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EVALUATION OF 2010 UTAH CRASH DATA REPORTED TO THE 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 Utah.

MCMIS Crash File records were matched to the Utah crash file to determine the nature and extent of underreporting. Overall, it is estimated that, for 2010, 71.4% of reportable crash involvements were reported.

Almost 90% fatal crash involvements were correctly reported. Reporting rates were lower for less severe collisions: 70.2% of injured/transported crashes and 71.3% of towed/disabled crashes were reported. Low reporting rates of crashes covered by local enforcement agencies were the primary factor in the overall reporting rate. The Utah Highway Patrol had the highest reporting rate. Rates were substantially lower for crashes coved by police departments and sheriff's offices.

Missing data rates are low for most variables. Corresponding data elements in the MCMIS and Utah crash files were reasonably consistent, except for vehicle configuration. Over 20% of records differed substantially on the type of vehicle. Improvements in training to may address this issue. About 70 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 MCMIS crash file are extracted by the States from their own crash records, and uploaded through the SafetyNet system. The usefulness of the MCMIS Crash file 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 was related 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 3 to 49.] Each State is 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 Utah in 2010. Utah is the 34th largest state by population and in most years ranks about 38th among the states in terms of the number of annual truck and bus fatal involvements. Between 2005 and 2009, the annual number of crash involvements reported by Utah to the MCMIS crash file varied widely, ranging from 469 to 1,799 each year. Over the same time span, the number of *fatal* truck and bus involvements in Utah identified in the standard fatal crash files has varied in a narrower range: 33 in 2005, 37 in 2006, 47 in 2007, 37 in 2008, and 32 in 2009.[2]

Police accident report (PAR) data for 2010 recorded in Utah's statewide files as of December 2011 were used in this analysis. The 2010 PAR file contains the crash records for 88,935 vehicles.

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

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

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

3. All cases in the Utah 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 Utah.

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 first step in the process is to review and prepare the State's crash data file and the MCMIS crash data file for the evaluation. The Utah PAR file and MCMIS Crash file each required some preparation before the Utah records in the MCMIS Crash file could be matched to the Utah PAR file. In the case of the MCMIS Crash file, the major tasks were to extract records reported from Utah and to identify and eliminate any duplicate records. The Utah PAR file was processed to create a comprehensive vehicle-level file from accident, vehicle, and person data. It was then reviewed to exclude any duplicate records.

The following two sections describe the methods used to prepare each file, and discusses 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 Utah. For calendar year 2010 there were 1,063 cases reported to the file from Utah. 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, city, street, vehicle identification number (VIN), and driver license number, 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, driver, and crash. 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 1,063 unique records.

2.2 Utah Police Accident Report File

The Utah PAR data for 2010 was obtained from the State in December 2011. The data were stored as SPSS database files, with separate files for crash, vehicle, person, and commercial vehicle information. The files contained records for 49,338 traffic crashes involving 88,935 traffic units. Data for the PAR file are coded from the State of Utah Investigating Officer's Report of Traffic Crash (DI-9, Rev. 11/08/05), completed by police officers (see Appendix A).

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 the numbers were recorded in a consistent format, eliminating the possibility of duplicate records based on similar, but not identical, number formats (such as 1000124664 and 1-00124664, for example).

There were no instances of multiple records with identical case numbers and vehicle numbers. 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. Records were examined for duplicate occurrences based on the fields for case number, accident date/time, crash county, city, road, VIN, and driver license number. Using this process, no duplicate pairs were found. The resulting PAR file has 88,935 unique cases.

3. Matching Process

The next step in the evaluation of the data was to match records from the Utah PAR file with corresponding records from the MCMIS file. There were 1,063 records from the MCMIS file available for matching, and 88,935 records from the Utah PAR file. All records from the Utah PAR data file are used in the match, even those that apparently did not meet the requirements for reporting to the MCMIS Crash file. This allows the identification of cases reported to the MCMIS Crash file that do 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. Ideally, the crash record identifier and vehicle number identifier should be adequate here, but even when the same identifiers are used in both files, matches on other variables are used to validate the match.

Case Number, which uniquely identifies a crash in the Utah PAR data, and Report Number, in the MCMIS Crash file, are obvious first choices. In the Utah PAR file, Case Number is a 10-digit numeric field; 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 (UT, in this case), followed by ten alphanumeric values. Fortunately, there was an exact correspondence between PAR Case 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. Appropriate combinations of these variables have a usefully high probability of uniquely identifying a crash. The PAR file contained all of these variables, except for Officer Badge Number. There is a Main Road Name variable in the PAR file which, although it was typically very general (such as "I-15"), did match MCMIS Crash Street in many cases. Those variables can be used to cross-check matches.

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. The Utah PAR data file contains all of these variables except the Vehicle License Plate Number. Driver License Number was unrecorded in 7.5% of PAR cases, and in 4.1% of MCMIS cases. Driver Age is missing in 6.7% of PAR cases and in 0.2% of MCMIS cases. Driver Date of Birth was not present in 6.9% of PAR cases, and in 4.1% of MCMIS cases. The percentages of missing data for these variables are all low enough to be useful in validating matches.

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 for case number, crash date (month, day), crash time (hour, minute), county, city, VIN, and driver license number. The second match step dropped driver license number and matched on case number, crash date, crash time, county, city, VIN, and driver last name. After some experimentation, the third match step eliminated case number and included crash date, crash hour, county, street, and driver license number. A fourth match used the variables for crash date, crash hour, county, city, and VIN. The variables used in the final (fifth) computer-based match attempt were crash date, county, driver date of birth year, and driver last name. The resulting matched records from steps 4 and 5 were verified by comparing 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 thirty unmatched MCMIS cases. A manual search of the Utah PAR file was conducted for each of these thirty records, searching by county, month, and day. In this search, all the crashes occurring in the same county and on the same day were manually reviewed for any evidence they referred to the crash in the MCMIS file. For each case, records were reviewed to find a crash on that road involving a truck or bus. This process resulted in matching 24 cases. In a couple of these cases the MCMIS VIN was the trailer VIN, which explains why that case did not initially match a PAR record during the computerized match. But comparing other variables for these cases confirmed the match. The six remaining unmatched MCMIS cases appeared to be duplicate records in the MCMIS file, as the PAR case they seemed to match had already been matched to another almost identical MCMIS case.

Computerized and manual review resulted in matching 1,057 (99.4 percent) of the MCMIS records to records in the PAR file. Only six 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/Utah PAR File Match, 2010

Step	Matching variables	Cases matched
Match 1	Case number, crash date (month, day), crash time (hour, minute), county, city, vehicle identification number, and driver license number	564
Match 2	Case number, crash date, crash time, county, city, vehicle identification number, and driver last name	160
Match 3	Crash date, crash hour, county, street, and driver license number	231
Match 4	Crash date, crash hour, county, city, and vehicle identification number	58
Match 5	Crash date, county, driver date of birth year, and driver last name	20
Match 6	Hand-matching attempt, using all available variables	24
Total cases matched		1,057

The matches 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 1,057 matches, which is 99.4 percent of the 1,063 records reported to MCMIS.

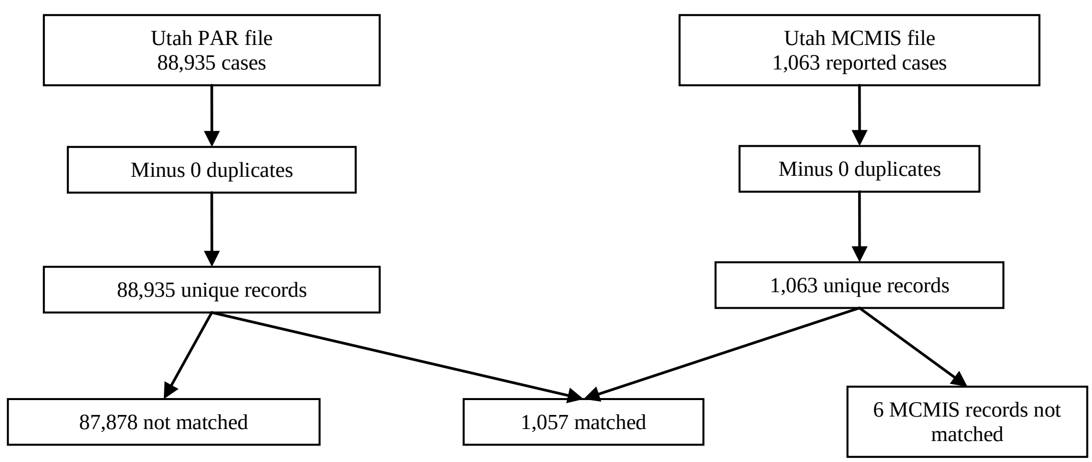

Figure 1 Case Flow in MCMIS/Utah Crash File Match

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, the necessary first step is to identify records that should have been reported. 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. This is done using the information available in the computerized crash files supplied by Utah. "Reportable" records meet criteria specified by the FMCSA. In essence, the MCMIS reporting criteria are applied to all the records in the Utah crash file in order to identify those that should be reported.

