



Safety Data Initiative

Using Statistics to Make the Transportation System Safer

2002 Safety in Numbers Conference

Georgetown University Conference Center

Washington, DC

January 9, 2002

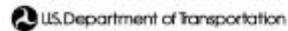




Safety in Numbers

Using Statistics to Make the Transportation System Safer

Sponsored by the Bureau of Transportation Statistics



AGENDA

8:00 am - 9:00 am	Registration and Continental Breakfast	West Lobby
9:00 am - 9:10 am	Welcome and Opening Remarks <i>Ashish Sen, Director</i> <i>Bureau of Transportation Statistics</i>	Grand Ballroom Salons ABG
9:10 am - 9:30 am	Keynote Speaker: <i>The Honorable Robert A. Borski, Member of Congress</i>	
9:30 am - 9:45 am	Safety Data Initiative Overview <i>Demetra Collia, Bureau of Transportation Statistics</i>	
9:45 am - 10:30 am	Progress Reports: <i>Project 1</i> <i>Terry Klein, Bureau of Transportation Statistics</i> <i>Projects 2, 3 and 5</i> <i>Sue Baker, Johns Hopkins School of Public Health</i> <i>Dennis Shanahan, Injury Analysis, LLC</i> <i>Bob Dodd, Dodd & Associates</i>	
10:30 am - 10:45 am	Coffee Break	West Lobby
10:45 am - 11:30 am	Progress Reports Continued: <i>Projects 6, 7 and 9</i> <i>Mei-Li Lin, National Safety Council</i> <i>Dick Paddock, Traffic Safety Analysis Systems & Services</i> <i>Sergey Sinelnikov, National Safety Council</i> <i>Barbara DeLucia, Robert Scopatz, Data Nexus, Inc.</i> <i>Project 10</i> <i>Dave Balderston, Federal Aviation Administration</i>	Grand Ballroom Salons ABG
11:30 am - 11:40 am	Description of Afternoon Project Level Discussions <i>Jeff Hanan, Facilitator</i> <i>Equals Three Communications</i>	

11:45 am - 1:15 pm	Lunch with Keynote Speaker <i>Christopher Hart, Assistant Administrator, Office of System Safety, Federal Aviation Administration</i>	Grand Ballroom Salons CHF
1:25 pm - 1:55 pm	Project Level Discussions – Session 1: <i>Project 1: Reengineer Data Programs Terry Klein, Kimberley Hill, Bureau of Transportation Statistics</i>	Conference Room 6
	<i>Project 2: Develop Common Criteria for Reporting Deaths & Injuries Dennis Shanahan, Injury Analysis, LLC</i>	Salon E
	<i>Project 3: Develop Common Denominators for Safety Measures Bob Dodd, Dodd & Associates</i>	Salon B
	<i>Project 5: Develop Common Data on Accident Circumstances Sue Baker, Johns Hopkins School of Public Health</i>	Conference Room 4
	<i>Project 6: Develop Better Data on Accident Precursors Dick Paddock, Traffic Safety Analysis Systems & Services</i>	Salon D
	<i>Project 7: Expand Collection of “Near-Miss” Data to all Modes Sergey Sinelnikov, National Safety Council</i>	Exec. Boardroom
	<i>Project 9: Explore Options for Using Technology in Data Collection Barbara DeLucia, Robert Scopatz, Data Nexus, Inc.</i>	Conference Room 5
	<i>Project 10: Expand, Improve & Coordinate Safety Data Analysis Dave Balderston, Federal Aviation Administration</i>	Conference Room 3
2:00 pm – 2:30 pm	Project Level Discussions – Session 2	(Repeated)
2:35 pm – 3:05 pm	Project Level Discussions – Session 3	(Repeated)
3:15 pm - 3:30 pm	TranStats/Intermodal Transportation Database Status Report <i>Jeff Butler, Bureau of Transportation Statistics</i>	Grand Ballroom Salons ABG
3:30 pm - 3:45 pm	Data Gaps Project Status <i>Bill Bannister, Bureau of Transportation Statistics</i>	
3:45 pm – 4:00 pm	Stakeholder Feedback Overview <i>Terry Klein, Bureau of Transportation Statistics</i>	
4:00 pm - 4:15 pm	Closing <i>Rick Kowalewski, Deputy Director Bureau of Transportation Statistics</i>	

Dr. Ashish Sen
Director, Bureau of Transportation Statistics
Welcoming Remarks
Safety in Numbers Intermodal Safety Data Conference
Washington, DC
January 9, 2002

Thank you, Demetra. Good morning. Thank you for joining us today in this continuing effort to make our transportation system even safer than it is today.

My acknowledgments to the National Safety Council for its support on this project, especially Vice President Chuck Hurley and Dr. Mei-Li Lin. Thanks to Professor Sue Baker of The Johns Hopkins Center for Injury Research and Policy for her leadership and work on this project and also for convincing an impressive group of transportation and data experts to work on our project.

Also, my acknowledgements to the scientists at The National Institute for Occupational Safety and Health. I hope for continuing collaborative scientific research with them in the area of transportation safety.

Thanks, too, to Demetra, Beth Bradley and Kim Hill for their continuing efforts on the Safety Data Plan and for their extra efforts to arrange this conference.

Thanks particularly to all these people at a time when the transportation system has been responding to the events of September 11.

We are all here today because there are too many people being killed as a result of transportation incidents. In 2000, there were more than 44,000 transportation-related deaths. That number is unacceptable and it makes the Safety Data Initiative a top priority.

Working together, we must improve the quality of safety data so planners and decision-makers can make more informed safety decisions. Informed decisions are more likely to lead to fewer deaths and injuries.

We all recognize that safety data are not everything that they could be or need to be. BTS has audited several DOT databases and the results were not reassuring. At least two databases needed to be re-engineered to make the data reliable.

We all know, from our personal experience, cases of other databases where the data are subject to systematic errors that prevent us from doing useful safety analysis.

One database on grade-crossing accidents, for example, appeared to show that the sounding of a locomotive horn at a grade crossing *reduced* safety rather than enhancing it. It was only when the agency's staff checked the accuracy of the data that the errors were discovered.

Timeliness is also a particularly critical problem —some of our safety data are not available for two years after the event. One senior DOT official characterized some of our safety data as being like "light from a distant star -- it may have been extinguished long ago by the time we see it." Timely data are essential to taking action on unsafe conditions.

We must gather safety data in a more consistent, systematic way from all modes of transportation. In some modes, "operator error" is commonly assigned as the "cause" of an accident, without ever investigating why the operator made the error, and what can be done to prevent similar errors in the future.

In some modes, operator fatigue is commonly reviewed as a possible contributing factor in an accident; in others, fatigue is only considered when its presence is unmistakable. We need to make sure that we are gathering systematic safety data.

We have been working together on the Safety Data Initiative for more than two years. When we met last year, I pledged that we would return to the stakeholders to share the draft reports of the implementation plan.

We believe we have a series of proposals that will make major advances in safety data. And we believe BTS can play a unique leadership role in coordinating improvements in transportation safety data.

We have the drafts for you today but the most important thing of all is for us to hear your comments. It is essential to us to have broad-based support for the projects and for all of us to reach agreement on the direction we are heading.

As we move forward after today, we will be submitting our report to Secretary Mineta in the near future and then we will be developing programs for the reauthorization process.

But, as in all our efforts, it must be a partnership. By working together, we will produce higher quality data that can lead to a safer transportation system.

Thank you for coming here today and for your work on these projects. Through projects such as the Safety Data Initiative, we will ensure that data remains the light in enlightened policy.

When we met last year, I called the Safety Data Initiative an ambitious undertaking and said we should aim high. Today, we are still keeping our vision high. With our vision, and with our joint efforts, we can, as Secretary Mineta has said, “create a dynasty of safety for the future.”

And now, I am proud to introduce our keynote speaker. Congressman Bob Borski from Philadelphia, PA has served on the House Transportation Committee since 1983 and has played a key role on every transportation bill the committee has considered.

In 1991, he led the effort on ISTEA to prevent expansion of the network that can be used by triple trailers. In this Congress, he became Ranking Member of the Highways and Transit Subcommittee.

Congressman Borski has a long-term interest in safety. As chairman of the House Investigations and Oversight Subcommittee in 1993 and 1994, he chaired hearings on safety comparisons across modes. We are honored to have Congressman Borski as our keynote speaker today.

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THE HONORABLE ROBERT A. BORSKI
RANKING DEMOCRATIC MEMBER
SUBCOMMITTEE ON HIGHWAYS AND TRANSIT
COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE
JANUARY 9, 2002

*Safety In Numbers Conference
Georgetown University Conference Center*

Good morning, Ladies and Gentlemen. I want to commend BTS for holding this conference on *Safety In Numbers* and for its efforts to improve transportation safety.

Transportation safety requires good research, and good research requires accurate and timely data collection and analysis.

Speaking as the Ranking Democrat on the Subcommittee on Highways and Transit, let me assure you that I support your efforts to advance this much needed initiative.

The Subcommittee on Highways and Transit has already initiated hearings on the reauthorization of TEA 21. Late last year we began with a series of TEA 21 success stories. Early this year, we expect to have the modal administrators up to testify, followed by hearings throughout the year as we prepare for, and look ahead to, the reauthorization of TEA 21 in 2003.

I am fully aware of BTS' interest in funding the safety data projects you will be discussing today, which are expected to cost some \$9 million.

TEA 21 authorized BTS at \$31 million annually, and it is my understanding that the appropriations committees fully funded that authorization each year. However, they did not fund the \$4 million authorization in AIR 21. TEA 21 reauthorization will be the next major piece of legislation for the Subcommittee and probably the next major opportunity for BTS to revise or expand its programs.

Let me give you a few thoughts about where I think improved data could pay the greatest dividends.

In comparison to other modes, improving highway safety is, by far, our greatest opportunity to save lives in transportation. Last year, 41,821 people were killed and an estimated 3.2 million people were injured in motor vehicle crashes, more than 1% of the nation's total population. Insurance, lost wages, health care and other costs related to highway crashes exceed \$150 billion annually, and losses in terms of human suffering are incalculable.

Crashes involving motor vehicles account for about 90 percent of all transportation fatalities. So it should be obvious that better highway safety data will lead to better planning, rulemaking and decision making, and a safer transportation system overall.

Trucking is a special concern. In 1999, more than 400,000 trucks were involved in traffic accidents – 5,362 people were killed and an estimated 142,000 were injured in those crashes.

Large trucks are over represented in fatal crashes. Although 13 percent of all traffic deaths resulted from crashes involving large trucks, these vehicles represent only 3 percent of all registered vehicles and about 7 percent of vehicle miles traveled. Fatality rates for large trucks are about 65 percent higher than passenger vehicles.

That is why the Subcommittee, in the Motor Carrier Safety Improvement Act of 1999, authorized \$15 million from the Highway Trust Fund to carry out a comprehensive study to determine the causes of, and contributing factors to, crashes involving large trucks. The legislation requires the study to be reviewed and updated every five years.

The study calls on DOT to develop measures to improve the evaluation of future truck crashes; monitor crash trends and identify causes and contributing factors; and develop effective safety countermeasures. The study is a prime example of our interest in using data and data analysis to make good transportation policy and programs – and not as a drunk would use a lamp post, for support rather than illumination.

Let me offer a few comments on some of the research projects you are developing:

Research Project #1: Reengineer DOT data programs

I think it's an excellent idea to reengineer the 40 or so data programs maintained by DOT related to safety and measures of exposure. An assessment of the quality of existing data is the first step in retooling DOT data programs.

Research Project #2: Develop common criteria for injuries and deaths

There are many inconsistencies between programs reporting injuries and deaths. Most modes count any death that occurs within 30 days of an incident. FRA counts deaths that occur within 365 days of an incident. The Coast Guard does not specify a time period.

For injuries, FMCSA counts an injured person being taken to a medical facility for immediate medical attention. The Coast Guard requires a report if there is an injury that requires medical treatment beyond first aid. RSPA requires a report for bodily harm resulting in loss of consciousness, the necessity to carry the person from the scene, necessity for medical treatment, or disability extending beyond the day of the accident.

The modes often treat similar circumstances differently. For example, incidents involving ground crews in aviation are counted while longshoremen in the maritime industry are not; rail maintenance workers are counted while shipyard and bus maintenance workers are not.

Clearly, there is a need to develop common criteria for reporting injuries and deaths.

Research Project #3: Develop common denominators for safety measures

The project to develop common denominators for safety measures will make comparative risk analysis across modes more precise. For example, highway safety data is currently based on accidents or deaths per vehicle mile traveled, whereas transit safety data is based on accidents or deaths per passenger mile of travel. These differences, and differences in other modes, make cross modal comparisons difficult.

Research Project #4: Advance the timeliness of safety data

The lack of timely data drives me crazy!

Most of the data reports submitted to Congress are at least two years old by the time they are released. We need timelier data to identify trends earlier, take corrective actions earlier, and thus reduce transportation related deaths and injuries. More timely data will lend greater credibility to DOT's performance reporting under the Government Performance and Results Act and other requirements of law.

Conclusion

Let me conclude with a general observation about the use of technology to improve transportation safety and security. Event recorders have long been used in the aviation industry to investigate accidents and to help determine the underlying causes of accidents. We should consider using event recorders in other modes so investigators can be more discriminating in accident investigations. A couple of your projects envision the use of these devices.

A large scale demonstration of the most promising crash avoidance technologies in automobiles should also be conducted – otherwise they will never be accepted. We cannot mandate these technologies in automobiles unless we can show conclusively that their safety benefits far outweigh their costs. A large scale demonstration of these technologies could be the next major step taken in the intelligent vehicle initiative authorized by TEA 21.

Finally, the events of September 11th have made us all aware of the need for enhanced security in transportation. The use of smart cards and vehicle usage monitoring systems could improve the security of drivers licenses and restrict access to sensitive transportation freight. These devices incorporate biometric and other information of the owner that can be checked against the same measures taken from the person attempting to use the card or operate the vehicle.

I urge you to be sensitive to security needs as you develop your research program. Thank you for asking me to speak this morning, and I wish you good luck in your discussions throughout the day.

PROJECT 1 OVERVIEW

Reengineer DOT Data Programs

BACKGROUND

In September 2000, the Bureau of Transportation Statistics (BTS) published the Safety Data Action Plan with the goal of providing the U.S. Department of Transportation (DOT) with quality data, capable of identifying, quantifying, and minimizing risk factors in U.S. travel. The Safety Data Action Plan identified 10 research projects to address specific shortcomings in current data collection and data quality within the various DOT databases. The first research project addresses reengineering DOT data programs.

DOT maintains in excess of 40 programs that capture either safety data or crucial related information, such as measures of exposure. A data quality review requested by Congress indicated that quality improvements can be made that will better serve the DOT mission. It was decided that the first step in reengineering data programs is a data quality audit of all major safety data systems to evaluate existing capabilities and determine needed improvements. This includes review and assessment of DOT data collection systems, as well as other transportation safety data systems not directly collected by DOT, but accessible within DOT data systems. The next step would be to implement recommendations for improvements, based on the assessment performed. This overview will focus on the data quality assessments phase. With improved data, DOT's safety programs will become not only more effective, but more cost-effective as well. The

Department can better address its strategic goal of improving safety by developing more targeted inspection, education, regulatory, and research programs.

Objective

As previously mentioned, the initial goal of this project is to conduct quality audits of transportation safety data systems. Due to resource constraints, BTS decided to conduct data quality assessments of five major data systems by the end of 2001. Data quality is a broad concept that refers, ultimately, to the usefulness of data for analysis and decisionmaking. The overall objective of this project is to ensure that decisionmakers can have a reasonable level of confidence in the source and reliability of transportation safety data.

Process

A data quality assessment template was developed to guide the person responsible for the assessment and to afford consistency between assessments. The template includes the following sections: Background, Frames and Sampling, Data Collection, Data Preparation, Data Dissemination, Sponsor Evaluation, Data Analysis, Assessment, and Recommendations and Suggestions for Data Quality Improvements. See the Attachment for details.

The selection of data systems was based on recommendations from the Safety Data Task Force members and include: the UNISHIP data system, the Hazardous Materials

Management Information System (HMIS), the Airline Passenger Origin and Destination Survey, the National Transit Database System – Safety & Security module, and the National Aviation Safety Data Analysis Center (NASDAC)) data system. Draft Data Quality Assessment Reports for each of the five data systems are under management review. Both the assessment and the recommendations for each system aim at improving the relevance, completeness, quality, timeliness, comparability and utility of transportation safety data.

DATA SYSTEM SPECIFICS AND RECOMMENDATIONS FOR DATA QUALITY IMPROVEMENTS

UNISHIP

UNISHIP is an enforcement database for hazardous materials shippers. Unlike many of the other safety databases, UNISHIP is not available to the general public. Its primary purpose under Federal Hazardous Materials Transportation Law is to provide DOT administrations with information on past violation histories of hazardous materials offenders for consideration when assessing civil penalties. In addition, information about pending enforcement actions against shippers is also collected and shared, thus allowing each administration to know if another administration is already involved in a pending case. Finally, administrations with active shipper inspection programs can use the information to plan inspections or consolidate enforcement cases across modes. Because the Intermodal Hazardous Materials Programs (IHMP) office of S-3 is in the process of preparing a final Information Resources Management (IRM) procedures document for UNISHIP, no

recommendations have been issued at this time. The IHMP IRM procedures document addresses UNISHIP data file transfer structures and file content issues for improving UNISHIP. It also lists related responsibilities for each Operating Administration (OA), and the Office of the Inspector General (IG). Additional updates to prior years data will be made as required under the final IRM procedures. Currently, the IHMP is working with the Research and Special Programs Administration (RSPA) to develop a schedule for beta-testing bimonthly transfers of UNISHIP data from each of the OAs using the new file content and transfer structures.

