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EVALUATION OF 2010 DELAWARE DATA REPORTED TO MCMIS CRASH FILE

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16. Abstract

This report is part of a series evaluating the data reported to the Motor Carrier Management Information System (MCMIS) Crash File undertaken by the Center for National Truck and Bus Statistics at the University of Michigan Transportation Research Institute. The earlier studies showed that reporting to the MCMIS Crash File was incomplete. This report examines the factors that are associated with reporting rates for the State of Delaware.

MCMIS Crash File records were matched to the Delaware crash file to determine the nature and extent of underreporting. Overall, it is estimated that, for 2010, 71.6% of reportable crash involvements were reported.

All fatal crash involvements were correctly reported. Reporting rates were lower for less severe collisions: 66.6% of injured/transported crashes and 76.6% of towed/disabled crashes were reported. Recognition by the reporting officer that a vehicle was a CMV was important, though no single factor was identified that explained the overall reporting rate.

Missing data rates are low for most variables. Corresponding data elements in the MCMIS and Delaware crash files were reasonably consistent, though specific problems were noted with respect to the MCMIS truck configuration variable. Over one-quarter of the records were inconsistent on this variable. Improvements in training to may address this issue. Only about 53 percent of records were submitted to the MCMIS file within 90 day post-crash period requirement.

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
	NOTE: volumes greater than 1000 L shall be shown in m^3			
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
^oF	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	^oC
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	$candela/m^2$	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
^oC	Celsius	1.8C+32	Fahrenheit	^oF
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	$candela/m^2$	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.
(Revised March 2003)

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1. Introduction

The Motor Carrier Management Information System (MCMIS) Crash file was developed by the Federal Motor Carrier Safety Administration (FMCSA) to serve as a census file of trucks and buses involved in traffic crashes meeting a specific crash severity threshold. FMCSA maintains the MCMIS file to support its mission to reduce crashes, injuries, and fatalities involving large trucks and buses. Accurate and complete crash data are essential to assess the safety of motor carrier operations and to design effective safety measures to prevent such crashes. The data in the file are extracted by the States from their own crash records, and uploaded through the SafetyNet system. The usefulness of the MCMIS Crash file thus depends upon individual states identifying and transmitting the correct records on the trucks and buses involved in traffic crashes that meet the crash file severity threshold.

The present report is one of a series of reports that evaluate the completeness and accuracy of the records submitted to the MCMIS Crash file. Previous reports showed some underreporting which seemed to be related in large part to problems in interpreting and applying the reporting criteria within the States' respective crash reporting systems. Smaller trucks, buses, and less severe crashes were more often not recognized as meeting the reporting criteria. States also had issues specific to the nature of their own systems. [See references 2 to 47.] The States are responsible for identifying and reporting qualifying crash involvements. Accordingly, improved completeness and accuracy ultimately depends upon the efficiency and effectiveness of individual state systems.

This report focuses on MCMIS Crash file reporting by Delaware in 2010. Between 2005 and 2009, Delaware reported from 297 to 444 involvements each year to the MCMIS Crash file. Delaware is the 45th largest state by population and in most years ranks about 45th among the states in terms of the number of annual truck and bus fatal involvements. In recent years the number of fatal truck and bus involvements in Delaware has ranged from 11 in 2005, 23 in 2006, 10 in 2007, 9 in 2008, and 10 in 2009.

Police accident report (PAR) data for 2010 recorded in Delaware's statewide files as of November 2011 were used in this analysis. The 2010 PAR file contains the crash records for 38,490 vehicles.

The process of evaluating state reporting consists of the following steps:

1. The complete police accident report file (PAR file hereafter) from Delaware was obtained for the most recent year available, which was 2010.

2. An algorithm was developed, using the data coded in the Delaware file, to identify cases that qualified for reporting to the MCMIS Crash file.

3. All cases in the Delaware PAR file—those that qualified for reporting to the Crash file as well as those that did not—were matched to the cases actually reported to the MCMIS Crash file from Delaware.

4. Cases that should have been reported, but were not, were compared with those that were reported to identify the sources of underreporting.

5. Cases that did not qualify but which were reported were examined to identify the extent and nature of overreporting.

2. Data Preparation

The Delaware PAR file and MCMIS Crash file each required some review and preparation before the Delaware records in the MCMIS Crash file could be matched to the Delaware PAR file. In the case of the MCMIS Crash file, the major tasks were to extract records reported from Delaware and to review to identify and eliminate any duplicate records. The Delaware PAR file was reformatted to create a comprehensive vehicle-level file from accident, vehicle, and person data.

The following two sections describe the methods used to prepare each file, and provides a discussion of some of the problems uncovered.

2.1 MCMIS Crash Data File

The 2010 MCMIS Crash file, as of July 28, 2011, was used to identify records submitted from Delaware. For calendar year 2010 there were 487 cases reported to the file from Delaware. An analysis file was constructed using all variables in the MCMIS file. This analysis file was examined for duplicate records (more than one record submitted for the same vehicle in the same crash; i.e., the report number and sequence number were identical). No such duplicates were found.

In addition, records were reviewed to find cases with identical values on accident number, accident date/time, county, street, officer badge number, vehicle identification number (VIN), and driver date of birth, but with different vehicle sequence numbers. The purpose of this review is to find and eliminate cases where more than one record was submitted for the same vehicle and driver within a given accident. Duplicates can be generated when, for example, a record is

corrected and the original record is not deleted. No such duplicates were found. The resulting MCMIS file contains 487 unique records.

2.2 Delaware Police Accident Report File

The Delaware PAR data for 2010 was obtained from the State in November 2011. The data were stored as Microsoft Access database files, representing Accident, Vehicle, and Person information. The files contained records for 20,675 traffic crashes involving 38,490 units. Data for the PAR file are coded by police officers using Delaware's E-Crash system. The E-Crash System is an electronic reporting system, in which reporting officers fill out the crash report using a computer program, rather than a paper form. E-Crash represents an evolution of the former TraACS software system. E-Crash was implemented on January 1, 2010, so the 2010 crash year represents the first complete year under the E-Crash system.

The PAR file was first examined for duplicate records (involvements where more than one record was submitted for the same vehicle in the same crash). A search for records with identical case and vehicle numbers found no instances of duplicates. In addition, examination of case numbers verified that they were recorded in a consistent format, so there was no reason to suspect duplicate records based on similar, but not identical, number formats (such as 0110005721 and 01100-5721, for example).

A search for records with identical case numbers and vehicle numbers found no instances. Just as in the preparation of the MCMIS Crash file, cases also were examined to determine if there were any records that contained identical time, place, and vehicle/driver variables, regardless of vehicle number. Two cases would not be expected to be identical on all variables. Records were examined for duplicate occurrences based on the fields for case number, accident date/time, crash county, VIN (first eleven characters), and vehicle license plate number. Using this process, 32 duplicate pairs were found. Although the vehicle ID number and a few other variables differed between both cases of the pairs, virtually all other variables were identical. In addition, driver age was identical for both cases for all pairs, except where the value was 0 or missing. The most likely explanation is that an extra record was entered during the process of applying corrections to the original record. These cases were considered to be duplicate records for the purposes of the current evaluation. One member of each pair was excluded from the file. The resulting PAR file has 38,458 unique cases.

3. Matching Process

The next step involved matching records from the Delaware PAR file to corresponding records from the MCMIS file. There were 487 records from the MCMIS file available for matching, and 38,458 records from the Delaware PAR file. All records from the Delaware PAR data file were used in the match, even those that apparently did not meet the requirements for reporting to the MCMIS Crash file. This allowed the identification of cases reported to the MCMIS Crash file that did not meet the reporting criteria.

Matching records between the two files is accomplished by using combinations of variables common to the two files that have a high probability of uniquely identifying crashes and specific vehicles within the crashes.

Complaint Number, used to uniquely identify a crash in the Delaware PAR data, and Report Number, in the MCMIS Crash file, are obvious first choices. Complaint Number in the Delaware PAR file is a 10-character alphanumeric field, and in the MCMIS Crash file Report Number is stored as a 12-character alphanumeric value. The report number in the MCMIS Crash file is constructed as follows: The first two columns contain the state abbreviation (DE, in this case), followed by ten alphanumeric values. Fortunately, there was an exact correspondence between PAR Complaint Number and the last ten digits of the MCMIS Report Number, so this variable could be used in the match.

Other data items that are useful in matching at the crash level include Crash Date, Crash Time (stored in military time as hour/minute), Crash County, Crash City, Crash Street, and Reporting Officer's Identification number. The PAR file contained all of these variables, except for Crash City and Officer Badge Number. There is a Location Description variable on the PAR file which contains a long text description of where the accident occurred (up to 929 characters). Although it cannot be directly matched to MCMIS Crash Street, those variables can be useful for match verification. The only matching PAR variable pertaining to crash location was County.

Variables in the MCMIS file that can be used to distinguish one vehicle from another within the same crash include vehicle license plate number, driver license number, VIN, driver date of birth, and driver last name. Of these, the PAR data file contains the first eleven characters of the VIN, Vehicle License Plate Number, and Driver Age. The first eleven characters of the VIN omit the serial numbers that identify a specific vehicle, but are nevertheless useful for matching purposes. The VIN was unrecorded in 9.4% of PAR cases, but in less than one percent of MCMIS cases. Vehicle License Plate Number is missing in 2.6% of PAR cases and in 0.2% of MCMIS cases. Driver Age was not present in 15.1% of PAR cases, but was missing in only 1.6% of MCMIS cases.

The match was performed in six steps, using the available variables. At each step, records in either file with duplicate values on all the match variables for the particular step were excluded prior to attempting the match, along with records with missing values for the match variables. The first match included the variables case number, crash date (month, day), crash time (hour, minute), county, VIN (first 11 digits), license plate number, and driver age. The second match step dropped license plate number and driver age, and matched on case number, crash date, crash time, county, and VIN. After some experimentation, the third match step included case number, crash date, crash time, county, and driver age. A fourth match used the variables for case number, crash date, crash hour, and VIN. Eliminating case number, the variables used in the final (fifth) attempt at a computer-based match were crash date and VIN. The resulting matched records from steps 3, 4, and 5 were verified by reviewing each entire record in both crash files to ensure that the correct cases were matched.