The method developed to identify reportable records is 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 or on a supplemental form, with instructions to the reporting officer to complete that information only for vehicles and crashes meeting the MCMIS selection criteria. This puts the reporting officer in a critical position, because the officer in the field must recognize a crash that meets the MCMIS reporting criteria, in order for the data to be reported to the MCMIS crash file are even collected.

Utah does not really follow that approach. There is an area on the DI-9 crash report for "commercial vehicle" (CMV) information, but this area is completed for any vehicle in any crash that meets the definition of a commercial vehicle. Moreover, only some of the MCMIS data is collected in this area. Much of the data for the MCMIS file is collected for all vehicles, and then combined with the CMV data for upload to the MCMIS crash file.

The Utah instruction manual states that the term “commercial vehicle” means any vehicle with one of more of the following characteristics:

- A truck having a GCWR of 10,001 or more pounds
- A vehicle displaying a hazardous material placard
- A vehicle designed to transport 9 or more people, including the driver.

Utah’s definition of a CMV corresponds precisely to the vehicle criteria for the MCMIS file. [1, p. 39.]

4.1 Vehicle Type

The Utah computerized crash file contains several variables that were used to identify reportable vehicles, including body type, cargo body type, trailing unit, vehicle 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 meet 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 that took 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 Body Type field. Body Type is a 22-level variable with codes for common vehicle types. Several of the codes seem to identify vehicle types that meet the MCMIS vehicle definition. Trucks with a gross vehicle weight rating (GVWR) over 10,000 lbs would probably be included in the body type codes for “Single Unit Truck[SUT hereinafter], 2 axles, 6 tires,” “SUT, 3+ axles,” ”Truck Tractor,” “Truck Trailer,” and “Heavy Truck Other.” There is a separate code level for “Pickup.” Some pickups have GVWRs over 10,000 lbs. and are used commercially. The body type field also includes codes that may identify qualifying buses, such as “School Bus,” “Bus/motorcoach (not school),” and possibly “Van or Mini van” (depending on the seating capacity).

The fields for cargo body, special function, trailing unit, personal use, and the VIN were used to validate the information in the Body Type field, and also to identify vehicles that may have been misclassified in the Body Type field. Information in the VINs is strong evidence as to whether a vehicle is reportable or not. VINs were decoded by David Hetzel of NISR, Inc., using software that he has developed. Hetzel decoded 86,507 VINs that were recorded in the Utah crash data. (VIN was unrecorded or invalid in 2,428 cases, 2.7 percent of all vehicles.) The vehicles with valid VINs were classified as light vehicles (GVWR < 10,000), motorhomes or campers, medium or 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 using the VIN.

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

VIN vehicle	N	Percent
Camper or motor home	20	0.0
Medium/heavy truck based motor home	20	0.0
Medium/heavy pickup (>10k lbs)	540	0.6
School bus	158	0.2
Cross country/intercity bus	37	0.0
Transit/commuter bus	111	0.1
Other bus	33	0.0
Single unit truck (10k-19.5k lbs)	475	0.5
Single unit truck (19.5k-26k lbs)	184	0.2
Single unit truck (>26k lbs)	716	0.8
Step van	26	0.0
Trailer	77	0.1
Truck tractor	1,549	1.7
Truck or bus	99	0.1
Possible bus	25	0.0
Possible large van	70	0.1
Light vehicle, VIN not decodable, or missing	84,795	95.3
Total	88,935	100.0

Note that not all the vehicles identified by the VIN-decoding software are necessarily reportable trucks or buses. For example, motor homes 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 manually decoded certain critical VINs where the computer decoding was ambiguous and other fields did not clearly indicate one way or the other.

The algorithm to select reportable vehicles was based on the Body Type coding, as validated by consistent codes in other fields describing the vehicle, including cargo body, make, special function, and VIN. All vehicles with a body type coded as SUT (3 or more axles) and Truck Tractor were selected as meeting the vehicle type criterion. Vehicles coded as SUT (2-axles, 6-tires) were taken if the VIN confirmed they were medium or heavy-duty trucks. Vehicles identified as Heavy Truck Other were taken if the VIN (confirmed by make and model year) did not indicate they were actually light vehicles. Pickups were taken if the VIN indicated they were GVWR Class 3 and they were not classified as personal use only. Some vehicles classified as light duty were taken if the VIN indicated they were actually heavy trucks, confirmed by make, cargo body type, and model year. All vehicles classified in the Body Type field as buses were taken, except for those that the VIN indicated were motorhomes.

Generally speaking, where the variables were consistent and identified a vehicle type that met the reporting criteria, those vehicles were taken. The VIN was used to exclude vehicles that are not reportable, such as those with GVWR less than 10,000 lbs., or to identify reportable vehicles misclassified as light vehicles.

In addition to these vehicle types, any vehicle, regardless of size, displaying a hazardous materials (hazmat) placard, also meets the MCMIS vehicle type definition. Utah's crash data includes a field for hazardous placard number, which was used to identify vehicles displaying a hazardous placard.

The full algorithm (using SAS© syntax) is reproduced in Appendix B.

Overall, this approach uses available information to the fullest extent while also being appropriately conservative. Most of the medium/heavy pickups were excluded 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 3,315 vehicles (3.7% of PAR cases) identified as meeting the MCMIS vehicle criteria, along with their classification in the Utah PAR body type field. In other states evaluated to date, the percentage of vehicle meeting the MCMIS reporting criteria has ranged from 2.6 to 6.1% of PAR cases, so the Utah result is well-aligned with other States.

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

MCMIS vehicle type	PAR body type	N	%
Truck	Passenger car-2dr	5	0.0
	Passenger car-4dr	2	0.0
	Pickup	73	0.1
	Van/mini van	10	0.0
	SUT,2ax,6tr	338	0.4
	SUT,3+ axles	286	0.3
	Truck tractor	535	0.6
	Truck trailer	1,209	1.4
	Heavy truck-other	501	0.6
Truck total		*2,959*	*3.3*
Bus	Passenger car-2dr	1	0.0
	School bus	149	0.2
	Bus/motorcoach, not school bus	205	0.2
Bus total		*355*	*0.4*
Hazmat vehicle	*Unknown*	*1*	*0.0*
Not a MCMIS reportable vehicle		85,626	96.3
Total		88,941	100.0

4.2 Crash severity

Crashes that meet the MCMIS reporting criteria include either a fatality or at least one injured person transported for immediate medical attention or at least one vehicle towed due to disabling damage. 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 Utah 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 Utah Person file includes information about the injury severity for each person involved in a crash. Utah classifies injury using the common KABCO scale: 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 with 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 Transported By field on the Person file which specifies the mode of transport to a medical facility. In addition, a Transported To field indicates the code for the specific medical facility. For ease of use, this variable was aggregated into three categories: Valid Hospital; Other/Unknown/Invalid Code; and Missing/NA.

After examining the Transported By variable in conjunction with the Transported To field, a decision was made to use the Transported By field along with Injury Severity to identify crashes meeting the injured and transported criteria. 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 (Ambulance, Helicopter, Law Enforcement, or Private Vehicle). 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. Information to identify towed/disabled vehicles is recorded on the Utah PAR vehicle file. A Disposition of Vehicle variable contains codes for Towed/disabled, Towed/impounded, and Towed Other, along with Retained by Driver, Hit and Run, Invalid code, Missing, NA, and Unknown. Another variable, Extent of Vehicle Deformity, records the amount of damage a vehicle sustained (for the most damaged area). It has the following code levels:

None:	No visible damage to the motor vehicle.
Minor:	Damage that does not affect the operation of or disable the motor vehicle and is mostly cosmetic in nature.
Moderate:	Damage that is between minor and severe.
Severe:	Intrusion of damage into the passenger compartment.
Unknown:	No information.