Hazardous Materials Information System (HMIS)

The Hazardous Materials Information System (HMIS) consists of six databases that support the mission of the Office of Hazardous Materials Safety (OHMS) in the Research and Special Programs Administration (RSPA). The initial hazardous materials incident reporting system was established in 1971 to meet the requirements of the Hazardous Materials Control Act of 1970. Of the six databases that constitute the HMIS, the only database with a large set of numeric elements with statistical properties is the Hazardous Materials Incident Reporting System (HMIRS).

When an unintentional release of a hazardous material occurs, during transit, loading/unloading, or temporary storage, Title 49 CFR 171.15 and 171.16 requires the transporting carrier to report the incident. Carriers must also notify the National Response Center immediately by telephone, and file an incident report within 30 days,

when any one of the following events occurs:

- one or more major transportation arteries or facilities are closed or shut down for one hour or more,
- the operational flight plan or routine of an aircraft is altered,
- an evacuation occurs lasting one or more hours,
- estimated carrier and/or property damage exceeds \$50,000, or
- a person is killed or hospitalized.

The HMIRS identifies the mode of transportation involved, the name of the reporting carrier, shipment information, the hazardous materials involved, the consequences of the incident, reporter information, and the nature of packaging, as well as the factors contributing to packaging failure. On average, carriers reported about 14,500 incidents per year during 1995 to 1997. The average number of incidents increased to about 17,200 records per year after intrastate reporting started in October 1998.

The assessment conducted by BTS points out positive qualities as well as potential problems within the HMIS system. This data quality assessment is currently under management review.

Airline Passenger Origin-Destination Survey

The Airline Passenger Origin-Destination Survey tracks passengers' use of the commercial air traffic system. It collects information on passenger origins, destinations, and routings. The Civil Aeronautics Board launched the first airline passenger survey in 1947, based on passenger reservations. The reporting basis changed from reservations to tickets in 1968.

After the Civil Aeronautics Board was terminated on December 31, 1984, the Origin-Destination Survey continued as a ticket-based survey under DOT's Research and Special Projects Administration. Since 1995, the Bureau of Transportation Statistics, Office of Airline Information (OAI), has conducted the survey by authorization of Title 14 CFR 241, 19-7.

The Airline Passenger Origin-Destination Survey relies on a 10-percent sample of tickets from large certificated air carriers conducting scheduled passenger services. About 12 million passenger tickets were sampled during 2000. Except for international data (itineraries including non-U.S. points), OAI releases all data from the Airline Passenger Origin-Destination Survey to the public.

Selected findings of the data quality assessment:

- Documentation for the Origin-Destination Survey is weak, thereby hindering the use of the data. The survey also lacks a source and accuracy statement to inform users of the limitations of the data.
- Although tickets are sampled continuously, air carriers report data for the Airline Passenger Origin-Destination Survey 45 days after the end of the quarter, and OAI then takes 75 days to prepare the data.
- Long-term data timeliness and quality gains can be realized if computerized reservation systems can be adapted as the basis for the Origin-Destination Survey. OAI would need to thoroughly test the feasibility and accuracy of such an approach.
- OAI should consider not releasing summary estimates for markets

where the sample size is below a certain minimum, e.g., 200 to 500 cases per quarter. Estimates of variance should be developed for any summary estimates published.

National Transit Database System – Safety & Security Module

The Federal Transit Administration (FTA) has responsibility for the National Transit Database (NTD) system, which is authorized by Title 49 U.S.C. Section 5335(a) and (a)(2). The NTD provides information describing the U.S. transit system with respect to investment, expenditures, operations, and performance. The assessment document provides background information on the NTD, but the actual assessment pertains only to the Safety and Security module.

BTS was given the unique opportunity to assess the pilot for the recent revision of the Safety and Security module. The Safety and Security module is being revised at the direction of the U.S. House and Senate Committees on Appropriations as specified in the Reports to the U.S. Department of Transportation (DOT) FY 2000 Appropriations Act. Recommendations have been made by BTS in the assessment document regarding the collection tool used to gather safety and security information. Current computer technology allows breaking the extensive information required on the Safety and Security Forms into a series of simple questions with appropriate response categories. BTS is recommending that a series of screening questions be used to lead the respondent through the new process, omitting items irrelevant to the mode for which incident data are being reported. It is recommended that response categories be linked to follow-up items for

additional detailed data. In this way, the respondent would only see questions and response categories relevant to their situation. An individual reporting a transit incident should be able to click on a button to view descriptive information pertaining to the questions asked on a particular screen. This can eliminate the need for repetitive references to hardcopy manuals while preparing the report. Built-in controls can prevent the respondent from entering data not of a specific type or outside a prespecified range. The use of such techniques will address certain legislative concerns by:

- Reducing the margin of error – with skip patterns in the instrument, the individuals reporting incident data need not be presented with a list of items and categories, some of which may not apply to them. Individuals reporting incident data for a transit agency that does not operate rail modes, for example, may not be familiar with the terminology and conditions relevant to rail modes.
- Reducing burden of data reporting – by presenting questions and categories specific to the mode involved, the time required for incident reporting is reduced.

The collection of more detailed information on safety and security incidents effectively addresses the congressional mandate to identify common causal factors involved in transit incidents, as specified in the Reports to the U.S. Department of Transportation FY 2000 Appropriation Act. Changing the reporting requirements from annually to monthly or quarterly (depending on the size of the transit authority) will greatly improve the timeliness of the safety and security information on transit incidents.

Because much of the historical data files are not available in text (ascii, or csv) format from NTD website, importing the data into statistical packages, e.g., SAS, proved to be quite difficult and time consuming. BTS recommends that FTA make the NTD data more accessible to users by ensuring that data can be easily and quickly read into statistical packages, like SAS, as well as into user-friendly packages like Excel.

National Aviation Safety Data Analysis Center (NASDAC) Data System

The Federal Aviation Administration's NASDAC data system is a growing, integrated metadata repository. Its User Committee is continuously providing input for enhancements. At present, the NASDAC contains 27 data systems imported from various source databases. There are a number of highly desirable features built into the operational facets of the repository and the number of users is growing. The NASDAC data system currently provides various resources to the aviation community, including:

- a centralized repository of aviation safety databases;
- a library of aviation safety studies and reference materials;
- local and wide area network access;

- Internet, Intranet, and Extranet access;
- data access, analysis, and retrieval software; and
- on-site technical and analytical support personnel.

The NASDAC Data Quality Assessment is being done in stages. This first stage assessment includes a total system overview of NASDAC. This is necessary in order to learn about the data repository, prior to the data quality assessment of individual NASDAC source databases.

Given that the NASDAC warehouses a significant number of various aviation safety databases, the NASDAC User Committee recommended that an automated data quality assessment capability (which could be applied to each source database) should be incorporated into the system. This automated data quality assessment capability is an integral component of NASDAC's Advanced Data Architecture (ADA). The ADA is in the development stage and will be implemented in early 2002. Since NASDAC's data quality assessment and data quality reporting capabilities are still in development stage and are not yet installed in the repository, the recommendations will be deferred until a review of this system component is conducted.

Attachment Data Quality Assessment Template

This is a worksheet for the information gathered and the assessments prepared during a detailed data quality assessment. The information gathered in Sections A through G serves as background material for the Assessment Report, which would consist of an Introduction followed by Sections H and I.

A. Background
1. Name of data system:
2. Sponsoring agency:
3. Legal authority: <i>Legislation, regulations</i>
4. When initiated:
5. Original purpose of data system:
6. Target population: <i>Events/objects/businesses/persons/etc. of interest and rationale for choosing</i>
7. History of data system: <i>Significant changes in purpose, data uses, collection strategies, etc.</i>
8. Future plans: <i>Have any? How are plans formulated?</i>

B. Frames and Sampling (if applicable)
1. Frame: <i>Minimum values for eligibility, sources, update procedures (source? how often updated? how current?), coverage of target population</i>
2. Sample design procedures: <i>Description of sampling technique, stratification/clustering, sample allocation, sample weighting (include post-stratification/benchmarking/calibration), variance estimation, redrawing/rotating (how often?)</i>
3. Sample size: <i>Size of frame, total number selected, number per stage if multistage</i>
4. Documentation: <i>Topics covered, intended audience</i>

C. Data Collection
<p>1. Reporting requirement: <i>Mandatory/voluntary, how enforced</i></p>
<p>2. Mode of data collection:</p>
<p>3. Frequency of data collection: <i>Periodic (annual/monthly/etc.), irregular/on-demand, e.g., whenever a particular event occurs</i></p>
<p>4. Geographic coverage: <i>Scope, detail</i></p>
<p>5. Associated data collection forms and instructions; <i>How are form(s) developed, when and why last changed, pretesting/usability testing</i></p>
<p>6. Form/instrument: <i>Reference period, summary of content (section by section), due date for completion of form, when data considered usable for reporting purposes, clarity of layout and instructions</i></p>
<p>7. Number of reports per reporting period:</p>
<p>8. Actual/typical reporter: <i>Number per form, characteristics, knowledge of subject, quality control</i></p>
<p>9. Amount of effort for reporter/data collector to complete form: <i>Time, research</i></p>
<p>10. Reporter feedback: <i>Difficulty with form, definitions, availability of information, etc., burden (time, research)</i></p>
<p>11. Documentation: <i>Topics covered, intended audience</i></p>

D. Data Preparation
1. Who prepares:
2. Editing: <i>Types of edits, how are error messages dealt with, verification procedures</i>
3. Late/missing reports: <i>Follow-up procedures, rate (and how calculate)</i>
4. Adjustment/imputation for late/missing reports: <i>Procedures, impact on estimates</i>
5. Missing items in reports: <i>Follow-up procedures, rate for key items</i>
6. Any imputation for missing items in reports: <i>Which items, procedures, impact on estimates</i>
7. Changes and updates: <i>Procedures, report files archived?</i>
8. ITDB preparation: <i>Changes made, reasons for changes, impact on estimates</i>
9. Documentation: <i>Topics covered, intended audience</i>

E. Data Dissemination
1. Intended audience: <i>DOT (which part?), Congress, State/local governments, industry/trade associations, researchers, etc.</i>
2. Other major uses (enforcement, etc.):
3. Confidentiality/privacy concerns and protections:
4. Reports and publications: <i>Name, date of release (relative to end of reporting period), particular target audience, format(s) released (hardcopy, online, CD, etc.), how label/identify revisions, description of data limitations included?</i>
5. Analysis: <i>Estimation procedures, statistical comparisons, seasonal/cyclical adjustment</i>
6. Tabular and graphical presentation:
7. Release of data: <i>What information released, what format, available to whom</i>

F. Sponsor Evaluation
1. Coverage of target population:
2. Validation of data:
3. Data quality/limitations of data: <i>Sources and accuracy stated, sampling error, nonsampling error</i>
4. User feedback: <i>Who are actual users, how well are needs met, how is feedback solicited, performance measures collected</i>
5. Prior reviews:

G. Data Quality Staff Data Analysis
1. Ease of access and use
2. Documentation sufficiency, accuracy: <i>Variable names, values, etc.</i>
3. Blank data elements:
4. Overuse of text fields:
5. Coding/classification problems: <i>Mutually exclusive and exhaustive, systematic, overuse of "other", "NEC", etc.</i>
6. Duplicate records:
7. Outliers:
8. Inconsistencies among items:
9. Ability to reproduce published/official estimates:
10. Relationship to other data: <i>Within data system over time, ability to relate to external data systems (e.g., standard definitions, codes), estimates, duplication between systems</i>
11. Anything else that looks strange:
12. Source of data used in DQ staff analysis: <i>Name of file, location, date acquired/accessed, version, etc.</i>

H. Assessment
<p>1. Relevance and Completeness: <i>User needs and data gaps, coverage of major issues, user involvement mechanisms, program review and monitoring policies [cf. Sections A, E, F]</i></p>
<p>2. Quality: <i>Design of data collection meet objectives, how carefully implemented, assessments of accuracy provided, quantification of accuracy and deficiencies [cf. Sections B, C, D, E, G]</i></p>
<p>3. Timeliness: <i>Delay between reference date and time information available, delay between time information available and time needed to be useful [cf. Sections A, C, E, F]</i></p>
<p>4. Comparability: <i>Ability to combine with other information, cross-modal consistency in concepts and definitions, consistency with non-DOT concepts and definitions [cf. B, C, G]</i></p>
<p>5. Utility: <i>Ease of obtaining information, suitability of format for users, availability of supplementary information/metadata needed to use data correctly, documentation, and its interpretability, statements describing limitations of the data [cf. Sections A, C, D, E, F, G]</i></p>

I. Recommendations and Suggestions for Data Quality Improvements
<p>1. “Tactical” (correcting any errors found during review):</p>
<p>2. “Strategic” (improving procedures): <i>Easy (low-lying fruit), hard (e.g., need additional resources)</i></p>
<p>3. Continuing: <i>Follow-up on implementation of recommendations, development of standards</i></p>

J. References

PROJECT 2 OVERVIEW

Develop Common Criteria for Reporting Injuries and Fatalities

BACKGROUND

In September 2000, the Bureau of Transportation Statistics (BTS) published the Safety Data Action Plan with the goal of providing the U.S. Department of Transportation (DOT) with data of a quality sufficient to identify, quantify, and minimize risk factors in U.S. travel. The Safety Data Action Plan identified several research projects to address specific shortcomings in current data collection and data quality within the various DOT databases.

The synthesis of the recommendations from this extensive research program can provide the foundation for a plan to improve data quality and comparability within DOT. It is anticipated that these improved data will lead to interventions that will advance the DOT Strategic Safety Goal of eliminating transportation-related deaths, injuries, and property damage.

Objective

The objective of this project was to devise injury coding standards for all DOT databases. This would ensure uniformity in injury event definitions and reporting criteria across modes and include sufficient mechanistic cause information for development of intervention strategies.

GENERAL APPROACH

The general approach was to inventory DOT and selected non-DOT databases, and identify, describe, and explore opportunities to reach the objective.

Scope

The scope was limited to a review of U.S. transportation safety databases including air, water, road, rail, transit, and pipeline, as well as a review of standards and best practices from non-transportation injury data systems or coding protocols. This review focused on data related to acute non-intentional injuries sustained by transportation workers and travelers, but also considered the potential for reporting chronic injuries and disabilities and intentional injuries such as homicide and suicide.

Data Sources

The data sources included the following federal agencies:

Department of Transportation agencies:

- Federal Aviation Administration (FAA)
- Federal Motor Carrier Safety Administration (FMCSA)
- Federal Transit Authority (FTA)

- Maritime Administration (MARAD)
- National Highway Traffic Safety Administration (NHTSA)
- Research and Special Programs Administration (RSPA) (under the Office of the Secretary of Transportation; includes hazardous materials, pipeline safety, and other special projects not mode-specific)
- U. S. Coast Guard (USCG)

Other federal agencies:

- National Center for Health Statistics of the Centers for Disease Control and Prevention (NCHS/CDC)
- National Institute for Occupational Safety and Health (NIOSH)
- Consumer Product Safety Commission (CPSC)
- National Transportation Safety Board (NTSB)
- Department of Defense (DOD)

Purpose of Injury Investigation/Data Collection

Investigations of transportation incidents are intended to determine the cause(s) of the incidents. DOT's Strategic Safety Goal is to "promote the public health and safety by working toward the elimination of transportation-related deaths, injuries, and property damage." The overriding philosophy is that the determination of cause factors will lead to prevention strategies. Although the elimination of injury-producing incidents is a justifiable and laudable goal, few believe it is achievable as long as humans are involved in the design, manufacture, operation, and maintenance of transportation systems. This is particularly true considering the constantly increasing

exposure in most, if not all, transportation modes.

A secondary goal of incident investigation and data collection should be to determine the cause(s) of injury. An appropriate balance needs to be reached between efforts directed toward incident prevention and those directed toward injury prevention. This secondary goal is frequently overlooked or underemphasized in the investigation of transportation incidents either because it is not recognized as important by the investigating agency or because of resource limitations. Some have argued that injury and survival factors investigations are unnecessary and detract from the main focus of investigations — the prevention of incidents. Such reasoning is based on the now discredited "zero defect" mentality that persisted in the 1970s and 1980s. In order to meet the DOT Strategic Safety Goal, both aspects of incident investigation must be aggressively pursued.

Injury investigation and the recording of injury data in transportation databases is generally undertaken to meet one or more of four main objectives:

1. to determine the "severity" of an incident,
2. to aid in the calculation of the "cost" of transportation incidents,
3. to provide a basis for management decisions related to prioritization and resource allocation, and
4. to provide a basis for developing prevention/mitigation strategies.

The first two objectives can be achieved with relatively rudimentary injury data, such as recording whether each person involved in the incident received fatal injuries, was otherwise injured, or was uninjured.

Depending on the goals of the organization, the third objective may be met with either rudimentary or more detailed data. To meet the fourth objective of providing a basis for developing injury mitigation strategies, however, requires not only descriptive data on the nature of the injuries sustained by persons involved in an incident, but also information relating to the mechanism or cause of those injuries.

