

## APPENDIX A

### Questionnaires

The questionnaires included in this appendix are arranged according to the intended audience. These include carriers and database administrators. The questionnaire below, one designed for truck carriers, was modified slightly for use with other modes.

#### **Truck Carrier Questions: TRB Root Cause Analysis Project**

Introduction: Battelle Memorial Institute, a nonprofit research and technology firm, is working on a project for the Transportation Research Board (TRB) that is to develop a set of recommendations for improving the effectiveness of the major federal databases when it comes to identifying the root causes of hazardous materials (hazmat) crashes. Some of the current databases do not even capture enough information to determine that an action by the driver of the other vehicle made the accident unavoidable. To get to some of these contributing causes, we know we need to capture more than just “vehicle ran off road.” What caused the vehicle to run off the road? Information you provide will be confidential and no other party will be able to identify you or link your name or organization to your responses. Furthermore, the information that you supply will not be used for any regulatory purpose.

Before we get to the questions, since we would like responses from companies of various sizes, we start with a few questions about your company.

1. *Roughly, what percentage of your shipments is placarded?* \_\_\_\_\_
2. *Roughly, what percentage of your placarded shipments is bulk?* \_\_\_\_\_
3. *About how many power units do you have in your fleet?* \_\_\_\_\_
4. *How many vehicle operators work for your company?* \_\_\_\_\_
5. *What is the percentage of vehicle operators who are company employees?* \_\_\_\_\_

Now, to the root cause questions. Assume that one of your drivers was involved in a hazmat accident. For purposes of discussion, one of the events was “vehicle ran off road.”

1. *As a company, do you attempt to determine why the driver ran off the road?* \_\_\_\_\_
  - a. *If yes, do you obtain supporting evidence for the driver’s statement?* \_\_\_\_\_
2. *If the driver suddenly lost control, would you search for a vehicle defect?* \_\_\_\_\_
  - a. *Would you look at the driver’s history to see if there had been health problems that might make it more difficult to drive safely?* \_\_\_\_\_

- b. *Would you visit the site and observe the road geometry or line-of-sight distance as possible contributing causes?* \_\_\_\_\_
  - c. *Are pictures taken of the accident scene and/or the damaged vehicle?* \_\_\_\_\_
  - d. *Are any or all of these findings documented in an accident report compiled by your company?* \_\_\_\_\_
  - e. *If yes, could we obtain copies of one or two of these reports?* \_\_\_\_\_
3. *Even in the absence of formal reporting, have corrective actions ever been taken as a result of a hazmat accident?* \_\_\_\_\_
- a. *If yes, what types of actions have been taken?*  
 \_\_\_\_\_  
 \_\_\_\_\_
4. *Do you see additional data that could be collected that would help identify the root causes of serious hazmat accidents?* \_\_\_\_\_
- a. *If yes, please identify the type of data that should be collected.* \_\_\_\_\_  
 \_\_\_\_\_
5. *Do you have suggestions for improving the **process** of completing crash forms for PHMSA's Hazardous Materials Incident Reporting System (HMIRS)?* \_\_\_\_\_
- a. *If yes, please list them.*  
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 \_\_\_\_\_  
 \_\_\_\_\_
  - b. *Are the criteria for filing a hazmat report clear?* \_\_\_\_\_
  - c. *Are there additional data that should be added to HMIRS?* \_\_\_\_\_
  - d. *If yes, please list data that should be added.*  
 \_\_\_\_\_  
 \_\_\_\_\_
  - e. *Are the instructions for populating the database adequate?* \_\_\_\_\_
  - f. *If not, how could the instructions be improved?*  
 \_\_\_\_\_  
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6. Do you have suggestions for improving the **quality** of PHMSA's Hazardous Materials Incident Reporting System (HMIRS)? \_\_\_\_\_

a. If yes, please list these suggestions.

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7. Should PHMSA contact carriers who have submitted an incomplete form for an accident to collect additional information? \_\_\_\_\_

a. If yes, please suggest what technique(s) you think will work best.

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8. Is special training given to the person completing the PHMSA crash form? \_\_\_\_\_

a. If yes, what sort of training?

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b. Would you take advantage of training if it were provided by PHMSA? \_\_\_\_\_

c. If yes, please suggest the type of training you would prefer.

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9. Do you use crash data in FMCSA's Motor Carrier Management Information System (MCMIS)? \_\_\_\_\_

a. If yes, do you have any recommendations for improving the usefulness of MCMIS crash data?

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b. Is there additional data that should be added to MCMIS to help identify crash causation?

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## Database Administrators

The questionnaires for database administrators were each designed for a particular agency. The one below was designed for PHMSA, the database administrator for HMIRS. The questionnaires used for the other agencies were modified slightly for use with each particular agency.

Introduction: Battelle Memorial Institute, a nonprofit research and technology firm, is working on a project for the Transportation Research Board (TRB) that is to develop a set of recommendations for improving the effectiveness of the major Federal databases when it comes to identifying the root causes of hazardous materials (hazmat) crashes. If you desire, your name will be kept confidential and no one will be able to identify you or link you to your responses.

1. *When an incident report is received from a carrier, could you describe the process that is used to enter the incident data into HMIRS?*

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- a. *Have you ever attempted to evaluate the accuracy of submitted records? \_\_\_\_\_ If yes, please describe the process you used.*

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- b. *If cost were not a factor, would the usefulness of HMIRS be improved if all records were checked for accuracy? \_\_\_\_\_*

- c. *If yes, please list the process you would follow.*

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- d. *What do you think are the benefits from checking accuracy?*

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2. Do you have an organized program at PHMSA for improving the completeness and accuracy of the data in your database? \_\_\_\_\_

a. If yes, please identify the major elements of the program.

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3. Has the program been effective? \_\_\_\_\_

a. If yes, please list which efforts have worked and indicate why.

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b. List which efforts have not been successful and indicate why.

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4. Have you ever estimated what fraction of the carriers are underreporting crashes with a hazmat spill? \_\_\_\_\_

a. If yes, please list which techniques have been effective.

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b. Explain why you think these techniques have been effective.

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c. *List which techniques have not been successful.*

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d. *Explain why you think these techniques have been ineffective.*

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5. *Does the underreporting of hazmat crashes by truck, rail, water, and air carriers differ?*

\_\_\_\_\_

a. *If yes, please estimate the percentage of crashes underreported for each mode for which you have data.*

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6. *What suggestions do you have personally for improving the effectiveness and the quality of data collection?*

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7. *Does the reporting completeness and accuracy differ by mode? \_\_\_\_\_*

a. *If yes, please explain the differences among the modes and discuss why they are different.*

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8. *Does PHMSA fine carriers discovered to be not reporting their hazmat spills? \_\_\_\_\_ If yes, how much is the typical fine? \_\_\_\_\_*

a. *Do carriers that have been fined start reporting their hazmat spills? \_\_\_\_\_*

9. Does PHMSA ever contact carriers who have submitted an incomplete form, or one with inaccurate information, to collect additional information? \_\_\_\_\_

a. If yes, please suggest what technique(s) have worked.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

10. Can you identify additional data that could be collected that would help identify the “root causes” of serious hazmat accidents? \_\_\_\_\_

a. If yes, please identify the type of data that could be collected. \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

11. If all hazmat incidents including non-spill incidents were reported in HMIRS, additional information could be collected about container successes and failures during a crash. Do you think this type of data would be valuable? \_\_\_\_\_

a. Are there practical methods for collecting these data without HMIRS requiring carriers to report all hazmat incidents? \_\_\_\_\_

b. If yes, what method could be used?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

12. Have you ever attempted to link the HMIRS database automatically with other databases such as MCMIS? \_\_\_\_\_

a. If yes, please list the specific database fields that were used.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

b. If no, please suggest changes in the structure, perhaps a “Rosetta Stone” table that could be developed to link HMIRS to other databases. List the database(s), specific fields, or “Rosetta Stone” table that could be added or changed to accomplish this.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

13. Do you use crash data in HMIRS for analyzing the “causes” of crashes? \_\_\_\_\_

a. If yes, which fields do you use for this purpose?

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\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

14. Are you planning to improve the **process** of completing crash forms for the Hazardous Materials Incident Reporting System (HMIRS)? \_\_\_\_\_

a. If yes, please list these changes.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

b. Are the criteria for filing a hazmat report clear? \_\_\_\_\_

c. Are the instructions for populating the database form adequate? \_\_\_\_\_

d. Are you planning on making any improvements to the instructions, such as online training? \_\_\_\_\_

e. If yes, please list below.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

15. Are there ongoing efforts for improving the **quality** of data in PHMSA’s Hazardous Materials Incident Reporting System (HMIRS)? \_\_\_\_\_

a. If yes, please describe these efforts.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

b. Can these changes be made without going through a formal rule making process?  
\_\_\_\_\_

c. If yes, how can this be done?

\_\_\_\_\_  
\_\_\_\_\_

d. Is the HMIRS regulatory reporting requirement an impediment for making changes?  
\_\_\_\_\_

16. *Would additional training of the person completing the PHMSA crash form at a carrier be of benefit? \_\_\_\_\_*

*a. If yes, what sort of training would you propose?*

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*b. Who should receive the training?*

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*c. Do you think training should be provided by PHMSA or could it be obtained by other means? \_\_\_\_\_*

*d. If yes, please suggest the type of training you think would be best.*

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## APPENDIX B

### Questionnaire Results for Carriers and Database Administrators

#### **B1 Summary of Carrier Results**

**Table B-1** displays shipment and operator information for the 13 carriers who responded to a request to complete an interview from the National Tank Truck Carriers (NTTC) and the three extremely large carriers that were interviewed via telephone. Two of these carriers also operate aircraft as part of their transportation business. **Table B-2** displays the freight carrier's response to questions involving a hypothetical hazmat accident in which the vehicle drove off the road. The names of the carriers have not been included in the table in order to protect the confidentiality of their responses. Each carrier response is grouped in somewhat arbitrary categories based on the number of power units operated by the company. The following are the categories used for the table:

- Small, less than 100 power units;
- Medium, 100 to 299 power units;
- Large, 300 to 499 power units;
- Very large, 500 to 999 power units; and
- Extremely large, 1,000 or more power units.

The carriers are listed in the order that the questionnaire results were received by the researchers.

<b>Table B-1. Questions about the company.</b>							
<b>Questions</b>	<b>Small Hazmat Carrier 1</b>	<b>Small Hazmat Carrier 2</b>	<b>Medium Hazmat Carrier 1</b>	<b>Small Hazmat Carrier 3</b>	<b>Large Hazmat Carrier 1</b>	<b>Medium Hazmat Carrier 2</b>	<b>Large Hazmat Carrier 2</b>
1. Roughly, what percentage of your shipments is placarded?	75%	10%	10%	75%	30%	99%	75%
2. Roughly, what percentage of your placarded shipments is bulk?	100%	10%	100%	60%	98%	Estimate 70%	80%
3. About how many power units do you have in your fleet?	90	92 + owners	125	70	375	287	315
4. How many vehicle operators work for your company?	95	100	115	70	300	325	653
5. What is the percentage of vehicle operators who are company employees?	70%	84%	100%	71%	100%	66%	100%

<b>Table B-1. Questions about the company.</b>							
<b>Questions</b>	<b>Large Hazmat Carrier 3</b>	<b>Very Large Hazmat Carrier 1</b>	<b>Very Large Hazmat Carrier 2</b>	<b>Very Large Hazmat Carrier 3</b>	<b>Small Hazmat Carrier 4</b>	<b>Very Large Hazmat Carrier 4</b>	<b>Medium Hazmat Carrier 3</b>
1. Roughly, what percentage of your shipments is placarded?	100%	60%	55%	46% — 94,413 loads annually	100%	20%	5%
2. Roughly, what percentage of your placarded shipments is bulk?	100%	100%	100%	100%	100%	100%	100%
3. About how many power units do you have in your fleet?	350	860	837	640	35	850	270
4. How many vehicle operators work for your company?	700	136	820	700	42	900	250
5. What is the percentage of vehicle operators who are company employees?	100%	84%	71%	83%	80%	95%	95%

<b>Table B-1. Questions about the company.</b>			
<b>Questions</b>	<b>Extremely Large Hazmat Carrier 1</b>	<b>Extremely Large Hazmat Carrier 2</b>	<b>Extremely Large Hazmat Carrier 3</b>
1. Roughly, what percentage of your shipments is placarded?	90%	No answer	
2. Roughly, what percentage of your placarded shipments is bulk?	99%	No answer	
3. About how many power units do you have in your fleet?	No answer	No answer	
4. How many vehicle operators work for your company?	No answer	No answer	
5. What is the percentage of vehicle operators who are company employees?	No answer	No answer	