Since moderate or severe damage would likely result in the vehicle being disabled, any vehicle that was towed and had moderate or severe damage was considered to meet the towed/disabled criterion. Accordingly, the following decision rule was used to identify vehicles that met the towed/disabled criterion:

- Vehicle with a disposition of Towed/disabled.
- Vehicle with a disposition of Towed/impounded *and* damage extent was either moderate or severe.
- Vehicle with a disposition of Towed Other *and* damage extent was either moderate or severe.

Any crash with one or more vehicles classified as towed/disabled was flagged as a towed/disabled crash. Similarly, any crash with a fatality or a person transported for immediate medical attention was flagged as a fatal or injury/transported crash. If the crash also included a reportable vehicle, that vehicle record was flagged as reportable to the MCMIS crash file.

In total, there were 1,390 vehicles identified in the Utah crash data as eligible trucks, buses, or hazmat placarded light vehicles in crashes with a fatal injury, nonfatal injury transported for treatment, or a towed/disabled vehicle. Table 5 shows the distribution by vehicle type. Medium or heavy trucks accounted for 92.1% of the vehicles, while 7.8% were buses, and there was one light vehicle transporting hazmat.

Table 5 Vehicles Meeting MCMIS Crash and Vehicle Criteria
Utah PAR File, 2010

Vehicle type	N	%
Truck	1,280	92.1
Bus	109	7.8
Other, transporting hazmat	1	0.0
Total	1,390	100.0

As Figure 1 above shows, there were 1,063 records reported to the MCMIS Crash file by Utah in 2010. Of these, 1,057 were matched to the Utah crash data file. Matches could not be found for 6 of the MCMIS records, despite an exhaustive manual search through the PAR file. If all 1,057 matched records were reportable, the reporting rate from Utah would be 76.0%. If all the 1,063 reported actually were reportable, the rate would rise to 76.5%. However, as discussed below, 64 of the reported cases did not meet the reporting criteria (overreported), because the crashes did not meet the severity or vehicle type criteria. In the end, 993 of the 1,309 reportable cases were actually reported, for a reporting rate of 71.4%.

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 then 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 procedure for identifying and extracting, in this case, about 1,300 records from almost 89,000. The purpose of this section is to compare the characteristics of the reported records with those that were not reported, 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 includes making sure that cases that do not meet the reporting criteria are not reported. Sixty-four reported records did not meet either the crash severity or vehicle type criteria, or both. (Table 6) Many of the overreported records (24) were eligible trucks or buses, but they were involved in minor crashes: There was no injured person transported for treatment or disabled vehicle towed due to disabling damage. Forty of the records were for vehicles that did not meet the vehicle type criteria. To confirm this, the VINs were decoded manually. They were found to be light vehicles, not trucks or buses, and there was no evidence that any of them were transporting hazardous materials. It cannot be known, of course, whether the data coded in the crash record is accurate, but if it is, these 64 records did not meet the reporting criteria. They amount only to about 6.0% of reported records.

Table 6 Vehicle Type and Crash Severity of Cases Reported but Not Reportable Utah 2010

	Crash severity				
Vehicle type	Fatal	Injured/ transported	Towed/ disabled	Other	Total
Truck	0	0	0	24	24
Other	2	11	24	3	40
Total	2	11	24	27	64

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 7 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 first column of numbers shows the total number of reportable records identified in the Utah crash file. The next column shows the reporting rate for each category of reportable records. The next column shows the number of reportable records that were not reported. Finally, the last column shows the proportion of all unreported cases accounted for by each category of reportable cases. 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 but four fatal crashes were correctly reported. The reporting rate for fatal crash involvements was 89.2%. The rates for injured/transported and towed/disabled crashes were lower, at 70.2% and 71.3% respectively. The differences between the reporting rate for fatal involvements and for the two non-fatal crash severities is statistically significant, meaning that it is unlikely to be due to chance alone. Fatal crashes may be handled by a different process than lesser severity crashes. Fatal crashes are likely given a higher level of scrutiny than non-fatal, and therefore are more likely to be recognized as meeting the reporting criteria.

Table 7 Reporting Rate by MCMIS Crash Severity, Utah 2010

Crash severity	Reportable cases	Reporting rate	Unreported cases	% of total unreported cases
Fatal	37	89.2	4	1.0
Injured/transported	379	70.2	113	28.5
Towed/disabled	974	71.3	280	70.5
Total	1,390	71.4	397	100.0

Reporting rates for the injured/transported group and towed/disabled are substantially the same. This suggests that the lower severity crashes are all handled by the same process and subjected to the same level of scrutiny.

Reporting rates were also calculated for crash severity measured by the KABCO injury severity scale, which is used by Utah and other states. In this scale, injuries are classified as fatal (K), incapacitating (A), non-incapacitating but evident (B), possibly injury (C), or no injury (O). Using this more fine-grained classification, the fatal rate was of course unchanged, but it was also observed that the reporting rate for the other severities varied within a narrow range, from 68.9% to 71.8%. Statistical tests showed no statistical significant differences between any of these rates. There is also no practical difference. It appears that, for non-fatal crashes injury severity itself does not influence the reporting rate.

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 8 shows the rates for the different top level types of vehicles. The reporting rate for trucks was 73.0%, slightly higher than the overall rate and significantly higher than the rate for buses, which was 53.2%. The difference in the reporting rates for trucks and buses is statistically significant. Overall, buses tend not to be recognized as meeting the reporting criteria, at least as readily as trucks are. On the other hand, unreported truck cases account for 86.9% of underreporting.

Table 8 Reporting Rate by MCMIS Vehicle Class, Utah 2010

MCMIS vehicle class	Reportable cases	Reporting rate	Unreported cases	% of total unreported cases
Truck	1,280	73.0	345	86.9
Bus	109	53.2	51	12.8
Light veh., hazmat placard	1	0.0	1	0.3
Total	1,390	71.4	397	100.0

One may note that the light vehicle transporting hazmat was not reported, but with only one reportable record, nothing can be concluded.

Table 9 provides more insight into the effect of vehicle configuration on reporting rates. It shows reporting rates by the body style field, as recorded on the DI-9 crash report. The first thing to note is that several of the body styles identify vehicles that do not, on their face, match vehicle types that should be reported, but these vehicles were identified as reportable by VIN and other information. For example, all of the pickup trucks in the table were at least GVWR class 3 and used for commercial purposes. More importantly, though, over 60 percent of the cases <u>not</u> reported were identified by the reporting officer as either a truck/tractor, truck/trailer, or heavy truck-other. (See the far-right column in the table.) Each of these types should be readily identified as a vehicle that should be reported to the MCMIS crash file. On the other hand, note the difference in reporting rates for the two bus types identified in the body style field. Over 65 percent of school bus involvements were reported, compared with only 43.5% of other bus types, including motorcoach buses.

Table 9 Reporting Rate by PAR Body Style, Utah 2010

PAR Body style	Reportable cases	Reporting rate	Unreported	% of total unreported
School bus	46	65.2	16	4.0
Bus/motorcoach, not school	62	43.5	35	8.8
Passenger car-2dr	3	0.0	3	0.8
Pickup	26	23.1	20	5.0
Van/mini van	5	0.0	5	1.3
SUT, 2 axle,6 tires	134	71.6	38	9.6
SUT, 3+ axles	111	67.6	36	9.1
Truck tractor	236	75.8	57	14.4
Truck trailer	568	83.3	95	23.9
Heavy truck-other	196	53.6	91	22.9
Other	2	100.0	0	0.0
Unknown	1	0.0	1	0.3
Total	1,390	71.4	397	100.0

Beyond the classification of vehicles on the DI-9 report, it appears that reporting rates for larger trucks are somewhat higher than for smaller trucks. Table 10 shows the vehicle type indicated by the VIN, including the GVWR range. Larger trucks are somewhat more readily recognized as fitting the reporting requirements than smaller trucks, even though the smaller ones also qualify. Within SUTs, the increase in reporting rate as the size of the vehicle increases is almost linear: SUTs with a GVWR between 10,000 lbs. and 19,500 lbs. (class 3 through 5) are reported at a 55.9% rate; SUTs rated between 19,500 and 26,000 (class 6) at 64.2%, and SUTs rated over 26,000 lbs. (class 7 and 8) were reported at a 69.5% rate. Truck tractors at 80.8% have the highest rate of all.

