Overall, the type of training shows surprisingly little variation among the accident categories. For example, the percentage of drivers in each accident category who received formal training varies from only 16% in the animal group to 22% in the loss of control group. In each accident category the percentage with formal training is within three percentage points of the 19% of the aggregate who received formal training. Drivers who learned to drive a truck from a family member or who grew up on a farm were overinvolved in animal accidents and underinvolved in roadside object accidents. The loss of control and lateral encroachment categories had relatively low percentages of drivers who had no training at all, and the animal, roadside object, and truck following categories all had relatively high percentages of drivers with no training.

Table 24 - Type of Training by Accident Type

Type of Training	Accident Type: Animal/ Ped.	Roadside Object	Loss of Control	Lateral Enc.	Truck Following	Total
None	14	20	16	33	15	98
Col. Pct.	43.8	47.6	34.8	35.1	46.9	39.8
Formal Training	5	8	10	17	6	46
Col. Pct.	15.6	19.0	21.7	18.1	18.8	18.7
Relative/farm	10	6	10	19	6	51
Col. Pct.	31.3	14.3	21.7	20.2	18.8	20.7
Military	0	3	4	7	1	15
Col. Pct.	0.0	7.1	8.7	7.4	3.1	6.1
Company	2	2	5	12	4	25
Col. Pct.	6.3	4.8	10.9	12.8	12.5	10.2
Other	0	3	0	2	0	5
Col. Pct.	0.0	7.1	0.0	2.1	0.0	2.0
Unknown	1	0	1	4	0	6
Col. Pct.	3.1	0.0	2.2	4.3	0.0	2.4
Total	32	42	46	94	32	246
Col. Pct.	100.0	100.0	100.0	100.0	100.0	100.0

Table 25 compares the accident types by the age group of the truck driver. The youngest group of drivers is overinvolved in the truck following accidents. Although they make up only 12.6% of all the accident-involved drivers, they represent over 34% of the drivers in truck following collisions. Conversely, drivers aged 50-59 are underinvolved in truck following accidents. Only one of the 41 drivers this age was involved in this type of collision. The drivers aged 30-39 have a higher number of animal accidents and fewer truck following accidents than would be expected based on the size of their age group. Some of these differences might be due to different types of trips and travel patterns among the age groups.

Table 25 - Driver Age by Accident Type

Driver Age	Accident Type: Animal/ Ped.	Roadside Object	Loss of Control	Lateral Enc.	Truck Following	Total
20-29	4	3	4	9	11	31
Col. Pct.	12.5	7.1	8.7	9.6	34.4	12.6
30-39	14	14	16	37	7	88
Col. Pct.	43.7	33.3	34.8	39.4	21.9	35.8
40-40	9	13	15	20	11	68
Col. Pct.	28.1	30.9	32.6	21.3	34.4	27.6
50-59	4	8	10	18	1	41
Col. Pct.	12.5	19.0	21.7	19.1	3.1	16.7
60+	1	4	1	10	2	18
Col. Pct.	3.1	9.2	2.2	10.6	6.2	7.3
Total	32	42	46	94	32	246
Col. Pct.	100.0	100.0	100.0	100.0	100.0	100.0

SUMMARY

This study analyzed information from the 1991 State of Michigan Official Traffic Accident Report form, known as the UD-10, the Supplemental Truck and Bus Traffic Accident Report, the UD-10T, and information obtained by UMTRI in a telephone interview with drivers of trucks involved in selected police-reported accidents in Michigan. The overall project was conducted jointly with the Department of Civil and Environmental Engineering at Michigan State University. (MSU) This report documents the methodology and results of the UMTRI portion of the research project. The focus of this study was to identify truck driver training issues.

The study focused on precollision events. In a previous study of passenger car opportunities for collision avoidance, collisions were classified based on roadway characteristics and the pre-collision positions and maneuvers of the involved vehicles. Based on this collision typology, the two most common collision situations for truck-tractors in Michigan were multivehicle, nonintersection, same direction accidents, and single-vehicle collisions. Together these account for nearly 55% of all tractor accident involvements in Michigan. Accidents were selected from these two collision types for the subsequent review of the accident reports and telephone interviews with the involved truck drivers. Selection of cases from the same direction group was limited to trucks with front or side damage, since the truck driver was not expected to be aware of pertinent precollision events when struck from the rear.

The scene diagram and narrative on the accident reports allowed the selected cases to be sorted into collision subtypes. The single-vehicle accidents were classified as animal/pedestrian, struck roadside object, and loss of control. Same-direction collisions

were separated into lane encroachment and truck following (rear-end collision). Survey questions for the driver interviews were tailored to the collision subtypes. The following material summarizes the findings for each subtype.