<b>Table B-2. Situation involving a hazmat accident (truck: “vehicle ran off the road”; air: “aircraft overshot runway”).</b>							
<b>Questions</b>	<b>Small Hazmat Carrier 1</b>	<b>Small Hazmat Carrier 2</b>	<b>Medium Hazmat Carrier 1</b>	<b>Small Hazmat Carrier 3</b>	<b>Large Hazmat Carrier 1</b>	<b>Medium Hazmat Carrier 2</b>	<b>Large Hazmat Carrier 2</b>
1. As a company, do you attempt to determine why the driver/pilot ran off the road/left the runway? If yes, do you obtain supporting evidence for the driver/pilot’s statement?	Yes and Yes	Yes and Yes	Yes and Yes	Yes and Yes	Yes and Yes	Yes, and obtain witness statements, photos, Qualcomm position reports, fuel purchases.	Yes and Yes
2. If the driver/pilot suddenly lost control, would you search for a vehicle/aircraft defect?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2a. Would you look at the driver/pilot’s history to see if there had been health problems that might make it more difficult to drive/operate an aircraft safely?	Yes	Probably	Yes	Yes	Yes	Only in a serious accident.	Yes
2b. Would you visit the site and observe the road/runway geometry or line-of-sight distance/lighting as possible contributing causes?	Yes	If feasible	Yes	If practical	Yes	Yes, when possible. Depending on the severity we may choose to hire an independent adjuster to investigate the area.	Yes

<b>Table B-2. Situation involving a hazmat accident (truck: “vehicle ran off the road”; air: “aircraft overshoot runway”).</b>							
<b>Questions</b>	<b>Large Hazmat Carrier 3</b>	<b>Very Large Hazmat Carrier 1</b>	<b>Very Large Hazmat Carrier 2</b>	<b>Very Large Hazmat Carrier 3</b>	<b>Small Hazmat Carrier 4</b>	<b>Very Large Hazmat Carrier 4</b>	<b>Medium Hazmat Carrier 3</b>
1. As a company, do you attempt to determine why the driver/pilot ran off the road/left the runway? If yes, do you obtain supporting evidence for the driver/pilot’s statement?	Yes and Yes	Yes and Yes	Yes and Yes	Yes and Yes	Yes and Yes	Yes and Yes	Yes
2. If the driver/pilot suddenly lost control, would you search for a vehicle/aircraft defect?	Yes	Depends on the facts of the incident.	Yes	Yes	Yes	Yes	Yes
2a. Would you look at the driver/pilot’s history to see if there had been health problems that might make it more difficult to drive/operate an aircraft safely?	Yes	Yes	Yes	Yes	Theoretically, health questions of this nature would have been discovered before hiring.	Yes	Yes
2b. Would you visit the site and observe the road/runway geometry or line-of-sight distance/lighting as possible contributing causes?	Yes	Yes	Yes	In most cases.	Yes	Yes	Yes

<b>Table B-2. Situation involving a hazmat accident (truck: “vehicle ran off the road”; air: “aircraft overshot runway”).</b>			
<b>Questions</b>	<b>Extremely Large Hazmat Carrier 1</b>	<b>Extremely Large Hazmat Carrier 2</b>	<b>Extremely Large Hazmat Carrier 3</b>
1. As a company, do you attempt to determine why the driver/pilot ran off the road/left the runway? If yes, do you obtain supporting evidence for the driver/pilot’s statement?	Truck: Yes and Yes	Truck: Yes and Yes Air: (Air crashes are very rare so they focus on incidents involving spills. A hazmat spill can potentially lead to a crash by damaging an aircraft or through the crew being overcome by toxic fumes.) Yes and Yes	Truck: Yes, always look for root causes of an accident. Yes Air: (The major problem they face for air crashes is undeclared shipments and not always knowing what is hazmat.) Yes and Yes
2. If the driver/pilot suddenly lost control, would you search for a vehicle/aircraft defect?	Truck: Yes	Truck: Perhaps Air: Yes	Truck: Yes Air: Yes
2a. Would you look at the driver/pilot’s history to see if there had been health problems that might make it more difficult to drive/operate an aircraft safely?	Truck: Yes	Truck: Yes Air: Unknown	Truck: Yes Air: No answer
2b. Would you visit the site and observe the road/runway geometry or line-of-sight distance/lighting as possible contributing causes?	Truck: Yes	Truck: Yes Air: Unknown	Truck: Yes Air: Unknown

<b>Table B-2. Situation involving a hazmat accident (truck: “vehicle ran off the road”; air: “aircraft overshot runway”).</b>							
<b>Questions</b>	<b>Small Hazmat Carrier 1</b>	<b>Small Hazmat Carrier 2</b>	<b>Medium Hazmat Carrier 1</b>	<b>Small Hazmat Carrier 3</b>	<b>Large Hazmat Carrier 1</b>	<b>Medium Hazmat Carrier 2</b>	<b>Large Hazmat Carrier 2</b>
2c. Are pictures taken of the accident scene and/or the damaged vehicle/aircraft?	Yes	Yes	Yes	Yes	Yes	Yes	Yes and Yes
2d. Are any or all of these findings documented in an accident report compiled by your company?	Yes	Yes	Yes	Yes	Yes	Yes, but not consistently	Yes
2e. If yes, could we obtain copies of one or two of these reports?	No, we have had none for the past 5 plus years.	No	No answer	No	No answer	Yes	Yes
3. Even in the absence of formal reporting, have corrective actions ever been taken as a result of a hazmat accident? If yes, what types of actions have been taken?	Yes, re-training, disciplinary action (suspension and termination).	Yes. We have only had two accidents. In one event, the driver was forced off the road in Canada and this was corroborated by other drivers. However, the Canadian hazmat unit did nothing to contain the spill. In the other event, the driver died, but witnesses told us what happened. No hazmat was spilled, however.	Yes. Change in unloading procedures enacted; drivers trained according to procedural changes.	No	Yes. Discipline, up to and including termination.	Yes. Working with our customer we changed the regular start times of our team drivers from midnight to 6 A.M. following days off. This was due to information obtained through a training program on “Managing a Trucking Lifestyle.”	Yes

<b>TableB-2. Situation involving a hazmat accident (truck: “vehicle ran off the road”; air: “aircraft overshot runway”).</b>							
<b>Questions</b>	<b>Large Hazmat Carrier 3</b>	<b>Very Large Hazmat Carrier 1</b>	<b>Very Large Hazmat Carrier 2</b>	<b>Very Large Hazmat Carrier 3</b>	<b>Small Hazmat Carrier 4</b>	<b>Very Large Hazmat Carrier 4</b>	<b>Medium Hazmat Carrier 3</b>
2c. Are pictures taken of the accident scene and/or the damaged vehicle/aircraft?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2d. Are any or all of these findings documented in an accident report compiled by your company?	Yes	Yes	Yes	Yes	All	Yes	Yes
2e. If yes, could we obtain copies of one or two of these reports?	Yes	No	No answer	Will review for consideration.	No	Yes	Yes
3. Even in the absence of formal reporting, have corrective actions ever been taken as a result of a hazmat accident? If yes, what types of actions have been taken?	Yes, additional awareness training for all drivers, defensive driving classes for involved drivers, rerouting if highway factors a concern.	Yes, adjustments made to the on-board speed governor to limit the usage at minimum and maximum speeds.	Yes, remedial training, counseling, suspension, probation, suspension, termination. Equipment modifications.	Yes, remedial re-training of the driver.	Yes, increased or modified training, addition of ESC on tractors, changes to trailer specifications.	Yes, vehicle education/ inspection, driver evaluation/ determination, re-training, counseling, classroom and remediation.	Yes, training courses, equipment modification, improve tracking equipment.

<b>Table B-2. Situation involving a hazmat accident (truck: “vehicle ran off the road”; air: “aircraft overshot runway”).</b>			
<b>Questions</b>	<b>Extremely Large Hazmat Carrier 1</b>	<b>Extremely Large Hazmat Carrier 2</b>	<b>Extremely Large Hazmat Carrier 3</b>
2c. Are pictures taken of the accident scene and/or the damaged vehicle/aircraft?	Truck: Yes	Truck: Yes, sometimes Air: Yes	Truck: Yes, sometimes Air: Yes
2d. Are any or all of these findings documented in an accident report compiled by your company?	Truck: Yes	Truck: Yes Air: Yes	Truck: Yes Air: Yes
2e. If yes, could we obtain copies of one or two of these reports?	Truck: We requested a copy of an accident report in a letter to David Bennett, executive vice president.	Truck: E-mail request sent Air: E-mail request sent 7/8	Truck: No answer Air: No answer
3. Even in the absence of formal reporting, have corrective actions ever been taken as a result of a hazmat accident? If yes, what types of actions have been taken?	Yes	Yes	Yes

**Table B-2. Situation involving a hazmat accident (truck: “vehicle ran off the road”; air: “aircraft overshot runway”).**

Questions	Small Hazmat Carrier 1	Small Hazmat Carrier 2	Medium Hazmat Carrier 1	Small Hazmat Carrier 3	Large Hazmat Carrier 1	Medium Hazmat Carrier 2	Large Hazmat Carrier 2
4. Do you see additional data that could be collected that would help identify the root causes of serious hazmat accidents? If yes, please identify the type of data that should be collected.	Yes, witness statements, police reports, driver log history, cell phone use report, satellite tracking records, driver license history, driver crash history, criminal record history.	Maybe, one big thing would be whether or not it was the fault of another driver (not truck driver).	Yes, vehicle performance reports; driver history, driver health information; post-crash vehicle inspection; vehicle maintenance history.	Yes, in-depth information regarding the driver’s activities during the period since the last 34-hour reset; accurate information regarding the ambient traffic flow.	No answer	Yes, hours of service, hours on duty prior to accident, last 34-hour break.	No
5. Do you have suggestions for improving the <b>process</b> of completing crash forms for PHMSA’s Hazardous Materials Incident Reporting System (HMIRS)?	No answer	No	No	No	No answer	No	No Answer
5a. If yes, please list them.	This task of reporting is contracted to the Spill Centre to be completed on our behalf in the event of a hazmat transportation incident.	No answer	No answer	No answer	No answer	N/A	Get the carrier industry involved in the design of the reporting criteria.
5b. Are the criteria for filing a hazmat report clear?	No answer	No answer	Yes	Yes	No answer	Yes	No

<b>Table B-2. Situation involving a hazmat accident (truck: “vehicle ran off the road”; air: “aircraft overshot runway”).</b>							
<b>Questions</b>	<b>Large Hazmat Carrier 3</b>	<b>Very Large Hazmat Carrier 1</b>	<b>Very Large Hazmat Carrier 2</b>	<b>Very Large Hazmat Carrier 3</b>	<b>Small Hazmat Carrier 4</b>	<b>Very Large Hazmat Carrier 4</b>	<b>Medium Hazmat Carrier 3</b>
4. Do you see additional data that could be collected that would help identify the root causes of serious hazmat accidents? If yes, please identify the type of data that should be collected.	No answer	Yes, if available, we always try to obtain the engine data to see what the driver was doing at the time of the accident.	No	No	No	Yes, ECM data, rollover technology data.	No
5. Do you have suggestions for improving the <b>process</b> of completing crash forms for PHMSA’s Hazardous Materials Incident Reporting System (HMIRS)?	No answer	No	No	No	No	No	No answer
5a. If yes, please list them.	No answer	No answer	No answer	No answer	No answer	No answer	Not used
5b. Are the criteria for filing a hazmat report clear?	No	Yes	Not always	Yes	Yes	Yes	Yes

<b>Table B-2. Situation involving a hazmat accident (truck: “vehicle ran off the road”; air: “aircraft overshot runway”).</b>							
<b>Questions</b>	<b>Small Hazmat Carrier 1</b>	<b>Small Hazmat Carrier 2</b>	<b>Medium Hazmat Carrier 1</b>	<b>Small Hazmat Carrier 3</b>	<b>Large Hazmat Carrier 1</b>	<b>Medium Hazmat Carrier 2</b>	<b>Large Hazmat Carrier 2</b>
5c. Are there additional data that should be added to HMIRS?	No answer	No answer	Yes	No	No answer	No	Reworded
5d. If yes, please list data that should be added.	No answer	No answer	No answer	No answer	No answer	N/A	It should be reworded in terms of the carrier industry terminology.
5e. Are the instructions for populating the database adequate?	No answer	No answer	Yes	Yes	No answer	Yes	Yes
5f. If not, how could the instructions be improved?	No answer	No answer	No answer	No answer	No answer	N/A	No answer
6. Do you have suggestions for improving the <b>quality</b> of PHMSA’s Hazardous Materials Incident Reporting System (HMIRS)? If yes, please list these suggestions.		No	Yes	No	No	Yes, Part VI needs to be as detailed as the first 5 parts. It has too much room for general information. The description of events should ask if there were other vehicles or parties involved, if there were charges against the other party, if there were contributing factors	Yes, involve industry in the design of the document.

	(i.e., weather, road conditions, obstructions, fatigue, maintenance history, hazmat training, hazmat experience, age of equipment, any other “human factors.”)
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**Table B-2 Situation involving a hazmat accident (truck: “vehicle ran off the road”; air: “aircraft overshot runway”).**

Questions	Large Hazmat Carrier 3	Very Large Hazmat Carrier 1	Very Large Hazmat Carrier 2	Very Large Hazmat Carrier 3	Small Hazmat Carrier 4	Very Large Hazmat Carrier 4	Medium Hazmat Carrier 3
5c. Are there additional data that should be added to HMIRS?	No answer	No	No	No	No	No answer	No
5d. If yes, please list data that should be added.	No answer	No answer	No answer	No answer	No answer	No answer	No answer
5e. Are the instructions for populating the database adequate?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
5f. If not, how could the instructions be improved?	No answer	No answer	No answer	No answer	No answer	No answer	No answer
6. Do you have suggestions for improving the <b>quality</b> of PHMSA’s Hazardous Materials Incident Reporting System (HMIRS)? If yes, please list these suggestions.	No answer	No	No	No	No	No	Yes, make it more user friendly.