Clearly, one cannot develop an effective prevention strategy for a particular type of injury if that injury is not adequately described and if the cause of the injury is not known. Consequently, the development of a database that can be used to formulate injury mitigation strategies requires considerably greater amounts and specificity of data than a database designed to meet the other objectives listed above.

The mechanism of an injury can be described on various levels. Frequently, the term is used in its general sense to describe the activity that caused a person to be injured. Examples include “automobile crash,” “fell from a height,” or “involved in an explosion.” Although this level of description provides some useful data, it states the obvious in most transportation incidents, and is thus not very useful for developing mitigation strategies. A more useful level of description requires the identification of the particular injury such as “left distal tibia fracture” and a clear mechanism of that injury such as “floorboard deformed inward.” This detailed joint description of injury and cause gives a clear picture not only of the injury but also of the specific cause of that injury. A database with this level of description allows the user to identify and quantify the occurrence of that injury and its associated mechanism over time and also suggests a

mitigation strategy — prevent the floorboard from deforming. Without such data, analysts could identify the injury, but the cause and potentially effective mitigation strategies would be left to speculation.

Detailed injury and mechanism data are indispensable in identifying and quantifying injury causes and performing a cost-benefit analysis of proposed prevention strategies. However, collection of reliable mechanistic data requires well-trained investigators, detailed analysis of the incident scene, and a higher level of resource commitment than is currently available in many incident investigations. Specifically, the process requires an analysis and description of all significant injuries, careful analysis of the environment to which the injured was exposed, an analysis of protective equipment (e.g., seats and restraints) to determine function or lack of function and use, and a knowledge of the crash dynamics, incident circumstances, and related structural failure modes.

Longitudinal analysis can identify consistent injury mechanisms suggesting the need and method of implementing injury prevention strategies and providing the justification for the expenditures involved. Such analysis was responsible, for example, for the improvements in automobile restraint technology introduced in the U.S. market over the past 40 years. In the 1960s, the lap belt was introduced into automobiles primarily to prevent ejection of occupants from vehicles during crashes. Subsequently, it was shown that although the lap belt prevented occupant ejection, it did not prevent upper torso and head contact with internal structures, and it even caused a constellation of injuries later referred to as the “seat belt syndrome.” Consequently, the lap/shoulder harness restraint system was

introduced. This innovation greatly reduced the injuries identified in many previous crashes, but was it shown to be insufficient to protect front seat occupants in other types of crashes. This led to the development of the air bag, which was first offered to enhance protection in frontal collisions for drivers, then all front seat occupants, and was subsequently refined to avoid certain serious injuries caused by the air bags themselves in some cases. Now the technology has been extended to protect both front and rear occupants in side impacts. These innovations have all been based on knowledge of injuries and causal mechanisms derived through crash investigations and a database with sufficient data to perform an accurate analysis and quantification of injury mechanisms.

Therefore, in a program to provide common injury data and common injury and event definitions across all modes of transportation, it is vital to establish clear objectives for the use of the data and to ensure that new data systems provide a sufficient level of detail, quality, and commonality to meet those objectives. To provide a data system that will provide a sufficient level of detail to develop and justify injury mitigation strategies will require that mechanistic data be collected and stored. For some modes, this will require a considerably higher level of commitment to incident investigations in terms of trained investigators and financial resources than currently available. Other modes currently have such systems in place.

INJURY INFORMATION COLLECTED BY EACH MODE

General

Each transportation mode is regulated by at least one federal agency with at least one database on injuries and property damage but with little coordination of data collected, definitions of events or injuries, or data-collection methods. The *Volpe National Transportation Systems Center Report* provided a comparison of reporting criteria and how fatality and injury data are captured and reported within agency databases. The working group for this project (2) obtained basic data for comparison from the Volpe report and provided more data on non-DOT databases.

Comparison of Databases

Injury Criteria Utilized in Existing Databases

The working group developed a matrix comparing each data source on 10 factors: agency responsibility with respect to injury investigation, identity and training of data collectors, nature of data sources, definitions of events that trigger investigation or report, event and circumstance inclusion criteria, inclusion of data on uninjured, fatality definition, injury definition, injury coding, and statutory requirements governing the scope of investigation and reporting.

Event Definitions

Most agencies use one or more of four factors as the threshold for reporting an incident: degree of injury, dollar amount of property damage, amount of substance released into environment, and type of occurrence. There is mode specificity and wide variation on each factor, although all

agencies report fatalities at the scene involving operation of a vehicle or pipeline.

Fatality Definitions

In some cases, whether a fatality is deemed transportation-related and reportable may depend on the function of the fatally injured person at time of death. Agencies also vary in the maximum elapsed time between injury and death permitted for reporting, with FRA allowing up to 365 days, while transit, highway, and aviation agencies allow up to 30 days, and pipeline and marine agencies do not specify any such limit.

Injury Definitions

Criteria for reporting injury vary widely. Examples include injuries requiring hospitalization, needing to be carried from the scene, needing medical treatment, disability beyond the day of injury, incapacitation or hospitalization beyond 24 hours, and so forth.

Person Inclusion Criteria

The function or location of victims at the time of an incident frequently determines if their injuries are reportable, and the specific criteria for inclusion vary widely across databases.

Uninjured Persons

Databases vary widely in whether or how uninjured occupants or bystanders are reported.

Data Collectors

The training and background of persons investigating and reporting data varies widely, with trained professional investigators in some modes, self-reporting owners or operators in others, and combinations of police accident reports and

trained investigators in the NHTSA database.

Injury Coding

There is no universally accepted system of injury classification and coding among any databases known to the working group. Most schemes focus on injury description, severity, and mechanism. The Abbreviated Injury Scale (AIS) is the most widely used and accepted system, classifying injury by body part, specific lesion, and severity on a 6-point ordinal scale with a 7th-digit to code "Unknown," where severity is looked at in terms of the threat to life of a single injury without respect to combined effect of multiple injuries on one person. The Injury Severity Score (ISS) and the Maximum AIS (MAIS) are functions of the AIS on a single injured person that measure overall injury severity. Most hospitals encode discharge diagnoses using the International Classification of Diseases, Clinical Modification, 9th Edition (ICD-9CM), which classifies injury and other diagnoses by a numerical code and will be revised within a year (ICD-10CM). A published conversion table exists to translate ICD-9CM codes into AIS. AIS does not specify injury mechanism or body part aspect (e.g., left or right, superior or inferior, anterior or posterior). The KABCO scheme allows nonmedically trained persons to make on-scene injury severity assessments, where K = Killed, A = Incapacitating Injury, B = Non-incapacitating injury, C = Possible injury, and O = No injury.

Discussion

Due to the wide variation among DOT modal agencies in event definitions, type and detail of injury data, and methods and resources applied to incident investigation and injury reporting, achieving common

criteria will require major changes in practices and resource allocation, and associated *Code of Federal Regulations* (CFR) specifications, in some or all agencies. The working group considered two approaches to establishing common criteria for reporting injuries and death: a minimal “least common denominator” approach and a proven current systems approach. The minimal approach would adapt the existing method with the least complexity and resource allocation to all modes to allow general cross-modal comparison of injury cost and severity, but would not provide sufficient data to identify injury causes or develop practical mitigation strategies.

In contrast, two proven current systems provide data sufficient to identify injury causes and support development and justification of mitigation strategies: the National Automotive Sampling System Crashworthiness Data System (NASS CDS) and the U.S. Army Aircraft Accident Reporting System (USA AARS). While the NASS CDS is a probability sample using trained investigators or analysts, the USA AARS is a total reporting system (census), using physicians to record the data. Both systems are based on AIS 90 with additional fields for pertinent injury and mechanism information. NHTSA and automobile manufacturers routinely use NASS CDS data to identify and mitigate injury hazards and to justify or oppose proposed rulemaking. The U.S. Army routinely uses USA AARS data to identify and mitigate causal factors associated with injuries.

RECOMMENDATIONS

General

In spite of the marked differences among transportation modes in event and injury definitions, inclusion criteria, and the reporting and coding of injury data, establishing common criteria for such reporting among the modes is a technically achievable goal. The main impediment to achieving the goal will be resource allocation. Nevertheless, in the spirit of the Safety Data Action Plan and DOT Strategic Safety Goal, the working group has developed the following set of recommendations that it believes will promote commonality among the modes and also improve the quality and utility of mechanistic incident and injury data for development of strategies to prevent injuries in vehicular crashes and other transportation-related incidents.

Event Definition

The working group recommends that all modes adopt the following definition of a reportable event.

Any incident involving the movement or operation or intended movement or operation of a motor vehicle, vessel, aircraft, pipeline, or other conveyance in the course of transporting persons or goods from one place to another:

- that occurs within U.S. jurisdiction or involves a U.S. commercial carrier;
- where the cause is intentional or unintentional;
- that results in substantial property damage; or
- that results in injury (requiring medical attention beyond first aid) or

death of anyone (passengers, crew, pedestrians, other workers, or bystanders) within 30 days of the event.

Fatality Definition

A transportation-related fatality one that results from injuries incurred in a transportation incident when the death occurs within 30 days of the incident.

Injury Definition

A transportation-related injury is one requiring medical attention beyond first aid given in a transportation incident.

Uninjured

To evaluate injury prevention countermeasures and the hazard associated with design features or environmental structures, record data for both injured and uninjured individuals exposed to the same potentially injurious event. At a minimum, age, sex, seating position, and occupant restraint use and availability should be recorded for uninjured individuals exposed to a reportable event.

Injury Classification and Coding

The working group recommends an injury reporting system patterned after the NASS CDS, with at least the following elements:

- source of injury data,
- complete AIS 90 code, including severity code,
- aspect of injury 1,
- aspect of injury 2, and
- injury source (one or more data fields).

Because injury mechanisms differ markedly across modes, an encompassing set of common codes cannot be developed for use across all modes. The working group

recommends that experts in each mode and/or database develop a set of codes patterned after the NASS CDS or USA AARS, after which commonalities can be identified and implemented while maintaining necessary mode-specific codes. The working group recommends a cost-benefit analysis of the feasibility of applying the adopted standards to historical data in DOT databases. If modes elect not to adopt the recommended common coding method, then the working group recommends that they adopt AIS for some commonality with other modes, and if the latter is not elected by a mode, then the mode is urged to adopt KABCO or a modification thereof as part of their injury-coding scheme.

Other Recommendations

Finally, the working group suggests two other recommendations that were outside the scope of the current project. First, each mode or database manager should consider opportunities for limiting detailed investigations of incidents to a valid statistical sample as has been done by NHTSA in the NASS CDS database. Sampling requires a high volume of incidents for precise statistical estimation. For this reason, it will not be practical for all modes, but it should be considered for general aviation and, most likely, recreational boating. Second, each mode should pursue opportunities for linking transportation databases to hospital databases, state or territory vital statistics, and other medical databases. Such linkages have the potential of reducing workload and resource requirements as well as increasing the accuracy of injury recording.

PROJECT 3 OVERVIEW

Common Denominators for Transportation Safety Evaluations

INTRODUCTION

Background

Transportation safety statistics are often reported as rates of events, such as crashes or deaths per some unit of activity (often called exposure). The type of exposure information used to calculate these rates varies greatly and is often specific to the type or mode of transportation system being evaluated. This mode-specific characteristic makes comparisons of the relative safety of different transportation modes very difficult. Consequently, transportation safety practitioners, policymakers, and the public often have difficulty accurately comparing the safety performance of different transportation modes.

In September of 2000, the Bureau of Transportation Statistics (BTS) of the U.S. Department of Transportation (DOT) initiated a project called the Safety Data Action Plan. The goal of the plan was to develop an approach to improve the quality of safety data throughout DOT. BTS identified 10 subject areas that would benefit from a focused effort to improve the quality of transportation safety data and information.

One of these topics was the development of common denominators for safety measures. The problem was defined as “Each mode uses a different set of denominators (*exposure measures*) for evaluating changes in safety risk” (Safety Data Action Plan).

The plan authors further observed “We need some set of common denominators that can be used to characterize transportation safety in a comparable way for comparable circumstances. It should be possible to compare the risk of recreational boating, for example, to the risk of recreational flying or recreational driving.”

While there are limitations to identifying cross-modal exposure measures, the potential benefits from such an effort are many. For example, having a common frame of reference for transportation safety metrics will allow researchers and policymakers to conduct evaluations that provide insight on some of the following issues:

- the overall safety of the transportation system;
- relative safety of different modes;
- comparison of the effectiveness of safety interventions for different modes;
- focus areas for research and/or funding; and
- strategic planning for transportation agencies including federal, state, and municipalities.

Objective

The objective of this project is to identify common denominators suitable for safety evaluations and comparisons within and

across various transportation modes (aviation, recreational boating, commercial fishing, etc.). Numerous factors will be considered, including the suitability of current exposure measures for cross mode comparisons, the possible need to develop new measures, and the methods required to develop these new measures.

GENERAL APPROACH

The project involved two main steps: baseline determination of current exposure measure characteristics and evaluation of cross-mode suitability of the exposure measures.

Baseline Determination

- Current exposure measures used in transportation safety evaluations were indexed and cataloged.
- Limitations and gaps associated with the current exposure measures were identified.
- Potential improvements in current exposure measure data systems were identified.

Cross Mode Exposure Measures

- Suitable, and unsuitable, cross mode comparisons were identified.
- Exposure measures needed to support these comparisons were identified.
- Recommendations for the use of exposure measures suitable for intra- and intermode comparisons were made including the development of new measures where appropriate.
- Approaches for implementing findings and recommendations were identified.

Scope

The scope of this project is limited to evaluation of exposure measures suitable for use in transportation safety related evaluations (both inter- and intramode). Primary attention was paid to U.S. DOT based data systems, although those data systems commonly used for exposure data maintained by non-DOT organizations are also included. Exposure measures for the following modes were considered:

- aviation,
- highway,
- railroad,
- transit,
- water, and
- pipeline.

Note: The working group for this project was concerned about defining what constitutes a transportation related occupational injury or death. This would have a direct impact on the exposure measures used for evaluating such injuries. Consequently, the Project 3 working group applied the scope definition used by the Project 5 and Project 2 working groups. Specifically, exposure measures were considered that were useful for rate calculations of transportation crashes or mishaps. The definition of crash and mishap was defined as:

- any incident involving the movement or operation of a vehicle, vessel, aircraft, pipeline, or other conveyance in the course of conveying persons or goods from one place to another;
- occurs within U.S. jurisdiction or involves a U.S. commercial carrier;
- is intention or unintentional; and
- results in substantial property damage or injury (requiring medical attention beyond first aid) or death within 30 days (e.g., passengers,

crew, pedestrians, other workers, or bystanders).

Information Sources

Data Sources

Exposure information is sometimes derived from data sources not originally designed for transportation safety analyses. An example might be the use of information derived from the registrations for recreational boats. Submittal of these data are required from each of the 50 states. The data is then collected by the U.S. Coast Guard and used for safety evaluations. The difficulty with this exposure data source is that individual states have different registration requirements and data may vary considerably. Further, this exposure source does not provide information on the activity associated with the boats. That is, how are the boats used, by whom, and so on? Finally, there is no federal control of boat registration, and thus changing the system to produce better exposure information will be difficult, as will be the case with other sources of exposure data (e.g., automobile registrations and licensed driver registries).

In contrast to the boat registration database, other sources of exposure data are specifically designed for use in safety evaluations. An example of this is the General Aviation and Air Taxi Survey conducted by the Federal Aviation Administration on a yearly basis. This survey collects information from a sample of aircraft owners who provide information on how the aircraft is used, how often it is flown, and how it is equipped, plus many other types of information that prove useful to analysts and policymakers.

For this project, the primary source of the exposure data is collected and maintained by the following government organizations.

U.S. Department of Transportation

Federal Aviation Administration (FAA)
Bureau of Transportation Statistics (BTS)
Surface Transportation Board (STB)
Federal Railroad Administration (FRA)
U.S. Maritime Administration (MARAD)
United States Coast Guard (USCG)
Federal Highway Administration (FHWA)
Federal Transit Authority (FTA)
Research and Special Projects
Administration (RSPA)

Other Federal Agencies

National Institute for Occupational Safety and Health (NIOSH)
U.S. Army Corps of Engineers
U.S. Census Bureau

Most of the exposure databases maintained by these organizations were evaluated by DOT's Volpe National Transportation Systems Center (Berk) and summarized in a report to support this project.

Expert Panel

In addition to the information provided by Volpe and the various government agencies, an expert panel of experienced transportation safety practitioners, researchers, and government representatives provided considerable input on the focus of the project and the associated recommendations.

Consideration of Approach

Initially, the working group assigned to this project spent a significant amount of time conceptualizing how cross modal comparisons would work. This became one of the first steps undertaken because the working group had little experience in using common exposure measures for comparisons across modes. Review of the relevant literature and comparison of the experience among the working group members demonstrated that such

comparisons appear to be somewhat uncommon.

Traditionally, transportation safety statistics are reported and compared within modes. Typical statistics arising out of these comparisons might include reporting rates of events, perhaps over time so comparisons could be made of the increase or decrease of unwanted events. In order to understand how cross modal comparisons might be used, a sample of potential questions or comparisons was derived from input from BTS staff. Some of these ideas are listed below.

How Common Exposure Measures Might Be Used

- Allocating research resources across modes (and across federal programs in general).
- Making modal choices for travel among the public (where there are logical choices to made (e.g., long automobile trips or bus trips versus airline travel).
- Identifying especially risky transportation occupations or activities.
- Monitoring overall transportation system safety performance and targeting interventions where the most benefit might be expected.
- Strategic planning for DOT and other governmental transportation authorities.
- Support for rulemaking.