After the five steps of the match were complete, there were still seven unmatched MCMIS cases. Each of these seven were manually searched in the crash data, and two were found. The remaining five involvements could not be located, despite a thorough manual review of all plausible cases. These five cases were searched for in the PAR file by county, month, and day. That is, all the crash records occurring in the same county and on the same day were manually reviewed for any evidence they referred to the same crash in the MCMIS file. For each case, records were reviewed to find a crash on that road involving a truck or bus. In addition, the VINs, Case Numbers, and License Plate Numbers of the unmatched MCMIS cases were also searched in the PAR file, regardless of county, date, and so on. No match was found. Even with an exhaustive manual review, the cases could not be located in the Delaware crash data.

The computerized and hand-matching resulted in matching 482 (99.0 percent) of the MCMIS records to the PAR file. Only five cases could not be matched. Table 1 shows the variables used in each match step and the number of records matched at each step.

Table 1 Steps in MCMIS/Delaware PAR File Match, 2010

Step	Matching variables	Cases matched
Match 1	Case number, crash date (month, day), crash time (hour, minute), county, vehicle identification number(11 digits), license plate number, and driver age	302
Match 2	Case number, crash date, crash time, county, and vehicle identification number(11 digits)	127
Match 3	Case number, crash date, crash time, county, and driver age	43
Match 4	Case number, crash date, crash hour, and vehicle identification number (11 digits)	6
Match 5	Crash date and vehicle identification number (11 digits)	2
Match 6	Hand-matching attempt, using all available variables	2
Total cases matched		482

The matches made were verified using other variables common to the MCMIS and PAR file as a final check to ensure each match was valid. The above procedure resulted in 482 matches, which is 99.0 percent of the 487 records reported to MCMIS.

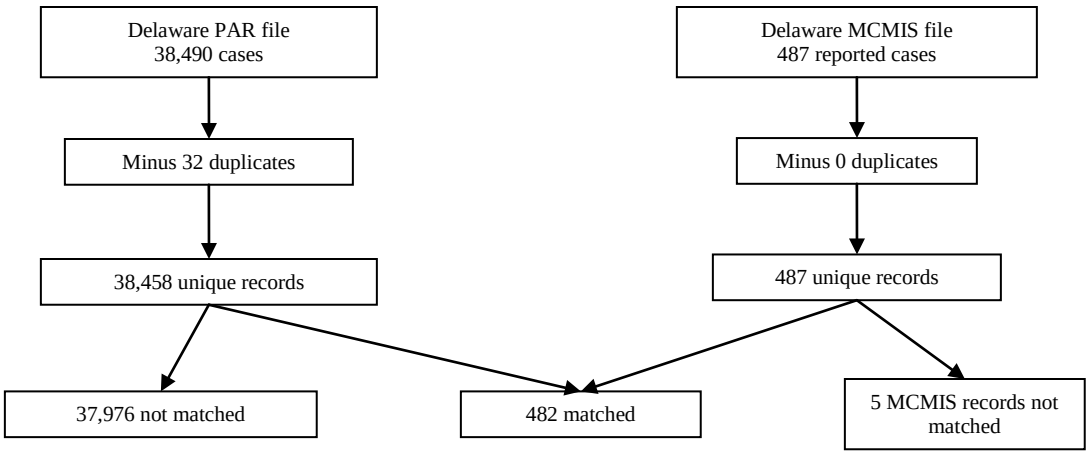

Figure 1 Case Flow in MCMIS/Delaware Crash File Match

The method of identifying cases reportable to the MCMIS Crash file is discussed in the next section.

4. Identifying Reportable Cases

To evaluate the completeness of reporting to the MCMIS crash file, it is necessary as a first step to identify records that qualify for reporting. Accordingly, vehicles that meet the vehicle type reporting criteria, as well as crashes that meet the crash severity criteria, must be identified in the State's crash file. Records are selected as reportable using the information available in the computerized crash files supplied by Delaware. Reportable records meet criteria specified by the FMCSA. The reporting criteria cover the type of vehicle and the severity of the crash. These criteria are discussed in more detail below, but the critical point is that records transmitted to the MCMIS Crash file must be selected from among all the records in the State's crash data, using the data that are available in the State's crash data.

The method developed to identify reportable records is specifically designed to be independent of any prior selection by the State being evaluated. This approach is necessary if there is to be an independent determination of the completeness of reporting. Accordingly, this process uses the information recorded by the officers on the crash report for all crashes.

The MCMIS criteria for a reportable crash involving a qualifying vehicle are shown in Table 2. Reportable records must meet both the vehicle type and crash severity criteria. The method used for vehicle criteria and crash severity are each discussed in turn.

Table 2 Vehicle and Crash Severity Threshold for MCMIS Crash File

Vehicle	Truck with GVWR over 10,000 or GCWR over 10,000, or Bus with seating for at least nine, including the driver, or Vehicle displaying a hazardous materials placard.
Accident	Fatality, or Injury transported to a medical facility for immediate medical attention, or Vehicle towed due to disabling damage.

Some States place some of the data elements intended for the MCMIS Crash file in a special section of the main form, with instructions to the reporting officer to complete that information only for vehicles and crashes that meet the MCMIS selection criteria. Delaware uses an electronic data entry form, in which if the officer indicates the vehicle is a Commercial Motor Vehicle (CMV) by answering "yes" to "Is this vehicle classified as a CMV?," the E-Crash online data entry system brings up an additional screen for officers to complete. This screen contains some of the specialized data elements required for the MCMIS file that are not collected elsewhere in E-Crash. Delaware defines a CMV as "[a] vehicle of a type required to be registered under this title designed, used or maintained for the transportation of persons or property for hire, compensation or profit, except taxicabs."

Delaware's definition of a CMV does not directly correspond to the vehicle criteria for the MCMIS file, which is based on the physical characteristics of the vehicle rather than its intended purpose. However, for most trucks the Delaware definition probably overlaps well with the set of vehicles specified by FMCSA's physical definition. For buses, the overlap is probably not as tight, given the seating capacity requirement. It also does not map well to the requirement to report crashes of light vehicles placarded to transport hazardous materials (hazmat).

Much of the information for the MCMIS crash file is extracted from basic information entered into E-Crash which should be completed on all vehicles in the crash. But there are a number of variables for the MCMIS file that come from the CMV-specific information, which is only completed for vehicles meeting the description quoted above.

4.1 Vehicle Type

The first step in determining reportable cases is to identify vehicles that qualify for reporting to the MCMIS Crash file. The Delaware computerized crash file contains several variables that were used, including vehicle style, vehicle configuration, make, model, and the VIN. Information from each of these fields was reviewed. In most cases, the information from multiple fields was entirely consistent and could be used to cleanly separate vehicles that met the MCMIS reporting criteria from those that do not. However, there were some records that appeared inconsistent. For example, a vehicle might be identified as a passenger car in one field, but as a truck in the model field. To deal with this situation, an algorithm was developed by reviewing hundreds of records

that takes advantage of multiple fields to make the most likely assignment as either a truck, bus, light vehicle with a hazmat placard, or a vehicle that does not meet the MCMIS vehicle type criteria.

The algorithm started with the Vehicle Style field. Vehicle style is a 21-level variable with codes for common vehicle types. Several of the codes seem to identify vehicle types that are meet the MCMIS vehicle definition. Trucks with a gross vehicle weight rating (GVWR) over 10,000 lbs would probably be included in the vehicle style codes for “Tractor & Semi-trailer” or “Other Truck Combination, Commercially Used Van.” There is a separate code level for “Pickup Truck,” which increasingly have GVWRs over 10,000 lbs. and are used commercially. The vehicle style field also includes codes that may identify qualifying buses, such as “Bus,” “School Bus,” and possibly “Minivan/Passenger Van” (depending on the seating capacity). It appears the reporting officer selects one of these 21 codes from the drop-down box for Body Style on the screen for Vehicle Information**.**

In addition, the fields for Make, Model, cargo body, vehicle configuration and the VIN were also used. The VINs were decoded by David Hetzel of NISR, Inc., using software that he has developed. Hetzel decoded 34,842 VINs that were recorded in the Delaware crash data. (VIN was unrecorded in 3,616 cases, 9.4 percent of all vehicles.) The vehicles with valid VINs were classified as light vehicles (<10,000 GVWR), motorhomes/campers, medium/heavy pickups, medium and heavy trucks, several different bus types (cross-country, school, transit, etc.), and trailer. Table 3 shows the distribution of vehicle types identified by the VIN. Note that not all the vehicles identified by the software are necessarily reportable trucks or buses. For example, motorhomes do not qualify, since they are designed for private transportation. In addition, some medium/heavy (GVWR class 3) pickups are used solely for personal transportation and not part of a business. But most of the categories, such as single unit trucks and truck tractors, identify vehicles that are virtually never used solely for personal transportation and thus always qualify.

In addition, Daniel Hershberger of UMTRI also manually decoded certain critical VINs where the computer decode was ambiguous, and other fields did not clearly indicate one way or the other.

The decision rule started with the vehicle style, which is the reporting officer's identification of the vehicle type, and used the other fields for validation. All cases coded tractor-semitrailer were taken, except if the field for vehicle configuration was blank and the VIN showed the vehicle was light duty. Pickups were only taken if the VIN showed the vehicle had a GVWR over 10,000 lbs. and there was evidence of commercial use. Several vehicles classified in the vehicle style field as "recreational vehicles" were taken because either the vehicle configuration variable showed that the vehicle was a valid truck or bus, or because the VIN showed the vehicle to have a GVWR of a medium or heavy truck. In all cases, the make and model fields were individually reviewed and were consistent with the vehicle being a truck or bus. For example, typical truck makes such as Peterbilt, Kenworth, or Freightliner were taken as confirming that the vehicle was a truck. And often the vehicle model was given as “dump,” “concrete mixer,” or simply “truck.” In all cases, there had to be two or more pieces of information to indicate either that the vehicle

qualified or did not qualify. Where the variables were consistent and identify a vehicle that met the reporting criteria, those vehicles were taken. The VIN was used to eliminate vehicles that are not reportable, such as those with GVWR less than 10,000 lbs., or to identify reportable vehicles misclassified as light vehicles.