<b>Table B-2. Situation involving a hazmat accident (truck: “vehicle ran off the road”; air: “aircraft overshot runway”).</b>			
<b>Questions</b>	<b>Extremely Large Hazmat Carrier 1</b>	<b>Extremely Large Hazmat Carrier 2</b>	<b>Extremely Large Hazmat Carrier 3</b>
5c. Are there additional data that should be added to HMIRS?	No	No	Yes
5d. If yes, please list data that should be added.			Multiple hazardous materials should be able to be listed.
5e. Are the instructions for populating the database adequate?	Yes	No since they provide additional 8 hours of training.	No since they provide additional 8 hours of training.
5f. If not, how could the instructions be improved?			
6. Do you have suggestions for improving the <b>quality</b> of PHMSA’s Hazardous Materials Incident Reporting System (HMIRS)? If yes, please list these suggestions.	No	No (don’t use the database).	Yes, there is no place on the form to indicate that a battery failure caused an incident and nothing to indicate a short circuit took place.

<b>Table B-2. Situation involving a hazmat accident (truck: “vehicle ran off the road”; air: “aircraft overshot runway”).</b>							
<b>Questions</b>	<b>Small Hazmat Carrier 1</b>	<b>Small Hazmat Carrier 2</b>	<b>Medium Hazmat Carrier 1</b>	<b>Small Hazmat Carrier 3</b>	<b>Large Hazmat Carrier 1</b>	<b>Medium Hazmat Carrier 2</b>	<b>Large Hazmat Carrier 2</b>
7. Should PHMSA contact carriers who have submitted an incomplete form for an accident to collect additional information? If yes, please suggest what technique(s) you think will work best.	Yes	No	Yes, letter.	Yes, telephone contact, and/or e-mail communication.	Yes	Yes, follow-up letter or e-mail requesting specific information.	Yes, redesign the form with carriers.
8. Is special training given to the person completing the PHMSA crash form?	No answer	No answer	No	No	No	No	Yes
8a. If yes, what sort of training?	No answer	No answer	No answer	No answer	No answer	N/A	Hands on
8b. Would you take advantage of training if it were provided by PHMSA?	No answer	Yes	Perhaps	Yes	Yes	Yes	Yes
8c. If yes, please suggest the type of training you would prefer.	No answer	Online training	No answer	One-day seminars seem to work best	No answer	Online or by CD	Web conference

<b>Table B-2. Situation involving a hazmat accident (truck: “vehicle ran off the road”; air: “aircraft overshot runway”).</b>							
<b>Questions</b>	<b>Large Hazmat Carrier 3</b>	<b>Very Large Hazmat Carrier 1</b>	<b>Very Large Hazmat Carrier 2</b>	<b>Very Large Hazmat Carrier 3</b>	<b>Small Hazmat Carrier 4</b>	<b>Very Large Hazmat Carrier 4</b>	<b>Medium Hazmat Carrier 3</b>
7. Should PHMSA contact carriers who have submitted an incomplete form for an accident to collect additional information? If yes, please suggest what technique(s) you think will work best.	No answer	Sure if it is needed, e-mail the submitted form with the request for supplement documentation so the blanks, if any, could be completed.	Yes, e-mails/letters	Yes	Yes, phone call	Yes, phone, e-mail	Yes, phone and e-mail
8. Is special training given to the person completing the PHMSA crash form?	No	Yes	Yes	No	No	Yes	Yes
8a. If yes, what sort of training?	No answer	Hands on	Conducted by EHS department, and all forms reviewed by EHS prior to submittal.	No answer	No answer	Introduction overview, then how to collect the appropriate data needed for the report.	Training by safety director
8b. Would you take advantage of training if it were provided by PHMSA?	Yes	Yes	Yes	No	Yes	Yes	Yes
8c. If yes, please suggest the type of training you would prefer.	Seminar	Webinar would be the most cost effective.	Webcast	No answer	Webinar	CBT, Webex	Classroom setting

<b>Table B-2 Situation involving a hazmat accident (truck: “vehicle ran off the road”; air: “aircraft overshot runway”).</b>			
<b>Questions</b>	<b>Extremely Large Hazmat Carrier 1</b>	<b>Extremely Large Hazmat Carrier 2</b>	<b>Extremely Large Hazmat Carrier 3</b>
7. Should PHMSA contact carriers who have submitted an incomplete form for an accident to collect additional information? If yes, please suggest what technique(s) you think will work best.	No answer	Unknown	Unknown
8. Is special training given to the person completing the PHMSA crash form?	No answer	Yes	Yes
8a. If yes, what sort of training?		Eight hours of training as part of a 40-hour dangerous goods course.	Training is given to analysts to be able to fill our forms.
8b. Would you take advantage of training if it were provided by PHMSA?		Not needed	Yes, perhaps
8c. If yes, please suggest the type of training you would prefer.			Could use training on how to identify root cause. It might be good to have training similar to that given to NTSB inspectors.

<b>Table B-2. Situation involving a hazmat accident (truck: “vehicle ran off the road”; air: “aircraft overshoot runway”).</b>							
<b>Questions</b>	<b>Small Hazmat Carrier 1</b>	<b>Small Hazmat Carrier 2</b>	<b>Medium Hazmat Carrier 1</b>	<b>Small Hazmat Carrier 3</b>	<b>Large Hazmat Carrier 1</b>	<b>Medium Hazmat Carrier 2</b>	<b>Large Hazmat Carrier 2</b>
9. Do you use crash data in FMCSA’s Motor Carrier Management Information System (MCMIS)?	No answer	Yes	Yes	Yes	Only for data purposes	Yes	Yes
9a. If yes, do you have any recommendations for improving the usefulness of MCMIS crash data?	No answer	No	Better response needed to incorrect information	Yes—MCMIS should clearly differentiate between accidents in which the motor carrier had a causal role and those in which the carrier was the “victim.”	No	The format is not user friendly.	Get updated information on a timely basis
9b. Is there additional data that should be added to MCMIS to help identify crash causation?	No answer	No answer	Information above	Yes—the specific cause as determined by on-scene investigators should be identified, as well as any and all contributing circumstances.	No answer	Yes—MCMIS does not address the issues of another party’s involvement/ information or preventability. It should at least address if a citation was issued to the motor carrier’s driver or not.	No answer

<b>Table B-2. Situation involving a hazmat accident (truck: “vehicle ran off the road”; air: “aircraft overshot runway”).</b>							
<b>Questions</b>	<b>Large Hazmat Carrier 3</b>	<b>Very Large Hazmat Carrier 1</b>	<b>Very Large Hazmat Carrier 2</b>	<b>Very Large Hazmat Carrier 3</b>	<b>Small Hazmat Carrier 4</b>	<b>Very Large Hazmat Carrier 4</b>	<b>Medium Hazmat Carrier 3</b>
9. Do you use crash data in FMCSA’s Motor Carrier Management Information System (MCMIS)?	Yes	Yes	Yes	Don’t use it but certainly review it since it is very questionable.	Yes	Yes	Yes
9a. If yes, do you have any recommendations for improving the usefulness of MCMIS crash data?	Delineate between preventable and non-preventable crashes	Maintain current information	No answer	No answer	No answer	No answer	No
9b. Is there additional data that should be added to MCMIS to help identify crash causation?	No answer	Names of repeat offenders such as driver’s name	No	No	No answer	No answer	No

<b>Table B-2. Situation involving a hazmat accident (truck: “vehicle ran off the road”; air: “aircraft overshot runway”).</b>			
<b>Questions</b>	<b>Extremely Large Hazmat Carrier 1</b>	<b>Extremely Large Hazmat Carrier 2</b>	<b>Extremely Large Hazmat Carrier 3</b>
9. Do you use crash data in FMCSA’s Motor Carrier Management Information System (MCMIS)? 9a. If yes, do you have any recommendations for improving the usefulness of MCMIS crash data? 9b. Is there additional data that should be added to MCMIS to help identify crash causation?	No and don’t use HMIRS data	No	Unknown

## **B2 Interview with a Water Carrier**

The company is an inland waterway towing company, with roughly 100 power vessels and a fleet of nearly 4,000 barges. Approximately 1% to 2% of the cargo transported is placarded, with 100% of these shipments moved as bulk materials. The carrier owns almost 200 tank barges, each of which is dedicated to bulk transport of hazardous materials. No special crew provisions are made when transporting a hazmat barge, as typically the barge is part of a consist that can contain up to 16 barges lashed together. Typical crew size on a vessel is seven to nine people.

When an event occurs that results in a hazmat spill, the carrier immediately contacts the National Response Center and the nearest (Coast Guard) captain of the port. Although the Coast Guard has a threshold for the amount spilled in making these notifications (i.e., for petroleum, any amount that creates a sheen; for chemicals, it is volumetrically based), company policy is that such contact is made when any amount is released. When a hazmat spill is reported, the carrier must follow up by completing and filing a Form CG-2692 (Report of Marine Accident, Injury, or Death) with the Coast Guard.

It is up to the Coast Guard (captain of the port) to decide whether to launch an investigation. When an investigation is conducted, the investigative officer collects information in a narrative format (rather than using a standardized template). Only if the Coast Guard initiates an investigation will the event qualify as a MISLE incident. If so, it is the Coast Guard that files the report, with the investigative officer entering information into the MISLE database. It is also the Coast Guard that decides whether to file/enter a report into HMIRS.

There has been a concern on the part of the waterway industry that the Coast Guard casualty data is not of sufficient quality to be used for rigorous accident/risk analysis. Among the reasons given is a general lack of knowledge on the part of Coast Guard investigators as to the nomenclature of the industry. This may be attributed to insufficient training and/or the fact that turnover in this position is rather high (i.e., no more than a three-year rotation).

One of the initiatives underway to improve upon this situation is a quality action team (i.e., task force) that has been formed within the Coast Guard 8th District. This district is headquartered in New Orleans and covers all or part of 26 states throughout the Gulf Coast and heartland of America. The initiative focuses on taking investigative reports that have been filed by the Coast Guard and having them returned to the carrier for validation/verification. This is done in a manner so that the carrier does not expose itself to any further liability. The goal is that, through this process, the Coast Guard will amass a more accurate database from which improved accident/risk analysis can be performed.

Within the carrier, any spill triggers a company investigation. The internal investigation is conducted by a team consisting of, at a minimum, the Operations Manager and a member of the Safety or Claims Department. As part of the investigation, the towing vessel pilot (or in the case of a fuel barge, the tanker man) must complete a spill investigation form and submit it to the operations manager. Pilots and tanker men receive formal training as to how to perform this procedure and it is also documented in an operations manual.

The carrier believes that in roughly 80% to 85% of the cases it investigates, the actual root cause(s) are found. The vast majority of these are due to human error, often associated with the operator performing multiple tasks (e.g., navigation while talking on the phone). The company considers this to be a significant enough problem that it has recently issued a multitasking policy.

Presently, the information associated with an investigation is stored electronically in a database, but is not organized in any manner that would support statistical analysis. Plans are underway to modify this database into a redesigned claims system, which would enable such analyses to be performed.

### **B3 Interviews with Database Managers**

The interviews included in this appendix are with PHMSA, FMCSA, and FRA. The first interview refers to the questionnaire for database managers found in Appendix A.

#### **B3.1 Questions for Agencies Maintaining Databases (PHMSA)**

Interview with PHMSA HMIRS manager, on 7/30/08.

##### **Question 1: What process does PHMSA follow in entering data for incident reports?**

Within the 30 days that filers have to submit reports, there are three primary methods:

- a. XML submissions—5 carriers do this on a *nightly* basis, including FedEx (they still do paper too, according to a PHMSA director).
- b. Online 5800.1 incident reporting application.
- c. Fillable PDF—This also includes ConWay Freight, which sends via e-mail with a PDF attachment.
- d. In addition, they receive faxes from some filers and *monthly* packages from UPS that contain the paper forms for all incidents within the past month.

[Note: You may want to follow the initial steps of the current online reporting system. It can only be used for incidents with one shipper and one hazardous material. Others require XML or paper submissions. Also, only original reports are allowed to be submitted online; supplemental reports require a paper submission.]

##### **Question 1a: What process does PHMSA follow to ensure the accuracy of submitted records?**

Reports filed by (a) and (b) go right into the database, which includes high-level quality control processing. For (c) and (d), they scan and OCR for accuracy and then enter into the database. They also employ character-to-character checks to ensure that the OCR process translated the paper form properly.