Table 10 Reporting Rate by Vehicle Type from the VIN, Utah 2010

VIN Vehicle Type	Reportable cases	Reporting rate	Unreported cases	% of total unreported
Transit/commuter bus	34	44.1	19	4.8
School bus	44	65.9	15	3.8
Cross-country/intercity bus	14	42.9	8	2.0
Bus	4	50.0	2	0.5
Med/heavy pickup	10	10.0	9	2.3
Step van	10	20.0	8	2.0
Single unit truck (10K-19.5K lbs)	102	55.9	45	11.3
Single unit truck (19.5K-26K lbs)	67	64.2	24	6.0
Single unit truck (>26K lbs)	279	69.5	85	21.4
Truck tractor	687	80.8	132	33.2
Trailer	14	57.1	6	1.5
Truck or bus	30	53.3	14	3.5
Unknown or GVWR<10K	95	68.4	30	7.6
Total	1,390	71.4	397	100.0

Each of the bus types are reported at lower rates. Bus types here are assigned by decoding the VIN only, so vehicle frames that are designed for school bus applications are assigned as school bus, high platform buses as cross-country/intercity bus, and so on. Bus type is defined here by the physical configuration of the vehicle alone. Interestingly, school buses are reported at the highest rate among the bus types. About two-thirds of reportable school bus involvements are actually reported, compared to only 42.9% of motorcoaches (cross-country/intercity), and 44.1% of transit/commuter buses. Possibly the latter are captured at lower rates because many are operated by units of government or quasi-public entities, but so are school buses, and motorcoaches typically are operated by unambiguously-private carriers. However, it should be noted that the differences among bus reporting rates are not statistically significant, even at the 0.1 level, so there is a chance that the observed differences are due to chance, rather reflecting a systematic difference. (The overall lower reporting rate for buses is statistically significant.)

5.2.2 Crash month

It was also tested whether delays in transmitting cases, or some process related to the time of year may account for some proportion of the underreporting observed in the 2010 data. This was done by calculating reporting rates by the month of the crash. Figure 2 shows that reporting rates by the month of the crash form an interesting pattern. There appears to be two clusters of rates.

In the first six months of the year, reportable crashes were reported at an average rate of 86.6%, ranging from 92.5% in March to a still-high 82.6% in June and 83.0% in February. However, from July through January, records were reported at a 60.5% rate, with a high of 66.4% in August and a low of 55.0% in December. The rates seem to cluster into two groups, with a high rate early in the year and then a step change to a lower rate in the second half of the year. This might be related to mere delays in record processing

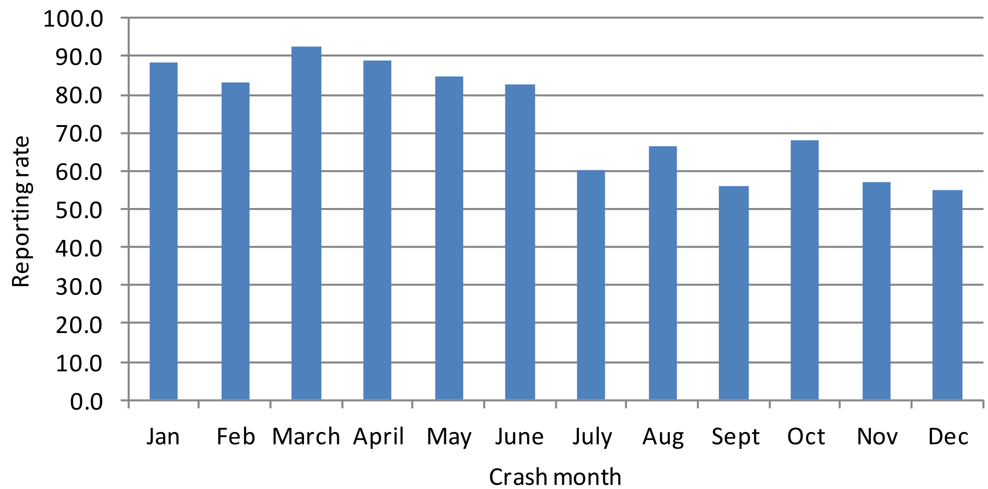

Figure 2 Reporting Rate by Crash Month, Utah 2010

5.2.3 Interstate Commerce and License State

Reporting rates were calculated to test whether vehicles that seem to be in interstate commerce are more likely to be reported than other, equally reportable vehicles. The commercial vehicle area of the DI-9 includes check boxes for "interstate" and "intrastate," to record whether the vehicle travels between states or entirely within the boundaries of Utah. Either or both boxes may be checked. In addition, the license state of the vehicle may be taken as a rough proxy for interstate travel, at least insofar as vehicles plated in other states must have travelled interstate. Obviously, records for reportable vehicles must be submitted to the MCMIS crash file regardless of whether they operate in interstate commerce; the purpose here is to test if that influences actual reporting.

Reportable records where the officer indicated "interstate" in the commercial vehicle area of the DI-9 are reported at a much higher rate than where "interstate" was marked no or left blank. (Table 11.) The reporting rate for such vehicles was almost 90%, compared to only 71.9% for those marked N, and only 37.5% where it was left blank. These differences are both substantial and statistically significant.

Table 11 Reporting Rate by Interstate Checkbox, Utah 2010

Interstate checkbox	Reportable cases	Reporting rate	Unreported	% of total unreported
Y	528	89.8	54	13.6
N	569	71.9	160	40.3
(blank)	293	37.5	183	46.1
Total	1,390	60.2	343	100.0

Yet it was noted that there were 248 records where both interstate and intrastate were marked N (no), and there is also the 293 records left blank. Vehicle registration state, as reflected by the license plate state, may be used as a partial proxy for whether a 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. An algorithm was developed to use registration state to fill in the blanks of the interstate field. Any vehicle marked interstate=Y was taken as interstate, regardless of vehicle registration. If interstate was marked N or left blank, vehicle registration in a state other than Utah is taken as evidence that the vehicle is in interstate commerce. If interstate is N and intrastate is Y, and vehicle registration state is Utah, then those vehicles were classified as intrastate. All other cases were coded unknown as to whether they were intra- or interstate. This classification method takes the greatest advantage of the information available to determine whether there was evidence, recorded by the reporting officer, as to whether a vehicle was in interstate or intrastate commerce.

Table 12 shows the reporting rates for the records classified by the method just described. Contrary to what was suggested by Table 11, there appears to be no significant difference between reporting rates for inter- and intrastate vehicles. The rate for interstate is slightly higher, 82.3% to 78.2%, but this difference is neither statistically significant nor practically significant. However, the rate for vehicles that could not be classified is only 50.8%, which is substantially lower, and moreover accounts for 55.7% of all unreported records. Most of these records are for Utah-plated vehicles, though either both the interstate and intrastate boxes were left blank or they were both marked N. This suggests that the effective reason for many (but not all) of the records that were overlooked is that they were not fully documented, with the CMV area left incomplete.

Table 12 Reporting Rate Classified as Interstate or Intrastate, Utah 2010

Classification	Reportable cases	Reporting rate	Unreported	% of total unreported
Interstate	715	82.3	127	32.0
Intrastate	225	78.2	49	12.3
Unknown	449	50.8	221	55.7
Total	1,390	71.4	397	100.0

Inspection of unreported records showed that over half had virtually nothing recorded in the CMV area of the DI-9.

5.2.4 Reporting agency

The Utah Highway Patrol covers most reportable crashes (64.6%), but 27.4% are covered by local police departments, and 7.8% are covered by sheriff's offices. The UHP's reporting rate is the highest of the different enforcement agency types. The reporting rate for the UHP is 88.5%, compared with 43.3% for crashes covered by local police departments and 29.6% for those covered by sheriff's offices. (Table 13.) These difference are substantial and statistically significant. They doubtless reflect differences in enforcement focus and training for the different levels of law enforcement. Note that the UHP reporting rate is almost identical to the rate for fatal crashes (Table 7), which was interpreted as reflecting the level of investigation done on the most serious crashes. The UHP rate is especially notable given that they cover almost two-thirds of MCMIS-reportable crashes. This gives an indication of what can be achieved in terms of reporting.

Table 13 Reporting Rate by Reporting Agency Type, Utah 2010

Reporting Agency	Reportable cases	Reporting rate	Unreported cases	% of total unreported cases
Highway Patrol	898	88.5	103	25.9
Police Department	381	43.3	216	54.4
Sheriff's Office	108	29.6	76	19.1
Other	3	33.3	2	0.5
Total	1,390	71.4	397	100.0

There were some differences in reporting rates between different police departments. Table 14 shows reporting rates for the top 12 police departments, ranked in terms of the number of reportable records. These 12 account for about 60% of all MCMIS-reportable crashes in Utah that were covered by police departments. Reporting rates vary substantially across these 12, but the sources of the variance are not known. The variation does not seem to have anything to do with size. The rate of Salt Lake City, which is the largest department, at 40.8% is about the same as the rate for all police departments as well as the rate for the set of the smallest police departments, all of which had 9 or fewer reportable records.