Review of the various exposure databases shows a large variation in how data are collected and used. Because of these many differences, it is inappropriate to expect a single set of exposure measures might to be suitable for all transportation modes. It may be that simple exposure measures (e.g., number of people transported by a mode)

are useable for cross-mode evaluations, but this measure may not be very informative. If efforts are made to find exposure measures that are more specific, such as the number of hours flown by a pilot during a fixed time frame, the applicability across the various modes seem to rapidly diminish.

In addition, it is clear that cross-modal exposure measures are only needed where there are meaningful cross-modal comparisons of risk. For example, the working group could not think of meaningful comparisons of say, the risk of flying on a commercial airliner versus the risk of riding in a recreational sailboat. In like fashion, it is clear that cross-modal exposure measures between two or more modes might change based on the risk question being asked. For example, the risk to freight between air and highway modes might require a different exposure measure than the risk to the operators of the freight carriers in the two modes.

Based on these considerations, the working group decided to apply a simple conceptual model applicable to all modes to help determine what types of cross modal exposure data might be valid and useable. There were four main categories (each with multiple subgroupings) included in this model.

Cross Modal Categories for Exposure Data

The four groupings used by the working group were associated with the underlying purpose of the transportation activity:

1. *Recreational use:* Includes activities such as pleasure boating, recreational flying, and recreational driving.
2. *Cargo and material transportation:* Includes transportation of cargo and materials by airplane, truck, pipeline, and water.

3. *Passenger transportation*: Includes all activities involving passenger transportation, both commercial and private.
4. *Occupational and Harvesting*: Includes occupational activities such as commercial fishing, truck driving, flying, etc.

These categories are not mutually exclusive, but they provide a starting point for discussing suitability of cross modal comparisons.

DISCUSSION OF CROSS MODAL EXPOSURE MEASURES

Working group 3 identified potential exposure measures that could be applied across modes. In some cases, these exposure measures are derived from current exposure data systems while in others, new data collection efforts might have to be undertaken.

As mentioned earlier, the results from the working groups' discussion on exposure measures suitable for cross modal evaluation are organized by the function of the transportation activity. These groups are passenger transportation, freight transportation, recreational use, and occupational activities.

Passenger Transportation

Modes involved in passenger transportation include aviation, highway, transit, maritime, and rail. The working group was also asked to consider walking and bicycling, but decided that only bicycling was suitable for inclusion in this evaluation of exposure measures. Exposure measures identified by the working group that might be of use are included below. Some of these exposure values are derived from actual measures (from surveys or required reports) while others are calculated from measures that are reported:

- person miles traveled (calculated),
- person hours of travel (calculated),
- average trip length in miles (measured),
- average trip length in time (measured),
- number of occupants in vehicle (measured),
- number of people using that mode of transportation per year (measured), and
- number of licensed drivers/operators (measured).

Freight Transportation

Modes involved in freight transportation include aviation, highway, maritime, rail, and pipeline. It should be noted that transportation of materials by pipeline is very different than transportation of most other freight. This characteristic caused a fair amount of discussion among working group members who had difficulty identifying common exposure measures for freight that would also include pipeline. Exposure measures identified by the working group that might be of use include:

- ton miles,
- cube miles,
- trip length in miles,

- trip length in time (these two values would allow speed values to be calculated),
- number of licensed drivers/operators,
- volume of materials transported,
- person miles traveled (calculated), and
- person hours of travel (calculated).

Occupational Transportation Exposure Measures

The working group felt strongly that the quality of occupational exposure data in the transportation industry must be improved. The group, however, had a difficult time determining which groups should be considered transportation workers. As discussed earlier in this paper, the working group decided that occupational-related exposure data should be limited to the actual operation of the vehicle. Support functions such as maintenance, loading, and other activities where the vehicle is stationary would not be included. It should be noted, however, that many occupational groups such as truck drivers, pilots, and others have responsibilities other than just operating their vehicles. These individuals may be required to load and unload trucks, wait for loading, and so on. These activities are considered part of the driver's work time (often called duty time) but are not typically recognized when measuring vehicle operation. This is critical if safety evaluations examine operator fatigue or circadian rhythm disruption. With this limitation in mind, occupational groups would include vehicle operators and crewmembers. It is also appropriate that individuals who rely on their personal vehicles to perform their jobs be included in this group.

There is some discrepancy in the group's definition with respect to occupational

exposure to workers maintaining the "facility." Here, highway transportation is considered somewhat unusual in that facility maintenance and development is done in the presence of moving vehicles (i.e., in highway work zones). This is not true (at least to the same extent) for other modes. Because of this difference, this group is not included here. The working group also decided to include commercial fisherman since they are dependent on the fishing vessel, a form of conveyance, for their livelihood.

Exposure measures identified by the working group for transportation worker exposure databases that might be suitable for cross mode evaluation include the following:

- hours on duty,
- person hours operating the vehicle,
- number of licensed drivers/operators,
- total number of individuals involved in that occupation, and
- active work zones in highway areas (including a measure of size i.e., length by number of lanes as well as a measure of amount of time in place).

Recreational Exposure Measures Suitable for Cross Modal Comparisons

The working group recognized that transportation related recreational activities are fairly common. The working group decided that recreational use of vehicles involved those activities associated with the pleasure of operating the vehicle—not using vehicles for transportation. Activities that might fit this profile included recreational

boating, recreational flying, recreational driving (for example, off- road exploration), and recreational bicycling. Common to all of these recreational uses of vehicles is the fact that traveling from one place to another is not the primary purpose.

Exposure measures identified by the working group for transportation related exposure measures that might be suitable for cross mode evaluation include the following:

- person hours operating the vehicle,
- total number of other participants involved in the recreational use of vehicles, and
- total number of vehicle occupants.

RECOMMENDATIONS

The following recommendations are based on the exposure data needed to support cross modal evaluations.

The general aviation activity survey should be expanded to collect information on the following topics:

- number of aircraft occupants;
- person miles traveled;
- trip length, miles;
- freight (ton miles); and
- hours on duty for professional pilots.

A program should be developed to capture the following types of information from commercial marine operators including commercial shippers and commercial fisherman. At this point, it is not clear if current data collection efforts for this group could be modified or if a new data collection program would need to be developed.

- trip length, miles;
- trip length, time;
- number of occupants or crew;
- hours on duty;

- person miles, stratified by position (crew, passenger, etc.); and
- person hours, stratified by position (crew, passenger, etc.).

The highway data collection efforts, HPMS, VIUS, NHTS, Transportation Annual Survey and Commodity Flow Survey should be reviewed to determine the accuracy of current estimates provided and their suitability for combination or modification to provide or enhance the following information for motor carriers.

- person miles traveled,
- person hours traveled,
- trip length,
- number of occupants,
- total number of trucks operated by commercial motor carriers,
- hours on duty for vehicle operators, and
- purpose of trip.

An ongoing and systematic survey should be undertaken to capture information from recreational boat operators on the following:

- person hours operating the boat;
- person hours on-board, including at anchor;
- total number of boat occupants;
- trip length, miles; and
- trip length, time.

The NHTS should be conducted more frequently to improve timeliness of information and modified to collect information on the following:

- recreational driving;
- recreational boating;
- person hours engaged in recreational driving;
- total number of occupants during recreation driving;
- recreational trip length, miles;
- recreational trip length, time; and

- increase frequency of survey to improve timeliness.

The Department of Transportation should work with State and other appropriate authorities to develop a central repository of demographic information derived from operating licenses and approvals. This would include:

- drivers' licenses,
- operator information for train and transit operators, and
- information on commercial marine operators.

PROJECT 5 OVERVIEW

Developing Common Data on Accident Circumstances

BACKGROUND

Over time, each transportation mode has developed its own way of describing the circumstances surrounding crashes and mishaps. Consequently, there is little consistency across modes in how data are collected and in the characteristics of data describing a mishap. Efforts to define important factors that may contribute to crashes/mishaps are often limited to a single factor or to a poorly delineated group of factors such as “operator error.” A more detailed characterization of human factors and crash survival factors is needed in most transportation modes.

Objective

The objective of Project 5 was to describe the type of data currently available, compare it with that needed by investigators and researchers in order to identify the factors and circumstances that are present in transportation crashes and incidents, and make recommendations for improved data. A major aim was identification of those data elements needed for application of a common conceptual framework of event factors across a wide variety of events and modes.

GENERAL APPROACH

- Identify a conceptual framework of crash/incident factors for use across transportation modes.
- Identify types of information collected on crash/incident factors for the various modes.
- Identify methods for categorization/coding of crash/incident factors by mode.
- Determine how crash/incident factor information is collected by mode.
- Identify limitations of current crash/incident factor categorizations by mode.
- Make recommendations for improvement.

Scope

This project identifies typical crash and incident factors for various modes used during investigations. Included are all transportation crashes or mishaps, defined as:

- any incident involving the movement or operation of a vehicle, vessel, aircraft, pipeline, or other conveyance in the course of conveying persons or goods from one place to another;
- occurring within U.S. jurisdiction or involves a U.S. commercial carrier;
- intentional or unintentional; and
- resulting in substantial property damage or injury (requiring medical attention beyond first aid) or death within 30 days of passengers, crew, pedestrians, other workers, or bystanders.

Data Sources

The data reviewed for this project were collected by U.S. Department of Transportation (DOT) agencies, other federal agencies, and nonfederal agencies such as state medical examiner offices.

CONCEPTUAL FRAMEWORK

We identified the Haddon Matrix as the ideal framework, because of its combination of simplicity and comprehensiveness. The 12-cell Haddon Matrix is the conceptual framework or model most widely used in the injury prevention field and is commonly used to analyze risk factors or prevention measures for mishaps and injuries. The matrix divides the injury event into three phases: “pre-event” (contributing to the likelihood that a crash or other potentially injurious or damaging event will occur); “event” (influencing the likelihood and severity of injury when a crash, fall, etc., occurs); and “post-event” (influencing the likelihood of survival or complete recovery).

Each of the three phases is further divided into four groups of risk factors: those related to 1) the operator or the person who may be injured, 2) the vector or vehicle that transmits the energy, 3) the physical environment, and 4) the social/cultural/organizational environment.

Advantages of the Haddon Matrix are that it is relevant to all transportation modes, is well known and widely applied in the injury field, and can be expanded to accommodate various taxonomies. It can be used to organize risk factors, exposure, circumstances of injury, and preventive measures.

Other analytical or conceptual frameworks such as SHEL and Event Tree Analysis were considered but are generally less comprehensive than the Haddon Matrix, although they may provide more details on one or more cells in the Haddon Matrix.

CRASH/INCIDENT DATA ELEMENTS

The primary databases for each mode should contain information on factors that contribute to the likelihood of a mishap or the occurrence and severity of injury and are structured in a multistage matrix covering pre-event, event, and post-event factors for the following: human factors, vehicle factors, physical environment factors, and social/organizational factors.

MAJOR GAPS AND LIMITATIONS IN DATA

- The quality of data is often less than optimal.
- Some important data elements are rarely collected, such as data on the injury mechanism, whether the person was at work, operator fatigue, and distractions; alcohol data are not routinely collected for all appropriate people.
- Lack of information on injury type and severity (except in NHTSA's NASS/CDS), for example, on surviving airplane passengers.
- Lack of information on uninjured passengers in some state police reports.
- Lack of narrative description, or lack of use of the information in narratives.
- Lack of detail on human factors.
- Lack of feedback to investigators.
- Absence of guidelines for law enforcement officers and others on whom we rely to provide data on transportation incidents.

- Some transportation events such as those involving off-road vehicles, suicide, terrorism and injuries that occur in the absence of a collision are typically not recorded by police or by a DOT agency.
- Linkage of crash investigation reports with death certificate and autopsy data is typically absent.

RECOMMENDATIONS

Data Quality, Adequacy, and Completeness

Changes should be implemented in all transportation systems to ensure that crucial data elements, as outlined in the full report, are included. In addition, the Bureau of Transportation Statistics should work closely with those states having good medical examiner systems to establish procedures for testing and for electronic reporting of all transportation deaths, including pedestrians and passengers.

Improved Methodology

The following recommendations may provide more and perhaps better data. Greater use can be made of sampling to obtain more detailed information on events of interest. Supplemental studies can be used in connection with sampling. For example, at various times data could be collected on all events involving certain types of vehicles or specific circumstances. Confidential reporting systems, similar to ASRS (NASA's Aviation Safety Reporting System) for aviation incidents, could be developed and used by other modes. Special studies using other national databases such as CPSC's National Electronic Injury Surveillance System (NEISS) could be used to address those transportation-related injuries for which data are not routinely

collected by DOT agencies. Finally, high-quality data from states or counties should be combined to provide more complete national estimates.

Improvements in Data to be Collected or Reported

Details about crash severity and mechanisms of injury are needed, especially for general aviation crashes. Systematic samples of crashes, as is currently done for automotive injuries through NASS/CDS, would be a good place to start.

Photographic evidence should be added to files in a format available to and usable by researchers.

All forms for reporting injuries and events should include narrative text on incident circumstances, which would need to be entered and analyzed.

The National Household Travel Survey (NHTS) should include information (e.g., age, gender) on nonfamily passengers.

Greater use should be made of GIS (geographic information systems) to identify exactly where crashes occur and to relate location to highway, seaway, rail, or other features.

To the extent feasible and productive, data elements should be made comparable across modes and among agencies.

Available data from non-DOT sources should be incorporated into DOT data records (e.g., race and occupation are available on the death certificate and should be added to DOT data on fatally injured operators or other persons).

For a sample of fatal crashes, it would be valuable to have linked crash investigation reports and autopsy data.

Greater Use of Technology to Improve Data

A variety of technologies could advance data-collection efforts:

- Incorporation of Event Data Recorder (EDR) data into police reports and FARS and NASS data, in a manner easy for researchers to use, should be an objective.
- Installation of Automatic Crash Notification (ACN) in all road vehicles should be encouraged and the data included in reports of investigators.
- Drop-down menus for data entry by crash investigators have promise; for example, crash investigators could use hand-held devices for entering information as they investigate a crash.
- As other technologies to obtain data (e.g., cameras, GPS/GIS, alerting devices) become available and reasonable in cost, they should be used and the data from them incorporated into incident/crash reports.
- Evaluations are needed to determine whether currently available automatic warning systems are working as intended. An example of this technology is radar, employed in trucks, that emits warning sounds if the vehicle is too close to an object.

Other Recommendations

In order to identify new problems in a timely fashion, data should be made available at least on a quarterly basis.

Easier access to data from the National Driver Registry, currently not available to researchers, would be desirable.

Greater use should be made of some databases such as ASRS.

Increased frequency of surveys that collect data that may change substantially each year would be helpful, e.g., Nationwide Personal Transportation Survey and Vehicle Inventory and Use Survey.

BTS should routinely obtain DOT-relevant data that are not contained in DOT databases (e.g., bicyclist injury data should be obtained from CPSC, since most do not involve motor vehicles and/or public roads and therefore are not included in police reports).

Creation of an office within BTS/DOT to assist external researchers with projects that require use of various DOT-sponsored data systems is especially important for projects requiring linked information from different data systems about individual cases.

Provision of data on the Internet would be helpful, such as data from FARS, GES, NTSB, NPTS; results of periodic DOT surveys such as the National Survey of Drinking and Driving Attitudes and Behavior; and where to find relevant data, both DOT and non-DOT.

DETAILED RESEARCH PROTOCOLS

Full proposals were developed for the following research suggestions, considered by Project 5 members to be the most important:

- Sampling System for Collecting Detailed Data on Aviation Crashes;
- Use of Narrative Text Mining to Supplant/Validate Fixed Field Responses of Naïve Coders;
- Human Factors Taxonomy, Event Data Recorders, and Transportation Safety; and
- Using Indexing Systems to Identify Precursors of Vehicle Crashes, Injuries, and Deaths (this proposal is especially relevant to Project 6).

CONCLUSIONS

The Department of Transportation's mandate includes the safety of the traveling public. Underlying the identification of transportation risks and potential remedies is the need for adequate data.

DOT's Bureau of Transportation Statistics has an opportunity to improve safety through enhancements to the data collected

by the various federal agencies. This report highlights many of the gaps and limitations in transportation data and recommends specific improvements.

Some data gaps and differences among various federal agencies reflect restrictions on legislative authority stipulated in the *Code of Federal Regulations*. Consequently, legislation must be passed to eliminate these gaps, a process that must be championed by each agency. Members of the Safety Data Action Plan were instructed to disregard the existence of legislative barriers when considering data problems and needed improvements.

Regardless of possible barriers to implementation of some aspects of the recommendations, we believe that major steps can and should be made to improve transportation data. Existing databases of the various modal agencies reflect interest in and commitment to useful data collection. We are therefore optimistic that this report will bear fruit.

PROJECT 6 OVERVIEW

Developing Better Data on Accident Precursors or Leading Indicators

INTRODUCTION

The Bureau of Transportation Statistics (BTS) has developed a *Safety Data Action Plan* that sets forth a number of projects intended to improve the quality, reliability, timeliness, completeness, and utility of safety data across all transportation modes. Project 6 focuses on the identifying relationships between precursors and safety outcomes. In particular, the goal of the project is to develop research studies that might significantly improve our ability to predict safety problems, and to identify data elements essential to predicting transportation injuries and fatalities.

A series of meetings between representatives of the various transportation modes were held in the summer and fall of 2001 and resulted in the development of 17 research topics. After discussions of the relative benefits and costs of each proposal, lists of both short-term and long-term projects were selected for further consideration.