During this process, they examine the form for personally identifiable information (PII), business rule inconsistencies, invalid dates, invalid commodities (by cross-checking with the commodities in the database). Fatalities and injuries are validated by their own subprocess to determine if they were caused by the hazardous materials. This includes obtaining coroner reports, death

certificates, etc. They read the comments to remove PII, for example, and also look for mention of injuries where none were marked on the form, for another example.

Additional checks include cases such as when the report shows that 5.5 gallons were spilled from a 5-gallon container. They will go back and ask the filer whether there were multiple packages that failed and request that they file a supplemental report or they will sometimes use an e-mail reply as confirmation to correct the data themselves. They look for city/county inconsistencies. If a shipper is an individual, they will not put that name in the database.

They post this data to the Web on a monthly basis.

There is no verification process other than the incident cost study that we have done for them in the past.

Respondent did indicate that they just became aware that their postal code table (with city, state, and zip) also has lat-long data and they will probably add this.

**Question 1b: What benefits would be achieved if PHMSA instituted additional accuracy checks on their data?**

Yes, respondent believes there would be a benefit from more verification, not just form-based validation. Respondent mentioned that sometimes the filers don't put in failure codes, costs, or fatalities. Sometimes the markings on packaging or the shipper is unknown, usually because someone who doesn't have access to that information is completing the form. For example, many big companies hire spill centers to complete the forms for them. Respondent thinks checking with significant or serious incidents would provide the most benefit.

The office director would not check them all, there are simply too many. However, as mentioned elsewhere in this summary, if it meets definition of a significant or serious incident, they will follow up for verification or to get missing information.

**Question 1c: What process would you follow that could enhance accuracy?**

In FY09, they will have the online Incident Reporting System require filers to fix incorrect data before accepting their submission. It would be nice if even more people used it [implying instead of paper or PDF submissions].

Respondent mentioned that PHMSA was releasing [it is now available] an online querying tool that can export all data to Excel so users can slice and dice it themselves. Phase II at the end of August will allow you to look at the 5800.1 data for an incident in a format that resembles the printed form (much as we did on the incident cost project). They currently get 107 requests a month for data and this would eliminate that part of what they do, freeing up resources to focus on other things.

**Question 2: Does PHMSA have an organized program at PHMSA for improving the completeness and accuracy of the data in your database?**

Only the online checking is really working now.

**Question 3: Has the program been effective?**

This is currently unknown.

**Question 4: How is underreporting estimated and what measures are taken to improve reporting?**

Staff regularly go to a Web crawler and look for incidents, which they put in the HMIRS. They also match things up with the telephonics [NRC record]; if there's not a match, it is flagged. They wait 60 days and then marry up the URI (underreported incident) to telephonics. Also, if it's reportable to Office of Hazardous Materials Safety (OHMS), they will send it to enforcement (a list is sent every 30 days). They have a goal to get the process automated to eliminate the 60-day period for enforcement to get it.

In addition, FMCSA sometimes sends over rollovers; Crisis Management Center (CMC) sends notifications and media clips. They get something every day.

They will also be pulling data out of the Hazmat Fusion Center. They want the Hazmat Fusion Center to capture any 911 call that goes out for a hazmat spill.

**Question 5: What is the difference in underreporting by mode?**

Both highway and rail show a greater incidence of URIs than expected by the modal distribution of incident reports. For example, 91% of all URIs are highway incidents whereas 86% of all reported incidents are highway incidents. For rail, it's 9% and 4%, respectively. Air has nearly 0% of the URIs (only 1 incident), but 10% of the reported incidents.

**Question 6: What suggestions do you have for improving data collection effectiveness/quality?**

If more companies would file online, improvements would be realized; whenever a human is involved, it adds error; the goal is to eventually reduce the amount of paper coming into the office. Also, more business rules in online tools, so a filer could not submit an inaccurate report.

**Question 7: Is there a difference in reporting completeness by mode?**

Respondent's initial response was *no*, but then described how there are lots of highway incident reports that are very incomplete, so answer changed to *not sure*. Respondent indicated that they get 15,000 to 20,000 reports a year.

**Question 8: Are carriers found to be not reporting fined?**

Lately, PHMSA has been getting more telephonics that were followed by a letter from enforcement for them to submit the written report.

From the regulations listed online (Title 49 CFR Part 107 Subpart D, Appendix A, Guidelines for Civil Penalties), the fine for not reporting a *telephonic* reportable incident is \$3,000. For not filing a 5800.1 within 30 days, the fine is \$500 to \$2,500.

The online Enforcement Notices and Penalty Action Reports from FY 2007 back through 2004, shows there was only one instance of a closed violation involving 171.15 and only five instances of closed violations of 171.16 and all six of these cases were closed in 2004.

Another PHMSA official in Hazmat Enforcement said that most of the cases they have are the result of immediate telephonic notification without the required written report follow up. Their approach is to not hammer them right off the bat since they did report telephonically, but send a letter requesting that they fill out the written report within a reasonable timeframe. In some cases, the company indicates that they should not have even reported telephonically, but were being overly cautious and a written report is not required. Respondent said that 99.9% of those receiving the letter send in the report. Fines for not reporting would not be shown in the “cases” reported in the Enforcement Notices data posted online (see above paragraph) because they would show up in ticketing reports instead. Respondent reviewed their data and determined that only five enforcement actions were taken in the 2006 to 2007 period, which he said included parts of 2008 as well. Three of those were closed (two with tickets and in one case, the violation was reduced to a warning due to a variety of factors, including remedial actions and faulty information provided by a training vendor). He did say that there were a lot of enforcement actions in the 2002 to 2003 timeframe, before they switched their approach to sending out letters and requesting the reports be submitted. Respondent also said there doesn’t appear to be cases of people failing to report a second time.

#### **Question 8a: Do PHMSA enforcement practices change behavior?**

Respondent suggested speaking with a senior inspector, in the Eastern Region Office in New Jersey, about this. The official is also looking at the completeness and accuracy of the data. This official worked on a couple of projects recently and uses incident data extensively for day-to-day work. Their inspection and investigation activity are based on data and incorrect entries cause them to go to places they don’t need to go to and cause them to miss going to places where they should.

For one activity, the official surveyed all enforcement personnel (the project grew to include all modes, but it was mostly PHMSA staff that responded). There were 32 responses (2 FMCSA, 2 FRA, 1 USCG, and the rest from PHMSA), and the information covered their usage of incident data and the issues they have, including correctness. The results were submitted to office director as part of some strategic activities on which he’s working. The office director said the interesting thing was how many people did **not** respond. It was very top-level and from an enforcement (not really an analytical perspective). He stressed that he didn’t feel comfortable with this survey being cited in any report, but he did provide me with the results with the caveat that I summarize the high points rather than sending it around. Most of the respondents were investigators (rather than managers of one sort or another) and most use the reports to help them prioritize their work or identify companies to inspect. Almost everyone found the reports to be useful or important to their jobs. There were differing opinions on whether the reports had missing useful or important information but most agreed that the reports were mostly accurate. There was also a mixed view on underreporting, with a fairly even split—among those that focus somewhat on that issue—between (a) many entities not reporting, (b) some carriers not reporting, (c) private carriers not reporting, and (d) most incidents are reported. One interesting general comment was that the shipper never finds out about the incident most of the time.

He did some analysis involving carrier reporting, specifically on packaging information, which is traditionally lacking. Only 7% of the reports examined had the data they like to see on packaging markings. They contacted carriers to get them to improve their reporting process to provide them these data.

**Question 9: Is there a follow-up contact to whom we should talk?**

The official suggested several contacts for this purpose.

**Question 10: Are there additional data that should be added?**

An official in the Risk Assessment and Accident Analysis Division of the Office of Hazardous Materials Technology thought of two specific items that would be beneficial:

1. The descriptions (of the accident in general and lessons learned) are very informative if filled out accurately and are more informative than those collected by checkboxes, filled-in numbers, etc. He's not sure how to get that information elsewhere on the report form.
2. The current form is pretty generic and not too specific to package or mode. He thinks a lot of the "garbage in" comes from the way the questions are asked. He thinks it would be better if the form were designed to be more interactive (instead of a standard form). You would only get asked specific questions related to that mode or packaging, for example. This would help identify emerging trends more quickly and would also help to shorten the form because many unrelated questions could be skipped.

He's working a lot on rollovers right now and issues he is concerned about include whether the incident happened on a flat surface, on a divided highway, on a curve, at an intersection, whether it was tripped or untripped, etc. These data are not available now and sometimes are found in the descriptions.

He also mentioned following up on cases such as when a filer seems to just cut and paste the narrative from other submissions—are they really providing good data or just completing the form?

The director thinks the cause codes are too nondescript and don't have good definitions. He would like to refine them with better definitions. As an example of the need, an official in the Atlanta field office asked a question about what was the difference between "this and that" [presumably two different codes] and there was no good answer—"your guess was as good as mine." There are too many codes, and they should be package-class specific—look at each package class and develop codes specific to it. Right now, PHMSA staff have to go into comment fields and they still can't always get the packaging information they need. There would be more codes for some package classes than others.

Another item he suggested was the ability to link an incident record to other data and information that they get for that incident later, such as NTSB reports, but this is more a data system issue, not a report issue. In one example, the NTSB reports for an incident deviated a lot from the reported values for hospitalizations and overall cost.

The official indicated that additional information about the drivers would be useful. What do we want to learn about these people?

- Description: age, sex, education, experience with that function, licenses, training, fitness for that function (fitness for duty)—health, disabilities (hearing, vision, other senses, etc.);
- Economic motivation: how compensated, promoted, etc.;
- Human factors: stress (e.g., quotas), complexity (weather, multitasking);
- Procedures; and
- Ergonomics.

Again, the questions have to have the description, context, and control. For context, we need quantities and percentage—how often were they successful doing the same thing? This could be asked of the carriers from their own perspective only. We do this for Special Permits.

**Question 11: Are these successes that should be mentioned?**

Yes, this is already happening for cargo tank rollovers with damage—a lot of them won't [leak].

**Question 12: Is there a method to link HMIRS to other databases?**

The new multimodal HIP (hazmat intelligence portal) is doing that. They are cleansing the data, identifying company names. They are also going to take the clean data out of the HIP and use it to fix their own data.

**Question 13: How can causes be identified?**

The director thought the cause fields were used, of course, but that they weren't really all that good for true causes. For example, he said that fire and rescue can make a definitive determination as to the cause of an incident, but that submitted incident reports they receive are often "cleaned by lawyers."

**Question 14. Is there a process for ensuring that forms are completed?**

This was discussed earlier in the interview.

**Question 14a: Are major improvements planned for the system?**

Nothing is planned; however, with the new online reporting tool, they can incorporate little tips and examples. Now, filers sometimes get frustrated with the online system, print out the form, complete it, and fax it in.

**Question 15: Are efforts underway to improve quality?**

They are trying to find out what is important for data analysis to guide them.

The director said there are two aspects to the reporting requirements, the regulations and the report itself. The rulemaking aspect is an impediment, primarily because it is the rule itself that specifies who has to report. He said it took 10 years to change the form the last time, making sure all stakeholders were heard, etc. To simply change the form itself, all that is required is to go through OMB's information collection procedures, which include 30-day and 60-day notices and the justification required by the Paperwork Reduction Act. As we talked, he determined that

if the specification of who has to report was added to the form itself, they would no longer have to go through the rulemaking process to make changes in the form and that they could do it more often and more quickly.

He also mentioned that making changes to their internal processes was an impediment as well.

**Question 16: Would additional training be beneficial?**

Both training and online help would be good. Key: emphasizing that it is important to complete the form as completely and accurately as possible.

*Insurance Questions*

**Question 1: Does liability affect reporting?**

**Question 1a: Do liability issues affect the amount of detail?**

The director said that that the more serious/significant incidents tend to have more detail to them; the reporters try to give the packaging involved whereas, for FedEx, only 7% had packaging information in them (and these were a little more than minor, not necessarily serious/significant—in other words, these incidents were a bit more of a nuisance to them than their standard incident). He believes that there was ambiguity in what was asked of them, however. He used Question 26b on the form as an example. He said that if the information requested is not there, they should (but just don't) follow the instructions. For Question 31, he said they rarely get this information. In addition, he pointed out a flaw in that even if the box was checked and a report number was included, the specific fire or police department or jurisdiction would still be unknown, making it more difficult to track down the report.

**Question 1b: Is thorough reporting related to carrier size?**

PHMSA has no direct data on skimping. You could download all the data for a period, determine on which fields you would want to base your determination of “skimping,” and then analyze the data by carrier size (perhaps for highway only, where you merge with MCMIS) to look for any differences in size class.