Single-vehicle collisions

Animal and pedestrian - The critical event is the truck making contact with an animal or pedestrian. The majority of these cases in the Michigan sample involve deer. A pedestrian was struck in only one of 32 cases reviewed. The deer accidents typically occur on a rural road at night in the fall. The deer appears so suddenly that the driver has no chance to avoid it (approximately one second, based on reported speeds and distances at sighting). Avoidance maneuvers are not recommended, since the consequences of the avoidance maneuvers are sometimes much worse than the deer collision.

Roadside object - The critical event is the truck striking an inanimate object alongside, or more rarely above, the roadway. Many of these cases involve off-tracking while making a turn and hitting a sign or other object on a corner. Some cases involve parked cars or overhead objects, such as bridges and wires. These are property damage accidents that generally occur at low speeds. They typically involve an error in judging clearance by the driver, usually on a right turn. Drivers reporting no driver training were somewhat over-represented in this collision type.

Loss of control - This is the largest of the single-vehicle subtypes. In these cases, the driver lost control of the truck, whether because of poor road conditions, speeding, inattention, making an avoidance maneuver, or some other reason. While the end result sometimes involved hitting a roadside object, the difference between this subtype and the roadside object subtype concerns control of the vehicle. The probability of injury in these collisions is relatively high at 37 percent. Weather was associated with this subtype, with half occurring in December through February, and 44 percent classified as weather-related. Empty trucks are also over-represented at 63 percent. Speeds are sometimes high, considering the road conditions. Generally, a combination of high speed, slippery roads, an empty truck with limited traction, and the necessity of an avoidance maneuver exceeds the driver's capabilities. These are the skills and vehicle handling knowledge that are addressed by the Michigan Decision Driving School.

Same direction collisions

Previous UMTRI studies have identified the same-direction collision type as most common for both cars and trucks. When a passenger car is the striking vehicle, the struck vehicle has usually been ahead of it for some time. Lane changes by either vehicle as a pre-collision event are not common. This review presents a much different picture when a truck is the striking vehicle. A pre-collision lane change maneuver (lateral encroachment) was reported in over 70 percent of the same-direction collisions

studied. In the remainder, the truck struck the vehicle traveling in front of it (truck following). Additional details are summarized for each subtype.

Lateral encroachment - These cases involve one vehicle moving into another vehicle's lane. Some involve lane change attempts when another vehicle was alongside the vehicle initiating the lane change. Others involve one vehicle moving suddenly in front of another vehicle such that the driver of the second vehicle cannot stop in time to avoid a collision. The collision occurred in the truck's lane two-thirds of the time, and in the other vehicle's lane one-third. When the collision occurred in the truck's lane, the other vehicle was encroaching, usually from the left. When the truck encroached, the driver was usually making a lane change to the right and reported that the other vehicle was in the blind spot. The lateral encroachment group is the largest subtype, representing almost 12 percent of all tractors involved in police-reported accidents in Michigan. The problem of not seeing vehicles when merging to the right may be best addressed by improved equipment, either better mirrors or other technology. Vision is generally better on the left, but here the encroachment is usually initiated by the other vehicle, leaving the truck driver with little opportunity for avoidance.

Truck following - The precollision situation is the truck following another vehicle down the road, and the critical event involves the truck striking that vehicle. These are typically rear-end collisions. The reverse situation, another vehicle striking the truck in the rear, was excluded from the survey sample because the truck driver would usually not be aware of an impending collision until it had occurred. Based on reported speeds and distances to the lead vehicle, drivers were following too closely to stop, even if they had braked immediately. A lack of driver training was somewhat over-represented in this subtype. Inattention was also a contributing factor, as was fatigue. The primary countermeasure for this subtype is increased following distances.

Collision subtypes covered in this study are summarized in Table 26. The percentage of all tractors involved in police-reported accidents in Michigan is shown, along with the estimated number of tractors involved annually in Michigan for each subtype. The last section covers limitations of the study.

Table 26 - Summary of Collision Types

Collision Types Reviewed	Percent of all Truck Involvements		Estimated No./Year
Single-vehicle	22.1%		
Animal/pedestrian		4.2%	327
Roadside object		6.8%	528
Loss of control		7.5%	580
Other/unknown		3.7%	288
Same Direction (striking)	17.3%		
Lateral encroachment		11.8%	915
Truck following (rearend)		4.3%	332
Other/unknown		1.3%	99
Collision types Reviewed	39.4%		

Limitations - The collision situations studied were the most common, but the findings are probably not applicable to other collision situations. Also, the study was limited to Michigan police-reported accidents. Some findings, such as the incidence of deer and weather-related loss of control, may not apply to other operating environments outside of Michigan.