Table 3 shows the VIN-based classification of all vehicles in the Delaware PAR file, based on Hetzel's VIN decoding. Most of the classifications clearly determine whether a vehicle met the MCMIS criteria. But this information was used in combination with the data recorded by the reporting officer, to confirm that all vehicles taken in fact met the reporting criteria.

Table 3 VIN-based Vehicle Type Classification, Delaware PAR file, 2010

VIN vehicle	N	Percent
Camper or motor home	4	0.0
Medium/heavy truck based motor home	1	0.0
Medium/heavy pickup (>10k lbs)	91	0.2
School bus	145	0.4
Cross country/intercity bus	17	0.0
Transit/commuter bus	36	0.1
Other bus type	16	0.0
Single unit truck (10k-19.5k lbs)	193	0.5
Single unit truck (19.5k-26k lbs)	138	0.4
Single unit truck (>26k lbs)	307	0.8
Step van	14	0.0
Trailer	16	0.0
Truck tractor	347	0.9
Truck or bus	104	0.3
Light vehicle, VIN not decodable, or missing	37,029	96.3
Total	38,458	100.0

Special attention also was given to pickup trucks, since an increasing number of pickups with a class 3 GVWR are used for personal transportation only, i.e., just like any other light passenger vehicle. If the PAR Vehicle Style variable denoted a pickup truck, and the decoded VIN indicated that the vehicle was an SUT(19.5K or greater), the vehicle was included as a qualifying truck. In addition, if a pickup truck was reported to MCMIS by the State, and the VIN decoded as a Class 3 or greater vehicle, then the vehicle was assumed reportable. However, if Vehicle Style indicated a pickup truck and the decoded VIN denoted a Medium/Heavy Pickup, SUT (10-19.5K), or Truck or Bus, but the State did not report the vehicle, then the vehicle would have been included as a qualifying truck only if there was evidence that it was used for commercial purposes. Unfortunately there were no variables available in the data file to confirm commercial use, so there may be some qualifying pickup trucks that were not designated as reportable vehicles, but were actually reportable (among the 91 in Table 3). Only sixteen of the 4,049 pickup trucks (according to the PAR Vehicle Style variable) were determined to be eligible MCMIS vehicles.

In addition to these vehicle types, any vehicle, regardless of size, displaying a hazardous materials placard, also meets the MCMIS vehicle type definition. Delaware's vehicle information includes a field named Cargo Contained Hazardous Materials (Yes or No). Two other variables, Trailer Hazardous Placarded1 and Trailer Hazardous Placarded2, also indicate the presence of hazardous placards. Using these three variables, 21 additional vehicles were identified that met this criteria.

The full method of identifying reportable vehicles is documented in Appendix A. Please see that appendix for the details.

Overall, this approach, while it uses available information to the fullest, is appropriately conservative. Most of the medium/heavy pickups were not included because no evidence could be found to establish commercial use, that is, to exclude the possibility that they are personal-use only. Given available information, it is believed the result is the most reasonable classification of the vehicles. Table 4 shows the 1,390 vehicles (3.6% of PAR cases) identified as meeting the MCMIS vehicle criteria. In other states we have evaluated, this figure has ranged from 2.6 to 6.1% of PAR cases.

Table 4 MCMIS-eligible Vehicles, Delaware PAR file, 2010

MCMIS Vehicle Type	PAR Vehicle Style	N	Percent
Truck	Passenger car	11	0.8
	Pickup truck	14	1.0
	Tractor & semitrailer	554	39.9
	Other truck comb/comm. used van	384	27.6
	Recreational vehicle	55	4.0
	Construction	11	0.8
	Minivan/passenger van	7	0.5
	Unknown	19	1.4
Total trucks		***1,055***	***75.9***
Bus	Other truck comb/comm. used van	28	2.0
	Bus	243	17.5
	School bus	33	2.4
	Recreational vehicle	1	0.1
	Minivan/passenger van	6	0.4
	Unknown	3	0.2
Total buses		***314***	***22.6***
Hazardous placarded light vehicle	Passenger car	12	0.9
	Pickup truck	2	0.1
	Other truck comb/comm. used van	2	0.1
	SUV	3	0.2
	Minivan/passenger van	1	0.1
	Unknown	1	0.1
Total hazmat placarded light vehicles		***21***	***1.5***
Total		1,390	100.0

4.2 Crash severity

With respect to crash severity, qualifying crashes involve two criteria, one covering injury to people and the other damage to vehicles. The injury criteria is any fatality or any injured person transported for immediate medical attention. With respect to damage to vehicles, any crash in which at least one vehicle is towed from the scene due to disabling damage also qualifies. Any crash meeting either one of those rules satisfies the crash severity criteria. If the crash also involves a vehicle that meets the reporting criteria for vehicles, then the record for that vehicle must be reported to the MCMIS crash file.

The crash data file supplied by Delaware contains the appropriate information to identify crashes that meet the personal injury criterion (an injured person transported for medical attention), and the vehicle damage criterion (a vehicle towed due to disabling damage).

The Delaware Person file includes information about the injury severity for each person involved in the crash. Delaware classifies injury using the common KABCO scale, where injuries are classified as fatal (K), incapacitating (A), non-incapacitating (B), possible injury (C), not injured (O), and unknown (U). This information was used to identify crashes that had one or more injured persons.

Fatal crashes can be readily identified. Any crash with a fatally injured person qualifies. If the most severe injury in the crash was a nonfatal injury, it is further necessary to determine if the person was transported for medical attention. For this, there is a Transport field on the Person file which specifies the mode of transport to a medical facility.

Crashes meeting the injured/transported criteria were thus identified as crashes involving an individual with an A-, B-, or C-injury *and* transport to a medical facility was indicated (EMS, Law Enforcement, EMS Helicopter, State Police Helicopter, or Other). Note that the injury criteria is applied at the *crash* level, meaning any person involved in the crash, not just in a vehicle that meets the MCMIS reporting criteria.

The other reporting criteria related to crash severity has to do with vehicle damage, i.e., whether any vehicle in the crash was towed due to disabling damage. Again, this criteria is applied at the crash level, not just to the trucks or buses that meet the vehicle type criteria. Such information is recorded on the Delaware PAR crash file. There is a Towed By variable containing values from 1 to 55, referring to Tow Companies. For ease of use, this variable was recoded into three categories: Tow company; Unknown/NA; and Missing. In addition, there is a Towed Due Damage variable that indicates if the vehicle was towed due to damage (Yes or No). An Extent of Damage/Removal variable records the amount of damage a vehicle sustained (No damage, Minor, Functional, Disabling, or Unknown).

Two rules for the Towed Due to Disabling Damage criterion were considered, based on the variables available:

Rule 1:

Towed Due Damage indicated as "yes" ***or*** Damage Extent/Removal was Disabling ***and*** a valid Tow Company was entered. The shaded area of Table 5 reflects these 10,555 cases.

Rule 2:

Damage Extent/Removal was indicated as Disabling Damage (which implies that the vehicle was towed, even if a valid tow company was not entered). According to Delaware definitions, Disabling Damage is defined as "Vehicle damage which precludes departure of the vehicle from the scene of the collision in its usual operating manner, after simple repairs." Using this definition, 11,196 cases would meet the tow/disabled criterion.

Table 5 Cases with Disabling Damage, Delaware PAR file, 2010

Damage Extent/Removal	Towed Due Damage	Towed By	No of cases
Disabling damage	No	Missing	602
Disabling damage	No	Unknown/NA	39
Disabling damage	Missing	Tow company	1
Disabling damage	No	Tow company	158
Disabling damage	Yes	Tow company	9,402
Disabling damage	Yes	Unknown/NA	994
Total			11,196

Under either rule, only vehicles with disabling damage are considered to be towed due to disabling damage. In application, it was decided to use the more restrictive rule, that is, rule 1. Under this rule, there is evidence that the vehicle was towed, either in the Towed Due to Damage field or in the Towed By field. In the remaining 641 cases, supposedly with disabling damage, there was no evidence of a tow, and while unlikely (if the damage was truly disabling) that is possible. In any case, this amounts to only 641 cases and likely had no effect on the selection of crashes meeting the MCMIS reporting threshold, since at this point, we are considering <u>all</u> crashes, not just those with vehicles that meet the MCMIS reporting rules.

In total, there were 603 vehicles identified in the Delaware PAR data as eligible trucks and buses in crashes with a K injury, A, B, C or Severity Unknown transported injury, or a towed/disabled vehicle. Table 6 shows the distribution by vehicle type. Medium or heavy trucks accounted for 74.6% of the vehicles, while 23.5% are buses. There were 11 light vehicles with hazmat placards involved in the serious crashes used for the evaluation.

Table 6 Vehicles Meeting MCMIS Accident and Vehicle Criteria
Delaware PAR File, 2010

Vehicle type	N	%
Truck	450	74.6
Bus	142	23.5
Other, transporting hazmat	11	1.8
Total	603	100.0

As Figure 1 above shows, there were 487 records reported to the MCMIS Crash file by Delaware in 2010. Of these, 482 were matched to the Delaware PAR file. Matches could not be found for five of the MCMIS records, despite a wide-ranging manual search through the PAR file. If all 482 matched records were reportable, the reporting rate from Delaware would be 79.9%. If all the 487 reported actually were reportable, the rate would rise to 80.8%. However, as discussed below, 50 of the reported cases did not meet the reporting criteria (overreported), primarily because the crashes did not meet the severity criteria. So in the end, 432 of the 603 reportable cases were actually reported, for a reporting rate of 71.6%.