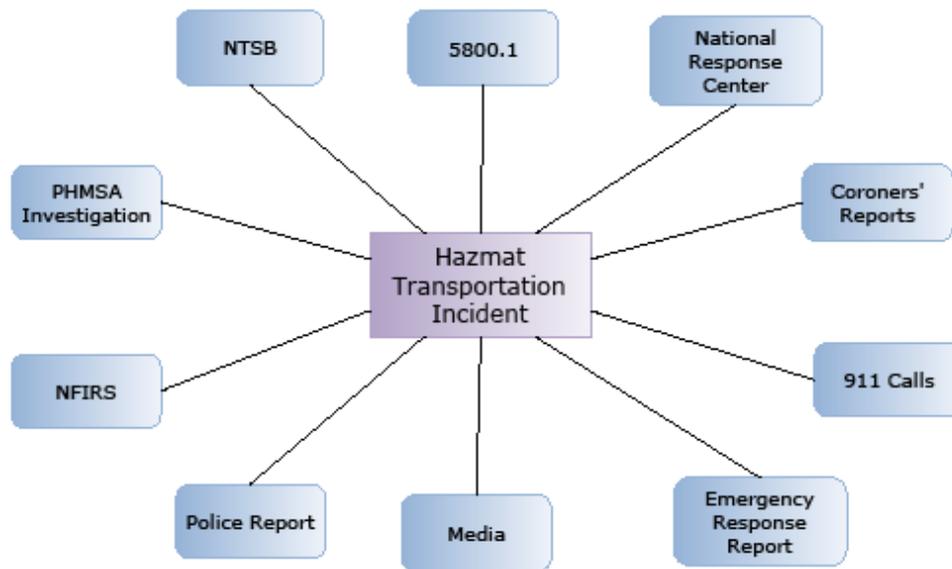
The director said that carrier size is definitely a factor. He did a study back in 1998 and had a new student trainee replicate it. Although it is not ready for release, he did provide some tidbits:

- Of the incidents reported, 85% are reported by 16 carriers; the majority are not serious and insignificant.
- Of the carriers that reported one to two incidents; the majority were classified serious or significant.
- In other words, mom and pops report serious incidents and bigger companies report anything.
- On average, 700 or fewer carriers report each year; of these, half consistently report to PHMSA.

- They divided carriers into the following three groups:
  - Group A is carriers that report between 1 and 20 incidents over a 5-year period.
  - Group B is carriers reporting 21 to 100 incidents over that period.
  - Group C is carriers reporting 101 to 35,000 incidents over that period.
  - Group A: 2,056 unique carriers (93%) reported 4,950 incidents (over 5 years).
  - Group B: 125 unique carriers (6%) reported 10,969 incidents.
  - Group C: 21 unique carriers (1%) reported 80,328 incidents, or 84% of all reported incidents (Group C).
- Of the fatalities, 63% were in Group A (47), 13% in Group C (and these were typically rail), and only 2 fatalities were in Group B.
- Of the serious incidents, Group A submitted 1,559 (31% of their reported incidents are serious), Group B submitted 927 (8%), and Group C submitted 625 (0.8%).
- He indicated that the last bullet seemed to indicate that they were not quite focused on the right group in terms of their data collection—the carriers that are in Group C are spending a lot of money (FedEx told them it was \$2 million per year) to report to DOT and are having an extremely small number of serious incidents.
- He also questioned their current definition of serious and whether it needed adjusting. He said that 86% of serious incidents were bulk releases; is a spill of 119 gallons really “serious” (“how serious is serious?”). He also questioned whether closing a major transportation artery in and of itself was sufficient to warrant an incident to be classified as serious.

#### *General Item*

The director shared his vision for incident reports in the future. He sees the 5800.1 as being just one input to the overall “incident record.” Other data would come from a number of sources. He shared the following graphic:



**Figure B-1. Future Data Future Inputs to Hazmat Transportation Incident Record.**

This is very similar to the general approach we used for the hazmat incident database developed for *Hazardous Materials Serious Crash Analysis: Phase 2* (Battelle 2005).

### **B3.2 Interview with Agencies Maintaining Databases (FMCSA)**

The following interview was conducted with a key administrator responsible for the management of the MCMIS database at FMCSA.

1. *When incident reports are received, from a state, could you describe the process that is used to enter the incident data into MCMIS?*

States upload crash reports through SafetyNet. States extract the data, either through an automated system or manually. That is, the data can be extracted using a computer program, or the cases can be keyed in directly. Certain fields are mandatory, such as carrier name and address. All fields are required, though blanks in non-mandatory fields do not result in rejecting the case.

- a. *Have you ever attempted to evaluate the accuracy of submitted records? Yes!*

*If yes, please describe the process you used.*

In many ways: 1) see the data quality module on the Analysis and Information Online (A & I) website, especially the Office of State Safety Data Quality (SSDQ) methodology; 2) University of Michigan Transportation Research Institute (UMTRI) is evaluating the completeness and accuracy of the MCMIS crash data; 3) on-site data reviews; 4) National Institute for Safety Research (NISR) (contractor) evaluates state crash report forms for compliance and accuracy; 5) NISR evaluates state extraction logic and methods; and 6) crash data collection training for enforcement personnel and, indeed, whomever asks.

2. *Do you have a program at FMCSA for improving the completeness and accuracy of the data in your database? Yes*

*a. If yes, please identify the major elements of the program.*

State Data Quality Improvement Program: 1) independent evaluation of the completeness and accuracy of the MCMIS crash data; 2) on-site (at the state) reviews of state processes; 3) evaluation of the accuracy and sufficiency of state crash forms to collect the MCMIS data; 4) on-site (at the state) evaluation of the data extraction logic and methods; 5) on-site (at the state) training for enforcement and other personnel; 6) three-day Data Quality and Training Conference in San Antonio for representatives of all the states.

3. *Has the program been effective? Yes*

*a. If yes, please list which efforts have worked and indicate why.*

In 2000, approximately 90,000 records were uploaded, when estimates from GES indicated that about 140,000 to 150,000 qualified. In 2006, 160,000 records were submitted. Preliminary count for 2007 is 154,000, but that number is expected to increase as states close their data years. It is impossible to identify which of the many efforts accounted for what proportion of the increase, but it is clear that the efforts are succeeding.

*b. List which efforts have not been successful and indicate why.*

Some states have been resistant to accept help.

4. *What suggestions do you have for improving the effectiveness and quality of data collection?*

Suggestions must be tailored to state's needs. There is no one-size-fits-all solution. FMCSA needs to provide funding and technical assistance to the states, as states are sometimes overwhelmed with their own state requirements. Moreover, the assistance must be continuing.

*a. Improving data collection by police officers?*

In-depth training by qualified individuals.

*b. Improving data handling and processing at the state level?*

Every state is different. States should not "stove-pipe" the process since it involves many different agencies within the state and the data are used by many different entities within the state. There should be a multi-agency approach involving all state stakeholders. Each needs to be sensitive to the needs of the other stakeholders. Also, there needs to be performance measures.

*c. Improving data handling and processing at FMCSA?*

Recognize and correct system bugs immediately. The process is too cumbersome at the moment.

*d. Should the number of steps in the data handling process be reduced? Yes*

*e. If yes, how should this be accomplished?*

Maximize electronic data collection and processing, as well as integrating other databases such as driver history, Commercial Driver's License Information System (CDLIS), etc.

5. *Should improvements be made to MCMIS specifically to improve data collection for hazardous materials crashes? Yes*
  - a. *If yes, should hazmat type and quantity and container (package) type be added?*

Quantity is unrealistic, as is package type.
  - b. *Please list other hazmat data that should be added.*

It is unrealistic to collect more hazmat data than are currently collected.
6. *Do you think that FMCSA should provide additional training to help improve data quality? Yes, we do.*
  - a. *If yes, please describe what sort of training that should be offered.*

FMCSA already has an extensive training program, described above. We attempt to train personnel at each step of the process of data acquisition, from the officer who collects the data (through direct training, visor cards for police vehicles, and train-the-trainer) to the state personnel who extract and upload the data, to FMCSA personnel who prepare the file.
  - b. *To whom should it be given?*

Any officer doing accident investigation; trainers, etc.
  - c. *Who should provide the training?*

Qualified instructors who intimately understand the material.
7. *States are sometimes very slow to submit their crash data to FMCSA. Please list potential measures to help improve submittal reliability.*

See the data quality module on the web.
8. *Can you identify additional data that could be collected that would help identify the "root causes" of serious hazmat accidents? Yes*
  - a. *If yes, please identify the type of data that should be collected.*

Pre-crash factors, as in the LTCCS.
9. *Should a descriptive field be added to MCMIS that would provide added insights into the reasons or "causes" of the crash? No.*
  - a. *If yes, please describe what the field would contain.*

The suggestion is not realistic because of the context. Police accident reports are used in litigation, and the officers would be challenged on any conclusions.

10. Can the MCMIS database be automatically linked with other databases such as HMIRS? It can be linked but there is no hard link, as in common case identifier.

a. If yes, please list the specific database, how the database can be linked with other databases. (List the specific fields.)

It is possible to match with FARS, but not by record number. The match is made using date, time, vehicle identification number, etc.

b. If no, please suggest how the database could be linked to other databases. List the database(s), specific fields that could be added or changed to accomplish this.

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11. Do you use crash data in MCMIS for analyzing the causes of crashes? No.

If yes, which fields do you use for this purpose?

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### **B3.3 Interview with Agencies Maintaining Databases (FRA)**

1. What was your academic and professional background prior to employment with FRA?

IT background, previously with firm that had contract to manage RAIRS system for FRA. Prior to FRA worked in IT industry since 1979.

2. How long have you been with FRA and in what type of position(s)?

Four years, as Division Director—IT

3. How long involved with FRA RAIRS system?

Four years

4. What are your responsibilities with RAIRS?

Oversight and management of all FRA databases, providing contractor support, and supervising staff.

5. How many others work with you on RAIRS?

One dozen people in division, including four OR analysts who provide support for enforcement office and others at FRA. Also three or four SAS developers who respond to requests and develop applications for website, and two SharePoint developers.

6. Which groups or offices at FRA use the RAIRS database or results derived from it?

Support entire agency in a wide variety of responsibilities including Government Performance and Results Act (GPRA) reporting, managing national inspection program, performance management, safety and compliance audits. Specific offices or areas include Railroad Development, Human Factors, Planning, and others.

7. *What are the most statistically intensive uses?*

Probably support of regulatory analyses and cost-benefit analyses.

8. *What are the principal objectives of these?*

(Did not discuss this question)

9. *Do these uses include root cause analysis of accidents or hazmat releases?*

FRA database and normal accident reports have had limited use for root cause analyses (RCAs) because they are “event” reports not detailed investigation of specific incidents. Their principal purpose is to enable accumulation of statistically valid database on incidents for analysis of historical trends. About 150 accidents per year are subject to more intensive investigation out of a total of about 3,000 annually. Even these more detailed analyses are not fully developed, in-depth RCA. In 2008, these reports were made available online, in addition to database, which has existed for many years.

FRA would like more data to enable normalization of results with regard to various parameters of interest. Among these are medications of employees involved in incidents and fatigue levels (i.e. hours on duty and work rest cycles prior to incident).

10. *Are you aware of use of the data outside of FRA, either by other agencies, academia, or the private sector, especially for root cause analyses?*

Within DOT, data are used by PHMSA, RITA, BTS, although not aware of use for RCA. Not aware of private sector use of data for RCA or other.

Currently a lot of attention to new risk analysis initiative at FRA and the data are being looked at in connection with that.

11. *If so, what are some examples these?*

See above, not aware of RCAs.

12. *Have there been internal FRA suggestions of ways that the database could be improved, especially for root cause analysis purposes?*

RCA falls within new Risk Analysis Division, which is a current priority at FRA.

13. *If so what are they and what are the objectives?*

The Risk Analysis Initiative is new but may lead to suggestions for changes. The IT group is responsible for ongoing development and maintenance of database and providing summaries and analyses in response to requests. They are not generally the initiators of analyses. There are also a number of other analysts at FRA in different divisions, including Office of Policy, Rail Development, and at Volpe as well.

14. *Are there barriers, either institutional or other, to implementing these changes and, if so, what are they?*

There is a statutory limit to what railroads must report so significant changes are not easily implemented. The two paths for significant changes would be via Rulemaking Process or RSAC.

15. *Have there been suggestions external to FRA to change or improve the database, especially for root cause analysis purposes?*

They have received inquiries from labor about more detail regarding operations data such as RCL (remote-controlled locomotives). NTSB has suggested expanding the cause codes. There is a notice of proposed rulemaking (NPRM) (Docket No. FRA-2006-26173) calling for technical clarifications, expanding the scope of the instructions and improving certain definitions, proposing some new accident cause codes and collection of some additional data.

16. *If so what are they and what are the objectives?*

(See above.)

17. *What problems are you aware of with regard to RAIRS?*

[No response.]

18. *Which of these are due to railroads and which to FRA processes?*

FRA is constantly monitoring railroad compliance with reporting requirements, especially timeliness of reporting. FRA's objective is to provide information to inspectors in a more timely manner.

As with any organization there are certain data "silos." It would be better to integrate FRA's data systems to enable easier analysis of information across different databases. One example is the railroad identity file. Several different versions are maintained and not easily kept consistent and there is redundancy in keeping them up to date. There can be substantial variation in the name used for different companies, making analyses less efficient to conduct and possibly incomplete.

There are some concerns about the consistency between railroads in how they interpret primary and secondary causes. Even within a railroad there can sometimes be problems. Such inconsistencies can interfere with, confound, or complicate analyses.