The overall interview response rate was only 47% of the sampled cases. The interview subject was always the driver. Consequently, the information should be regarded as the truck driver's point of view. Some information could be compared with the accident report, but often the driver is also the police officer's source as well. Some inconsistencies were noted. Based on driver interviews, the other vehicle encroached on the truck 76 percent of the time. In cases where the driver could not be contacted, the police reports indicated that the other vehicle encroached on the truck in 57 percent of the cases. This result is suggestive of differences in point of view. Another possible source of bias is the drivers that could not be reached, or less often, drivers that refused the interview. The response rate was highest for the animal/pedestrian subtype at 78%, and lowest for the truck following at 41%. Drivers that did not respond may be more likely to be at fault than drivers who participated.

APPENDIX A: Interview Introduction

I'm calling from the Transportation Research Institute at The University of Michigan. We are doing a study for the Michigan Truck Safety Commission. We're contacting truck drivers who were involved in the most common types of accidents in Michigan during 1991. The Commission wants to use information from professional drivers like yourself to improve truck driver training programs to make them more relevant to everyday driving situations and to help everyone avoid collisions. I'll be asking you about your recollection of accident events, but we are not concerned with who was at fault. Participation in the study is voluntary and all responses will be kept strictly confidential. No identifying information will be used in any results or reports of the survey findings.

APPENDIX B: Purpose of the UD-10 Study

The following is a suggested response if the driver wants to know why we're asking all these questions about the accident:

One of the original goals in traffic safety research was to find ways to improve vehicle crashworthiness in order to protect occupants. Police reports were originally designed with this goal in mind, so most of the information on them pertains to the crash itself and the results of the crash. Police reports record the degree of damage to each vehicle, initial impact points, injuries sustained by motorists, and the type of collision configuration, like a head-on crash or a rear-end collision.

Over the last couple of decades, vehicle crashworthiness has improved. Energy-absorbing structures have been refined, vehicle interiors have become more forgiving, and more people are taking advantage of restraint systems, both safety belts and air bags. With these changes, the focus of traffic safety research has shifted more towards collision avoidance—preventing a crash from happening in the first place rather than reducing the severity of its outcome.

To develop collision avoidance systems we need information about pre-crash situations. This includes the relative positions of the vehicles before the crash, how fast they were moving, and what sort of maneuvers they were making. This type of information is usually not available on police reports, so we're turning to professional drivers for their assistance.

APPENDIX C: Interview Questionnaires

Driver Training and Crash Avoidance Survey

Accident Record #_____

Vehicle # from UD10_____

Date of accident_____/_____/ 1

Model year 19_____ _____

Truck make _____ _____ -

Power unit type *(Circle)* (1) Straight (2) Tractor _____

Configuration

(Circle) (1) Bobtail (2) Single (3) Double (4) Triple _____

(5) Other *(specify)*:_____

(if not a tractor **stop here**)

Trailer body style

(Circle) (1) Van (2) Tank (3) Flatbed (4) Dump

(5) Cement mixer (6) Auto carrier (7) Refuse

(8) Other *(specify)* _____ _____ -

Number of axles on each unit:

Tractor _____ _____ -

1st trailer_____ _____

2nd trailer_____ _____

3rd trailer_____ _____ -

Circle the response, if "other" specify

Carrier designation: Intrastate Interstate _____

Carrier type: For-hire Private Other_____ _____

Load information: Full/Partial Empty _____

Was the driver familiar with the route traveled on that day?
(How often had been that way prior to the accident day?)
If yes, did something unusual/unexpected happen prior to the accident?
If no, did the lack of familiarity have an effect on the accident involvement?
(ie.:too much attention directed at navigating, missed lane change for exit, etc)

Single Vehicle Situation

Case # _____

Vehicle #_____

Section 1 - Animal & Pedestrian Accidents

1a- When did you first see the *animal/pedestrian?* _____

(Was it on the road or shoulder? Specify what was hit (Deer, pedestrian) How many were there?)

1b- What was the distance between the truck and the *(animal/pedestrian)* at that moment? ***(Skip to Section 4)*** _____

Section 2 - Ran Off Road/Loss of Control

2a- What event or maneuver do you think triggered the accident? _____

2b- What were you looking at just before_____?(the event just described) _____

(Side or rear-view mirrors, road signs, other vehicles, radio, etc)

2c- What objects were hit during the accident? ***(Skip to Section 4)*** _____

Section 3 - Roadside Object/No Loss of Control

3- Did you notice the object you struck before you collided with it? _____

Section 4 - To be asked on all cases

4a- What was the truck's speed at that moment? _____

4b- Were there environmental factors (like road curvature, visibility, weather, road surface condition, etc.) that contributed to the accident? _____

(Don't ask if answer to Q3 is no)**

4c- Did you make any avoidance attempt or warning? ie: braking, steering, accelerating, sounding horn, etc. _____

Don't ask about these two factors. If either or both are mentioned during the interview, get details and record.