5. Factors Associated with Reporting

This section discusses factors that apparently influence the probability of correctly reporting records to the MCMIS crash file. The process of moving from the events of a traffic crash to identifying a small subset of all crashes and uploading their records to the MCMIS crash file is complex and involves many steps, from the reporting officer collecting comprehensive and complete information, to the process of identifying and extracting, in this case, about 600 records from over 38,000. The purpose of this section is to compare the characteristics of the reported records with those that were not reported, in order to identify types of records that may be more likely to be overlooked. The goal is to assist the process of achieving complete reporting by understanding why records that should have been reported were not.

5.1 Overreporting

Complete and accurate reporting also includes making sure that cases that do not meet the reporting criteria were not reported. Fifty reported records did not meet either the crash severity or vehicle type criteria, or both. (Table 7) Most of the overreported records (42) were eligible trucks or buses, but the crash they were involved in did not meet the severity criteria: there was no injured person transported for treatment or disabled vehicle towed due to disabling damage. Seven of the records were for a vehicle that did not meet the vehicle type criteria. To confirm this, the VINs were decoded manually and the vehicles were demonstrated to be a light vehicle, not a bus, and there was no evidence that the vehicle was transporting hazardous materials. (These records are shown in the shaded boxes in the table.) It cannot be known, of course, whether the data coded in the crash record is accurate, but if it is, these fifty cases did not meet the reporting criteria. They amount to about 10 percent of reported records.

Table 7 Vehicle Type and Crash Severity of Cases Reported but Not Reportable Delaware 2010

Vehicle type	Crash severity			Total
	Injured/ transported	Towed/ disabled	Other	
Truck	0	0	35	35
Bus	0	0	7	7
Other	4	3	1	8
Total	4	3	43	50

5.2 Underreporting

This section considers a wide variety of factors that might influence the probability that a reportable case would be correctly identified and properly reported. The factors considered include the reporting criteria (vehicle type and crash severity), type of reporting agency, vehicle characteristics, and other factors.

5.2.1 Reporting Criteria

Table 8 shows reporting rates, the number of unreported cases, and the proportion of unreported cases for the levels of the MCMIS crash severity criteria. The format of the table will be used throughout this report. The column giving the proportion of unreported cases can be used to identify opportunities where the greatest improvement in reporting rates may be realized.

All fatal crashes were correctly reported. The rates for injured/transported and towed/disabled crashes were substantially lower, at 66.6% and 76.6% respectively. There were only 11 fatal cases, but it is likely that fatal crashes are handled by a different process than lower severity crashes. Fatal crashes are likely given a higher level of scrutiny than non-fatal, and so are more likely to be included.

Table 8 Reporting Rate by MCMIS Crash Severity, Delaware

Crash severity	Reportable cases	Reporting rate	Unreported cases	% of total unreported cases
Fatal	11	100.0	0	0.0
Injured/trans	323	66.6	108	63.2
Towed/disabled	269	76.6	63	36.8
Total	603	71.6	171	100.0

The lower reporting rate for the injured/transported group than towed/disabled is unusual. The difference (66.6% and 76.6%) is statistically significant and fairly substantial. Usually we see more severe crashes reported at a higher rate than less severe.

We can examine the relationship between crash severity and reporting probability in more detail by looking at the rates by the most severe injury in the crash. Delaware uses the KABCO injury

scale, which classifies injuries as disabling, non-incapacitating but evident, and complaint of pain. The relationship between injury severity and reporting probability is reasonably strong but actually trends backwards from what would be expected, i.e., less severe crashes are somewhat more likely to be reported. Figure 2 shows the reporting rate by crash severity, where crash severity is measured by the most severe injury in the crash. Fatal crashes are excluded because it is likely that they are reported by a different process. A linear regression line has been fitted to the data, and as can be seen, the data fall fairly neatly along the line. The R^2 shows that variations in injury severity explain about 64% of the variation in reporting rates, which is strong.

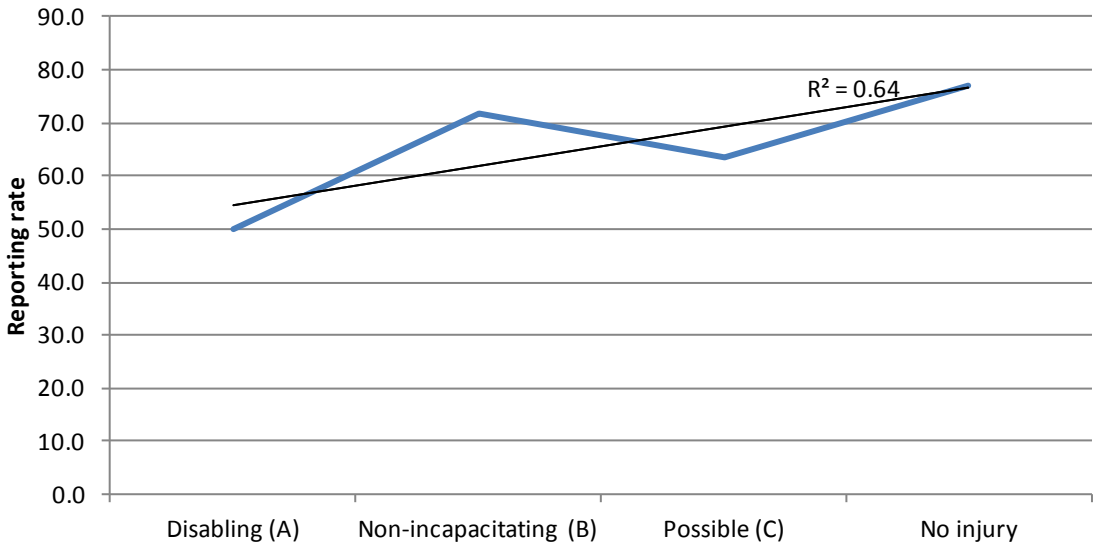

Figure 2 Reporting Rate by Most Severe Injury in the Crash, Delaware 2010

Only about 50% of crashes with A-injuries are reported, compared with 77.1% of crashes with no injuries but at least one towed/disabled vehicle. A-injuries are, of course, the most serious non-fatal injuries, since they are incapacitating. In almost all cases, an A-injured person would have to be transported for immediate medical attention. (And of course all reportable cases have evidence that the person was in fact transported.) Yet reportable A-injury cases have the lowest rate, and crashes with only a towed/disabled vehicle–and no injuries–have the highest rate, excepting fatal crashes. It is not known why this pattern is observed in the data.

We did observe that, overall, there are about twice as many B-injuries as C-injuries in the Delaware crash data, which is the reverse of the national distribution and what we have observed in every other state evaluated. This is very unlikely and may indicate a programming error in the E-Crash system. However, it should also be noted that though the distribution of injuries by severity level is unusual, it should not affect the evaluation here as long as all injuries and whether they were transported are recorded.

The second component of the MCMIS Crash file criteria is the vehicle type. As described above, trucks, buses, and other vehicles transporting sufficient amounts of hazmat to require a placard all meet the reporting requirements. Table 9 shows the rates for the different top level types of vehicles. The reporting rate for trucks was 74.7%, a bit higher than the overall rate, while the rate

for buses is somewhat lower at 67.6%. While the rate for buses is lower, the difference is not statistically significant. There may be some tendency to report buses at a lower rate, but overall considering buses as a whole, it is not significant.

Table 9 Reporting Rate by MCMIS Vehicle Class, Delaware 2010

MCMIS vehicle class	Reportable cases	Reporting rate	Unreported cases	% of total unreported cases
Truck	450	74.7	114	66.7
Bus	142	67.6	46	26.9
Light veh., hazmat placard	11	0.0	11	6.4
Total	603	71.6	171	100.0

Note, however, than none of the light vehicles transporting hazmat were reported. It appears that these vehicles are not included in the reporting process.

Table 10 provides more insight into the effect of vehicle configuration on reporting rates. It shows reporting rates by PAR vehicle style, as recorded in the E-Crash system. The first thing to note is that several of the possible styles may or may not be reportable vehicles, while others should identify primarily reportable vehicles. Virtually all of the tractor-semitrailer type should qualify, as should most vehicles classified as "bus" or "school bus." It may be plausible that an officer would apply the "other truck combination/commercially used van" for some light duty vehicle types, such as minivans used in a business, but that type would clearly include qualifying straight trucks. Over 75 percent of the cases not reported were identified by the reporting officer as either a tractor-semitrailer, other truck combination, or a bus.

Table 10 Reporting Rate by PAR Vehicle Style, Delaware 2010

PAR Vehicle style	Reportable cases	Reporting rate	Unreported	% of total unreported
Passenger car*	11	18.2	9	5.3
Pickup truck†	13	92.3	1	0.6
Tractor & semitrailer	242	80.6	47	27.5
Other truck combination, commercially used van‡	169	65.7	58	33.9
Bus	108	77.8	24	14.0
School bus	15	46.7	8	4.7
Recreational vehicle	23	47.8	12	7.0
Construction	2	50.0	1	0.6
SUV, hazardous placarded	1	0.0	1	0.6
Minivan, passenger van†	9	44.4	5	2.9
Unknown†	10	50.0	5	2.9
Total	603	71.6	171	100.0

* 5 displayed hazmat placards
† 1 displayed a hazmat placard
‡ 2 displayed hazmat placards

On the other hand, some of the types would not seem to designate a reportable vehicle, such as the recreational vehicle, passenger car, and minivan types. However, please recall that each of the vehicles was verified as reportable by VIN and by other evidence that the vehicle was a reportable truck or bus, such as the make or model. Some of these vehicles displayed hazmat placards. In the case of pickups, most of these vehicles were medium duty trucks by VIN, usually class 3 through 6.