Table 14 Reporting Rate for Selected Police Departments, Utah 2010

Police department	Reportable cases	Reporting rate	Unreported cases	% of total unreported cases
Salt Lake City	49	40.8	29	13.4
West Valley	34	44.1	19	8.8
Sandy	22	72.7	6	2.8
Ogden	20	35.0	13	6.0
Murray	16	37.5	10	4.6
West Jordan	16	81.3	3	1.4
Provo	14	35.7	9	4.2
Spanish Fork	13	38.5	8	3.7
Taylorsville	13	7.7	12	5.6
South Salt Lake	12	25.0	9	4.2
Layton	11	54.5	5	2.3
Draper	9	77.8	2	0.9
All other	152	40.1	91	42.1
Total	381	43.3	216	100.0

Reporting rates for different sheriff's offices were all relatively low, with little significant variation. Table 15 shows the counts of reportable cases and reporting rates for the top 5 sheriff's offices, in terms of the number of MCMIS-reportable crashes, as well as the other 18 offices, aggregated into the All Other category. Only the top 5 are shown because the rest covered 3 or fewer reportable crashes. Jurisdictions that cover so few would have more difficulty in becoming proficient, though their rates were not notably lower than the rates for the few larger offices. As with police departments, differences in the training and enforcement focus of sheriff's offices as such most likely contribute to the lower rates of reporting, compared with the UHP.

Table 15 Reporting Rate for Selected Sheriff Offices, Utah 2010

Sheriff office	Reportable cases	Reporting rate	Unreported cases	% of total unreported cases
Salt Lake Unified	34	38.2	21	27.6
Weber Co Sheriff	18	38.9	11	14.5
Uintah Co Sheriff	12	33.3	8	10.5
Cache Co Sheriff	8	0.0	8	10.5
Tooele Co Sheriff	7	28.6	5	6.6
All other sheriff's off.	29	20.7	23	30.3
Total	108	29.6	76	100.0

Reporting rate differences between the UHP and police department/sheriff's offices appear to be the primary explanation for the overall reporting rate in Utah. Several factors have been identified that apparently affect the reporting rate—fatal crashes are reported at a higher rate than nonfatal crashes; reporting rates are higher for trucks in comparison with buses, and for large trucks in comparison with smaller trucks; and obviously interstate carriers are reported at higher rates than carriers that aren't obviously interstate. But when these factors are each examined separately for UHP and other enforcement agencies, there is a clear difference between the two groups.

Looking just at UHP-covered cases, there is little significant difference in reporting rates across the different factors. In terms of crash severity, reporting rates are about the same, whether the crash was a fatal, injury/transported, or towed/disabled crash. Towed/disabled crashes were reported at a slightly lower rate than injured/transported, 86.9% to 91.6%, but this difference is relatively small and both rates are high. Similarly, the UHP reported 88.6% of reportable truck crashes and 84.2% of reportable bus crashes. These reporting rates are quite high and can be interpreted as close to full reporting.

In fact, the reason that the overall reporting rate for fatal involvements is different from the reporting rates for injured/transported and towed/disabled is simply because almost all fatal involvements (31 of 37) were covered by the UHP.

In contrast, police departments and sheriff's offices reported only 33.6% of injured/transported and 42.8% of towed/disabled crashes. Rates were similarly low for truck crashes and bus crashes. Only 38.8% of reportable truck crashes covered by the local enforcement agencies were reported, and only 46.7% of the reportable bus crashes.

In many cases, it appears that the fundamental reason for the lower reporting rates for local enforcement agencies is that the CMV area of the DI-9 is not being properly completed. Considering the interstate checkbox, 59.2% were left blank when the case was reported by one of the local agencies, compared with 0.2% for crashes covered by the UHP. Carrier name was left blank on 68.9% of reportable crashes covered by local agencies, but it was blank for only 31.0%--still high—of reportable crashes covered by the UHP.

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. In 2010, there were 26 reportable crashes identified in the Utah crash data in which there was a vehicle fire, 24 involving a truck and 2 involving a bus. The reporting rate for crashes involving fire was actually somewhat higher than the overall reporting rate, 80.8% to 71.4%, which may be because crashes with fires tend to be more severe, and thus more likely to be reported, than other crashes. Only 2 of the fires involved buses; one was reported and the other was not.

Table 16 Reporting Rate for Crashes Involving Fire, Utah 2010

Vehicle type	Reportable cases	Reporting rate	Unreported cases	% of total unreported cases
Truck	24	83.3	4	80.0
Bus	2	50.0	1	20.0
Total	26	80.8	5	100.0

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.

All cases reported to the MCMIS crash file from Utah for 2010 are used in the evaluation of data quality, since the purpose of the analysis is to examine the quality of the data as reported.

6.1 Missing data

Table 17 shows missing data rates for selected, important variables in the MCMIS Crash file. Missing data rates on almost all variables are either zero or only a few percent. On most fundamental, structural variables, such as date, time, number of fatalities and number of injuries, missing data rates are zero. This is a reflection of the thoroughness with which the data are maintained.

None of the fields not related to hazmat have significantly high rates of missing data. The missing data rate for DOT number is computed only for carriers coded as “Interstate,” which therefore must have a DOT number, and is only 2.6%. The highest missing data rates are for driver variables and range from 2.4% to 5.0%. Overall, the rates of missing data are exceptionally low, reflecting very complete data collection on these variables.

Table 17 Missing Data Rates for Selected MCMIS Crash File Variables, Utah 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	0.0
Accident hour	0.0	Event one	0.0
Accident minute	0.0	Event two	0.0
County	0.0	Event three	0.0
Body type	0.0	Event four	0.0
Configuration	0.8	Number of vehicles	0.0
GVWR class	2.6	Road access	0.0
DOT number *	2.6	Road surface	0.0
Carrier state	0.0	Road trafficway	0.0
Citation issued	2.4	Towaway	0.0
Driver date of birth	4.0	Truck or bus	0.0
Driver license number	4.1	Vehicle license number	1.7

Variable	Percent unrecorded	Variable	Percent unrecorded
Driver license state	4.0	Vehicle license state	0.9
Driver license class	5.0	VIN	2.0
Driver license valid	2.4	Weather	0.0

* Based on cases where the carrier is coded interstate.

Hazardous materials variable	Percent unrecorded
Hazardous materials placard	83.9
Percentages of hazmat placarded vehicles only:	
Hazardous cargo release	0.0
Hazardous materials class (1-digit)	100.0
Hazardous materials class (4-digit)	100.0
Hazardous materials name	100.0

The bottom portion of the table shows missing data rates for the hazardous materials (hazmat) variables. Whether the vehicle displayed a Hazmat Placard was unrecorded in 83.9% percent of cases. 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 171 Utah MCMIS records where the vehicle displayed a hazmat placard, indicating it was carrying hazmat. Hazmat cargo release was recorded in every case, but no MCMIS hazmat records had any data for, hazmat 1-digit class, hazmat 4-digit class, or hazmat materials name.

Incidentally, it was noted that in the Utah crash data, the field in the data file for hazmat placard often had a 4-digit UN code or the two-level hazmat class code. This information was apparently not transferred to the appropriate fields in the MCMIS crash data. On the other hand, there is no place on the form to record hazmat materials name.

6.2 Inconsistent codes

The second check on data quality is to compare values for the records in the Utah crash data with values for comparable variables in the MCMIS Crash file. Inconsistencies here may indicate a problem in preparing the data for upload. Data were compared for as many substantive variables as possible, excluding variables used to match records in the two files. Records were counted as inconsistent only if definitive values were marked in each and those values were contradictory. Cases that were blank in one but had data in the other were not counted as inconsistent. Likewise, cases that might have a definitive value in one but a more general but not inconsistent value in the other were not counted as inconsistent. For example, some records were coded “heavy truck, other” in the MCMIS file, but “SUT, 2-axle, 6-tire” in the Utah data. These cases were not counted as inconsistent because both values identify trucktypes. But cases marked “truck tractor” in the MCMIS data and “school bus” in the Utah data were counted as inconsistent.

Note that we are only comparing values as recorded in the files, not evaluating which values are correct (if there is a difference). When there are differences between the files, it is impossible to know which version is accurate, without reinvestigating the case. Values for 1,057 records were compared.