Equipment _____

Driver condition _____

Lateral Encroachment Situation

Case # _____

Vehicle #_____

When did you first see the _____?
(Other vehicle involved) _____

Whose lane did the accident occur in? _____

Which lane did the accident occur in? (left, center, right, shoulder, etc.)

Describe the pre-crash maneuvers by the involved vehicles _____

Did the truck make a lane change? _____

***If yes**: did you check the side &/or rear-view mirrors first?* _____

***If yes again**: was there a problem of a blind spot?* _____

Were there environmental factors (like road curvature, visibility, weather, road surface condition, etc.) that contributed to the accident? _____

Did you make any avoidance attempt or warning? ie: braking, steering, accelerating, sounding horn, etc _____

Don't ask about these two factors. If either or both are mentioned during the interview, get details and record.

Equipment _____

Driver condition _____

Truck Following Situation

Case # _____ -

Vehicle #_____

When did you first see the _____?
(*other vehicle involved*) _____

What event or maneuver do you think triggered the accident? _____ -
(Not necessarily an involved vehicle or even a vehicle)

Describe all pre-crash events/maneuvers by the involved vehicles. _____ -
(Determine what all involved vehicles were doing at that moment.)

What were you looking at just before_____?*(the lead vehicle stopped/slowed down/ appeared in front of you)* _____ -
(ie.:Side or rear-view mirrors, road signs, other vehicles, radio, etc)

What was the truck's speed at that moment? (*the moment the lead vehicle stopped/slowed down/ appeared in front of you)* _____

What was the speed of the vehicle you hit? (Follow-up: How much slower than you was it going?) _____ -

What was the distance between the two vehicles at that moment? _____ -

Were there environmental factors (like road curvature, visibility, weather, road surface condition, etc.) that contributed to the accident? _____ -

Did you make any avoidance attempt or warning? ie: braking, steering, accelerating, sounding horn, etc _____

Don't ask about these two factors. If either or both are mentioned during the interview, get details and record.

Equipment _____ -

Driver condition _____

Driver Training and Crash Avoidance Survey

	Sequence of Events (for this vehicle)				
Ran off road	1	2	3	4	5
Jackknife	1	2	3	4	5
Overturn	1	2	3	4	5
Downhill runaway	1	2	3	4	5
Cargo loss/shift	1	2	3	4	5
Explosion/fire	1	2	3	4	5
Separation of units	1	2	3	4	5
Collision Involving:					
Pedestrian	1	2	3	4	5
Motor vehicle in transport	1	2	3	4	5
Parked vehicle	1	2	3	4	5
Train	1	2	3	4	5
Pedalcycle	1	2	3	4	5
Animal	1	2	3	4	5
Fixed object	1	2	3	4	5
Other object	1	2	3	4	5
Other	1	2	3	4	5

Experience and training

Driver age _____

Total years driving tractor combinations _____

Years driving doubles (if applic) _____

How long driving for this carrier? _____

What type of formal truck driver training did you receive before starting your job as a truck driver?

Classroom_____ On the Road_____

How many_____hrs./wks./mos.

How long had you been driving that day (or since last eight hours off-duty) before the accident happened? _____

APPENDIX D: Database Coding Forms

Coding Form for No Call Cases

UMTRI Case # _ _ _ _ _ _

Vehicle # _ (default=1)

PAR obtained? 1=Yes
2=No

10-T form in folder? 1=Yes
2=No
9=N/A (if PAR=2)

Interview status 1=Complete
2=Partial
3=Refused
4=Unable to locate
5=No call (default)
6=NSV

Ruptured/damaged fuel tank on truck? 1=Yes
2=No
9=unknown (if PAR=2)

Sample category 1=SV
2=SD

Reason for no call 1=hit and run
2=gross equipment failure
3=lost load
4=fire/explosion
5=separation of units
6=other

Detailed description _____ (alpha)

Coding Form for A&P Cases

UMTRI Case # _ _ _ _ _ _

Vehicle # _ (default=1)

10-T form in folder? 1=Yes
2=No

Interview status 1=Complete
2=Partial
3=Refused
4=Unable to locate
5=No call
6=NSV