Typically, larger trucks are somewhat more readily recognized as fitting the reporting requirements than smaller trucks, even though the smaller ones also qualify. But this observation does not appear to be true in the Delaware experience. Table 11 shows the vehicle type indicated by the VIN, including the GVWR range. Just looking at single unit trucks (SUT) and truck tractors, all are reported at about the same rate, indicating that truck size is not critical to the probability of reporting. SUTs with a GVWR between 10,000 lbs. and 19,500 lbs. (class 3 through 5) are reported at a 79.2% rate, trucks rated between 19,500 and 26,000 (class 6) at 73.4%, and SUTs rated over 26,000 lbs. (class 7 and 8) were reported at a 76.3% rate. Those rates are reasonably consistent with the 79.4% rate for truck-tractors. The two lowest rates are for vehicles that decode as cross-country buses, which are usually operated by intercity passenger carriers or charter/tour operations, and vehicles where the VIN was unknown. These two groups account for about a third of the unreported records.

Table 11 Reporting Rate by Vehicle Type from the VIN, Delaware 2010

VIN Vehicle Type	Reportable cases	Reporting rate	Unreported	% of total unreported
School bus	59	78.0	13	7.6
Cross country/intercity bus	10	50.0	5	2.9
Transit/commuter bus	22	90.9	2	1.2
Bus	2	100.0	0	0.0
Single unit truck (10K-19.5K lbs)	48	79.2	10	5.8
Single unit truck (19.5K-26K lbs)	64	73.4	17	9.9
Single unit truck (>26K lbs)	114	76.3	27	15.8
Truck tractor	155	79.4	32	18.7
Trailer	3	66.7	1	0.6
Truck or bus	31	71.0	9	5.3
Unknown VIN or GVWR <10K lbs	95	42.1	55	32.2
Total	603	71.6	171	100.0

Other than the cross-country bus type, reporting rates for buses (as identified in the VIN) are quite comparable to those of trucks. Rates for school buses are about the same, while over 90 percent of vehicles decoded as transit/commuter buses are reported. Differences in vehicle type, as indicated by the VIN, do not seem to shed light on why some reportable cases are reported, while others are not.

5.2.2 Case Processing

It was also tested whether delays in transmitting cases may account for some proportion of the underreporting observed in the 2010 data. However, that does not appear to be the case. Figure 3

shows reporting rates according to month of the crash. The overall reporting rate appears to be reasonably stable over the course of the year. There are no marked lows or highs. The overall rate was 71.6% and the reporting rate for most months was within a few percentage points of that number. April saw the lowest rate, at 62.5%, but both the preceding and following months were very near the overall rate. There do not appear to be any seasonal factors that might account for the overall rate of reporting, though there is some tendency for the reporting rates to increase toward the end of the year.

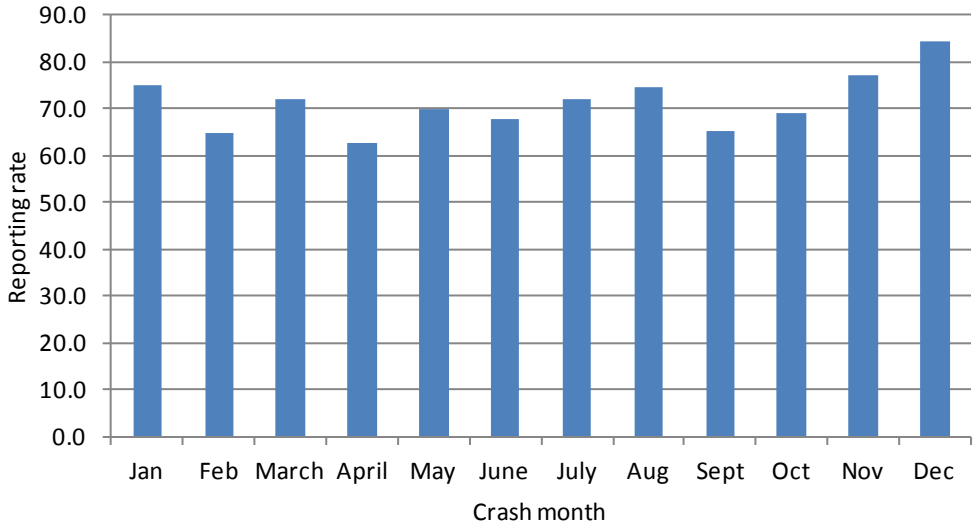

Figure 3 Reporting Rate by Crash Month, Delaware 2010

5.2.3 License state and Identified as "Commercial Vehicle"

The State within which the truck is licensed may be used as a partial proxy for whether the carrier operates in interstate commerce. Clearly, many in-state registered trucks are in interstate commerce, but those licensed out of state must be in interstate commerce. Overall, trucks (or buses) involved in a reportable crash are only somewhat more likely to be properly reported if they had out-of-state license plates than trucks plated in-state. The difference is only 73.7% to 69.8%, which is not statistically significant, nor of much practical significance.

Table 12 Reporting Rate by Vehicle Registration State, Delaware 2010

Registration state	Reportable cases	Reporting rate	Unreported	% of total unreported
In-state	318	69.8	96	56.1
Out-state	285	73.7	75	43.9
Total	603	71.6	171	100.0

The E-Crash system also includes a checkbox on the vehicle dialog box for whether a vehicle qualifies as a commercial vehicle. "Commercial vehicle" is defined in the E-Crash Manual as "[a] vehicle of a type required to be registered under this title designed, used or maintained for the transportation of persons or property for hire, compensation or profit, except taxicabs." [1]

When the checkbox is checked, additional CMV information is collected on the carrier and vehicle configuration. This carrier and vehicle information is intended to complete the fields required for the MCMIS crash reporting system. The fields on this tab, along with other data in the E-Crash system, covers all the data required to be reported.

Identification of the vehicle as a CMV is strongly associated with reporting the case to MCMIS, but it does not completely explain the overall reporting rate. Almost 85 percent of reportable vehicles were correctly identified as a CMV (509 out of 603.) And the reporting rate was higher for vehicles identified as a CMV than for those that were not. (Table 13) Precisely 75.0% of reportable vehicles that had been identified as a CMV were correctly reported, compared with only 52.7% of reportable vehicles where the Is CMV field was left blank. This difference is substantial and statistically significant. It is clear that checking the field makes a big difference in the probability of reporting.

Table 13 Reporting Rates by Identification as CMV
Delaware 2010

CMV checkbox	Reportable cases	Reporting rate	Unreported	% of total unreported
Yes	509	75.0	127	74.3
No	1	100.0	0	0.0
Unrecorded	93	52.7	44	25.7
Total	603	71.6	171	100.0

However, note that 25 percent of reportable cases where the officer correctly identified the vehicle as a CMV were still not reported. These unreported cases account for almost three quarters of all unreported cases. Note also that over half of reportable cases that were not identified as a CMV were still reported. So there is clearly a secondary process that reviews potentially reportable records and identifies some for upload to the MCMIS system.

5.2.4 County of occurrence and reporting agency

Other available fields were also searched for factors that varied by reporting rates. Sometimes there are geographical differences by the county in which the crash occurred. Table 14 shows reporting rates by the three counties of Delaware. There are effectively no differences in the reporting rates. New Castle accounts for almost two-thirds of the unreported cases, but its reporting rate is not effectively different from those of the other two counties.

Table 14 Reporting Rate by Crash County, Delaware 2010

County	Reportable cases	Reporting rate	Unreported cases	% of total unreported cases
Kent	95	72.6	26	15.2
New Castle	400	72.3	111	64.9
Sussex	108	68.5	34	19.9
Total	603	71.6	171	100.0

The vast majority of crashes are covered either by the Delaware State Police (DSP) or by a police department, with the DSP covering over 70 percent of reportable crashes. There are some differences in reporting rates by the DSP and police departments. Overall, reportable crashes covered by the DSP were reported at a higher rate than those covered by local police departments. The difference is not great. About 73.7% of reportable crashes covered by the DSP were correctly reported, compared with about 65.3% for crashes covered by police departments. (Table 15.) This difference is statistically significant, though not large. Still, it may indicate differences in enforcement focus or training, or some process difference between the two groups.

Table 15 Reporting Rate by Reporting Agency Type, Delaware 2010

Reporting Agency	Reportable cases	Reporting rate	Unreported cases	% of total unreported cases
State Police	438	73.7	115	67.3
Police Department	150	65.3	52	30.4
Other	15	73.3	4	2.3
Total	603	71.6	171	100.0

There were some differences in reporting rates between different police departments. Table 16 shows reporting rates for the top five police departments, ranked in terms of the number of unreported cases, rather than in terms of reporting rates. (The percent of total unreported cases in this table is calculated based on all reportable records in the State, not just those covered by PDs.) Focusing on unreported cases selects departments that can contribute the most to improving the overall reporting rate. Note that the Wilmington PD is one of the highest but also has a reporting rate higher than the rate for all PDs as well as higher than the overall state rate. It is on the list because it handles a lot of cases, relative to the other PDs. Rates among these five vary widely, from 16.7% for Georgetown, which reported one of the five reportable cases it handled, to Wilmington, which reported 36 out of its 47. It is not known what accounts for the observed differences in the reporting rates. Training issues may be involved.

Table 16 Reporting Rate for Selected Police Departments, Delaware 2010

Police department	Reportable cases	Reporting rate	Unreported cases	% of total unreported cases*
Wilmington	47	76.6	11	6.4
New Castle County	21	47.6	11	6.4
Middletown	8	37.5	5	2.9
Georgetown	6	16.7	5	2.9
Dover	14	71.4	4	2.3
Five Dept. Total	96	62.5	36	21.1
All Police Depts.	150	65.3	52	30.4

* Percentages of all unreported cases, not just from police departments

As Table 15 showed, crashes covered by the State Police tended to have higher reporting rates than those covered by police departments. But there was also some variation between DSP Troops in terms of the percentage of reportable cases reporting. Overall, Troop 5 had the highest rate at 89.3%, while the rate for Troop 2 was 59.6%. Some of the differences between the reporting rates of the Troops in the table are statistically significant, though most Troops fall within a fairly narrow range. Reporting rates for five of the troops are within about 10 percentage points or less. The number of crashes covered does not seem to have anything to do with the reporting rate. The troop with the most reportable crashes has the second highest reporting rate, while the second fewest reportable crashes has the highest rate. Linear regression confirmed the lack of a relationship between reportable crashes and reporting rate. As in the case of police departments, it is likely that training and enforcement focus accounts for variations in reporting rates.