Overall, the coded values were consistent between the two files on the variables compared, with specific exceptions related to vehicle configuration, cargo body, and hazardous materials. Table 18 identifies the 13 fields that were compared and summarizes the results. The variables for light condition, road condition, and weather condition were identical. Road trafficway (roadway description in Utah) differed in only 4 crashes, in most instances on whether there was a positive barrier or not. Likewise, driver license class and license state were substantially identical, with only one actual contradictory record for each. On the other hand, there were 21 cases that differed on the number of vehicles involved in the crash. In almost all of these cases, there was only a difference of 1 vehicle. In 3 cases, the difference was 2 vehicles.

Table 18 Consistency of Data in MCMIS and Utah Crash Files

Variable	Comment
Number of vehicles	21 cases inconsistent.
Roadway type	4 inconsistent types.
Road surface condition	No inconsistencies.
Weather	No inconsistencies.
Light condition	No inconsistencies.
Body type	1 actual inconsistency; 129 cases with a cargo body in PAR data but N/A in the MCMIS data.
Vehicle configuration	208 inconsistencies, which is about 20% of all records.
License state	1 actual inconsistency, which looks like a corrected typo (NE for NB).
Interstate	30 marked intrastate in MCMIS are coded interstate in Utah; 159 interstate in MCMIS are marked N for interstate in Utah data and Y for intrastate.
First event	2 inconsistencies.
Driver license class	1 inconsistency.
Hazmat release	No contradictions (some blank in one and data in the other).
Hazmat placard	171 Y in MCMIS, but only 48 of those coded Y in the Utah data. 9 no's in Utah are Y in MCMIS.

More significant differences were found when comparing vehicle configuration between the two files. The list of possible body types in the Utah crash file is similar but not identical to the configuration list in the MCMIS file. There 208 records with inconsistent configurations between the two files. Table 19 tabulates the different combinations of MCMIS configuration and Utah body type codes that were observed. The biggest problems are with tractor bobtail and tractor-semitrailer types. In some areas of the country, the word bobtail is used to refer to a truck without a trailer, but in the MCMIS data, bobtail is reserved for a truck tractor–equipped with a fifth wheel–operating without a trailer. Note that 100 cases coded as a single-unit truck (SUT) in the Utah data were coded truck tractor (bobtail) in the MCMIS data. In addition, 12 pickups and 12 buses in the Utah crash file were also coded as bobtails in the MCMIS crash file. There were also 48 records identified as tractor-semitrailers in the MCMIS data that were coded as either a 2-axle or 3-axle SUT in the Utah data. Nine doubles in the MCMIS data were identified as 3-axle SUTs in the Utah data.

Table 19 Configuration Inconsistencies

MCMIS configuration	Utah body type	N
Bus(seats >15, incl. dr.)	Heavy truck-other	1
SUT, 2-axle, 6-tire	Truck trailer	1
SUT, 3+ axles	SUT, 2-axle,6-tire	1
	Truck tractor	1
	Truck trailer	1
	Heavy truck-other	1
Truck tractor (bobtail)	Pickup	12
	SUV	1
	Van/mini van	2
	SUT, 2-axle, 6-tire	71
	SUT, 3+ axles	29
	Truck trailer	16
	School bus	7
	Bus/motorcoach, not school	5
Tractor/semitrailer	SUT, 2-axle, 6-tire	18
	SUT, 3+ axles	30
Tractor/double	SUT, 3+ axles	9
Tractor/triple	SUT, 3+ axles	1
Unk. heavy truck, >10,000 lbs.	SUV	1
Total inconsistent records		208

Two other areas of inconsistent data were noted. These relate to the identification interstate carriers and whether vehicles displayed hazmat placards. With respect to the interstate question, 30 records marked intrastate in the MCMIS file were marked interstate in the Utah data. In addition, there were 159 records in the MCMIS data that were marked interstate, but in the Utah data, those records were marked “N” for interstate and “Y” for intrastate. The interstate field in the MCMIS file may not be transcribed directly from the interstate and intrastate fields in the Utah crash data. Determining whether a truck or bus operator is interstate or not can be difficult, and clearly many officers apply different standards. The instructions in the *Utah Investigators Vehicle Crash report Instruction Manual* are ambiguous, referring to “travel” existing or occurring between two or more states. It’s not clear whether that refers to the specific trip, the specific vehicle, or the carrier in general. The data in the MCMIS crash file may be derived from a different source than the interstate and intrastate fields in the Utah crash data.

There also was a significant number of records that were inconsistent on hazmat data. The MCMIS data recorded 171 vehicles marked as displaying a hazmat placard, but only 48 of those had data in the hazmat placard field in the Utah crash file. An additional 9 records were coded “no” or “none” for hazmat placard number in the Utah crash file, but were coded as displaying a hazmat placard in the MCMIS data. Hazardous materials in cargo are relatively infrequent so this amount of inconsistency is significant.

The origin of these inconsistencies is not known. But when large numbers of records are inconsistent, that suggests that there may be a problem with understanding the definitions of the terms and applying them consistently in practice. Again, it is not known which information is correct, and most fields examined were highly consistent or identical. With respect to the inconsistencies identified, there does not appear to be any stable pattern to the inconsistencies that would suggest computer programming errors. More likely, they are the result of misunderstanding of the meaning of certain terms, manual data preparation, or corrections made to one file that were not reflected in the other.

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 Utah, 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 3 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 70 percent (69.0%) of the records were submitted within 90 days of the crash. Ninety percent of the records were submitted with 234 days of the crash, which is about two and half times greater than the 90 day grace period. The median time between crash occurrence and record upload was 45 days, and the greatest delay was 440 days. For about 5% of the records, the period between the crash and record submission was more than 300 days. Still, a significant majority of records are submitted within the 90 reporting period.

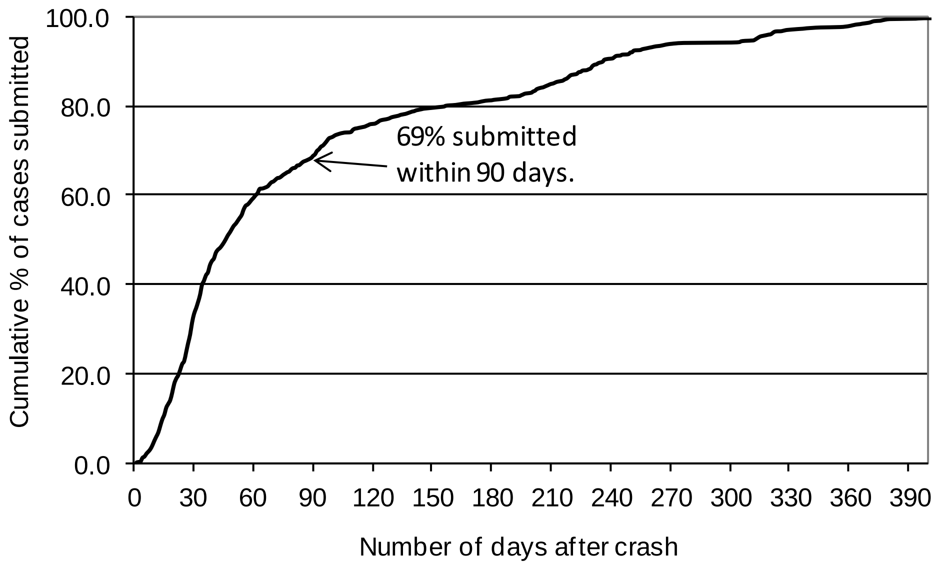

Figure 3 Cumulative Percent of Cases Submitted to MCMIS Crash File by Number of Days After Crash, Utah 2010

The first date on which crash records from 2010 were uploaded was February 16, 2010, when 27 records were uploaded. On average, uploads occurred every 12.2 days between then and May 24, 2011, when the last upload occurred. About a quarter of the records were submitted after the close of the calendar year. Generally speaking the number of records uploaded per submission was significant. An average of 28.0 records were submitted per upload. About 50 percent of the uploads contained 20 or more records. The largest single upload was of 102 records.

7. Summary and Discussion

The computerized Utah crash data would appear to support selecting reportable records using an algorithm in software, because the coded data, on their face, have the information necessary to distinguish records that meet the MCMIS reporting criteria from those that do not. The evaluation of the data showed that the crash severity criterion could be applied using the fields for injury and transported by to identify injured/transported crashes, and the fields for vehicle damage and disposition of vehicle could be used to identify towed/disabled. Identifying reportable vehicles was somewhat more challenging since it was necessary to look at fields other than just the body type field. We found helpful to compare cargo body type, make, and model, as well as to decode the VIN to confirm vehicles as trucks or buses. But using the body type variable as implemented could increase the reporting rate significantly. A software-based selection algorithm could raise the reporting rate significantly.