Ruptured/damaged fuel tank on truck? 1=Yes
2=No

COMPLETE THE FOLLOWING IF INTERVIEW STATUS=1, 2, OR 6:

Model year _ _

Make _____ (alpha)

PTYP 1=Straight
2=Tractor (default)

Config 1=Bobtail
2=Single
3=Double
4=Triple
5=Other _____ (specify)

STOP HERE IF INTERVIEW STATUS=6

(default=N/A)

Trailer Body Style 1=Van
2=Tank
3=Flatbed
4=Dump
5=Cement mixer
6=Auto carrier
7=Refuse
8=Other _____ (specify) (default=N/A)

Tractor number of axles _

First trailer number of axles _

Second trailer number of axles _ (default=0)

Third trailer number of axles _ (default=0)

Carrier designation 1=Intrastate
2=Interstate

Carrier type 1=For-hire
2=Private
3=Other _____ (default=N/A)
(specify)

Load info. 1=Full/partial
2=Empty

Driver familiar with route? 1=Yes
2=No

IF FAMILIAR=1, ELSE GO TO FAMILIAR=2 QUESTIONS:
How often had driver been that way? _____ (alpha)
(default=N/A)

Did something unusual/unexpected happen? 1=Yes
2=No
9=N/A (default)

IF UNUSUAL=1, ELSE GO TO A&P QUESTIONS:
What happened? _____ (alpha) (default=N/A)

IF FAMILIAR=2, ELSE GO TO A&P QUESTIONS:
Did lack of familiarity have effect on accident? 1=Yes
2=No
9=N/A (default)

IF LACK OF FAMILIARITY=1, ELSE GO TO A&P QUESTIONS:
How so? _____ (alpha) (default=N/A)

A&P QUESTIONS

What was hit? 1=Pedestrian
2=Deer (default)
3=Other _____ (default=N/A)
(specify)

First seen on road or shoulder? 1=Road
2=Shoulder
3=Never saw it

How many were in the roadway? 1=One
2=Two or more

Who hit whom? 1=Truck hit animal or pedestrian
2=Animal ran into side of truck

Distance between truck and animal/pedestrian when first seen
_____ (alpha)

Truck's speed in mph _____ (alpha)

Contributing environmental factors _____ (alpha)

Avoidance attempts/warnings _____ (alpha)

Equipment _____ (alpha) (default=N/A)

Driver condition _____ (alpha) (default=N/A)

Any other pre-collision info _____ (alpha)

SEQUENCE OF EVENTS

First event _ (default=13)
Second event _ (default=0)
Third event _ (default=0)
Fourth event _ (default=0)
Fifth event _ (default=0)

Codes:
0=none
1=ran off road
2=jackknife
3=overturn
4=downhill runaway
5=cargo loss/shift
6=explosion/fire
7=separation of units
8=pedestrian
9=motor vehicle
10=parked vehicle
11=train
12=pedalcycle
13=animal
14=fixed object
15=other object
16=other

EXPERIENCE AND TRAINING

Driver age _ _

Total years driving tractors _ _

If CONFIG=3, years driving doubles _ _ 99=N/A (default)

How long driving for this carrier? _____ (alpha)

Type of formal training _____ (alpha)

Classroom training? 1=Yes
2=No
9=N/A (default)

On the road training? 1=Yes
2=No
9=N/A (default)

Length of training _ 98=unknown 99=N/A (default)

Unit 1=Hours
2=Weeks
3=Months
9=N/A (default)

Hours driven before accident _ _ 98=unknown
(use decimals if necessary, e.g. 0.5=1/2 hour)

Coding Form for Roadside Object Cases

UMTRI Case # _ _ _ _ _ _

Vehicle # _ (default=1)

10-T form in folder? 1=Yes
2=No

Interview status 1=Complete
2=Partial
3=Refused
4=Unable to locate
5=No call
6=NSV

Ruptured/damaged fuel tank on truck? 1=Yes
2=No

COMPLETE THE FOLLOWING IF INTERVIEW STATUS=1, 2, OR 6:

Model year _ _

Make _____ (alpha)

PTYP 1=Straight
2=Tractor (default)

Config 1=Bobtail
2=Single
3=Double
4=Triple
5=Other _____ (specify)

STOP HERE IF INTERVIEW STATUS=6

(default=N/A)

Trailer Body Style 1=Van
2=Tank
3=Flatbed
4=Dump
5=Cement mixer
6=Auto carrier
7=Refuse
8=Other _____ (specify) (default=N/A)

Tractor number of axles _

First trailer number of axles _

Second trailer number of axles _ (default=0)

Third trailer number of axles _ (default=0)