Table 17 Reporting Rate by State Police Post, Delaware 2010

State Police Post	Reportable cases	Reporting rate	Unreported cases	% of total unreported cases*
DSP Troop 1	53	67.9	17	9.9
DSP Troop 2	57	59.6	23	13.5
DSP Troop 3	61	73.8	16	9.4
DSP Troop 4	30	63.3	11	6.4
DSP Troop 5	28	89.3	3	1.8
DSP Troop 6	113	83.2	19	11.1
DSP Troop 7	25	68.0	8	4.7
DSP Troop 9	71	74.6	18	10.5
All SP Posts	438	73.7	115	67.3

* Percentages of all unreported cases, not just from state police.

5.2.5 Fire Occurrence

FMCSA has a special interest in ensuring that reportable crash involvements in which a vehicle fire occurred are accurately reported. With respect to the occurrence of fire in reportable crash involvements, there was only one such case, and it was not reported. The case involved a bus, which experienced a fire. It is somewhat surprising that there was only one recorded fire among the 603 reportable cases, but there is no evidence in the crash data of any others.

6. Data Quality and Reporting Latency of Reported Cases

In this section, the quality of data reported to the MCMIS crash file is considered, as well as reporting latency (time elapsed from crash occurrence to when the crash was reported). Two aspects of data quality are examined. The first is the amount of missing data. Missing data rates affect the usefulness of a data file because records with missing data cannot contribute to an analysis. The second aspect of data quality considered here is the consistency of coding between records as they appear in the State crash file and in the MCMIS Crash file. Inconsistencies may

indicate problems in translating information recorded on the crash report to the values in the MCMIS Crash file.

In this section of the evaluation, all cases reported to the MCMIS crash file from Delaware for 2010 are used, since the purpose of the analysis is to examine the quality of the data as reported (i.e., whether reportable or not).

6.1 Missing data

Table 18 shows missing data rates for selected, important variables in the MCMIS Crash file. Missing data rates are low. On most fundamental, structural variables, such as date, time, number of fatalities and number of injuries, missing data rates are either zero or extremely low.

None of the fields not related to hazmat have significantly high rates of missing data. (Table 18.) Rates for some of the sequence of events variables may appear to be high, but likely reflect the fact that crashes typically include only one harmful event, the collision itself. The missing data rate for DOT number is calculated only for carriers coded as "Interstate," which therefore must have a DOT number, and is 5.8%. Other missing data rates for non-hazmat variables range from 0.0 to 2.1% (excepting Events two through four). Overall, the rates of missing data are exceptionally low, reflecting very complete data collection on these variables.

Table 18 Missing Data Rates for Selected MCMIS Crash File Variables, Delaware 2010

Variable	Percent unrecorded	Variable	Percent unrecorded
Report number	0.0	Fatal injuries	0.0
Accident year	0.0	Non-fatal injuries	0.0
Accident month	0.0	Interstate	0.0
Accident day	0.0	Light	0.2
Accident hour	0.0	Event one	2.1
Accident minute	0.0	Event two	97.1
County	0.0	Event three	99.2
Body type	0.0	Event four	99.8
Configuration	0.0	Number of vehicles	0.0
GVWR class	0.0	Road access	0.2
DOT number *	5.8	Road surface	0.2
Carrier state	0.0	Road trafficway	0.0
Citation issued	1.4	Towaway	0.0
Driver date of birth	1.6	Truck or bus	0.0
Driver license number	1.4	Vehicle license number	0.2

Variable	Percent unrecorded	Variable	Percent unrecorded
Driver license state	1.4	Vehicle license state	0.0
Driver license class	1.4	VIN	0.6
Driver license valid	1.4	Weather	0.2

* Based on cases where the carrier is coded interstate.

Hazardous materials variable	Percent unrecorded
Hazardous materials placard	98.6
Percentages of hazmat placarded vehicles only:	
Hazardous cargo release	16.7
Hazardous materials class (1-digit)	16.7
Hazardous materials class (4-digit)	16.7
Hazardous materials name	33.3

The second section of the table shows missing data rates for the hazardous materials (hazmat) variables. Whether the vehicle displayed a Hazmat Placard was unrecorded in 98.6% percent of cases. This data is collected by means of a dropdown box on the vehicle tab of the E-Crash report. Realistically, it is likely that missing data for this field means that the vehicle did not display a placard. The other missing data rates shown are limited to the six Delaware MCMIS records where the vehicle displayed a hazmat placard, indicating it was carrying hazmat. Cargo release, hazmat 1-digit class and hazmat 4-digit class were recorded for five of the six records, while hazmat materials name was recorded for four of the six records.

6.2 Inconsistent codes

The second check on data quality is to compare values for the records in the Delaware crash data with values for comparable variables in the MCMIS Crash file. Inconsistencies here may indicate a problem in preparing the data for upload. This comparison was made for as many substantive variables as possible, other than those that were used to match records in the two files. Note that this is only a comparison of the values as recorded in the files, not an evaluation of which values are correct (if there is a difference). When there are differences, it is impossible to know, without reinvestigating the case, which version is the more accurate.

Overall, the coded values were consistent between the two files, on the variables compared, with the exception of variables describing vehicle type. The variables for light condition, road condition, and weather condition were virtually identical, with only five discrepancies for light condition and two for weather condition. Thirty-five cases differed on road trafficway, with most of the differences accounted for by divided highways. Twenty-nine cases were coded one-way in the Delaware file but two-way divided in the MCMIS file. It is likely that the reporting officer was only considering the roadway on a divided, limited access road, and the cases were corrected before upload.

With respect to hazmat placard, there were some significant differences. In the Delaware crash file,459 records were coded “no” (hazmat placard) and five were coded “yes,” but were left

unrecorded in the MCMIS data. One record was coded “yes” in the Delaware data but “no” in the MCMIS data. The problem here is primarily allowing records in MCMIS to be unrecorded when there is valid data in the Delaware crash file. These differences may reflect a process of reviewing and correcting fields in the data prior to submitting the records to the MCMIS file. It is concerning when fields are allowed to be left unrecorded when there is data. It is not known what the explanation is for the six cases coded “yes” in the Delaware data, but left unrecorded or changed to “no” in the MCMIS version of the record. Again, there is probably a program of reviewing and preparing the records for upload and the differences were probably introduced at that point.

There was also some inconsistencies between vehicle type as coded in the State crash data and vehicle configuration in the MCMIS crash file. For this comparison, the Vehicle Style field in the Delaware data was compared with Vehicle Configuration in the MCMIS data, and Vehicle Configuration and Cargo Body Type in the Delaware file were compared with the corresponding variables in the MCMIS file. For each comparison there was a relatively large number of inconsistencies. For example, in the comparison between Vehicle Style and the MCMIS Vehicle Configuration variables, 35 of the 482 records differed. Fields were counted as differing if they pointed to specific types that were clearly different. There were nine records identified as a tractor-semitrailer in the Vehicle Style field that were coded as SUT, (single unit truck) with 3 or more axles. Eight tractor-semitrailers in the Delaware data were changed to 2-axle SUTs in the MCMIS file. There was a similar magnitude of inconsistency in terms of coding cargo bodies, with 45 records that were coded with one type of cargo body in the Delaware data but a different type in the MCMIS crash file.

The greatest differences were noted in the coding of Vehicle Configuration in the State crash file and in the MCMIS. Over a quarter of the cases differed, despite the fact that the fields have the same structure and code levels in both files. Cases coded tractor-semitrailer in the MCMIS file account for most of the differences. Forty-nine records (10.2% of all) were coded truck pulling a trailer in the Delaware file and tractor-semitrailer in the MCMIS data. Nineteen were coded as either a 2-axle or 3-axle SUT. There was also a large number of cases that were coded as a 2-axle SUT in one file but a 3-axle SUT in the other. Again, it is not known which record is correct. The most likely explanation is that the reporting officers are not always aware of the finer distinctions in truck configurations, and that the records are corrected before submitting to the MCMIS crash file.

Despite these differences, there does not appear to be any consistent pattern to the inconsistencies, so they are not likely to be computer programming errors. More likely, they are the result of manual preparation.

6.3 Reporting latency

Reporting latency also reflects data quality. All reportable crash involvements for a calendar year are required to be transmitted to the MCMIS Crash file within 90 days of the date of the crash, so all crash records should be in the file by March 31. The 2010 MCMIS Crash file as of July 28,

2011, 208 days after the end of 2011, was used to identify records submitted from Delaware, so all 2010 cases should have been reported by that date.

Crash reports are required to be submitted to the MCMIS Crash file within 90 days of the crash (not within 90 days of the end of the calendar year). Figure 4 shows the cumulative percent of cases submitted by latency in days, i.e. the number of days between the crash date and the date the case was uploaded to the MCMIS Crash file. Almost 53 percent (52.8%) of the records were submitted within 90 days of the crash. Ninety percent of the records were submitted with 323 days of the crash, or, about three and half times more than the 90 day grace period. The median time between crash occurrence and record upload was 78 days, but for a significant number of records the delay was much greater. Forty percent of the records were submitted more than 150 days after the crash, with the greatest delay 409 days.