The overall reporting rate was computed to be 71.4%. This rate varied by a number of factors. Fatal involvements were reported at a substantially higher rate than nonfatal, with almost 90% of fatal involvements reported, compared to only around 70 percent of injured/transported and towed/disabled involvements. Reporting rates were found to vary across other dimensions as well. Trucks were reported at significantly higher rates than buses (73.0% to 53.2%), and bigger trucks tended to be reported at a higher rate than medium-sized trucks. This is well-illustrated by the pattern of reporting for the major truck types classified by decoding the VIN, which is probably the most precise way of sorting them. Rates varied almost linearly with truck size. About 56% of GVWR class 3-5 SUTs were reported, 64.2% of class 6, 69.5% of class 7 and 8 SUTs, and 80.8% of truck tractors, which are primarily class 8. There is a strong tendency for reporting to capture the biggest trucks in the most serious crashes,.

The primary underlying factor in reporting rates proved to be the type of enforcement agency that covered the crash. The Utah Highway Patrol consistently has the highest reporting rates, averaging almost 90% of reportable crash involvements. Reporting rates are significantly higher than other enforcement agency types, regardless of crash severity, type of vehicle (truck or bus), or the size of the vehicle. For example, it was found, as reported in the previous paragraph, that reporting rates overall were higher for trucks with higher GVWRs. However, for the UHP, there was relatively little variation and the variation is not practically significant. The reporting rate was 89.2% for class 3-5 SUTs, 86.1% for class 6 SUTs, 92.0% for class 7 and 8 SUTs, and 92.6% for truck tractors. The UHP reported 100% of reportable school bus and cross-country bus (motorcoach) crash involvements.

Reporting rates for the other two enforcement agency types–police departments and sheriff's offices–were significantly lower, across the board. For example, only about a third of injured/transported crashes covered by local police departments or sheriff's offices were reported, and only about 42.8% of towed/disabled crashes. Only 38.9% of reportable truck involvements and about 46.7% of reportable bus involvements covered by the local agencies were reported.

One factor that appears to contribute strongly to the different reporting rates is the extent to which the CMV area on the DI-9 is completed, including whether the interstate checkbox is left blank or not. The interstate check box was left blank in almost 60% of reportable records completed by the local agencies, compared with only 0.2% of reportable crashes covered by the UHP. And in terms of filling the carrier name–a proxy for completing the section–missing data rates were almost a mirror images of each other: Carrier name was left blank in almost 70% of reportable crashes covered by local police departments or sheriff's offices, but only 31.0% of those covered by the UHP.

Clearly, training, education, and support for local agencies has the potential for significant improvements in the state-wide reporting rate.

In terms of the data reported to the MCMIS crash file, about 70% of cases were reported within the 90 day post-crash reporting requirement. Overall, the data are well-maintained and complete for the most part. Missing data rates on almost all variables are zero, meaning every record had valid data. Data were missing for only about 2-5% of some driver variables, notably date of birth and certain licensing variables. On the other hand, there are significant problems for data on hazmat where the vehicle is identified as displaying a hazmat placard. Data on the 1-digit hazmat code, the 4-digit hazmat code, and the hazmat material name were missing from every record. It appears that this information is in the Utah crash data in the hazmat_placard field (from the CMV area of the DI-9), but it is not being transcribed to the MCMIS records.

There were also 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. About 20% of the reported records had substantially different information in body type field that in the corresponding MCMIS configuration field. Most of the differences were records coded as truck tractor (bobtail) in the MCMIS data and as some type of SUT, truck and trailer, or even a type of bus in the Utah crash data. In addition, about a quarter of the inconsistencies were records coded as an SUT in the Utah data and as a tractor/semitrailer in the MCMIS crash file. These differences may be introduced when the data are prepared for upload.

It cannot be determined which record–the Utah record or the MCMIS record–is correct but the number of cases that are inconsistent is a concern. It is possible that the records are corrected during a manual review prior to submission to the MCMIS crash file. If so, training and guidance that improves the accuracy of the reporting officers' classification of the vehicle, as well as more accurately identifying vehicles as CMVs, should substantially improve the overall reporting rate.

Accurate and complete data are essential to monitoring and improving the safety of motor carrier operations. The Utah DI-9 crash report seems well-designed to support complete reporting. This evaluation has identified several areas that could be strengthened to improve the overall crash reporting rate. They include:

- Improve reporting rates by local police departments and Sheriff's offices.
- Insure that the CMV area of the DI-9 is accurately completed, particularly by local enforcement agencies.
- Improve the accuracy and consistency of coding interstate and intrastate in the CMV area.
- Extract hazmat 1-digit and 4-digit codes from the hazmat_placard field. Consider adding a hazmat materials name field.
- Improve the accuracy of assigning body style by reporting officers.
- Work to increase the proportion of records reported within the 90-day reporting period.

It is the goal of this report to contribute to complete and accurate reporting to the MCMIS crash file. Addressing the weaknesses and building on the strengths identified in this report should result in an improved data collection and reporting process.

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Appendix A Utah Crash Report Form

D1-9 Rev. 03/08

DI 9 STATE OF UTAH INVESTIGATING OFFICER'S REPORT OF TRAFFIC CRASH DI 9 Page ___ of ___

1 TIME Date of Crash Month / Day / Year Day of Week 1 2 3 4 5 6 7 S M T W T F S Military Time DLD Number

2 LOCATION PLACE WHERE CRASH OCCURRED: COUNTY CODE City or Town of Jurisdiction ___ Case Number

If crash was outside city limits indicate distance from city limits or nearest town ___ Miles N S E W of ___ City or Town Latitude Longitude

2 ROAD, STREET, HWY CRASH OCCURRED: ___ Street Name or Highway Number UDOT USE ONLY REPORTABLE CRASH ☐ YES ☐ NO 14

1. AT THE INTERSECTION WITH ___

2. IF NOT AT INTERSECTION ___ Feet ☐ ☐ ☐ ☐ N S E W of ___ Nearest intersection, street, house no., landmark UDOT USE 14

3 ___ Tenth of a mile ☐ ☐ ☐ ☐ N S E W of Mile Post ___ Be sure to complete if road has mile post

3 VEH # (Odd) VIN # PLATE NUMBER STATE EXP DATE mm/yy COLOR MODEL MODEL YEAR yyyy OCCUPANT(S) # 15

4 DRIVER FIRST INITIAL LAST STREET, CITY, STATE, ZIP PHONE ( ) 15

4 DRIVER LICENSE STATE NUMBER CLASS ENDORSEMENT(S) RESTRICTION(S) DATE OF BIRTH mm / dd / yyyy AGE CHARGES ☐ YES ☐ NO ☐ PENDING ☐ UNKNOWN CITATION # 16

OWNER FIRST INITIAL LAST STREET, CITY, STATE, ZIP PHONE ( ) ☐ Same as Driver 16

5 CARRIER COMMERCIAL VEHICLE INFO NAME STREET, CITY, STATE, ZIP PHONE ( ) ☐ Same as Driver ☐ CDL Presented at Scene 17a

5 US DOT # CVSA INSPECTION # GCWR / GVWR (check one) ☐ 10,001 lbs or LESS ☐ 10,001 - 26,000 lbs ☐ MORE THAN 26,000 lbs HAZ MAT RELEASED ☐ YES ☐ NO HAZ MAT PLACARD # or NAME - CLASS CARGO CODE ☐ GOVT ☐ PERSONAL ☐ INTERSTATE ☐ INTRASTATE 17a

6 1ST TRAILER LICENSE PLATE # STATE EXP DATE mm / yy LENGTH 2ND TRAILER LICENSE PLATE # STATE EXP DATE mm / yy LENGTH 3RD TRAILER LICENSE PLATE # STATE EXP DATE mm / yy LENGTH 17b

6 SPEED POSTED POSTED ADVISORY EST TRAVEL EST IMPACT ESTIMATED BY: ☐ Officer ☐ Driver ☐ Occupant ☐ Witness ☐ None SEQUENCE OF EVENTS (Codes 01, 69 - 96) FIRST EVENT SECOND EVENT THIRD EVENT FOURTH EVENT MOST HARMFUL EVENT For VEHICLE (Use codes 00, 07 - 69) 17b