19. *Do you have suggestions for improvement or changes that could be made to the database?*

FRA is looking for ways to improve turnaround time. Currently it is a monthly "batch" process. The vision is for continuous flow of information into database, enabling rapid detection of trends or evidence of potential problems. Presently, there is about a two-month delay.

FRA is developing SharePoint tools to help railroads understand deficiencies. Related to this is that although FRA permits (encourages) electronic submittal of data, some Class 1 railroads still prefer to submit paper records. This reduces efficiency and introduces the possibility of transcription errors.

*20. What are they and how would they help?*

Correcting the integration problem is part of FRA's data architecture initiative.

There are limitations in FRA's ability to collect more detail on employee hours worked and miles traveled. Railroads are only required to submit "rolled up" systemwide data on a monthly basis. This has interfered with their ability to address certain questions. For example, FRA would like to normalize results by state but can not. In general, they can not normalize geographically. They also must estimate miles operated by crewmembers because it is not directly recorded, thereby interfering with certain normalizations of the data that they would like to perform.

Another problem is that yard-switching miles are not recorded directly, but instead are estimated based on person-hours worked by the crew. This has a potential impact on the reliability of this parameter for normalization of incidents, etc.

Another area that FRA would like to see better utilized is reporting of incident location using latitude/longitude (lat/long) coordinates. The record-layout permits that but compliance is voluntary so it is inconsistently reported. The FRA Geographic Information System (GIS) group is developing a linkage between lat/lon coordinates and linear locations along rail lines.

They have approached several railroads about setting up data sharing sites to facilitate the exchange and use of more accurate, up-to-date data and ensure better consistency. This is part the SharePoint system referenced above.

As part of FRA's risk initiative, they would like more data on "upstream," or precursor, events that may be predictive of problems. For example, data on Signals Passed at Danger (SPADs), or employee hours of service.

*Other Topics Discussed not in Response to Specific Questions*

In addition to the reportable incidents, railroads are required to complete Form 618097 to record all incidents. These are meant to capture all incidents but are not required to be reported to FRA. They are subject to inspection by FRA personnel but FRA does not have regular access to them except for compliance purposes. There is a similar requirement that railroads keep records of lesser injuries.

## APPENDIX C

### Brief Summary of the 2005 MCMIS Crash Records

This analysis is based on the vehicle crashes reported in MCMIS for calendar year 2005. Analysis results include the following:

- There were the 158,908 records for 2005 in the updated MCMIS database.
- Of the 158,908 records, a total of 147,773 involved trucks.
- Each accident in MCMIS stored in the *CRASH\_MASTER* table can have many *CRASH\_EVENT* records tied to it. The first record in the events table tied to a crash is assigned a sequence number of one. The number is incremented for each subsequent record associated with the same incident. The 147,773 truck accidents that occurred in 2005 had 200,657 event records.
- No crash listed more than four events. The number of crashes with one to four events associated with them is shown in [Table C-1](#).
- The top 10 initial events associated with accidents involving trucks are shown in [Table C-2](#).

**Table C-1. Count of truck crashes with one or more event sequences.**

Number of Sequences	Truck Crash Count
1	81487
2	20605
3	8252
4	13301

**Table C-2. Crash event listed as sequence number = 1.**

Number of Crashes	Event Code	Event Description
91,390	13	Collision involving motor vehicles in transport
9,960	98	Other
9,957	1	Non collision ran off road
4,164	18	Collision involving fixed objects
3,244	3	Non collision overturn (rollover)
3,062	14	Collision involving parked motor vehicle
2,538	10	Non collision other
1,426	2	Non collision cargo loss or shift
1,272	20	Collision with other movable object
1,237	8	Non collision cross median/centerline

- The highest number, equaling 91,390 events, was related to “*Collisions involving motor vehicles in transport.*”
- The second highest, or 9,960, was due to “*Other.*” There is a special field to describe the other reason, however another reason was only provided for 641 records, about 6% of the *Other* events.
- The third highest events were accidents due to “*Non collision ran off road.*” A total of 9,957 event records related to such accidents.
- There are a total of 548 entries where a truck was involved in hazmat released. **Table C-3** shows the type of events that occurred in these incidents. The information from this table can help gain a better understanding of some of the reasons for accidents that occur when hazardous material is transported on roads.

**Table C-3. Top 10 event types for trucks involved in hazmat accidents.**

Number of Crashes	EVENT Code	Event Description
212	13	Collision involving motor vehicles in transport
119	1	Non collision ran off road
54	98	Other
47	3	Non collision overturn (rollover)
32	18	Collision involving fixed objects
20	10	Non collision other
13	8	Non collision cross median/centerline
13	20	Collision with other movable object
10	5	Non collision jackknife

- The highest number, equaling 212 of the 548 hazmat events, was related to “*Collisions involving motor vehicles in transport.*”
- The second highest, or 119 of the 548 hazmat events, was due to “*Non collision ran off road.*”

### Description of Hazardous Material Crashes in MCMIS

There are five fields in MCMIS that should be filled out if the truck involved in the crash was carrying hazardous materials. These fields are as follows:

- *VEHICLE\_HAZMAT\_PLACARD,*
- *VEHICLE\_HAZMAT\_NUMBER,*
- *VEHICLE\_HAZMAT\_MATERIAL,*
- *VEHICLE\_HAZMAT\_CLASS\_ID,* and
- *HAZMAT\_RELEASED.*

The first and last fields are populated with “Y” or “N” and the middle three fields are text fields for the UN number, the name of the hazardous material, and the one-digit hazmat class number. There are a total of 3,649 records with “Y” as an entry for the first or last of the five parameters and an entry for one or more of the other three entries. In looking at those records, 25 were eliminated because of the parameter *TRUCK\_BUS* = “B,” signifying that the vehicle involved was a bus and not a truck. An additional 128 were eliminated because only the *HAZARDOUS\_MATERIAL* field was filled in and the entry was the name of the carrier and not the name of a hazardous material. This leaves 3,496 crashes that were potential crashes involving a truck carrying hazardous materials.

- Of these, 2,576 crashes involved trucks and *VEHICLE\_HAZMAT\_PLACARD* = “Y”, indicating that it was recorded as a truck carrying sufficient hazardous material to require a placard. There were 35,990 where the entry was left blank and there were 109,207 where the entry was “N.”
- Of the 2,576 crashes that were placarded, *HAZMAT\_RELEASE* = “Y” for 342 records indicating that the hazardous material was released from the vehicle. There were 350 crashes where the entry was left blank and there were 1,883 where the entry was “N.”
- Removing the restriction that the vehicle be placarded increases the total number of records with *HAZMAT\_RELEASE* = “Y” to 653, a 90% increase in the number of hazmat spills. Since a non-bulk shipment of a single material from a single shipper weighing less than 4,000 kg need not be placarded if it is not a Class 1 or 7 material [49 CFR 172.301(a)(3)], it is not unexpected that there would be additional hazmat spills recorded that were not placarded shipments. However, a nearly 100% increase in the number of spills would seem to indicate that spills from non-placarded shipments are over-represented in the database and is probably an indication of tabulation errors.

For placarded shipments, there were 1,889 crashes with an entry in the *VEHICLE\_HAZMAT\_NUMBER* field, and 1,707 crashes with an entry in the *VEHICLE\_HAZMAT\_CLASS\_ID* field. The former field is reserved for entering the four-digit UN number and the latter for entering the one-digit hazmat class number. The break down by hazard class is shown in [Table C-4](#). The count in the second column was obtained by taking the 4 digit UN Number, and using Table 1 in 49 CFR Part 172, translating it to its corresponding one-digit hazmat class. If all the information were entered correctly, there would be no need for two columns of entries because the entries for each hazard class would be the same.

- If the requirement that the shipment be placarded is removed, then the number of crashes based on the four-digit UN number increases to 2,226, and on the one-digit hazmat class number increases to 1,989. The breakdown by hazard class for all shipments is shown in [Table C-5](#). Once again, if all the information were tabulated correctly, there would be no need for two columns because the entries for each hazard class would be the same.

**Table C-4. Comparison of 1-digit HM with 4-digit UN entries converted to 1-digit HM entry for placarded shipments in MCMIS for 2005.**

1-Digit HM Class	Count Using 4-Digit UN Number (Converted to 1-Digit HM Entry)	Count Using 1-Digit HM Entry
Null	595	869
Unmatched	100	
1	50	96
2	385	342
3	1080	893
4	20	23
5	31	34
6	28	18
7	3	6
8	179	172
9	113	123
Total excluding unmatched and null	1889	1707

**Table C-5. Comparison of 1-digit HM with 4-digit UN entries converted to 1-digit HM entry for all shipments in MCMIS for 2005.**

1-Digit HM Class	Count Using 4-Digit UN Number (Converted to 1-Digit HM Entry)	Count Using 1-Digit HM Entry
Unmatched	278	
1	88	114
2	446	402
3	1256	965
4	24	27
5	39	40
6	33	19
7	5	10
8	203	187
9	132	225
Total excluding unmatched	2226	1989

- Based on the placard exclusion regulation, the number of Class 1 and 7 crashes should be the same in Tables C-4 and C-5. This is not the case, and since there are not many Class 1 and 7 crashes recorded, in terms of percentages the differences for these classes of shipments is higher than another class.

- If the hazardous information were properly filled out, there should be no null or unmatched entries in Tables C-4 and C-5. Consequently, the totals for the various hazmat classes would be higher. Excluding Class 1 and 7 shipments, which must be placarded for any quantity of material being shipped, non-bulk shipments of hazardous materials in the other classes weighing less than 4,000 kg need not be placarded. Comparing the HM class entries in Table C-4 and C-5 shows that the totals for all shipments are higher for all classes, even Class 1 and 7, which should be the same.
- If the fields in the database were being properly filled out, the number of crashes based on the four-digit UN number and the number based on the one-digit hazard class number should be the same and there would be no nulls or unmatched entries. The nulls occur when the shipment is placarded and there is no entry for the one-digit HM class entry or the four-digit UN number entry. The unmatched entries occur when the four-digit UN number entry is converted to the one-digit HM class number using the table in 49 CFR Part 172. They are considered unmatched if the UN number is not listed in the Part 172 table. For the placarded shipments, there are 595 entries with no four-digit UN entry and 869 entries with no one-digit hazmat class entry. Adding to the difference is an additional 100 crashes for which UN numbers were provided that could not be matched with the UN numbers contained in the list of hazardous materials in 49 CFR Part 172. When the placard restriction was removed, the 100 unmatched UN numbers increased to 278. For the shipment totals in Table C-5, null entries could not be measured because a correct null entry means that it is not a hazardous material shipment.

**Table C-6** shows a comparison of the one-digit HM class number entered in the `VEHICLE_HAZMAT_CLASS_ID` with a one-digit HM class number obtained by taking the UN number recorded in the `VEHICLE_HAZMAT_NUMBER` field and using the table in 49 CFR Part 172, translating the UN number into the one-digit HM class number.

- In Table C-6, if all the entries were consistent, then there only would be counts on the diagonals. Although the largest values on the diagonal are for Classes 2, 3, 5, 6, 8 and 9, it is evident that there are a lot of data entry errors in the five hazmat class tables in MCMIS for 2005.
- Based on Table C-6, there are 323 of the 2,758 entries, about 12%, that are not on the diagonal. If the null and unmatched values are added, the conclusion can be made that about one-third of the hazardous material shipments have entries in the four-digit UN number and the one-digit HM class number that are null or incorrect entries. This error rate would make it impossible to draw any conclusions about contributing causes if the characteristics of the hazardous material were a contributing cause for the accident or its severity.
- In Table C-5 there are 278 entries that could not be apportioned among the nine hazmat classes. If they could have been apportioned, the total would have become 2,504 crashes. Therefore, because of incomplete data entry, there are 515 crashes with four-digit UN numbers in the `VEHICLE_HAZMAT_NUMBER` field that cannot be matched up with the one-digit HM entries because of nulls in the `VEHICLE_HAZMAT_CLASS_ID` field.

- Based on the regulations, all shipments of Class 1 and 7 materials should be placarded. Based on the data in Tables C-5 and C-6, either the regulation is being violated or the entries in the MCMIS Crash file are not correct.

**Table C-6. Comparison of 1-digit HM class entry with 1-digit entry based on UN number.**

1-Digit HM Class from UN Number	1-Digit HM Class Entry								
	1	2	3	4	5	6	7	8	9
1	13	14	16		1			1	5
2	5	281	22	1			1	3	9
3	34	67	1662	22				5	18
4				16				1	2
5	5				35			1	
6	1	6	1			17	2	4	1
7			1	1			2		1
8	2	5	25	1	15	4		289	5
9			11	3	1				120

Table C-7 shows additional details about the 342 entries that were truck related with a vehicle hazmat placard and had hazmat released.