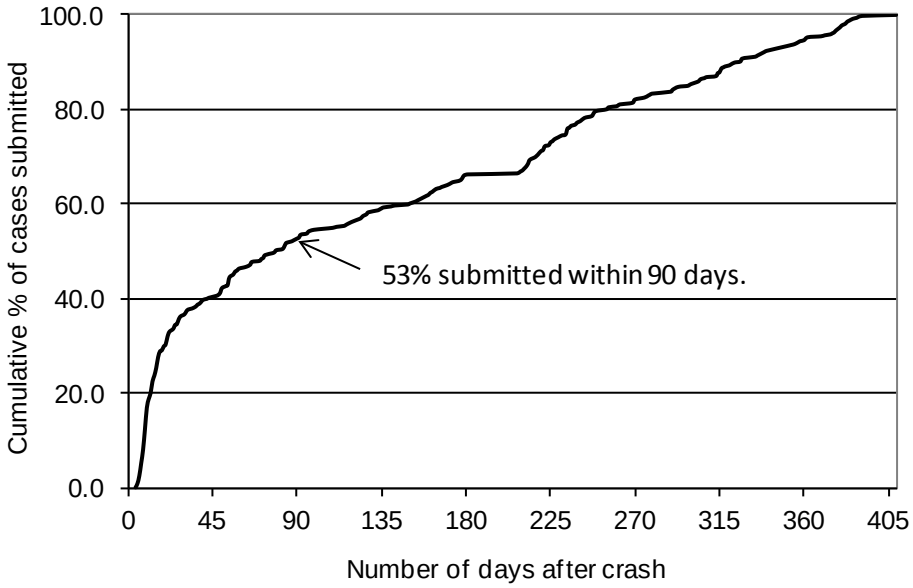

Figure 4 Cumulative Percent of Cases Submitted to MCMIS Crash File by Number of Days After Crash, Delaware 2010

The first date on which crash records from 2010 were uploaded was February 26, 2010 when nine records were uploaded. On average, uploads occurred every 7.4 days between then and May 18, 2011, when the last upload occurred. An average of 8.1 records were submitted per upload. About 50 percent of the uploads contained three or fewer records, though the largest single upload was of 57 records. Almost half of the records were submitted after the close of the calendar year.

7. Summary and Discussion

Delaware recently adopted a new electronic reporting system, called E-Crash, which is an evolution of the former TraACS software system. E-Crash is an electronic interface that walks the officer through the crash report. It provides real-time feedback to improve accuracy and

completeness, and even allows officers to search registration databases for Delaware-registered vehicles, which should improve the accuracy of vehicle descriptor information.

Reportable vehicles were identified using a combination of variables, including determining the vehicle's GVWR and likely power unit type from the VIN. The primary information used was the Vehicle Style field, as corroborated by the VIN and other vehicle fields in the file. In most cases, the information was consistent and it was relatively easy to determine if a vehicle met the MCMIS threshold. However, there were some situations in which vehicle style pointed to one type, but the VIN pointed to a different one. In these instances, the information in multiple fields were reviewed to make the assignment. In the end, about 1,400 vehicles were identified as meeting the MCMIS vehicle type criteria: either a truck with a GVWR (or GCWR) over 10,000 lbs, or a bus seating 9 or more, including the driver, or a light vehicle placarded to transport hazmat. In identifying reportable vehicles, the use of available information was maximized, using all available information.

Identifying crashes that meet the criteria by severity was more straightforward, because Delaware codes the needed data. Injury severity for each involved person is captured, along with whether the person was transported. In addition, vehicle damage is recorded, along with whether the vehicle was towed due to damage. Using the crash severity information along with the identification of reportable vehicles, 603 records were identified as meeting the MCMIS reporting criteria.

Of the 603 reportable records, 432 were actually reported to the MCMIS crash file, for a reporting rate of 71.6%. In addition, about 50 other records were reported that did not qualify, primarily because they were not involved in a crash that meet the severity criteria, though some of the records were for vehicles that were neither trucks nor buses nor light vehicles displaying a hazmat placard.

The crash data were analyzed to identify factors that were associated with lower rates of reporting. The purpose is to find ways to strengthen the reporting process.

All fatal crash involvements were reported. The process of identifying and reporting fatal involvements apparently works very effectively. Reporting rates were lower for nonfatal crashes, and had an unusual pattern. In most other states evaluated so far, crashes of higher severity tended to be reported at higher rates than crashes of lower severity. But in the Delaware data, the opposite was true. And this unexpected pattern was observed whether crash severity was measured using the MCMIS crash classification (fatal, injured/transported, or towed/disabled) or the KABCO scale. About two-thirds of reportable injured/transported crashes were reported, but almost 77 percent of towed/disabled. Only about 50% of A-injury (incapacitating injury) crashes were reported, compared with 77.1% of reportable crashes with no injury (reportable because at least one involved vehicle was towed due to disabling damage).

The reason for this inverse relationship is unknown. We checked our code thoroughly to make sure that we had not made a programming error. The code checked out and accurately captures

the underlying relationship in the data. However, the explanation for this phenomenon may help understand how reporting rates could be increased.

With respect to vehicle types, trucks are somewhat more likely to be reported than buses, but the effect is not large and not statistically significant. Within truck types as identified by VIN, truck size did not affect the probability of reporting. However, it is noteworthy the VIN was unknown for almost a third of the unreported vehicles. Vehicle style, make, model, and vehicle configuration were relied on for these to identify as a reportable vehicle, but the fact that the VIN was unknown means that searching for the vehicle in the registration file would have been more difficult. This may have complicated the task in Delaware of selecting these vehicles. And it may in part explain why there were differences in reporting related to how vehicles were classified in the Vehicle Style field, which is the field used by the reporting officer to assign vehicle type. Vehicles given the "tractor & semitrailer" type were reported at a very high rate, while reportable vehicles given the "other truck combination" type, which is more ambiguous and does not as clearly identify a medium or heavy truck, were reported at substantially lower rates.

None of the light vehicles displaying hazmat placards were reported, so that type is entirely overlooked.

Several other factors were related to reporting rates, though no single factor seemed to explain the overall rate. Instate registered vehicles were reported at a lower rate than out of state, which implies that out of state vehicles are more readily recognized as appropriate to the Federal crash file. The difference was not large, but there was some tendency.

Perhaps not surprisingly, whether the reporting officer checked the box indicating that the vehicle was a CMV had a significant effect. If the officer checked that box for a vehicle in a reportable crash, about three-quarters went on to being reported; but if the officer did not, only a little more than half were reported. This appears to be a more important factor in the reporting process.

The type of enforcement agency that covered the crash also influenced the probability of reporting. Crashes covered by the State Police were reported at a higher rate than those covered by police departments. The difference was not large, but it was statistically significant and may point to differences in training and enforcement focus that affect how officers handle the cases. Relatively large differences were observed between individual police departments and even between DSP troops. Greater uniformity in crash reporting could produce significant improvements in the overall reporting rate. The best reporting rate was for DSP Troop 5, where almost 90 percent of reportable crashes were actually reported.

In terms of the data reported, only about half of cases were reported within the 90 day post-crash reporting requirement. For the 2010 crash year at least, most of the reporting occurred after the close of the year, when there was an apparent effort to close out reporting in the first few months of 2011.

Missing data rates for most fields reported to the MCMIS Crash file are quite low. But there were some inconsistencies between code values in the State crash data and the corresponding record in the MCMIS crash file, particularly with regard to vehicle configuration. For the most part, these inconsistencies did not appear to be reflective of a systematic problem, e.g., a computer programming problem in reformatting the data to submit to SafetyNet. Instead, it appears that the inconsistency is introduced when the data are prepared for upload. There may be a manual process in which each case is reviewed and corrected prior to upload. The biggest difference is between vehicle configuration in the MCMIS file and in the Delaware file. The same variable is used in both cases, but they differed in about 25 percent of the cases reported to MCMIS.

It cannot be determined with certainty which version of the variable is correct, but it is assumed that the manual review is probably correcting the cases. If so, training and guidance that improves the accuracy of the reporting officers' classification of the vehicle here, as well as more accurately identifying vehicles as CMVs, should substantially improve the overall reporting rate.

Overall, the E-Crash system seems well designed to support the process of reporting records to the MCMIS crash file. The data collected include all the information needed to identify reportable vehicles, including both the vehicle type criteria as well as the crash severity criteria. The results here may indicate that improvements in vehicle identification–by removing the ambiguity of certain vehicle style classifications and by improved training in truck and bus types–could address some of the underreporting issues identified. Accurate and complete data are essential to monitoring and improving the safety of motor carrier operations. It is certainly the goal of this report to contribute to that result, by identifying both strengths and weaknesses so that the overall process may be improved.

8. References

1 *E-Crash & Tow-slip Manual,* Delaware Criminal Justice Information System. Prepared by Ann E. Hill. State of Delaware, n.d.

2 Blower, D., and Matteson, A., Evaluation of Missouri Crash Data Reported to MCMIS Crash File. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. January 2004. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

3 Blower, D., and Matteson, A., Evaluation of the Motor Carrier Management Information System Crash File, Phase One. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. March 2003. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

4 Blower, D., and Matteson, A., Patterns of MCMIS Crash File Underreporting in Ohio. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. August 2003. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

5 Blower, D., and Matteson, A., Evaluation of Michigan Crash Data Reported to MCMIS Crash File. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. September 2004. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

6 Blower, D., and Matteson, A., Evaluation of Florida Crash Data Reported to MCMIS Crash File. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. December 2004. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

7 Matteson, A., and Blower, D., Evaluation of California Crash Data Reported to MCMIS Crash File. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. February 2005. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

8 Green, P.E., and Blower, D., Evaluation of New Jersey Crash Data Reported to MCMIS Crash File. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. February 2005. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

9 Green, P.E., and Blower, D., Evaluation of New Mexico Crash Data Reported to MCMIS Crash File. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. July 2005. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

10 Matteson, A., and Blower, D., Evaluation of North Carolina Crash Data Reported to MCMIS Crash File. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. May 2005. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

11 Matteson, A., and Blower, D., Evaluation of Illinois Crash Data Reported to MCMIS Crash File. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. July 2005. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

12 Blower, D., and Matteson, A., Evaluation of Washington Crash Data Reported to MCMIS Crash File. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. June 2006. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

13 Blower, D., and Matteson, A., Evaluation of Iowa Crash Data Reported to MCMIS Crash File. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. August 2006. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

14 Blower, D., and Matteson, A., Evaluation of 2005 Missouri Crash Data Reported to MCMIS Crash File. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. September 2006. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

15 Green, P.E., and Matteson, A., Evaluation of Maryland Crash Data Reported to MCMIS Crash File. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. July 2006. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