7 VEHICLE DAMAGE ESTIMATED DAMAGE ☐ NO DAMAGE ☐ $1 - $999 ☐ $1,000 or MORE INSURANCE COMPANY EFFECTIVE DATE EXPIRATION DATE POLICY NUMBER 18

7 INSURANCE APPEARS VALID ☐ YES ☐ NO AGENCY/AGENT THAT SOLD POLICY ADDRESS PHONE ( ) 18

VEH # (Odd) VIN # PLATE NUMBER STATE EXP DATE mm/yy COLOR MODEL MODEL YEAR yyyy OCCUPANT(S) #

8 DRIVER FIRST INITIAL LAST STREET, CITY, STATE, ZIP PHONE ( ) 19

8 DRIVER LICENSE STATE NUMBER CLASS ENDORSEMENT(S) RESTRICTION(S) DATE OF BIRTH mm / dd / yyyy AGE CHARGES ☐ YES ☐ NO ☐ PENDING ☐ UNKNOWN CITATION # 19

9 OWNER FIRST INITIAL LAST STREET, CITY, STATE, ZIP PHONE ( ) ☐ Same as Driver 20

9 CARRIER COMMERCIAL VEHICLE INFO NAME STREET, CITY, STATE, ZIP PHONE ( ) ☐ Same as Driver ☐ CDL Presented at Scene 20

10 US DOT # CVSA INSPECTION # GCWR / GVWR (check one) ☐ 10,001 lbs or LESS ☐ 10,001 - 26,000 lbs ☐ MORE THAN 26,000 lbs HAZ MAT RELEASED ☐ YES ☐ NO HAZ MAT PLACARD # or NAME - CLASS CARGO CODE ☐ GOVT ☐ PERSONAL ☐ INTERSTATE ☐ INTRASTATE

10 1ST TRAILER LICENSE PLATE # STATE EXP DATE mm / yy LENGTH 2ND TRAILER LICENSE PLATE # STATE EXP DATE mm / yy LENGTH 3RD TRAILER LICENSE PLATE # STATE EXP DATE mm / yy LENGTH 21

SPEED POSTED POSTED ADVISORY EST TRAVEL EST IMPACT ESTIMATED BY: ☐ Officer ☐ Driver ☐ Occupant ☐ Witness ☐ None SEQUENCE OF EVENTS (Codes 01, 69 - 96) FIRST EVENT SECOND EVENT THIRD EVENT FOURTH EVENT MOST HARMFUL EVENT For VEHICLE (Use codes 00, 07 - 69) 21

11 VEHICLE DAMAGE ESTIMATED DAMAGE ☐ NO DAMAGE ☐ $1 - $999 ☐ $1,000 or MORE INSURANCE COMPANY EFFECTIVE DATE EXPIRATION DATE POLICY NUMBER

11 INSURANCE APPEARS VALID ☐ YES ☐ NO AGENCY/AGENT THAT SOLD POLICY ADDRESS PHONE ( ) 22

Work Zone? ☐ Yes ☐ No ☐ Unknown Total # of Lanes on Roadway Damage to Property Other than Vehicles (Name object and state nature)

12 Workers Present? ☐ Yes ☐ No ☐ Unknown # Vehicles Involved Name and Address of Owner of Object Struck Phone ( ) PROPERTY DAMAGE ESTIMATE ☐ $1,000 OR MORE ☐ LESS THAN $1,000 23

WITNESSES

Name ___ Address ___ Phone ( )

Name ___ Address ___ Phone ( )

13 Law Enforcement Activity Time Notified of Crash Arrived at Scene Use Military Time Date Notified of Crash mm / dd / yy Investigation Completed mm / dd / yy Field Diagram ☐ Yes ☐ No Video ☐ Yes ☐ No Photo(s) ☐ Yes ☐ No ☐ Digital ☐ Film

☐ ORIGINAL REPORT ☐ ADDITIONAL PERSONS REPORT ☐ SUPPLEMENTAL REPORT ☐ AMENDED REPORT

State Law Requires a Reportable Crash Report to be Forwarded to Dept. of Public Safety Within 10 Days Following Completion of Investigation.
Mail ORIGINAL REPORT TO: Driver License Division, 4501 South 2700 West, P.O. Box 144501, Salt Lake City, Utah 84114-4501

FRONT

(11)(12)(13)
(21)(22)(23)
(31)(32)(33)
(41)(42)(43)
(51)

SEATING POSITION

11 - Motorcycle Driver
21 - Motorcycle Passenger
18 - Front Row Other
28 - Second Row Other
38 - Third Row Other
48 - Fourth Row Other
50 - Sleeper Section of Cab (Truck)
51 - Enclosed Cargo Area
52 - Unenclosed Cargo Area
54 - Trailing Unit
55 - Riding on Vehicle Exterior
56 - Seating Position 11, Not Driver
57 - Right Side Driver
60 - Non-Motorist
97 - Other*
99 - Unknown

EMS Time Called: EMS Time Arrived:

Disposition of Vehicle # TOWED BY:

Disposition of Vehicle # TOWED BY:

	Person Type	Seating Position	Sex	INJURY Level	INJURY ARea	INJURY Cause	Transported By	Safety Equipment	Used Property	Air Bag	Ejection	Ejection Path	Extrication
VEH # DRIVER Transported to: BAC													
VEH # DRIVER Transported to: BAC													

PERSON(S) INVOLVED

VEH # Name DOB Age Transported to: BAC
Address Phone ( )

VEH # Name DOB Age Transported to: BAC
Address Phone ( )

24 VEH # Name DOB Age Transported to: BAC 30
Address Phone ( )

24 VEH # Name DOB Age Transported to: BAC
Address Phone ( )

25 DIAGRAM of CRASH ☐ NO DIAGRAM - Reason: _____ 1. Officer not at scene 2. Vehicles moved 3. Other _____ DLD# 31

Indicates Direction of North

26

27 32

33

34

28

35

29 36

DESCRIBE WHAT HAPPENED
(Refer to Vehicle by Number) _____

37

PRINT

OFFICER'S RANK AND NAME	I.D. #	DEPARTMENT	CASE NUMBER	SUPERVISOR'S APPROVAL	DATE OF REPORT

Appendix B Reportable Vehicle Identification Algorithm

Trkbush

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

Body_type

1='Passenger car-2dr'
2='Passenger car-4dr'
3='Station wagon'
4='Pickup'
5='SUV'
6='Van/mini van'
7='SUT,2ax,6tr'
8='SUT,3+ axles'
9='Truck tractor'
10='Truck trailer'
11='Heavy truck-oth'
12='Motorcycle'
13='School bus'
14='Bus/motorcoach,not sch'
15='Farm equipment'
16='Motorized scooter,etc'
17='ORV'
18='RV/motor home'
19='Trailer only'
20='ATV-street legal'
97='Other'
99='Unknown'

;

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

26=TRUCK/BUS - POSSIBLE

27=LARGE VAN - POSSIBLE

28=OTHER BUS TYPE

```
/** Trucks ****************/

    if body_type=11 and not (hetzel_vehtype in (1,2) and cargo_body_type in
(89,96)) then trkbush=1;
    else if body_type=1 and hetzel_vehtype in (22,20,21,23) then trkbush=1;
    else if body_type=2 and hetzel_vehtype=23 then trkbush=1;

/*
Pickups, with commercial use indicated (is_purpose_personal var renamed as
personal-from cmv file
*/
    else if body_type=4 and hetzel_vehtype =2 and trailing_unit in (1,97) and
personal='N'and cmvrec=1 then trkbush=1;
    else if body_type=4 and hetzel_vehtype in (10,20) and personal='N' then
trkbush=1;
    else if body_type=4 and hetzel_vehtype in (16,22,21,23) then trkbush=1;


    else if body_type=6 and hetzel_vehtype in (11,21) then trkbush=1;
    else if body_type=7 and ((hetzel_vehtype in (11,22,20,21,23,25)) OR
        (hetzel_vehtype=2 and personal='N')) then trkbush=1;
    else if body_type=8 then trkbush=1;
    else if body_type=9 then trkbush=1;
    else if body_type=10 and (cmvrec=1 or hetzel_vehtype in (22,20,21,23))
then trkbush=1;

/** Buses *****************/
    else if body_type=14 and hetzel_vehtype not in (19) and veh_model ne
'motorhome' then trkbush=2;
    else if body_type=1 and hetzel_vehtype in (16) then trkbush=2;
    else if body_type=13 and hetzel_vehtype ne 24 then trkbush=2;

/** Hazmat ****************/
    else if hazplac_recode = 'yes' or hazrel='Y' then trkbush=3;

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