Carrier designation 1=Intrastate
2=Interstate

Carrier type 1=For-hire
2=Private
3=Other _____ (default=N/A)
(specify)

Load info. 1=Full/partial
2=Empty

Driver familiar with route? 1=Yes
2=No

IF FAMILIAR=1, ELSE GO TO FAMILIAR=2 QUESTIONS:
How often had driver been that way? _____ (alpha)
(default=N/A)

Did something unusual/unexpected happen? 1=Yes
2=No
9=N/A (default)

IF UNUSUAL=1, ELSE GO TO RO QUESTIONS:
What happened? _____ (alpha) (default=N/A)

IF FAMILIAR=2, ELSE GO TO RO QUESTIONS:
Did lack of familiarity have effect on accident? 1=Yes
2=No
9=N/A (default)

IF LACK OF FAMILIARITY=1, ELSE GO TO RO QUESTIONS:
How so? _____ (alpha) (default=N/A)

ROADSIDE OBJECT QUESTIONS

What was hit? _____ (alpha)

Object noticed before struck? 1=Yes
2=No

Truck's speed in mph _____ (alpha)

Contributing environmental factors _____ (alpha)

Avoidance attempts/warnings _____ (alpha) (default=N/A)
(N/A if object noticed=2)

Equipment _____ (alpha) (default=N/A)

Driver condition _____ (alpha) (default=N/A)

Any other pre-collision info _____ (alpha)

SEQUENCE OF EVENTS

		Codes:
First event _	(default=14)	0=none
		1=ran off road
Second event _	(default=0)	2=jackknife
		3=overturn
Third event _	(default=0)	4=downhill runaway
		5=cargo loss/shift
Fourth event _	(default=0)	6=explosion/fire
		7=separation of units
Fifth event _	(default=0)	8=pedestrian
		9=motor vehicle
		10=parked vehicle
		11=train
		12=pedalcycle
		13=animal
		14=fixed object
		15=other object
		16=other

EXPERIENCE AND TRAINING

Driver age _ _

Total years driving tractors _ _

If CONFIG=3, years driving doubles _ _ 99=N/A (default)

How long driving for this carrier? _____ (alpha)

Type of formal training _____ (alpha)

Classroom training? 1=Yes
2=No
9=N/A (default)

On the road training? 1=Yes
2=No
9=N/A (default)

Length of training _ 98=unknown 99=N/A (default)

Unit 1=Hours
2=Weeks
3=Months
9=N/A (default)

Hours driven before accident _ _ 98=unknown
(use decimals if necessary, e.g. 0.5=1/2 hour)

Coding Form for Loss of Control Cases

UMTRI Case # _ _ _ _ _ _

Vehicle # _ (default=1)

10-T form in folder? 1=Yes
2=No

Interview status 1=Complete
2=Partial
3=Refused
4=Unable to locate
5=No call
6=NSV

Ruptured/damaged fuel tank on truck? 1=Yes
2=No

COMPLETE THE FOLLOWING IF INTERVIEW STATUS=1, 2, OR 6:

Model year _ _

Make _____ (alpha)

PTYP 1=Straight
2=Tractor (default)

Config 1=Bobtail
2=Single
3=Double
4=Triple
5=Other _____ (specify)

STOP HERE IF INTERVIEW STATUS=6

(default=N/A)

Trailer Body Style 1=Van
2=Tank
3=Flatbed
4=Dump
5=Cement mixer
6=Auto carrier
7=Refuse
8=Other _____ (specify)

(default=N/A)

Tractor number of axles _

First trailer number of axles _

Second trailer number of axles _ (default=0)

Third trailer number of axles _ (default=0)

Carrier designation 1=Intrastate
2=Interstate

Carrier type 1=For-hire
2=Private
3=Other _____ (default=N/A)
(specify)

Load info. 1=Full/partial
2=Empty

Driver familiar with route? 1=Yes
2=No

IF FAMILIAR=1, ELSE GO TO FAMILIAR=2 QUESTIONS:
How often had driver been that way? _____ (alpha)
(default=N/A)

Did something unusual/unexpected happen? 1=Yes
2=No
9=N/A (default)

IF UNUSUAL=1, ELSE GO TO LC QUESTIONS:
What happened? _____ (alpha) (default=N/A)

IF FAMILIAR=2, ELSE GO TO LC QUESTIONS:
Did lack of familiarity have effect on accident? 1=Yes
2=No
9=N/A (default)

IF LACK OF FAMILIARITY=1, ELSE GO TO LC QUESTIONS:
How so? _____ (alpha) (default=N/A)

LOSS OF CONTROL QUESTIONS

Triggering event _____ (alpha)