During the fall of 2001, suggestions identified as high priority were developed into formal research proposals. Several well-qualified statisticians were brought in to develop the research protocols, and knowledge-base representatives from the appropriate modes helped establish specific data collection mechanisms and research implementation plans.

Background

During the development of the *Safety Data Action Plan*, it was recognized that in order to justify significant efforts to gather better or new data on accident precursors, there was a need to prove the value of collecting the data. Even if there were significant efforts to gather more complete, accurate data in an area covered by existing data collection processes, the additional cost of this expanded effort would require justification. One possible justification for these additional data collection costs would be compelling evidence of the ability to predict accidents based on information provided by these additional data.

The main objective in Project 6 is to identify accident precursors or leading indicators for further research on hypothesis testing and establishing relationships between risk and predictors. The results of this research can also be used to target or redirect programs for greater effectiveness (i.e., fewer fatalities and injuries).

The working team for this project was composed of staff from the National Safety Council (NSC), Traffic Safety Analysis Systems & Services, Inc. (TSASS), and representatives from each of the modes, who could provide technical input and content-based expertise.

METHOD

Efforts within Project 6 were organized along a series of subprojects and phases. The first of these was a literature review performed by the Volpe National Transportation Systems Center and NSC staff. Other major phases included candidate research project identification, project prioritization, research protocol development, and report preparation.

Volpe Literature Search/Review

The Volpe staff reviewed a number of information sources to compile an Access database of precursor-accident relationships that have been identified or studied. NSC staff then reviewed the documents and identified several potential research projects for further study.

Solicitation of Precursor Ideas

Subsequently, BTS and NSC hosted a series of meetings with team members to solicit suggestions for research into accident precursors. These meetings were attended by staff from each DOT mode and resulted in roughly 20 suggestions for research. A review of the projects revealed several common themes among members of the working team from which combined project descriptions were drawn.

Once a set of candidate projects was formulated, the team was then called on to establish criteria for prioritizing the research suggestions. Eight criteria were adopted. The proposed projects were ranked by all team members based on the criteria listed below. The numbers in parentheses represent the pooled weight out of 100 percent, based on team member balloting:

- *Increased understanding (20%)*
Does this add to our knowledge? Has it been done before?
- *Cost-effectiveness (15%)*

Is this worth more than the cost of research or implementation?
Consideration of length of research effort.

- *Feasibility of implementation (14%)*
If it proves a strong relationship, will we implement the results in terms of changes to our data collection?
- *Likely impact (16%)*
Will this make a difference with respect to safety and /or policy?
- *Anticipated cost of research (8%)*
Is this likely to be expensive or inexpensive to research?
- *Adaptability to other/multiple modes (11%)*
Do you think multiple modes could use the results of this research?
- *Cross-function (7%)*
Would the results be used by multiple functions (operations, planning, enforcement)?
- *External consumer (9%)*
What will be the reaction by outside stakeholders (industry, states, etc.)?

Review and Refinement

During the period when the proposed projects were ranked by the working team, additional information on data availability was collected. In particular, the project sponsors were asked to provide information on the likely source of data to be used in the proposed research. If that source existed, they were asked to provide information about the accessibility, completeness, and reliability of the data. If there was no current source for the data, they were asked to suggest how the data might be collected, and to provide some insight about the potential difficulties in obtaining data. The description of each project was then updated and expanded to the extent possible.

RESULTS

Proposed Research Projects that evaluate the relationship between a specific precursor and a safety outcome fall within the following four categories.

Evaluation of a Type of Data or Method of Collection

Several of the proposed projects were directed toward evaluating the general type of data or a method of gathering data to predict accidents.

“Text Mining to Establish Sequence of Events” addressed the general sense that the sequence of events might be an excellent predictor of accidents, but recognized that this information is seldom coded within safety datasets. However, many safety data files contain narrative information that might indicate the sequence of events, if properly processed. Text mining is an analytical tool that draws on the ability of computer programs to look for patterns within large volumes of text information. This project, if pursued, would look at narrative information in the accident files of several modes to establish if, indeed, text mining technology can generate a set of discrete events, and sequence those events as well as a human might. Examples of the types of data files that would be utilized included: narratives of traffic crashes from police agencies that use laptops (text files) to record traffic accident data as well as similar data from the aviation and maritime modes.

Another project, entitled “A Human Factors Analysis of Precursors Associated with Incidents/Accidents,” attempts to apply the JANUS approach to classifying precursors to maritime accident information. By incorporating aspects of Reason's "Swiss Cheese" model of human error, the Human

Factors Analysis and Classification System (HFACS) developed by Shappell and Wiegmann, and the HERA model used by EUROCONTROL, a common taxonomy can be developed for the examination of incidents within multiple domains.

The third project, entitled “Value of Volunteered Safety Information as Precursors,” draws on experience in the aviation industry. It calls for a detailed review and analysis of information obtained from existing voluntary reporting systems where hazardous situations are reported to an authority by vehicle operators or the public. The goal of this project is to establish the reliability and utility of data obtained through these systems in identifying potential accident precursors.

Other projects within this topic area include:

- retrospective interview and survey information about operator distractions, misunderstandings, etc., that might have increased the likelihood of operator error, resulting in an accident, or near-accident;
- an assessment of the data needs for GIS systems that support safety analysis;
- documentation of safety successes as well as failures (i.e., where a safety design succeeded in mitigating the severity of an incident); and
- various forms of data modeling to establish potential for accidents.

Safety Culture Analysis

Establishing a methodology for documenting and assessing the “Safety Culture” of operators and companies was recommended by several modes. These projects focused on attributes of the operator (both the driver and the company), which might allow the characterization of accident risk. An

example was given of a small charter flight operation, trucking company, or fishing operation that was owner-operated and the possibility that the combined workload of being both the driver and manager of a small company might increase the likelihood of accidents.

The project with the highest rating in this group was proposed by the Federal Aviation Administration, entitled: “Organizational Safety Culture and Other Indicators of Accident Risk.” Other projects with similar focus, but slightly different approaches, include the NIOSH proposal “Using an Indexing System to Identify Precursors for Vehicle Crashes, Injuries and Deaths” and the Maritime Administration proposal “Study Feasibility of Possible Profiling Systems.” These projects attempt to establish measures or classification criteria that allow evaluation of a commercial operator for potential accident involvement. All of these projects received strong support across modes, and they appeared to have good potential for technology transfer from one mode to another.

Specific Precursor-Outcome Relationships

The project with the highest rating in this category focused on workload as a specific precursor to accidents. Other projects within this group addressed the following precursors:

1. experience and training as predictor of hazardous materials incidents,
2. noise levels and distraction,
3. social needs and nocturnal work activity,
4. tracking undeclared hazardous materials shipments,
5. traffic intensity at the sector level, and
6. driving records as a predictor of crash involvement.

The first three are specific risk factors that might be considered under “Safety Culture” efforts. Projects 4 and 5 were specific to a particular USDOT mode. The last project investigates the potential link between sudden changes in driving patterns and increased likelihood for causing accidents.

Technology Transfer

The project entitled “Use of Flight Data Recorder Information to Predict Accidents” was developed on the concept that data from vehicle data recorders can be used to establish patterns of operation, such as evasive or abrupt maneuvers that would be potential predictors of accidents. The growing use of computer technology for vehicle control and monitoring in all modes can make such analysis possible. Modes that can most benefit from this study include Aviation, Maritime, and Highway.

GENERAL CONCLUSIONS AND NEXT STEPS

The proposed research efforts covered a wide range of specific accident types and transportation environments. Results of such research efforts have the potential to make significant contributions to the field of transportation safety. Several of the proposed projects can be done utilizing existing data sources in a relatively short time frame, while others can be started with minimal new data collection efforts. However, most of the proposed projects will likely entail a two-year time commitment.

PROJECT 7 OVERVIEW

Expand the Collection of “Near-Miss” Data to All Modes

INTRODUCTION

Background

Virtually all transportation incidents are preceded by a chain of events or circumstances – any one of which might have prevented the incident if it had gone another way. In a large number of cases, operators are aware of these “close calls” or “near-misses” and may have information that could prevent future mishaps. However, most of our modal programs are focused on collecting data only on events that meet the threshold of a reportable accident. Thus, the large majority of cases where we could capture useful data on accident precursors or on effective prevention strategies remain unexposed.

Collecting and analyzing reports of near-misses provide a route of access to the causes of hazards that have the potential of leading to crashes. Lessons learned from near-misses can be used in designing countermeasures that not only reduce the number of transportation-related safety incidents, but, in some cases, even prevent catastrophic events of certain types from ever occurring. Thus, high-quality data on near-misses is needed to strengthen preventive efforts and reduce the burden of transportation-related incidents on individuals and society.

The Department of Transportation (DOT) has been working toward the elimination of transportation-related fatalities and injuries

in the United States. Toward this end, DOT has made a commitment to improve safety data collection and reporting across all transportation modes. As a result, a series of workshops held in 1999 and a Safety Data Conference in April 2000 brought together experts from different transportation modes who developed the Safety Data Action Plan (SDAP). The SDAP is comprised of 10 research projects intended to improve the quality and timeliness of existing transportation safety data, collect better data on accident circumstances, precursors, and leading indicators, and expand the use of technology in data collection.

This project attempts to: a) describe systems now employed in the collection of data on near-misses in various modes, b) specify requirements for collection and analysis of voluntary data that will be useful in prevention efforts, and c) propose studies aimed at expanding the collection of near-miss data across all transportation modes.

Purpose

The immediate purpose of the present project is to study near-miss events capable of leading to accidents within all modes of transportation. It involves the study of existing systems for identifying and reporting near-misses, identifying potential benefits and problems, exploring the transferability of reporting from aviation and maritime modes to other modes, and proposing a coordinated effort across DOT for implementing such systems.

A near-miss situation is one that could have resulted in accidental harm or damage but failed to in the absence of any specific measure designed to prevent it. The original title of the project refers to the term *near-miss*. However, the term “near” implies a spatial or temporal proximity that does not apply to the many situations that arise and are corrected well before and at a great distance from an actual accident. Some reported situations center on specific events, while others involve generally prevailing conditions. In this context, the term “unsafe situations” appears to be more descriptive and, therefore, is used in this research project.

The ultimate purpose of this activity is to provide statistical data that will lead to the prevention of accidents. To accomplish this, the data gathered must identify causes of unsafe situations in terms that can be applied to their reduction, and ultimately result in reducing the incidence and severity of transportation accidents.

A resolution adapted by the DOT Safety Council in January 2000 supported the development of precursor data for industrial and transportation-related safety incidences and, specifically, pointed in the direction of capturing information on factors associated with unsafe situations.

Objectives

The goals of this project are to study existing systems for recording and reporting unsafe situations, produce operational definitions and criteria for such situations in each transportation mode, identify potential benefits and problems with data collection, improve cross-modal utility of the data, and explore the transferability of unsafe situation reporting from aviation to other modes.

The Heinrich Pyramid depicts the relationship of accidents to two forms of unsafe situations. One consists of recorded *incidents* that produced consequences that could have resulted in injury, or damage meeting accident report thresholds, but failed to do so. The second level represents unrecorded *occurrences* of events or conditions that raised the danger of an accident or incident, but due to fortunate circumstances, failed to do so. Both of these represent sources of information that could be applied to the prevention of accidents if they were reported, analyzed, and disseminated.

When it comes to causative factors, unsafe situations represent less a separate subset of precursors to accidents than simply the same precursors with different outcomes. The conditions that lead to an unsafe situation on one occasion can result in a real accident on another. If that were not the case, there would be little point in studying near accidents. What the additional study of unsafe situations brings is:

1. a greater number of episodes from which accident contributors can be gained, and
2. the opportunity in some instances to identify preventive measures from those steps that actually succeeded in avoiding an accident.

Methodology

The project objectives were met in the following four phases.

Development of Unsafe Situation Data Systems Matrix

The first step in meeting objectives of the project was to examine the systems engaged in data collection on unsafe situations and to identify the properties of each. These included the manner in which reports are collected, the information furnished, protections to reporters, access to data, including web access, analyses performed, and reports furnished. This work has been accomplished by soliciting input from personnel involved with these systems and technical experts from transportation modes, as well as through extensive literature review.

Human Factors Taxonomy

The second part of the project involves development of a human factors taxonomy – a classification structure developed as a key piece to the utility of the unsafe situation data systems across transportation modes. While the project is concerned exclusively with analysis of unsafe situations, any human factors taxonomy would apply equally well to the accidents, whose prevention is the ultimate goal of such analysis.

Individual reports of unsafe situations have been useful in identifying causes that are sufficiently serious as to serve as a basis of corrective action. The bulk of reporting, however, involves situations that may not be serious enough to prompt action by themselves but occur often enough to merit attention. A formal mechanism for identifying frequent situations would require some means of aggregating those with similar causes to permit the compilation of statistics. The need for such taxonomies is greatest for the most frequent and most diverse of causes, those involving human factors.

Guidelines for Voluntary Reporting of Unsafe Situations

The third step in the project was to develop guidelines for systems focused on both collecting and analyzing unsafe situation data. Two such systems were:

1. developing taxonomies for classifying and coding causes of unsafe situations, and
2. devising systems of voluntary reporting across modes.

Research efforts concentrated on voluntary reporting mechanisms, incentives, and barriers for voluntary reporting, data recording methods and databases, the types of data available from unsafe situations, the scope and quality of the data, means used to infer causes from information furnished, and the statistical methods used to estimate the prevalence of various causative factors.

Automated Methods of Data Collection

One additional source of information on unsafe situations involves automated methods of data collection. A segment of the project was devoted to this topic and included a discussion of technological methods currently in use and new ideas for automatic reporting.

Information Sources

Materials presented in this project were obtained from the following agencies and sources of information.

Department of Transportation

- Bureau of Transportation Statistics (BTS)
- Federal Aviation Administration (FAA)
- Federal Highway Administration (FHWA)
- Federal Motor Carrier Safety Administration (FMCSA)
- Federal Railroad Administration (FRA)
- Federal Transit Authority (FTA)

- Maritime Administration (MARAD)
- National Highway Traffic Safety Administration (NHTSA)
- Research and Special Programs Administration (RSPA)
- United States Coast Guard (USCG)

Other Organizations

- Aviation Safety Reporting System (ASRS)
- Confidential Human Factors Incident Reporting Programme (CHIRP)
- National Institute for Occupational Safety and Health (NIOSH)

Safety Data Task Force

A Safety Data Task Force with representatives from each transportation mode, safety policy and analysis offices, and BTS staff provided feedback on the project's scope, objectives, and progress.

Volpe Group Background Report

The Volpe National Transportation Systems Center prepared a background report describing existing and planned voluntary safety reporting systems. The Volpe Report outlined the DOT confidentiality regulations and explored opportunities for extending BTS's legislative data protections to other data systems.

PROCESS

Modal Matrix

A search for systems that collect information on unsafe conditions revealed several either in operation or on the drawing board. The search encompassed unsafe situations that caused incidents resulting in damage below the threshold for reporting, as well as accidents themselves, in order to take

advantage of characteristics that apply across all levels of hazard. For each system, these included its history, the information being collected, its sources, the analyses being performed, information being furnished, and the means of access.

Information presented in a matrix format is the most effective way to consider individual components in a systematic manner. Furthermore, it helped the investigators to benchmark the aviation industry practices, discover previously unidentified problems with unsafe situation data reporting, acquisition, management, and analysis, and recommend solutions for transferring the aviation experiences to other transportation modes.

Several systems have been developed and implemented in aviation in the United States and abroad. The Aviation Safety Reporting System (ASRS) is a nationwide system that collects, analyzes, and responds to voluntarily submitted reports of unsafe aviation situations in order to lessen the likelihood of aviation accidents. The ASRS and its structure served as a prototype for other reporting systems in aviation as well as systems within other modes listed here.

Aviation

- Near Midair Collisions System (NMACS) – United States
- FAA Accident/Incident Data System (AIDS) – United States
- National Transportation Safety Board (NTSB) Aviation Accident/Incident Database – United States
- Confidential Human Factors Incident Reporting Programme (CHIRP) – United Kingdom
- International Civil Aviation Organization (ICAO)
- The Global Analysis and Information Network (GAIN) (proposed)

Maritime

- The Nautical Institute International Marine Accident Reporting Scheme (MARS)
- Safety Incident Management Information System (SIMIS) – United States
- The International Maritime Information Safety System (IMISS) (proposed)

Motor Carrier

- Hazardous Materials Incident Report System – United States

Rail

- Signals Passed at Danger (SPAD) system – United Kingdom

Intermodal

- Securitas – Canada

A great volume of data has been and will be collected on unsafe situations in transportation. Most of the systems for collecting information on unsafe situations come from aviation, primarily commercial air carriers. While similar concerns have stimulated efforts to extend the approach to the maritime industry, progress has been less evident. Thus far, little effort appears to have been devoted to the effort by the rail industry. Within modes where accidents are sufficiently plentiful to provide insight into causes, there is still room for examining categories of operation characterized by relatively few but very serious accidents.

Human Factors Taxonomy

In order to aggregate data and compile statistics on the causes of unsafe situations, some means of classifying them into categories is needed. This is particularly challenging for causes arising from the

human component. The more tangible aspects of causes, relating to equipment, weather, and surfaces such as highways, runways, and rails, tend to fall into numerous but readily identifiable categories. However, the characteristics of people that lead to unsafe situations cover a wider range, particularly their errors, which are unique to each situation.