**Table C-7. Percentages of fields with data where vehicle is placarded and hazardous material is released.**

Field Name	With Data	No Data
Vehicle Hazmat Material	121 (35.4%)	221 (64.6%)
Vehicle Hazmat Class ID	275 (80%)	67 (20%)
Vehicle Hazmat Number	288 (84.2%)	54 (15.8%)

- A total of 121 of the 342 (35.4%) entries had the name of the hazardous material while 64% did not have any information. A large majority (80%) of the trucks with placards involved in a hazmat release had a vehicle hazmat class ID and more than 84% showed the vehicle hazmat number.
- Of the 342 entries, only 16 had no data or an entry of “Unknown” in all three fields (*VEHICLE\_HAZMAT\_MATERIAL*, *VEHICLE\_HAZMAT\_CLASS\_ID*, and *VEHICLE\_HAZMAT\_NUMBER*).
- A total of 653 records indicated that hazmat was released.
- The *HAZMAT\_MATERIAL* field is one of the five hazmat fields in MCMIS that provide useful information on the hazmat shipment. Of the 3,496 crash records that have entries in one or more of the five hazmat fields, only 377 records have entries in all five fields. The *HAZMAT\_MATERIAL* field is the most poorly filled out field of the five. Although

there are entries in 1,142 of the records, there were only 793 records containing the name of a listed hazardous material. Of the 349, the difference between 1,142 and 793, there were only 95 that were identified solely based on the entry in the HAZMAT\_MATERIAL field and, of those 95, only 7 contained the name of a listed hazardous material. This means that an additional 88 records should not have been included in the 3,496 hazmat truck crashes, leaving an estimated annual total in 2005 of 3,408 hazmat truck crashes based on one or more valid entries in the five hazmat fields.

## APPENDIX D

### The Percent of Missing Data for Variables from TIFA/FARS, 1999-2004

**Table D-1. Accident-level variables from FARS.**

Variable	Percent of Involvements with Missing Data	Label
v1	0.0	CASE STATE
v2	0.0	CASE NUMBER
v104	0.0	VEHICLE NUMBER
v7	0.1	CITY
v8	0.0	COUNTY
v9	0.0	ACCIDENT DATE - MONTH
v10	0.0	ACCIDENT DATE - DAY
v11	0.0	ACCIDENT DATE - YEAR
v12	0.1	ACCIDENT TIME - HOUR
v13	0.1	ACCIDENT TIME - MINUTE
v14	0.0	NUMBER OF VEHICLE FORMS
v15	0.0	NUMBER OF PERSON FORMS
v16	1.6	LAND USE
v17	2.1	NATIONAL HIGHWAY SYSTEM
v18	1.6	ROADWAY FUNCTION CLASS
v19	1.0	ROUTE SIGNING
v20	0.0	TRAFFICWAY IDENTIFIER #1
v20_2	0.0	TRAFFICWAY IDENTIFIER #2 - NEW IN 2004
v21	14.0	MILEPOINT
v22	0.1	SPECIAL JURISDICTION
v23	0.0	FIRST HARMFUL EVENT
v24	0.1	MANNER OF COLLISION
v25	0.0	RELATION TO JUNCTION
v26	0.1	RELATION TO ROADWAY
v27	0.8	TRAFFICWAY FLOW
v28	1.5	NUMBER OF TRAVEL LANES
v29	1.4	SPEED LIMIT
v30	0.3	ROADWAY ALIGNMENT
v31	1.9	ROADWAY PROFILE
v32	3.2	ROADWAY SURFACE TYPE
v33	0.2	ROADWY SURFACE CONDITION
v34	0.1	TRAFFIC CONTROL DEVICE
v35	0.2	TRAFFIC CONT FUNCTIONING
v36	0.0	HIT AND RUN
v37	0.1	LIGHT CONDITION
v38	0.1	ATMOSPHERIC CONDITIONS
v39	0.4	CONSTRUCTION/MAINT ZONE
v40	32.1	EMS NOTIFIED – HOUR

Variable	Percent of Involvements with Missing Data	Label
v41	31.8	EMS NOTIFIED – MINUTE
v42	30.0	EMS ARRIVAL – HOUR
v43	32.5	EMS ARRIVAL – MINUTE
v46	0.0	SCHOOL BUS RELATED
v48	0.1	RAIL GRADE CROSSING ID
v49	0.0	NUMBER FATALITIES IN ACC
v50	0.0	DAY OF WEEK
v51	0.0	NUMBER DRINKING DRIVERS
v52	0.0	ACCIDENT DATE – JULIAN
v53	0.0	NUMBER UNINJURED IN ACC
v54	0.0	NUMBER C-INJURED IN ACC
v55	0.0	NUMBER B-INJURED IN ACC
v56	0.0	NUMBER A-INJURED IN ACC
v57	0.0	NUMBER K-INJURED IN ACC
v58	0.0	NUM UNK INJURED IN ACC
v59	0.3	ACC RELATED FACTORS #1
v60	0.3	ACC RELATED FACTORS #2
v61	0.3	ACC RELATED FACTORS #3
v71	66.1	LATITUDE - GLOBAL POSITION
v72	66.1	LONGITUD - GLOBAL POSITION

**Table D-2. Vehicle-level variables from FARS.**

Variable	Missing Data (Unknown)	Label
v107	0.1	NUMBER OF OCCUPANTS
v108	0.6	VEHICLE MAKE
v109	0.1	VEHICLE MAKE-MODEL
v110	0.1	BODY TYPE
v111	0.8	MODEL YEAR
v112	3.1	VIN
v123	1.3	REGISTRATION STATE
v124	1.6	REGISTERED VEHICLE OWNER
v125	0.0	ROLLOVER
v126	0.0	JACKKNIFE
v127	23.3	TRAVEL SPEED
v128	2.5	HAZARDOUS CARGO
v129	0.8	VEHICLE TRAILERING
v130	0.3	VEHICLE CONFIGURATION
v131	13.9	NUMBER OF AXLES
v132	0.6	CARGO BODY TYPE
v133	0.1	SPECIAL USE
v134	0.0	EMERGENCY USE
v135	1.4	IMPACT POINT – INITIAL
v136	1.5	IMPACT POINT – PRINCIPAL
v137	1.7	EXTENT OF DEFORMATION
v138	0.2	VEHICLE ROLE
v139	2.8	MANNER OF LEAVING SCENE
v140	0.0	FIRE OCCURRENCE
v142	0.2	VEHICLE MANEUVER
v143	33.5	CRASH AVOIDANCE MANEUVER
v144	0.0	MOST HARMFUL EVENT
v145	0.0	NUMBER OF DEATHS IN VEH
v151	6.3	VIN TRUCK FUEL CODE
v152	5.5	VIN TRUCK WEIGHT CODE
v153	0.7	VIN TRUCK SERIES
v155	0.1	LENGTH OF VIN
v156	0.0	NUMBER UNINJURED IN VEH
v157	0.0	NUMBER C-INJURED IN VEH
v158	0.0	NUMBER B-INJURED IN VEH
v159	0.0	NUMBER A-INJURED IN VEH
v160	0.0	NUMBER K-INJURED IN VEH
v161	0.0	NUM UNK INJURED IN VEH
v162	1.8	VEH RELATED FACTORS #1
v163	1.8	VEH RELATED FACTORS #2
v164	0.6	UNDERRIDE/OVERRIDE
v170	21.7	MOTOR CARRIER ID
v171	16.9	BUS USE
v172	17.8	GVWR
v173	0.0	VEHICLE EVENT #1 – NEW IN 2004

Variable	Missing Data (Unknown)	Label
v174	60.0	VEHICLE EVENT #2 – NEW IN 2004
v175	77.1	VEHICLE EVENT #3 – NEW IN 2004
v176	88.4	VEHICLE EVENT #4 – NEW IN 2004
v177	95.1	VEHICLE EVENT #5 – NEW IN 2004
v178	98.0	VEHICLE EVENT #6 – NEW IN 2004

**Table D-3. Driver-level variables from FARS.**

Variable	Missing Data (Unknown)	Label
v207	0.0	DRIVER PRESENCE
v208	0.0	DRIVER DRINKING
v209	1.7	LICENSE STATE
v210	3.7	NON-CDL LICENSE STATUS 1999-2003
v210A	3.6	NON-CDL LICENSE TYPE - NEW IN 2004, SUBSET OF OLD VAR 210
v210B	3.6	NON-CDL LICENSE STATUS - NEW IN 2004, SUBSET OF OLD VAR 210
v211	4.5	LICENSE CLASS COMPLIANCE
v212	3.9	CDL LICENSE STATUS
v213	8.3	LICENSE ENDORSEMENTS
v214	4.2	LICENSE RESTRICTIONS MET
v216	4.2	NUMBER OF PREV ACCIDENTS
v217	4.2	NUMBER PREV SUSPENSIONS
v218	4.2	NUMBER OF PREV DWI CONV
v219	4.2	NUM PREV SPEEDING CONV
v220	4.2	NUM PREV OTHER MV CONV
v221	4.2	LAST ACCIDENT – MONTH
v222	4.2	LAST ACCIDENT – YEAR
v223	4.2	FIRST ACCIDENT – MONTH
v224	4.2	FIRST ACCIDENT – YEAR
v227	1.1	DRIVER RELATED FACTORS #1
v228	1.1	DRIVER RELATED FACTORS #2
v229	1.1	DRIVER RELATED FACTORS #3
v230	1.1	DRIVER RELATED FACTORS #4
v231	3.4	VIOLATIONS CHARGED #1
v232	2.7	VIOLATIONS CHARGED #2
v233	2.7	VIOLATIONS CHARGED #3
v235	4.8	DRIVER HEIGHT (INCHES)
v236	24.7	DRIVER WEIGHT
v306	0.0	OCCUPANT NUMBER
v308	1.6	OCCUPANT AGE
v309	1.4	OCCUPANT SEX
v310	1.0	OCCUPANT TYPE
v311	1.0	OCC SEATING POSITION
v312	10.2	RESTRAINT SYSTEM USE
v313	0.4	AIR BAG AVAIL/FUNCTION
v314	1.2	OCCUPANT EJECTION
v315	4.5	EJECTION PATH
v316	1.4	OCCUPANT EXTRICATION
v321	6.6	DRUG INVOLVEMENT
v322	90.7	DRUG DETERMINATION
v323	14.9	DRUG TEST TYPE #1
v324	15.2	DRUG TEST RESULTS #1
v325	7.3	DRUG TEST TYPE #2
v326	7.3	DRUG TEST RESULTS #2

Variable	Missing Data (Unknown)	Label
v327	7.2	DRUG TEST TYPE #3
v328	7.2	DRUG TEST RESULTS #3
v329	1.3	OCCUPANT INJURY SEVERITY
v330	2.5	OCC TAKEN TO HOSPITAL
v331	1.2	OCC DEATH DATE – MONTH
v332	1.3	OCC DEATH DATE – DAY
v333	1.2	OCC DEATH DATE - YEAR
v334	2.0	OCC DEATH TIME - HOURS
v335	2.2	OCC DEATH TIME - MINUTES
v336	74.5	LAG TIME ACC/DEATH - HRS
v342	4.3	OCC FATAL INJURY AT WORK
v345	9.8	OCC ALCOHOL INVOLVEMENT
v346	76.3	OCC METH ALC DETERMINAT
v347	9.1	ALCOHOL TEST TYPE
v348	8.7	OCC ALCOHOL TEST RESULT
v361	5.3	RACE
v362	5.5	HISPANIC ORIGIN
v363	34.7	OCC DEAD ON ARRIVAL

**Table D-4. Vehicle-level variables from TIFA.**

Variable	Missing Data (Unknown)	Label
v1001	2.3	POWER UNIT MAKE
v1002	2.3	POWER UNIT YEAR
v1003	2.4	CAB STYLE
v1004	7.1	SLEEPER PRESENT
v1005	2.8	FUEL TYPE
v1006	4.7	TRUCK MODEL
v1007	2.0	POWER UNIT TYPE
v1008	2.4	STRT TRUCK BODY STYLE
v1009	0.0	STRT TRUCK OTHER BODY
v1010	2.4	POWER UNIT NO. OF AXLES
v1011	2.6	POWER UNIT LIFT AXLES
v1012	4.8	POWER UNIT LENGTH
v1013	3.6	POWER UNIT CARGO WEIGHT
v1014	4.3	POWER UNIT EMPTY WEIGHT
v1015	3.7	POWER UNIT CARGO
v1016	3.2	POWER UNIT HAZ. CARGO
v1017	2.1	1ST TRAILER TYPE
v1018	1.2	1ST TRAILER NO. OF AXLES
v1019	1.3	1ST TRAILER LIFT AXLES
v1020	4.2	1ST TRAILER EMPTY WEIGHT
v1021	3.0	1ST TRAILER CARGO WEIGHT
v1022	2.5	1ST TRAILER LENGTH
v1023	0.7	1ST TRAILER BODY
v1024	0.0	1ST TRAILER OTHER BODY
v1025	3.1	1ST TRAILER CARGO
v1026	1.6	1ST TRAILER HAZ. CARGO
v1027	2.0	2ND TRAILER TYPE
v1028	0.0	2ND TRAILER NO. OF AXLES
v1029	0.0	2ND TRAILER LIFT AXLES
v1030	0.1	2ND TRAILER EMPTY WEIGHT
v1031	0.1	2ND TRAILER CARGO WEIGHT
v1032	0.1	2ND TRAILER LENGTH
v1033	0.0	2ND TRAILER BODY
v1034	0.0	2ND TRAILER OTHER BODY
v1035	0.1	2ND TRAILER CARGO
v1036	0.1	2ND TRAILER HAZ. CARGO
v1037	2.0	3RD TRAILER TYPE
v1038	0.0	3RD TRAILER NO. OF AXLES
v1039	0.0	3RD TRAILER LIFT AXLES
v1040	0.0	3RD TRAILER EMPTY WEIGHT
v1041	0.0	3RD TRAILER CARGO WEIGHT
v1042	0.0	3RD TRAILER LENGTH
v1043	0.0	3RD TRAILER BODY
v1044	0.0	3RD TRAILER OTHER BODY
v1045	0.0	3RD TRAILER CARGO

Variable	Missing Data (Unknown)	Label
v1046	0.0	3RD TRAILER HAZ. CARGO
v1047	2.0	VEHICLE CONFIGURATION
v1048	2.0	VEHICLE COMBINATION CODE
v1049	2.2	NO. OF TRAILERS
v1050	4.2	GROSS VEHICLE WEIGHT RATING
v1051	7.8	EMPTY COMBINATION WEIGHT
v1052	20.3	GROSS COMBINATION WEIGHT
v1053	7.6	TOTAL LENGTH
v1054	14.1	TOTAL WIDTH
v1055	0.0	SPECIFIC CARGO
v1056	7.8	CARGO SPILLAGE
v1057	7.8	AREA OF OPERATION
v1058	5.1	OPERATING AUTHORITY
v1059	5.3	ACCIDENT TYPE
v1061	15.8	TRIP TYPE
v1062	34.5	HOURS DRIVING

## APPENDIX E

### Selected Analyses Performed with the Hazmat Accident Database

The process described in Section 4.7 to create the Hazmat Accident Database resulted in a set of data that could be used to perform root cause analysis of not only individual crashes but entire categories of hazmat crashes. This appendix addresses selected analytical results for each of the major parameters listed in Table 4-28 in Section 4.9.2.