What was driver looking at? _____ (alpha)

What objects were hit? _____ (alpha)

Truck's speed in mph _____ (alpha)

Contributing environmental factors _____ (alpha)

Avoidance attempts/warnings _____ (alpha)

Equipment _____ (alpha) (default=N/A)

Driver condition _____ (alpha) (default=N/A)

Any other pre-collision info _____ (alpha)

SEQUENCE OF EVENTS

First event _

Second event _ (default=0)

Third event _ (default=0)

Fourth event _ (default=0)

Fifth event _ (default=0)

Codes:
0=none
1=ran off road
2=jackknife
3=overturn
4=downhill runaway
5=cargo loss/shift
6=explosion/fire
7=separation of units
8=pedestrian
9=motor vehicle
10=parked vehicle
11=train
12=pedalcycle
13=animal
14=fixed object
15=other object
16=other

EXPERIENCE AND TRAINING

Driver age _ _

Total years driving tractors _ _

If CONFIG=3, years driving doubles _ _ 99=N/A (default)

How long driving for this carrier? _____ (alpha)

Type of formal training _____ (alpha)

Classroom training? 1=Yes
2=No
9=N/A (default)

On the road training? 1=Yes
2=No
9=N/A (default)

Length of training _ 98=unknown 99=N/A (default)

Unit 1=Hours
2=Weeks
3=Months
9=N/A (default)

Hours driven before accident _ _ 98=unknown
(use decimals if necessary, e.g. 0.5=1/2 hour)

Coding Form for Lateral Encroachment Cases

UMTRI Case # _ _ _ _ _ _

Vehicle # _ (default=1)

10-T form in folder? 1=Yes
2=No

Interview status 1=Complete
2=Partial
3=Refused
4=Unable to locate
5=No call
6=NSV

Ruptured/damaged fuel tank on truck? 1=Yes
2=No

COMPLETE THE FOLLOWING IF INTERVIEW STATUS=1, 2, OR 6:

Model year _ _

Make _____ (alpha)

PTYP 1=Straight
2=Tractor (default)

Config 1=Bobtail
2=Single
3=Double
4=Triple
5=Other _____ (specify)

STOP HERE IF INTERVIEW STATUS=6

(default=N/A)

Trailer Body Style 1=Van
2=Tank
3=Flatbed
4=Dump
5=Cement mixer
6=Auto carrier
7=Refuse
8=Other _____ (specify) (default=N/A)

Tractor number of axles _

First trailer number of axles _

Second trailer number of axles _ (default=0)

Third trailer number of axles _ (default=0)

Carrier designation 1=Intrastate
2=Interstate

Carrier type 1=For-hire
2=Private
3=Other _____ (default=N/A)
(specify)

Load info. 1=Full/partial
2=Empty

Driver familiar with route? 1=Yes
2=No
9=Unknown

IF FAMILIAR=1, ELSE GO TO FAMILIAR=2 QUESTIONS:
How often had driver been that way? _____ (alpha)
(default=N/A)

Did something unusual/unexpected happen? 1=Yes
2=No
9=N/A (default)

IF UNUSUAL=1, ELSE GO TO LE QUESTIONS:
What happened? _____ (alpha) (default=N/A)

IF FAMILIAR=2, ELSE GO TO LE QUESTIONS:
Did lack of familiarity have effect on accident? 1=Yes
2=No
9=N/A (default)

IF LACK OF FAMILIARITY=1, ELSE GO TO LE QUESTIONS:
How so? _____ (alpha) (default=N/A)

LATERAL ENCROACHMENT QUESTIONS

When did driver first see other vehicle? _____ (alpha)

Whose lane? 1=Truck driver's
2=Other vehicle's
3=Other
4=Indeterminate

Which lane? 1=Left lane
2=Center lane
3=Right lane
4=Shoulder
5=Other _____ (default=N/A)
(specify)

Pre-crash events/maneuvers by truck _____ (alpha)

Pre-crash events/maneuvers by vehicle that collided with truck _____

(alpha)

Pre-crash events/maneuvers by any other involved vehicles _____

(alpha)

Did truck depart lane as initiating event in the accident, not as an avoidance maneuver?
1=Yes
2=No
3=Truck was merging

If lane change=1,3 check mirrors?
1=Yes
2=No
9=N/A (default)

If check mirrors=1, blind spot?
1=Yes
2=No
9=N/A (default)

Contributing environmental factors _____ (alpha)

Avoidance attempts/warnings _____ (alpha)

Equipment _____ (alpha) (default=N/A)

Driver condition _____ (alpha) (default=N/A)

Any other pre-collision info _____ (alpha)