Taxonomies of human causes have been structured at two levels. One involves the specific errors that lead to individual situations, where “error” refers not only to mistakes that make the person responsible for the situation but also the absence of actions that could have prevented them. The second level involves predisposing factors that lead to errors, including the psychological and physical characteristics of people, the hardware and software with which they interact, and the surrounding physical, social, and organizational environments in which activity takes place. Where equipment fails, the first step is to find out specifically what broke and then correct the design, manufacturing, or maintenance flaws that allow the failure to occur. Similarly, efforts to overcome the causes that lie in human factors must start by identifying the specific errors and then correct the predisposing conditions that lead to them.

Voluntary Reporting of Unsafe Situations

The process of developing cross-modal guiding principles for voluntary reporting of unsafe situations was based primarily on the experiences of the ASRS demonstrating that analysis of such events is key to improvement in transportation safety. In order to capitalize on the success of the ASRS and other programs, any system geared toward voluntary reporting should be based on the following premises:

- voluntary participation
- reporter confidentiality
- guaranteed immunity
- system operated by a nonregulatory third-party agency
- buy-in and support from the community
- ease of data submission
- follow-up opportunity for further investigation, and
- feedback—evidence of data output, implementation, and countermeasures.

Because each transportation mode has its unique characteristics and environment, the applicability of these factors may vary. However, there are common themes. These guiding principles lay down the rules for future investigations that will put them into practice. A proposal for a pilot study addresses the transferability and future implementation.

Automated Collection of Unsafe Situation Data

The reporting of accidents, incidents, and occurrences by participants and witnesses has provided information capable of guiding preventive efforts in all transportation modes, at least to some degree. However, it takes time, and is dependent on both the ability and willingness of informants to report events accurately. Advances in technology offer the opportunity to record events automatically in a way that will allow the nature and origins to be ascertained and verified objectively.

RECOMMENDATIONS

On the basis of project findings, the following proposals for collection and analysis of unsafe situation data were developed.

Outcome Classification and Coding

Development of taxonomies for collecting and coding of unsafe situations at the levels of human error and the predisposing factors that produce them is of high and urgent priority. The factors that predispose errors tend to fall into the same general categories across modes and have been the subject of suitable taxonomies, most notably the SHELL matrix. However, the behaviors required by various forms of transportation and, therefore, the errors that arise, vary across modes as well as across operations within mode. While some taxonomies of human error have been developed and applied to prevention, they do not involve the modes given primary attention for analysis of unsafe situations.

Voluntary Self-Reporting

A high-priority study, specifically called for in this project, is extension of voluntary self-reporting from aviation to other transportation modes. Where accidents occur, they are typically the subject of mandatory reports by investigating officers and those involved. However, where events only raise the possibility of accidents, the only sources of information are the parties involved in them, and requiring reports becomes problematic. The alternative is voluntary reporting, which has been successfully employed in aviation for the past 25 years. A proposed study would examine the requirements for extending voluntary self-reporting to other modes, to include sources of, and ways of overcoming, possible resistance.

Marine Traffic Study

The technology employed in studying flight patterns could be extended to marine traffic

through an additional project. To permit tracking ship movements in areas not readily registered by ground-based radar, other forms of measurement (e.g., use of satellites and Global Positioning System (GPS)) would be studied.

Large Truck Headway Analysis

One specific extension of technology to another mode will be collection of truck headway data to compile statistics capable of revealing the conditions associated with unsafe following distances. The study could employ rearward distance measurement devices (e.g., laser) to detect short headways of trucks encountered in the traffic stream as well as location-determining devices such as GPS to allow headways to be associated with various roadway characteristics.

CONCLUSION

The collection, analysis, and reporting of data describing unsafe situations that do not result in reportable accidents can be beneficial in preventing damage, injury, and death within all modes of transportation. Such data are of particular value in modes characterized by relatively few but highly serious accidents.

While the nature of unsafe acts tends to be mode-specific, the basic methods of data collection and analysis, developed largely in aviation, can be extended across modes. Within the United States, voluntary reports have been the prevalent source of information concerning unsafe acts.

Both voluntary reports and automated systems of data collection can be successful in securing information on the nature and causes of unsafe situations in transportation. In both cases, the confidentiality and privacy

of information sources have to be effectively protected.

Thus far, attempts to correct conditions leading to unsafe situations have been based primarily on individual reports. Gaining greater benefit from reporting systems requires developing means of classifying causes in a manner that allows data aggregation and identification of the most prevalent causes.

The greatest challenge to classification and aggregation of causes involves human error, which may be defined as lack of any action that could have prevented a situation from arising, and could be reasonably expected (it does not involve culpability or blame). The distinctive elements of individual errors complicate grouping into categories.

Although error taxonomies in some transportation modes have been successful in identifying and initiating steps to prevent the most frequent needs, they are based primarily on accidents, and are as yet lacking in those currently subject to self-reporting systems. The need for taxonomies is recognized, and efforts to develop them are currently under way.

Based on identified errors, a wide range of remedial processes can be employed to address predisposing conditions involving underlying physical and psychological, hardware, environmental, social, and organizational factors. These factors are largely the same across modes, and available taxonomies of predisposing conditions can be applied to their classification.

An assumption underlying the search for causes of unsafe situations is that they are also the causes of accidents, and processes designed to prevent them would also prevent accidents. Therefore, taxonomies of human

error and their predisposing conditions would apply equally to the analysis of accident data.

PROJECT 9 OVERVIEW

Exploring Options for Using Technology in Data Collection

INTRODUCTION

The U.S. Department of Transportation (DOT) maintains over 40 programs that capture either safety data or crucial related information (e.g., measures of exposure). A recent data quality review requested by Congress suggests that improvements can be made that will better serve the DOT mission.

The objective of this project is to explore options for using technology to facilitate more timely data collection, improve data quality, and assure the relevance of transportation safety data. This overview briefly describes the project's background, methods, results, and recommendations. The project's final product is a prioritized set of work plans identifying promising technologies for field-testing.

Background

DOT's safety mission extends to all modes of transportation: air, highway, commercial trucks and buses, rail, pipeline, and waterway. In each of these modes, data-collection technologies have enhanced the

ability of each agency to collect key safety data in a timely and accurate fashion. This project identifies new applications of existing or emerging technologies for further testing across the modes.

Each of the modes within DOT is engaged in technology projects, many of which relate directly to data collection and the safety mission of their administration. There are some commonalities in the types of technology being used, most notably in the area of event data recorders in vehicles and the use of global positioning systems (GPS) and geographic information systems (GIS) for obtaining and analyzing location information.

As a starting point, the Volpe National Transportation Systems Center compiled a listing of some existing data-collection projects within DOT that utilize technology at some level. There are a large number of ongoing technology projects within DOT. Some of these technologies are already in use in more than one mode. The Project 9 research team identified additional data-collection technologies.

Objectives

The objectives of this project were to identify potential uses of technology to:

- improve the timeliness of basic data collection,
- improve the accuracy of data collected,
- improve the usefulness of the data collected,
- improve the cost-effectiveness of the data-collection system overall, and
- establish or increase utilization of technology across transportation modes.

Scope

Project 9 was primarily centered on two activities: 1) identifying existing technologies already used in one mode that could have potential application to data collection for other modes; and 2) identifying “new” technologies for safety data collection. The sources of new technologies were defined as any non-DOT entity including other government agencies and the private sector. DOT modal experts also identified candidate technologies that might have an innovative application for their mode. The experts wrote descriptions of technologies and expanded the list to include additional projects that, in their judgment, could provide important safety data either in their mode or in another DOT mode.

GENERAL APPROACH

This project solicited input from the various modes of transportation about uses of technology for Data-Collection Elements. Of particular interest were those technologies that could be pilot tested or implemented in one mode and then the

results transferred for use by one or more other modes. This section of the report outlines how each of these tasks was conducted.

Data Collection Issues and Potential Technologies

As part of the Bureau of Transportation Statistics (BTS) SDI work group sessions, modal representatives described data-collection issues faced by specific program areas within their administration. A subset of these data-collection issues had clear safety implications for the mode. As such, they were useful in the effort to identify a preliminary set of data-collection issues for each of the modes.

The DOT modes, as well as state and local government agencies, are engaged in a large number of data-collection technology projects. As detailed in the Background Section of this overview, the Volpe Center provided descriptions of data-collection technologies currently in use that cover a broad range of applications. Modal experts in each of these applications were identified and contacted by BTS staff. The experts were asked to describe the technology in sufficient detail to enable project team members to decide whether it had potential application to identified Data Collection Elements needs. Experts were also asked to comment on the potential applicability of selected technologies to other data-collection needs, both within and outside their mode. This effort resulted in a list of existing technologies and additional information on other areas where those technologies might be applied for data-collection.

Technology Transfer Opportunities

Experts in each of the modes were asked to provide contacts outside of DOT who are using or developing technologies that might be applicable to Data-Collection Elements inside DOT. These contacts were drawn from industry and other government agencies (federal, state, and local government, as well as foreign governments' transportation agencies). Further contacts were identified through these initial industry and other government agency contacts, web-based searches, and business-to-business listings. Each of the contacts was asked to provide descriptions of technologies in sufficient detail that the project team could decide whether the technology had potential application in addressing Data Collection Elements needs in DOT.

Technology Prioritization

The tasks described above produced a substantial list of new and existing technologies with cross-modal transfer potential. These technologies were evaluated in order to develop a set of proposed technology projects for Work Group B prioritization. In order to develop the technology projects for prioritization the project team grouped the technologies into eight general categories. Within each of the categories, several example projects were described. The following criteria were used to evaluate each project:

- *Cost-effectiveness*: A statement of whether the project promises a reasonable "return on investment" in that the savings (cost reductions, lives or resources saved) are demonstrably larger than the costs of implementing the project.
- *Feasibility*: A statement of the likelihood that the technology can be

implemented as described and the likelihood that, as implemented, the technology will meet the functional specifications.

- *Likely impact*: A statement of the concrete changes that will occur once the technology is implemented (improved data quality, timeliness, accessibility of the data).
- *Anticipated cost*: An estimate of the cost of implementation of the technology at the level or extent required to achieve the desired outcome.
- *Maintainability*: A statement of the projected, annualized maintenance costs for a "standard" implementation of the technology, and, where needed, a qualitative assessment of the ability to maintain the technology once installed.
- *Potential for expansion and/or new applications*: A statement of the probable further uses for the technology, should it prove successful in the evaluation project. Does the technology have the potential to add new features and/or new operating characteristics?
- *Accessibility*: A statement of the level of technical expertise required to operate and/or maintain the technology in a manner that will maximize the benefits of the implementation. High accessibility means that a low level of skill or training would be required to keep the technology functioning as desired.
- *Strategic importance*: Reviewer's judgment of how well this project fits with the agency's strategic plan and mission.
- *Adaptability*: Reviewer's judgment of how well this technology fits with

existing technology projects in the agency.

- *Cross-functional application:* Reviewer's judgment of further applications of this technology within their mode.
- *Industry buy-in:* Reviewer's judgment of how this technology project would be perceived by the affected industries.

In order to prioritize the technologies, Group B members were asked to read the general description of each technology type, review each of the several example implementation descriptions, and then simply rank order the eight technologies based on the needs of their own mode for safety data collection. The participants were encouraged to use the example descriptions to help determine the value of the technology to their mode.

EVALUATION OF THE EIGHT MOST PROMISING DATA COLLECTION TECHNOLOGIES

The Work Group B members selected the following eight technologies, in order of priority:

- Electronic Identification/Security (Smart Cards),
- Operator Performance Monitoring,
- Hands-Free Operation (wearable computers for data collection),
- Vehicle Usage Monitoring Systems,
- Imaging (x-ray, mm-wave, and satellite),
- Voice-Activated Data Input,
- Automated Control Device Data Collection,
- Pattern Recognition Software.

Each of these technologies is described briefly in the following eight sections. Some potential data collection elements that

may depend on a specific application and/or interface with other technologies are also listed for each technology.

Electronic Identification/Security (Smart Cards)

Smart cards are credit-card size devices with embedded memory circuits. The devices can be written to or read using a simple, inexpensive computer interface. Smart cards are currently being tested for use as credit/bank cards and potentially in some driver licensing applications. The maritime industry uses these devices now for tracking training and qualifications.

Smart cards offer the potential for increased security by incorporating biometric information on the owner of the card that can be checked against the same measures taken from the person attempting to use the card. The most promising of these biometric data sources include thumbprints and retinal prints. Implementation involving thumbprints is the simpler and less expensive of the two options.

Some potential data-collection elements:

- user identification;
- date, time, start, end, and route of travel;
- speed, lane keeping, following distance, and other performance measures;
- waiting times;
- vehicle configuration;
- way points;
- time at controls; and
- user qualifications and experience.

Operator Performance Monitoring

Checking employees' readiness for service can be accomplished using technologies that: a) require a pre-test before operation

and/or b) provide ongoing monitoring or feedback on performance during operation. Such systems are in place aboard some ships and have been tested in commercial motor vehicles (e.g., lane departure warning devices for detecting drowsy drivers). The primary goal of such systems is to provide feedback to the operator in order to improve safety by alerting them to lapses in concentration. The systems could also be used to collect data on the prevalence of selected types of operator behaviors.

Some potential data-collection elements:

- user readiness to perform;
- user reaction time to hazard warnings;
- control movements in response to specific events;
- lane departures, speed, following distances; and
- accuracy of identification on simulated objects throughout the workday.

Hands-Free Operation

Many transportation activities occur away from a desk or vehicle, for example, inspections, assessment, or enforcement duties. The usefulness of hand-held computers is limited by their size and the need for the operator to hold the device in one hand in order to use it with the other hand. There are computing devices integrated into uniforms or outer safety garments (e.g., safety vests) that may support these field data-collection activities in a much more natural way. The device may include a small ocular “screen” for display of information visually, a voice input/output device, a small keyboard strapped to one arm, and various accessories such as GPS, bar code readers, smart card readers, magnetic stripe readers, and communications devices for sending and

receiving data via radio, cell phone, or other method.

Some potential data-collection elements:

- standard law enforcement reports, and
- data entry for numerous safety data elements.

Vehicle Usage Monitoring Systems

As an advancement over Event Data Recorders now found in commercial aircraft, trains, ships, and motor vehicles, usage monitoring systems would serve to collect additional data elements not currently available. For example, collecting data on the user of the vehicle could ensure that only authorized personnel can operate a vehicle or perform a particular task onboard the vehicle. Collecting information on the route taken, speeds reached, and start/end points of trips would be useful in surface transportation modes. Links to other onboard systems (e.g., hazard indicators and telemetry systems) will allow the storage of data on operators’ response to incidents or near-incidents.

Some potential data-collection elements:

- user identification;
- route taken, starting point, and ending point; and
- time and date of travel via computer-based clock/calendar.

Imaging

Imaging capabilities have expanded and the costs of the data have begun to drop in recent years. Satellite imaging systems already in existence can identify moving objects with a high degree of reliability and millimeter wave imaging systems that can detect plastics underneath clothing. These systems have obvious applications in

security in all modes and for use in system performance monitoring for traffic control.

Some potential data-collection elements:

- traffic volume, vehicle classification;
- speed, delay;
- origin/destination and duration of travel;
- incident response;
- platooning of traffic;
- ramp metering and intersection signal control optimization;
- location, duration, and extent of event;
- time to first response;
- progress of response;
- concealed object identification; and
- image database for developing pattern recognition software.

Voice-Activated Data Input

Data collection, especially in adverse environments, has benefited recently from advances in real-time voice interface technology. Essentially, this technology allows a user to enter data or perform functions on a computer by speaking into a microphone. Computer software analyzes the speech and interprets the resulting words as data, text, or commands. In the simplest applications, a limited vocabulary is used in order to increase the accuracy of translation. Broader applications (e.g., word processing or spreadsheet-type software) must allow for an unlimited vocabulary, and thus the capacity for the translation software to “learn” both the speaker’s vocal mannerisms and new items in its dictionary of terms or commands. In conjunction with event data recorders and intelligent transportation system technology, voice data input has numerous applications from simple replacement of keyboards for data entry in adverse environments to enhanced security for command and control situations.

Some potential data-collection elements:

- user identification;
- route taken, starting point, and ending point;
- time and date of travel;
- control inputs;
- comparison of control inputs to actual operation;
- presence of hazards; and
- response to events.

Automated Control Device Data Collection

A variety of automated control devices are now planned or in operation across the DOT modes: a remote control system for commercial aircraft is being tested, automated ships are already in use in the maritime industry, and motor vehicle automated control systems are being testing by various manufacturers. The common denominator for all of these systems are data requirements for making the software-based decision of when to take control and for operating safely in automated modes.

Some potential data-collection elements:

- user identification;
- speed changes;
- travel position;
- logged travel course;
- type of aircraft, vehicle, ship;
- behaviors leading up to event;
- successful and unsuccessful avoidance maneuvers; and
- identification of specific hazards.

Pattern Recognition Software

Pattern recognition software is a class of software designed to identify target “items” from a stream of data in real time. Variants of this type of software are programmed to deal with images (e.g., sorting applications,

facial recognition), auditory patterns (e.g., speech recognition, looking for key phrases), or even odors (e.g., molecule detection systems). All of these systems involve the programming of a particular pattern to be searched for from among an incoming stream of data. When the system detects that pattern (or one labeled “similar enough” through a set of “fuzzy” algorithms), the software can alert users to the presence (or probable presence) of the target item, whether that item is a person, a weapon, or a spike in fluid flow readings.