#### Vehicle

Vehicle configuration is closely related to safety and particularly to vehicle performance in an accident.

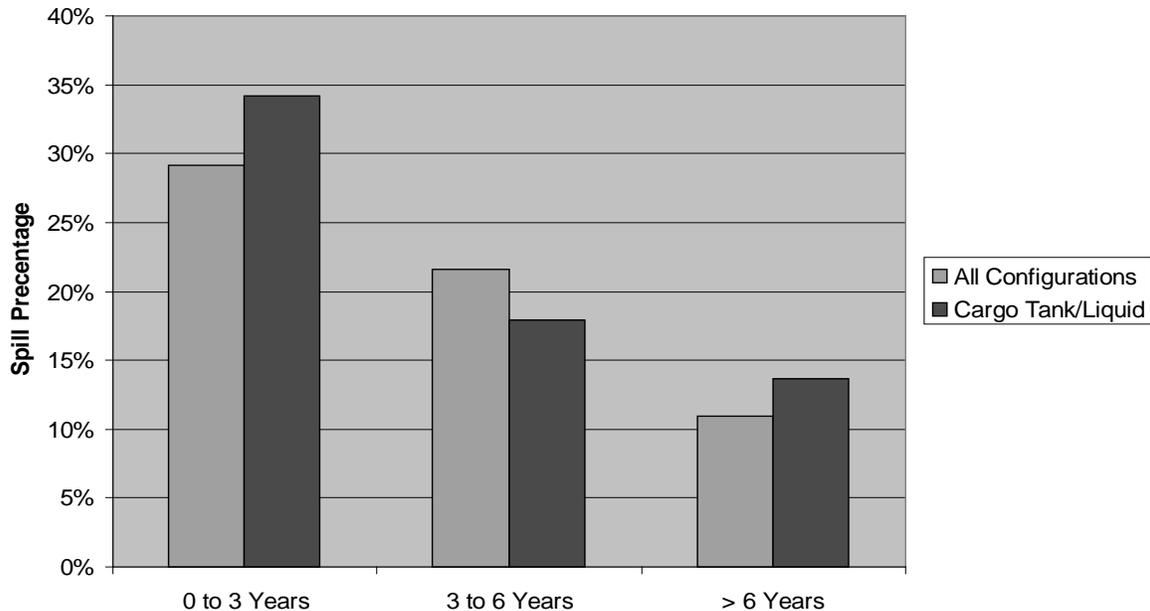
- The most common vehicle configuration used in transporting hazardous material involved in crashes is the tractor/semitrailer. This configuration is involved in 60% of all crashes. The next most common configuration is the straight truck, being involved in 30% of all hazmat crashes. The tractor/semitrailer configuration is the dominant vehicle configuration for all classes of hazardous materials except for Division 2.1, where 69% of the crashes involve the straight truck configuration.
- The straight truck vehicle configuration has a somewhat lower spill-to-crash ratio than the tractor/semitrailer configuration, 13% versus 18%, respectively. This lower ratio is because the straight truck configuration is dominated by Division 2.1 shipments, which have a much lower spill-to-crash ratio, 8%.

#### Driver

Driver age and experience are among the factors closely related to hazmat safety.

- The average age of a hazmat driver involved in a crash was 44. The spill-to-crash ratio by driver age follows an upside-down bell shaped curve, with drivers 45 to 54 years old having the lowest spill-to-crash percentage (14%). The age category with the highest spill-to-crash ratio was the 18-to-24-year-old group at 32%, the next highest was the greater-than-65-year-old group at 27%. Even though they represented the largest segment of the driver population, middle-aged drivers have the lowest spill-to-crash percentage.
- A serious hazmat crash is likely to be more severe if it involves a driver with less experience (see Figure E-1). Inexperience often leads to problems with recognition and decision making. Using the spill percentage (the weighted number of spills divided by the weighted number of crashes) as an indicator of severity for the crashes in which driver experience was obtained, spills occurred in about 20% of the crashes. This percentage is close to 30% for drivers with less than three years of experience and about 10% for drivers with more than six years of experience.
- There is an extremely low spill-to-crash ratio for crashes where the primary reason is “other vehicle induced,” in contrast to a relatively high spill-to-crash ratio when driver

error is involved. Although crashes occur frequently where the other vehicle is at fault, spills are far more likely to occur in crashes where the hazmat truck driver is at fault.

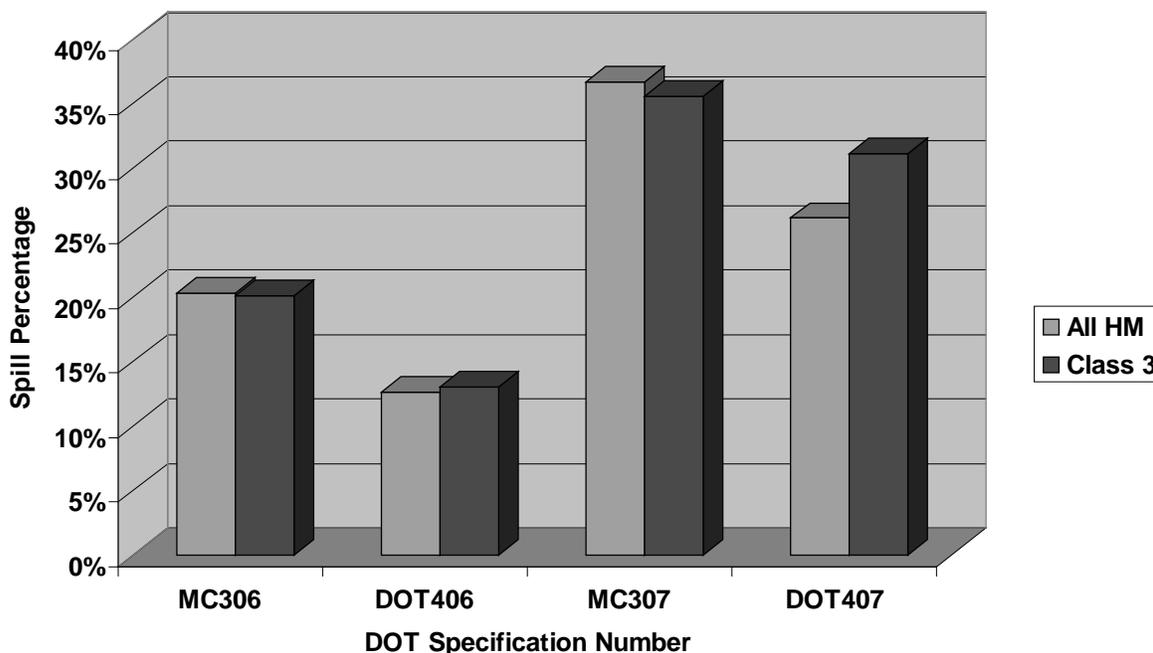


**Figure E-1. Cargo tank spill-to-crash ratio versus driver experience.**

## Packaging

The type of cargo tank is closely related to the percentage of crashes with spills.

- When the DOT406 specification tank (newer and more robust than the MC306 tank) was involved in a serious crash, hazardous material was spilled 13% of the time as compared to MC306 tanks, which experienced spills 20% of the time. The difference is even larger when comparing the DOT407 and MC307 specification designs. Spills occurred in 26% of the crashes for the DOT407 and 37% of the crashes for the MC307. The introduction of the DOT406 and DOT407 designs has enhanced container integrity (see [Figure E-2](#)).
- The annual estimate for the number of crashes for MC306 cargo tanks is 2.2 times that of DOT406 cargo tanks (283 and 130, respectively). With the assumption that the crash rates for these cargo configurations are relatively equal, this implies that the DOT406 containers have not fully penetrated the market.



**Figure E-2. Spill performance versus cargo tank specification.**

- Of all serious cargo tank crashes, 25% are single-vehicle crashes. The single-vehicle crashes account for 66% of the spills, 76% of the rollovers, and 77% of the crashes that result in both rollover and spill. This cargo configuration is commonly used for Class 2, 3, 8, and 9 shipments. Driver recognition and driver performance errors were frequently listed as the primary cause for these single-vehicle crashes.
- Rollovers occur in approximately 22% of all serious hazmat crashes involving cargo tanks. An analysis of rollover percentage as a function of the loading (empty, part full, and full), shows a linear increase in the tendency to rollover based on the quantity of cargo. The higher center of gravity of a full tanker truck may be the reason why full tanker trucks are more likely to rollover. Hazmat tanker truck rollovers are important for safety and risk analyses because of the strong correlation between rollovers and spills. Rollovers are most likely on entrance and exit ramps, where more than 87% of all rollovers result in a spill.

## Infrastructure

Crashes with spills are correlated with road type.

- Spills occur in about 14% of the serious crashes on Interstates. On average, however, spills occur in 18% of all crashes. The results also show that rollover events occur in 19% of all crashes on Interstates, compared to an average of 23% when considering all road types. These differences may be associated with Interstate design elements such as medians, shoulders, and guardrails that reduce the likelihood that a truck will be involved in a rollover.

- On divided highways, there are about 15 hazmat spills for every 100 crashes. This low spill rate is counterbalanced by the high spill rate on entrance and exit ramps, almost 50 hazmat spills per 100 crashes. On undivided highways, there are about 20 hazmat spills per 100 crashes, just slightly above the average of 18 hazmat spills per 100 crashes. The lower spill rate for divided highways is expected due to the high correlation between Interstates and divided highways.

## Situational

Pre-crash conditions, as well as the level of hazardous material in a cargo tank, are discussed below.

- Two pre-crash conditions dominate, *in traffic lane* and *maneuvering*. Maneuvering is defined as any driver activity involving changing lanes such as passing or turning as well as going around a curve. *In traffic lane* is the pre-crash condition for more than 70% of all crashes and leads to about 65% of all spills. Although *maneuvering* is the primary cause for fewer crashes (about 25%), it results in a larger percentage of the spills (about 35%). One plausible explanation is that a crash that begins with a driver performing a maneuvering action is more likely to lead to the driver losing control of the vehicle, resulting in a rollover. Although rollovers occur in only 24% of all hazmat crashes, they account for more than 75% of all spills.
- Only 25% of all serious crashes are single-vehicle crashes. However, more than 60% of all spills result from single-vehicle crashes. Sixty percent of all crashes are multiple-vehicle crashes that occur while the hazmat vehicle is within the traffic lane. These dominate the crash total. The multiple-vehicle maneuvering crashes, and the single-vehicle crashes that occur while maneuvering and when within traffic lanes are more equally distributed, each contributing about equally to the crash total. Spills occur in approximately 18% of all crashes and the contributions are about equal (about one-third each) from single-vehicle crashes that occur while the vehicle is in its traffic lane, single-vehicle crashes that occur when maneuvering, and multiple-vehicle crashes that occur while the vehicle is in its traffic lane.
- Data analysis confirms that the spill-to-crash ratio is significantly higher for rollover events than for other crash types. Class 2 tanks typically are more robust because they contain either a low-temperature liquid or a gas under pressure. With more data, it might be possible to examine the effect of the tank specification on the spill probability in rollover and non-rollover crashes. Keeping the hazmat truck upright appears to be an important mitigation strategy for preventing serious consequences in a hazmat crash.