16 Green, P.E., and Matteson, A., Evaluation of 2005 Ohio Crash Data Reported to MCMIS Crash File. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. December 2006. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

17 Blower, D., and Matteson, A., Evaluation of 2005 Louisiana Crash Data Reported to MCMIS Crash File. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. December 2006. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

18 Blower, D., and Matteson, A., Evaluation of 2005 Nebraska Crash Data Reported to MCMIS Crash File. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. February 2007. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

19 Blower, D., and Matteson, A., Evaluation of 2005 South Dakota Crash Data Reported to MCMIS Crash File. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. March 2007. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

20 Blower, D., and Matteson, A., Evaluation of 2004 Tennessee Crash Data Reported to MCMIS Crash File. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. May 2007. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

21 Green, P.E., and Matteson, A., Evaluation of 2005 Arizona Crash Data Reported to MCMIS Crash File. University of Michigan Transportation Research Institute, Ann

Arbor, Michigan. June 2007. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

22 Blower, D., and Matteson, A., Evaluation of 2005 Pennsylvania Crash Data Reported to MCMIS Crash File. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. Sept 2007. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

23 Green, P.E., and Matteson, A., Evaluation of 2005 Indiana Crash Data Reported to MCMIS Crash File. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. Sept 2007. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

24 Blower, D., and Matteson, A., Evaluation of 2005 Connecticut Crash Data Reported to MCMIS Crash File. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. Sept 2007. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

25 Green, P.E., and Matteson, A., Evaluation of 2005 Alabama Crash Data Reported to MCMIS Crash File. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. Sept 2007. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

26 Green, P.E., and Matteson, A., Evaluation of 2006 Georgia Crash Data Reported to MCMIS Crash File. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. November 2007. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

27 Green, P.E., and Matteson, A., Evaluation of 2006 Idaho Crash Data Reported to MCMIS Crash File. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. December 2007. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

28 Blower, D., and Matteson, A., Evaluation of 2006 Kentucky Crash Data Reported to MCMIS Crash File. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. December 2007. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

29 Green, P.E., and Matteson, A., Evaluation of 2006 Wisconsin Crash Data Reported to MCMIS Crash File. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. March 2008. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

30 Matteson, A., and Blower, D., Evaluation of 2006 Maine Crash Data Reported to MCMIS Crash File. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. June 2008. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

31 Green, P.E., and Matteson, A., Evaluation of 2006 South Carolina Crash Data Reported to MCMIS Crash File. University of Michigan Transportation Research Institute, Ann

Arbor, Michigan. July 2008. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

32 Blower, D., and Matteson, A., Evaluation of 2007 Arkansas Crash Data Reported to MCMIS Crash File. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. December 2008. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

33 Blower, D., and Matteson, A., Evaluation of 2007 Minnesota Crash Data Reported to MCMIS Crash File. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. March 2009. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

34 Blower, D., and Matteson, A., Evaluation of 2007 Oklahoma Crash Data Reported to MCMIS Crash File. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. June 2009. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

35 Blower, D., and Matteson, A., Evaluation of 2008 North Dakota Crash Data Reported to MCMIS Crash File. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. July 2009. 34 p. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

36 Blower, D., and Matteson, A. Evaluation of 2008 Vermont Crash Data Reported to MCMIS Crash File. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. September 2009. 40 p. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

37 Blower, D., and Matteson, A. Evaluation of 2007 Texas Crash Data Reported to MCMIS Crash File. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. November 2009. 35 p. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

38 Blower, D., and Matteson, A. Evaluation of 2008 Mississippi Crash Data Reported to MCMIS Crash File. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. January 2010. 38 p. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

39 Blower, D., and Matteson, A. Evaluation of 2008 Kansas Crash Data Reported to MCMIS Crash File. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. February 2010. 39 p. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

40 Green, Paul E., and Matteson, A. Evaluation of 2008 Florida Crash Data Reported to the MCMIS Crash File. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. September 2010. 46 p. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

41 Blower, D., and Matteson, A. Evaluation of 2008 Colorado Crash Data Reported to MCMIS Crash File. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. November 2010. 45 p. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

42 Blower, D., and Matteson, A. Evaluation of 2007 Montana Crash Data Reported to MCMIS Crash File. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. March 2011. 35 p. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

43 Blower, D., and Matteson, A. Evaluation of 2008 Alaska Crash Data Reported to MCMIS Crash File. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. May 2011. 41 p. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

44 Green, Paul E., and Matteson, A. Evaluation of 2009 Virginia Crash Data Reported to the MCMIS Crash File. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. June 2011. 47 p. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

45 Blower, D., and Matteson, A. Evaluation of 2008 Rhode Island Data Reported to MCMIS Crash File. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. July 2011. 43 p. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

46 Blower, D., and Matteson, A. Evaluation of 2009 New York Crash Data Reported to MCMIS Crash File. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. September 2011. 42 p. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

47 Blower, D., and Matteson, A. Evaluation of 2009 Oregon Crash Data Reported to MCMIS Crash File. University of Michigan Transportation Research Institute, Ann Arbor, Michigan. October 2011. 37 p. Sponsor: Federal Motor Carrier Safety Administration, U.S. D.O.T.

Appendix A Reportable Vehicle Identification Algorithm

```
Trkbush
      1=truck,2=bus,3=hazplac,8=other

Vehstyle
     1=Passenger Car
     3=Pickup Truck
     4=Tractor&Semi-Trlr
     5=OthTrkCombo,CommerUsedVan
     6=Farm Tractor
     7=Taxi
     8=Bus
     9=School Bus
     10=Motorcycle
     11=Scooter
     12=Unknown
     14=Ambulance
     15=Fire Apparatus
     16=Recreational Veh
     17=Construction
     20=Snowmobile
     21=Horse and Buggy
     22=Train
     23=ATV
     68=SUV
     69=Minivan/PassVan

VIN_vehtype
      1=UNKNOWN VIN
      2=GVWR GROUP1,<10K
      6=CAMPER/MOTOR HOME
      10=MED/HVY PICKUP
      11=STEP VAN
      15=TRANSIT/COMMUTER BUS
      16=SCHOOL BUS
      17=X-COUNTRY/INTERCITY BUS
      18=BUS
      19=MED/HVY TRUCK BASED MOTORHOME
      20=SUT (10-19.5K)
      21=SUT (19.5-26K)
      22=SUT (>26K)
```

```
      23=TRUCK TRACTOR
      24=TRAILER
      25=TRUCK OR BUS

/** Trucks *****************************************************************/
      if vehstyle =17 and vin_vehtype=22 then trkbush=1;
      /*truck,construction*/

      else if vehstyle =69 and vin_vehtype in (21,22) then trkbush=1;
      /*truck,minivan*/

      else if vehstyle =5 and vehconfig =1 and vin_vehtype=2 then trkbush=3;
      /*hazplac veh <10K*/
      else if vehstyle =5 and vehconfig in (2,3,4,5,6,7,8,9) then trkbush=1;
      /*truck,combo*/
      else if vehstyle =5 and vin_vehtype in (20,21,22) then trkbush=1;
      /*truck,combo*/
      else if vehstyle =5 and vehconfig in (10,11) then trkbush=2; /*buses*/
      else if vehconfig=. and vehstyle=5 and vin_vehtype in (1) then
      trkbush=1; /* truck,combo*/

      else if vehstyle=1 and vehconfig in (2,3,4,5,6,7,8,9) then trkbush=1;
      /* truck,passcar*/
      else if vehstyle=1 and vin_vehtype in (21,22) then trkbush=1;
      /*truck,passcar*/

      else if vehstyle=3 and vin_vehtype in (21,22) then trkbush=1;
      /*truck,likely heavy*/

      /** After looking at over-reported cases, we decided to add these
      pickups **************/
      else if vin11 in ('JBDC4814647','1GBKC34J6YF','JALE5W16587',
      '1FDLF47G9VE','1HTSAZRKXLH','1GBJC34R6XF','1GBE6H1J4RJ',
      'JALC4B16277','1FDWF37R98E') then trkbush=1;

      else if vehstyle=16 and vehconfig in (2,3,4,5,6,7,8,9) then trkbush=1;
      /* truck,recveh */
      else if vehstyle=16 and vin_vehtype in (21,22) then trkbush=1;
      /*truck,recveh */
      else if vehstyle=16 and vin_vehtype =23 then trkbush=1;
      /*truck,recveh*/
```

```
      else if vehstyle=4 /*and not (vehconfig =. and vin_vehtype =20)*/ then
      trkbush=1; /* truck,tracsemi-revised after looking at over-reported
      cases*/

      else if vehstyle=12 and vehconfig in (2,3,4,5,6,7,8,9) then trkbush=1;
      /* truck, unknown */
      else if vehstyle=12 and vin_vehtype in (21,22) then trkbush=1;
      /* truck, unknown */

/** Buses ***************************************************************/
     else if vehstyle =8 and vehconfig=11 and vin_vehtype=6 then trkbush=8;
     /*other, exclude motor home*/
     else if vehstyle in (8,9) then trkbush=2; /* bus */
     else if vehstyle =16 and vehconfig in (10,11) then trkbush=2; /* bus */
      else if vehstyle =16 and vin_vehtype in (15,16,17,18) then trkbush=2;
      /* bus */
     else if vehstyle=12 and vehconfig in (10,11) then trkbush=2; /* bus */
     else if vehstyle=69 and vehconfig in (10) then trkbush=2; /*bus*/

 /** Additional revisions after examining Over-reported cases ********/
     else if vin11 in ('1FDXE45F9YH','1FBSS31L58D','1GBJG31F5X1') then
     trkbush=2; /* bus*/

/** Hazmat placarded ****************************************************/
     else if cargo_contained_hazmat = '01' or trailer_hazplac_1 ne ' '
     or trailer_hazplac_2 ne ' ' then trkbush=3; /* hazplac */

     else trkbush=8; /*other*/
     format trkbush ptrbusf.;
     label trkbush='1=truck,2=bus,3=hazplac,8=other';
run;
```