Some potential data-collection elements:

- object identification and profiling;
- enhanced assistance to screening personnel;
- concentrations of specific substances; and
- flow rates, variations in environmental factors.

RECOMMENDATIONS

The first three technologies listed in the previous section (Electronic Identification/ Security Smart Cards, Operator Performance Monitoring, and Hands-Free Operation) clearly had the most support from all the modes surveyed. This indicates broad possibilities for application of these technologies. It is recommended that at least one, if not several, pilot projects be developed in these three technology areas. The examples provided in the final report should provide a good starting point. The remaining five technologies each have support from at least one mode, indicating that these might be worth a single project as a proof of concept and/or to develop the idea further for the other modes to review. It is recommended that BTS and the mode(s) that supported these technology ideas work together to develop a single pilot project of each technology. Statements from the

Group B participants in support of or critical of the application of each of the technologies are included in the Recommendations Section of the final report.

PROJECT 10 OVERVIEW

Expand, Improve, and Coordinate Safety Data Analysis

BACKGROUND

Research professionals, worldwide, analyze safety data to assess the extent, investigate the circumstances, and determine the causes of transportation-related deaths and injuries. The results of their analyses inform the selection, development, and implementation of safety policies and specific countermeasures for hazards in all modes of transportation.

Although data analysis is essential for the formulation, implementation, and evaluation of transportation safety countermeasures and policies, improvements are needed:

- Resources for safety analysis and evaluation are presently insufficient, apparently because of a decline in recognition of data analysis as a tool for improving transportation safety.
- Data analysis methods and proficiency levels are diverse, without generally accepted standards for either the application of these methods or the evaluation of their adequacy.
- Fora for intermodal interchange of safety research methods, analysis tools, and information on best practices for improving safety data analysis do not presently exist.

These deficiencies currently constrain the processes of discovery and evaluation required to optimize the productivity of transportation safety research. The constraint has an adverse impact on the

potential effectiveness of transportation safety programs.

Goal

The goal of this project is to increase the extent to which analyses of transportation safety data help to save lives and prevent injuries from hazards in all transportation modes. Achieving this goal requires improvements in the development, application, and assessment of methods for analyzing transportation safety data and for applying the results of this analysis to enhance transportation safety policies and programs.

Objectives

This project has two specific objectives in order to accomplish the goal.

Report on Transportation Safety Data Analysis

The team will produce a report that will:

- Inventory data analysis tools and analytic expertise currently employed by organizations and individuals conducting safety research for each transportation mode.
- Assess the current status of:
 - Data analysis by public organizations, private organizations, and individuals that conduct

highway, aviation, rail, marine, and pipeline safety research or formulate and enforce transportation safety policy.

- Tools used to identify and measure the consequences of causes and circumstances of transportation-related deaths and injuries for each mode of transportation.
- Best practices and lessons learned within organizations and by individuals conducting and applying the results of safety research for each of the transportation modes.
- Resources needed to support the analysis of safety data to improve the effectiveness of transportation safety programs.
- Recommend standards, technologies, training, evaluation, and other requirements to improve safety data analysis capabilities for each mode.
- Recommend venues and protocols for interchanges of safety data analysis best practices and lessons-learned.

Intermodal interchanges of information on data analysis

The team will formulate a strategy for program development and coordination of fora, training, and other options for information exchanges on data analysis efforts, statistical and other analysis tools, best practices and lessons-learned, impacts, and resource requirements.

The Working Team

The initiative to improve and expand safety data analysis will be accomplished by a team BTS established through its Safety Data Initiative. Participants represent all DOT modes as well as principal public and private organizations involved in sponsorship, conduct, or application of transportation safety research.

Technical support is provided to the team by BTS and the U.S Department of Transportation Volpe National Transportation Systems Center (Volpe Center).

TASKS

To achieve its objectives, the team will accomplish the following tasks:

- identify leaders in transportation safety research,
- conduct a transportation safety data analysis survey,
- construct an inventory of analysis methods,
- develop a DOT safety data analysis improvement plan,
- formulate an outreach strategy, and
- produce the Transportation Safety Data Analysis Report.

Leaders in Transportation Safety Research

The team will identify leaders in transportation safety research worldwide and establish mechanisms for their involvement in this project.

Transportation Safety Data Analysis Survey

The team will conduct a survey to acquire information on needs and requirements for

safety data analysis, analysis methods, and best practices by organizations and individuals involved in safety research in all transportation modes.

With support from BTS, the Volpe Center, and NIOSH, the working team will:

- develop the survey methodology and questions,
- identify respondents (e.g., program managers, principal investigators and technical experts in safety research for each transportation mode),
- coordinate execution of the survey in their respective organizations,
- code the data and analyze the findings, and
- develop summary of findings.

The team will summarize the survey methodology and findings in the Transportation Safety Data Analysis report.

Analysis Methods Inventory

The survey findings will include information on the application of data analysis methods for transportation safety research. The working team will:

- compile a list of the methods used for safety research in each mode;
- develop a bibliography of transportation safety research studies that use these methods;
- identify analysis resources, including personnel, facilities, instrumentation and equipment for the employment of these methods; and
- identify critical research issues, and strategies for their resolution.

This inventory will be included as an appendix in the Transportation Safety Data Analysis report.

DOT Safety Data Analysis Improvement Plan

For each mode of transportation, the team will identify and evaluate:

- strengths and weakness of safety data analysis applications and practices,
- best safety data analysis practices,
- resource needs for safety data analysis, and
- lessons learned from the application of safety analysis methodologies and practices.

Based on this information, the working team will develop a plan for improving safety data analysis in the Department of Transportation. The plan will include performance standards, recommendations for developing new analytic methodologies, recommendations for technology applications, best practices and benchmarking, and training guidelines. This plan will be included in the Transportation Safety Data Analysis report.

Outreach Strategy

The team will develop a strategy for outreach to foster improvements in transportation safety data analysis. The strategy will involve objectives and guidelines for:

- sponsorship of a safety data analysis “strike force,”
- development of presentations for national and international conferences and other meetings,
- curriculum for a safety risks and costs analysis and management short course, and
- a website and publication program.

The team will present the outreach strategy in the Transportation Safety Data Analysis report.

Transportation Safety Data Analysis Report

The team will assemble and edit the information developed in Tasks 1 through 5 to produce the Transportation Safety Data Analysis report.

APPENDIX

Safety Data Analysis Survey

OVERVIEW

This Appendix presents the instrument for the survey conducted by the working team from December 2001 through January 2002. The goal for conducting the survey is to acquire information on methods used to analyze transportation safety data. The purpose is to develop recommendations for facilitating improvements in transportation safety data analysis. Toward these ends, the specific survey objectives are to identify the following.

- Methods that U.S. Department of Transportation (DOT) agencies use to analyze the safety of road, air, rail, water and pipeline transportation systems
- Research problems that the agencies address with safety data analysis
- Impact of safety data analyses on Federal transportation policies
- DOT analysis resources and capabilities
- Needs for improvement.

The survey principally focuses on quantitative analysis of safety data, though it also covers qualitative analysis methods. The survey acquires information on analysis used to address safety problems, to identify areas for transportation safety improvement, and to develop recommendations for facilitation of data analysis for all transportation modes. This includes, for example, the development of resources for information on and providing training in the use of analysis methods, developing guidelines for use of these methods, and developing standards or “best practices” for research.

Safety Data Analysis Purpose and Analysis Objectives

In conducting the survey, the team assumed that the purpose of safety data analysis is to produce knowledge in order to save lives, prevent injuries, and protect property from hazards in transportation. To achieve this purpose, public and private highway, aviation, rail, marine, and pipeline safety organizations sponsor, conduct, and use the results of transportation safety research worldwide. Safety professionals analyze data to assess the extent, investigate the circumstances, and determine the causes of transportation-related deaths, injuries, and property damage. The results of their analyses inform the development and implementation of policies for hazard mitigation and measures to minimize the consequences of accidents or other mishaps for all modes of transportation.

Areas Considered for Possible Improvement

Successful analysis requires capabilities to produce accurate and useful information on hazards and risks in an increasingly complicated transportation environment. However:

- Resources for safety analysis may presently be insufficient, perhaps because of a decline in recognition of the value of data analysis as a tool for improving transportation safety.

- Since data analysis methods and proficiency levels are diverse, generally accepted standards for their application or the evaluation of their adequacy may not exist.
- Fora for intermodal interchange of safety research methods, analysis tools, and information on best practices for improving safety data analysis do not presently exist.

The team hypothesized that these or other deficiencies might constrain the productivity of transportation safety research, with adverse impacts on the effectiveness of safety programs. One purpose of the survey was to evaluate the extent of possible deficiencies, and recommend steps to improve safety data analysis for all transportation modes.

METHOD

To acquire information on transportation safety data analysis, the team surveyed organizations that conduct and sponsor safety research. Questions were developed to facilitate these discussions about data analysis purposes, programs, and the analysis used. These interviews will identify quantitative and qualitative safety analysis methods, areas of research, resources used to conduct analysis, and recommendations for actions that might be taken to improve safety data analysis for each of the transportation modes.

The following survey instrument was sent to prospective modal contacts in preparation for their interviews.

Survey Instrument

The Bureau of Transportation Statistics (BTS) requests your participation in the survey of transportation safety professionals conducted by its Safety Data Initiative, Safety Data Analysis Working Team. Participants represent public and private organizations involved in the sponsorship or conduct of safety data analysis or the use of analysis products. It is essential that recommendations in the forthcoming report on Transportation Safety Data Analysis reflect your knowledge and experience, and BTS very much appreciates your consideration and participation in the survey to ensure this occurs. To arrange for your participation, BTS will contact you to arrange a time for you to meet with Dr. Lynn Weidman, Ms. Paulette Grady, and Dr. Alex Blumenstiel. The meeting will be an opportunity to discuss critical issues in safety data analysis. The questions in the attachment to this document are intended to facilitate discussion at this meeting.

The purpose of the survey is to ensure that professionals who sponsor or conduct analysis, or use analysis products join in exploring critical issues affecting transportation safety data analysis and participate in the development of recommendations for improvement. The information that you provide by participating in this survey will be crucial in forming recommendations for solving these problems.

Safety Data Analysis Issues

The goal of safety data analysis is to produce knowledge in order to save lives, prevent injuries, and protect property from hazards in transportation. To reach this goal, public and private highway, aviation, rail, marine, and pipeline safety organizations sponsor, conduct, and use the

results of transportation safety research worldwide. Safety professionals analyze data to assess the extent, investigate the circumstances and determine the causes of transportation-related deaths, injuries and property damage. The results of their analyses inform the development and implementation of policies for mitigation of accidents and measures to minimize their consequences for all modes of transportation.

Achievement of the goal requires the capability to produce accurate and useful information on hazards and risks in an increasingly complicated environment. However, insufficient resources and capabilities even now constrain safety data analysis and limit its benefits for the development of effective transportation policies and hazard controls. The future viability and contribution of data analysis to further improvements in transportation safety remain uncertain.

Reasons for this uncertainty include:

- Resources for safety analysis are presently insufficient, apparently because of a decline in recognition of the value of data analysis as a tool for improving transportation safety.
- Data analysis methods and proficiency levels are diverse, with generally accepted standards for neither the application of these methods nor the evaluation of their adequacy.
- Fora for intermodal interchange of safety research methods, analysis tools, and information on best practices for improving safety data analysis do not presently exist.

Specific Safety Data Analysis Questions

The Safety Data Analysis Working Team offers the attached list of questions to facilitate discussion and the formulation of recommendations for improvement of data analysis tools and analytic expertise for transportation safety research. The questions request information on:

- Data sources, problems addressed by and uses of transportation safety data analysis products
- Methods and tools used to identify and measure the consequences of causes and circumstances of transportation-related deaths, injuries and property damage for each mode of transportation
- Expertise and resources applied and needed to support the analysis of safety data
- Best practices and lessons learned within organizations and by individuals conducting and applying the results of safety research for each of the transportation modes
- Needs for and the effectiveness of training.

The working team will use the information you provide to formulate:

- Recommendations for standards, technologies, training, evaluation and other requirements to improve safety data analysis capabilities for each mode
- Recommendations for venues and protocols for interchanges of safety data analysis best practice and lessons-learned.

- A strategy for program development and coordination of fora, training, and other options for information exchanges on data analysis efforts, statistical and other analysis tools, best practices and lessons-learned, impacts, and resource requirements.

Your assistance in this effort is crucial for success of the initiative to improve safety data analysis in all modes of transportation.

We very much appreciate your time and effort in contributing to the initiative and will call you to arrange a meeting.

Thank you.

Sincerely,

Dave Balderston
Federal Aviation Administration Office of Systems Safety
Chair, Safety Data Analysis Working Team

Name: _____

Title: _____

Agency/Organization: _____

Address: _____

Phone: _____

Fax: _____

E-mail: _____

Please summarize your own interests and efforts in conducting, sponsoring or using products of safety data analysis.

INTERVIEW QUESTIONS

1.1 What organizations use your agency's information systems for safety research?

1.1.1 In house

1.1.2 Other agencies

1.1.3 Private research, academic or other non-profit organizations

1.1.4 Commercial enterprises

1.2 What are the principal problems that your agency has addressed by analyzing safety data over the last five years?

1.3 What are the principal sources of the data used for this analysis?

1.3.1 Your agency's information systems (list)

1.3.2 Other DOT, government or other organizations' information systems (identify)

1.4 What kinds of analysis were (are) used?

1.5 What standards are applied to evaluate the analysis results?

1.6 Has your agency established requirements or guidelines to ensure that analysis results are used to inform policy development?

1.6.1 What are the requirements or guidelines?

1.7 What recent operational, development, enforcement or other policies or requirements have been informed by the results of safety data analysis?

2 Methods and Tools

2.1 What kinds of analytical methods and tools does your agency use?
Examples are:

2.1.1 Hazard analysis

2.1.2 Risk analysis and modeling

2.1.3 Probability statistics

2.1.4 Correlations and analysis of variance

2.1.5 Other statistical tests

2.1.6 Geographical information system

2.1.7 Video or graphical analysis

2.1.8 Simulation

2.2 Does your agency recommend, require or promote the use of particular tools specifically for safety assessment, risk analysis or other safety-related analysis applications?

2.2.1 If it does, what are these tools and how are they used?

2.3 Are analysis methods or tools developed specifically or applied for

- purposes that are unique to your agency?
- 2.3.1 If so, what are these methods or tools, what are their sources, and how are they used?
- 2.4 What analysis methods and tools does your agency use that can be used by other DOT modes?
- 2.4.1 For what purposes does your agency use these tools?
- 2.4.2 What other agencies use the tools? For what purposes?
- 2.4.3 For what other purposes could your agency and other agencies use the tools?
- 2.4.4 Are there studies that you have wanted but haven't been able to find the methods to do properly?
- 2.4.5 Does your agency develop or sponsor the development of new tools for safety analysis? What tools has it developed?
- 2.4.6 Who uses them?
- 2.4.7 For what are they used?
- 2.4.8 What methods or tools is your agency currently developing or testing?
- 2.5 Does your agency have a policy for use of particular types of analytic tools to answer specific types of safety questions? For example, the FAA develops and applies blunder models to assess impacts of aircraft separation standards. It uses hazard assessment to assess the potential impacts on safety of new aeronautical technologies. Does your agency use similar tools for similar purposes? Other examples?
- 2.6 What are limitations of the analysis tools that you agency uses?
- 2.7 Are there actions that BTS can take to help improve the agency's analysis capabilities?
- 3 Expertise and Resources**
- 3.1 What proportion of your agency's safety analysis expertise is in-house?
- 3.2 What is the composition of this expertise, in skills and qualifications?
- 3.3 How many FTEs on average has your agency devoted overall to safety-related analysis work during the past 5 years?
- 3.3.1 In house
- 3.3.2 Other
- 3.4 Does your agency have a specific organization unit with the mission to develop and apply safety analysis methods and tools?
- 3.4.1 Size of the unit (FTEs)?
- 3.4.2 Funding?
- 3.4.3 Other responsibilities?

- 3.5 What has your agency's annual level of funding for safety data analysis been over the past five years?
- 3.6 What is its FY 2002 level of funding for this activity?
- 3.7 Does your agency need to change the number of FTEs, funding, skill mix or staff qualifications devoted to safety analysis? If so, in what ways and why have priorities changed?
- 3.8 What is your agency's plan for safety analysis support for the next five years?
- 4 Lessons Learned and Best Practices**
- 4.1 How does your agency measure and evaluate productivity in its in-house and sponsored or contracted research and analysis programs?
- 4.2 Does your agency have a policy in place to formalize best practices for safety research and analysis?
- 4.3 How does your agency:
- 4.3.1 Identify lessons learned?
- 4.3.2 Formalize best practices for productive safety research and analysis efforts?
- 4.4 If lessons learned and best practices have been identified and formalized, have they improved safety analysis? If so, how?
- 4.5 Is documentation of lessons-learned and productivity improvements available?
- 4.6 In what form?
- 4.7 Has the documentation been useful?
- 4.8 What improvements in the application of best practices and lessons-learned may be needed?
- 4.9 What resources (FTEs and budget) are applied to evaluate your agency's safety analysis methods, tools and results?
- 4.10 What are your agency's plans for improving safety data analysis over the next five years?
- 4.11 Training methods
- Does your agency have specific goals for improving its safety analysis capabilities that can be achieved through training? If so, what are these goals?
 - What improvements are needed or planned to help your agency achieve its goals?
 - What level of funding is needed for these improvements?
 - Does your agency currently provide training in safety data analysis?
 - Formal Courses (Internal, External)
 - Training materials


- Mentoring
- Does your agency have a policy regarding the use of specific training methods for improving its safety analysis capability?
- In the past 5 years, what resources has your agency devoted on average for training its staff in safety data analysis?