SEQUENCE OF EVENTS

First event _ (default=9)
Second event _ (default=0)
Third event _ (default=0)
Fourth event _ (default=0)
Fifth event _ (default=0)

Codes:
0=none
1=ran off road
2=jackknife
3=overturn
4=downhill runaway
5=cargo loss/shift
6=explosion/fire
7=separation of units
8=pedestrian
9=motor vehicle
10=parked vehicle
11=train
12=pedalcycle
13=animal
14=fixed object
15=other object
16=other

EXPERIENCE AND TRAINING

Driver age _ _

Total years driving tractors _ _

If CONFIG=3, years driving doubles _ _ 99=N/A (default)

How long driving for this carrier? _____ (alpha)

Type of formal training _____ (alpha)

Classroom training? 1=Yes
2=No
9=N/A (default)

On the road training? 1=Yes
2=No
9=N/A (default)

Length of training _ 98=unknown 99=N/A (default)

Unit 1=Hours
2=Weeks
3=Months
9=N/A (default)

Hours driven before accident _ _ 98=unknown
(use decimals if necessary, e.g. 0.5=1/2 hour)

Coding Form for Truck Following Cases

UMTRI Case # _ _ _ _ _ _

Vehicle # _ (default=1)

10-T form in folder? 1=Yes
2=No

Interview status 1=Complete
2=Partial
3=Refused
4=Unable to locate
5=No call
6=NSV

Ruptured/damaged fuel tank on truck? 1=Yes
2=No

COMPLETE THE FOLLOWING IF INTERVIEW STATUS=1, 2, OR 6:

Model year _ _

Make _____ (alpha)

PTYP 1=Straight
2=Tractor (default)

Config 1=Bobtail
2=Single
3=Double
4=Triple
5=Other _____ (specify)

STOP HERE IF INTERVIEW STATUS=6

(default=N/A)

Trailer Body Style 1=Van
2=Tank
3=Flatbed
4=Dump
5=Cement mixer
6=Auto carrier
7=Refuse
8=Other _____ (specify) (default=N/A)

Tractor number of axles _

First trailer number of axles _

Second trailer number of axles _ (default=0)

Third trailer number of axles _ (default=0)

Carrier designation 1=Intrastate
2=Interstate

Carrier type 1=For-hire
2=Private
3=Other _____ (default=N/A)
(specify)

Load info. 1=Full/partial
2=Empty
9=Unknown

Driver familiar with route? 1=Yes
2=No

IF FAMILIAR=1, ELSE GO TO FAMILIAR=2 QUESTIONS:
How often had driver been that way? _____ (alpha)
(default=N/A)

Did something unusual/unexpected happen? 1=Yes
2=No
9=N/A (default)

IF UNUSUAL=1, ELSE GO TO TF QUESTIONS:
What happened? _____ (alpha) (default=N/A)

IF FAMILIAR=2, ELSE GO TO TF QUESTIONS:
Did lack of familiarity have effect on accident? 1=Yes
2=No
9=N/A (default)

IF LACK OF FAMILIARITY=1, ELSE GO TO TF QUESTIONS:
How so? _____ (alpha) (default=N/A)

TRUCK FOLLOWING QUESTIONS

When did driver first see other vehicle? _____ (alpha)

Triggering event _____ (alpha)

Pre-crash events/maneuvers by truck _____ (alpha)

Pre-crash events/maneuvers by lead vehicle _____ (alpha)

Pre-crash events/maneuvers by any other involved vehicles
_____
(alpha)

What was driver looking at? _____ (alpha)

Truck's speed in mph _____ (alpha)

Speed of lead vehicle in mph _____ (alpha)

Distance between the two vehicles _____ (alpha)

Contributing environmental factors _____ (alpha)

Avoidance attempts/warnings _____ (alpha)

Equipment _____ (alpha) (default=N/A)

Driver condition _____ (alpha) (default=N/A)

Any other pre-collision info _____ (alpha)

SEQUENCE OF EVENTS

First event _ (default=9)
Second event _ (default=0)
Third event _ (default=0)
Fourth event _ (default=0)
Fifth event _ (default=0)

Codes:
0=none
1=ran off road
2=jackknife
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4=downhill runaway
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8=pedestrian
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14=fixed object
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16=other

EXPERIENCE AND TRAINING

Driver age _ _

Total years driving tractors _ _

If CONFIG=3, years driving doubles _ _ 99=N/A (default)

How long driving for this carrier? _____ (alpha)

Type of formal training _____ (alpha)

Classroom training? 1=Yes
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Length of training _ 98=unknown 99=N/A (default)

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(use decimals if necessary, e.g. 0.5=1/2 hour)