5.6.1 Courses

5.6.2 Training materials

5.6.3 Other.

5.7 How is staff selected for this training? How is the effectiveness of the training measured? What have been the results?



Safety in Numbers
Using Statistics to Make the Transportation System Safer

Research Project #1

Reengineering DOT Data Programs

Reengineering DOT Data Programs

Objective

- Ensure decision makers have confidence in source and reliability of transportation safety data

Reengineering DOT Data Programs

Phase I

- Conduct data quality assessments of transportation safety data systems

Reengineering DOT Data Programs

Data Quality Assessment Template

- Background Information
- Frames and Sampling
- Data Collection
- Data Preparation
- Data Dissemination
- Sponsor Evaluation
- Data Analysis
- Assessment
- Recommendations

Reengineering DOT Data Programs

Selected Data Systems

- UNISHIP
- Hazardous Materials Management Information System (HMIS)
- Airline Passenger Origin and Destination Survey
- National Transit Database System – Safety & Security module
- National Aviation Safety Data Analysis Center (NASDAC) data system

Reengineering DOT Data Programs

UNISHIP

- Primary purpose is to provide DOT administrations with information on past violation histories of hazardous materials offenders to be used when assessing civil penalties

Reengineering DOT Data Programs

Hazardous Materials Management Information System (HMIS)

- Includes information on incidents involving unintentional release of a hazardous material during transit, loading/unloading, or temporary storage

Reengineering DOT Data Programs

Airline Passenger Origin & Destination Survey

- Tracks how passengers use the commercial air traffic system
- Collects information on passenger origins, destinations, and routings.
- Conducted by BTS Office of Airline Information (OAI) since 1995

Reengineering DOT Data Programs

National Transit Database System – Safety & Security Module

- Describes U.S. transit system with respect to investment, expenditures, operations, & performance
- Assessment pertains only to the Safety & Security Module

Reengineering DOT Data Programs

National Aviation Safety Data Analysis Center (NASDAC)

- Centralized repository of 27 aviation databases
- Library of aviation safety studies and reference materials
- Data access, analysis and retrieval software
- On-site technical and analytical support personnel

Reengineering DOT Data Programs

Conclusion

- BTS will continue to assess DOT databases that capture safety data in an effort to address the department's strategic goal of improving transportation safety.

 **Safety in Numbers**
Using Statistics to Make the Transportation System Safer

Research Project #2

Develop Common Criteria for Injury and Fatality Reporting

Develop Common Criteria for Injury and Fatality Reporting

Objectives

- Recommend common injury coding standards across transportation modes
- Develop uniform event definitions
- Develop common injury reporting criteria
- Provide sufficiently robust data to:
 - Develop mitigation strategies
 - Prioritize research and resource allocation

Develop Common Criteria for Injury and Fatality Reporting

General Approach

- Form working group
- Inventory DOT and selected non-DOT databases
- Describe current definitions/processes/injury coding schemes
- Develop recommendations for a common scheme

Develop Common Criteria for Injury and Fatality Reporting

Purpose of Injury Reporting

- Help determine incident severity and cost
- Provide objective basis for development of injury mitigation/prevention strategies
- Provide basis for management decisions
 - Resource prioritization
 - Resource allocation
 - Research

Develop Common Criteria for Injury and Fatality Reporting

Elements of Injury Reporting

- Injury location
 - Body region/organ system
 - Aspect
- Injury type/description
- Injury severity
- Injury cause/mechanism

Develop Common Criteria for Injury and Fatality Reporting

Findings

- High degree of variability among databases:
 - Event definition
 - Injury definitions
 - Inclusion criteria
 - Investigation methodology
 - Injury reporting

Develop Common Criteria for Injury and Fatality Reporting

Findings (Cont.)

- Little or no coordination between agencies
- Reporting criteria range from rudimentary to highly sophisticated
- Definitions and scope frequently established by statutory mandates
- AIS is the most prevalent injury coding scheme

Develop Common Criteria for Injury and Fatality Reporting

Recommendations

- Reportable event
 - Transportation incident
 - Defined as previously noted
- Transportation-related injury
 - Any injury requiring medical attention beyond first aid incurred as the result of a reportable event
 - First aid-emergency treatment pending definitive medical care

Develop Common Criteria for Injury and Fatality Reporting

Recommendations

- Fatality definition
 - Fatality resulting from injuries sustained in a transportation incident when the death occurs within 30 days of the incident
- Uninjured
 - Uninjured persons involved in a transportation incident should be reported

Develop Common Criteria for Injury and Fatality Reporting

Recommendations

- Injury Coding
- Adopt a system similar to the NASS CDS
 - Minimum elements for each injury:
 - Source of recorded injury data
 - Complete AIS 90 code
 - Injury Aspect 1
 - Injury Aspect 2
 - Multiple mechanism fields

Develop Common Criteria for Injury and Fatality Reporting

Recommendations

- Injury aspect
 - AIS does not include aspect information
 - Locating the injury to right-left, inferior-superior, anterior-posterior is important to determining injury mechanisms
 - Use of several fields more accurately describes location

Develop Common Criteria for Injury and Fatality Reporting

Recommendations

- Injury mechanism
 - Attributes trauma to the physical source of injury
 - Essential for the determination of prevention strategies
 - If you do not know what caused the injury, how can you prevent it?
 - Basic coding structure can be applied to all modes
 - Specific codes will be unique to each mode

Develop Common Criteria for Injury and Fatality Reporting

Recommendations

- Statistical Sampling
 - Should consider opportunities for statistical sampling of incidents within modes
 - Requires a relatively high volume of incidents
 - Currently utilized by NASS CDS
 - Probably practical for general aviation and recreational boating

Develop Common Criteria for Injury and Fatality Reporting

Recommendations

- Database linkage
 - Consider opportunities for linkage to other databases
 - Hospital
 - Vital statistics
 - Other medical databases

Develop Common Criteria for Injury and Fatality Reporting

Conclusions

- Adoption of the Working Group recommendations will require considerable change for most modes
- Changes are essential for establishing a robust injury surveillance system able to support the vision of the DOT

Research Project #3

Develop Common Denominators for Safety Measures

Develop Common Denominators for Safety Measures

Goals

- Develop or identify common denominators suitable for transportation safety measurement
- Should be usable within and across various transportation modes

Develop Common Denominators for Safety Measures

Scope

- Limited to evaluation of exposure measures suitable for transportation safety evaluations
- Includes crashes, incidents and injuries to occupants and/or workers

Develop Common Denominators for Safety Measures

Modes Considered

- Aviation
 - General aviation
 - Air carrier
- Highway
 - Passenger car
 - Trucks
 - Transit services
 - Bicycles
- Rail
 - Passenger and freight
 - Transit systems employing rail
- Maritime
 - Commercial
 - Recreational
- Pipeline

Develop Common Denominators for Safety Measures

General Approach

- Exposure measures currently used identified
- Limitations and gaps of current environment identified, by mode and by type of activity

Develop Common Denominators for Safety Measures

General Approach

- Recommendations developed to correct for limitations and gaps
- Recommendations for exposure measures suitable for intra- and inter-mode comparisons developed
- Approaches for implementing findings and recommendations developed

Develop Common Denominators for Safety Measures

General Recommendation 1

- General aviation activity survey should be expanded to collect information on:
 - Number of aircraft occupants
 - Trip length, miles
 - Amount of freight carried
 - Hours on duty for professional pilots

Develop Common Denominators for Safety Measures

General Recommendation 2

- A process needs to be developed to capture information from commercial marine operators that would include:
 - Trip length, miles
 - Trip length, time
 - Number of occupants including crew
 - Hours on duty for crewmembers

Develop Common Denominators for Safety Measures

General Recommendation 3

- Highway data collection systems (HPMS, VIUS, NHTS, etc.) should be reviewed to determine accuracy of estimates currently provided. Accurate estimates are needed for:
 - Trip length in distance and time
 - Number of vehicle occupants
 - Total number of trucks operated by commercial operators
 - Hours on duty for professional drivers

Develop Common Denominators for Safety Measures

General Recommendation 4

- An ongoing and systematic survey should be undertaken to collect information from recreation and boat operators on:
 - Total number of occupants per trip
 - Trip length in time and distance
 - Type and size of boat (sailboat, power, etc.)
 - Number of hours underway compared to time at anchor

Develop Common Denominators for Safety Measures

General Recommendation 5

- The National Household Transportation Survey (NHTS) should be conducted more frequently (every two years) to improve timeliness of information. It should also be modified to collect information on:
 - Recreational use of transportation
 - Trip length and distance where applicable
 - Number of occupants
 - Transportation mode used for recreation

Develop Common Denominators for Safety Measures

General Recommendation 6

- The U.S. Department of Transportation should work with State and local authorities to develop a central repository of vehicle operator demographic information derived from operator licenses and other sources. This information should be collected for operators of highway vehicles and transit system vehicles.

Research Project #5

Develop Common Data on
Accident Circumstances

Common Data on Accident Circumstances Objectives

- Determine most important data items
 - Identify useful conceptual framework
- Describe what is now collected
- Identify gaps
- Make recommendations

Common Data on Accident Circumstances

Conceptual Framework: The Haddon Matrix

- Three phases:
 - pre-event - contributing to likelihood that a potentially damaging event will occur
 - event - influencing the chance of injury when an event (crash, fall, etc.) occurs
 - post-event - influencing the chance of survival or complete recovery

Common Data on Accident Circumstances

The Haddon Matrix

	Human	Vehicle	Physical Environment	Social Environment
Pre-Event				
Event				
Post-Event				

Common Data on Accident Circumstances

Advantages of the Haddon Matrix

- Relevant to all transportation modes
- Well-known and widely applied in the injury field

Common Data on Accident Circumstances

Advantages of the Haddon Matrix

- Can be expanded to accommodate various taxonomies
- Can be used to organize
 - Risk factors
 - Exposure
 - Circumstances of injury
 - Preventive measures

Common Data on Accident Circumstances

First Recommendation: Data Elements

- The primary databases for each mode should contain information on the factors that contribute to the likelihood of a mishap or the occurrence or severity of injury.

Common Data on Accident Circumstances

Pre-Event Human Factors

- Operator age, sex, prior record, training, licensure, experience
- Involvement of alcohol and drug use
- Fatigue, length of time on duty, last rest
- Distractions and operator errors
- Medical conditions
- Whether operator was at work
- Other occupants – number, age, sex, at work

Common Data on Accident Circumstances

Data Gaps Include Lack of:

- Information on injury type and severity
- Information on uninjured passengers
- Narrative description
- Detail on human factors
- Guidelines for recording data
- Feedback to investigators
- Linkage with death certificate information

Common Data on Accident Circumstances

Other Data Limitations

- Quality of data often less than optimal
- Some events not recorded by police or DOT
 - Mishaps of off-road vehicles
 - Suicide
 - Terrorism
 - Injuries without collision

Common Data on Accident Circumstances

Other Data Limitations

- Little data on
 - Injury mechanism
 - Whether at work
 - Operator fatigue and distractions

Common Data on Accident Circumstances

Recommended Data Improvements

- Details on crash severity and injury mechanism, at least for samples of crashes
- Inclusion of narrative text
- Greater use of GIS to identify exact location
- Incorporation of data from non-DOT sources
- Greater comparability of data across modes

Common Data on Accident Circumstances

Recommended Improvements in Methods

- Greater use of sampling
- Supplemental studies, e.g., certain vehicles
- Confidential reporting systems
- Special studies using other national databases such as CPSC's NEISS

Common Data on Accident Circumstances

Use of Technology to Improve Data

- Incorporation of Event Data Recorder (EDR) data in police reports
- Installation of Automatic Crash Notification (ACN) in all road vehicles
- Evaluation of effectiveness of current automatic warning systems

Common Data on Accident Circumstances

Other Recommendations

- More timely data, on quarterly basis
- Increased frequency of national surveys such as personal transportation survey
- Data on bicyclist injuries should be obtained from CPSC

Common Data on Accident Circumstances

Conclusion

- Major steps can and should be taken to improve transportation safety data.

Research Project #6

Develop Better Data on Accident
Precursors or Leading Indicators

Improve Data on Accident Precursors or Leading Indicators

Project Purpose

- Identify precursors that might be strong predictors of accidents
- Establish research projects that would evaluate the strength of the precursor to predict accidents

Improve Data on Accident Precursors or Leading Indicators

Project Tasks

- Form Working Group from modal safety experts
- Volpe review of current work

Improve Data on Accident Precursors or Leading Indicators

Project Tasks

- Identify Potential-Accident relationships
- Prioritize Proposed projects
- Develop Research protocols

Improve Data on Accident Precursors or Leading Indicators

Proposed Research Areas

- Evaluation of Data or Method of Collection
- Safety Culture Analysis
- Specific Precursor-Outcome Relationships
- Technology Transfer

Improve Data on Accident Precursors or Leading Indicators

Evaluation of Data or Method of Collection

- Mining to Establish Sequence of Events
 - Use Text Mining to search narrative reports for the sequence of events that resulted in an accident.

Improve Data on Accident Precursors or Leading Indicators Evaluation of Data or Method of Collection

- A Human Factors Analysis of Precursors Associated with Incidents/Accidents
 - Looks at Reason's 'Swiss cheese' model of accidents
 - Incorporates human factors aspects to help understand the combination of factors that result in an accident

Improve Data on Accident Precursors or Leading Indicators Evaluation of Data or Method of Collection

- Other proposals:
 - Retrospective interview and survey information
 - Assessment of data needs for GIS
 - Documentation of safety "successes" as well as failures
 - Various forms of data modeling to establish potential for accidents

Improve Data on Accident Precursors or Leading Indicators

Safety Culture Analysis

- Organizational safety culture and other indicators of accident risk
 - Investigate both the “driver” and the company
 - Workload - an indicator of accident risk
 - Identify “culture” attributes that are characteristic of “problem” operators

Improve Data on Accident Precursors or Leading Indicators

Safety Culture Analysis

- Study the Feasibility of Possible Profiling Systems
 - Investigate the operability and utility of “profiling” of carriers & operators
- Using an Indexing System to Identify Precursors for Vehicle Crashes, Injuries and Deaths
 - Utilize a point system to rate risk of accidents

Improve Data on Accident Precursors or Leading Indicators

Specific Precursor-Outcome Relationships

- Experience & Training As Predictor of Hazardous Materials Incidents
- Several other proposals:
 - Noise Levels and Distraction
 - Social Needs and Nocturnal Work Activity
 - Tracking Undeclared Hazardous Materials Shipments
 - Traffic Intensity at the Sector Level
 - Driving Records as a Predictor of Crash Involvement

Improve Data on Accident Precursors or Leading Indicators

Technology Transfer

- Use of Flight Data Recorder Technology to Predict Accidents in other modes

Improve Data on Accident Precursors or Leading Indicators

Select Projects for Research

- Input:
 - Stakeholder Input
 - Safety in Numbers Conference
 - DOT Safety Data Task Force
- Top projects to be identified for funding early in 2002.

Research Project #7

Expand the Collection of
“Near-Miss” Data to All Modes

Collection of “Near-Miss” Data Background

- Definition
 - A situation that could have resulted in accidental harm or damage but failed to in the absence of any specific measure designed to prevent it.
- - “Near-Miss” vs. “Unsafe Situation”

Collection of “Near-Miss” Data

Benefits of Unsafe Situation Reporting

- Injury Prevention
- In-depth quantitative analysis
- Stronger safety efforts
- Cost-efficiency

Collection of “Near-Miss” Data

Methods of Data Collection

- Automated data recording systems
- Voluntary self-reporting systems

Collection of “Near-Miss” Data

Existing Data Systems

- Aviation
 - Aviation Safety Reporting System (ASRS)
 - Near Midair Collision System (NMACS)
 - The Confidential Human Factors Incident Reporting Programme (CHIRP)
 - The Global Analysis and Information Network (GAIN)

Collection of “Near-Miss” Data

Existing Data Systems

- Maritime
 - The Nautical Institute International Marine Accident Reporting Scheme (MARS)
 - Safety Incident Management Information System (SIMIS)
 - The International Maritime Information Safety System (IMISS)
- Rail
 - Signal Passed at Danger (SPAD) system
- Intermodal
 - Secutitas

Collection of “Near-Miss” Data

Project Goals & Objectives

- Study Existing Data Systems
- Identify Potential Benefits and Problems
- Explore Transferability of Reporting
- Improve Cross-Modal Utility of Data
- Improve Data Analysis Process

Collection of “Near-Miss” Data

Methodology

- Data Systems Matrix
- Human Factors Taxonomy
- Voluntary Reporting Guidelines
- Automated Methods of Data Collection

Collection of “Near-Miss” Data

Data Systems Matrix

- Background
- Structure
- Program Input
- Data Management
- Program Output

Collection of “Near-Miss” Data

Human Factors Taxonomy

- Purpose
 - Classification of causes
- Elements
 - Level 1 – specific errors
 - Level 2 – predisposing conditions
- Methods
 - Intermodal taxonomy - pilot testing

Collection of “Near-Miss” Data

Key Elements in Voluntary Reporting

- Voluntary participation
- Confidentiality
- Legislative protection & immunity
- Non-regulatory host agency
- Buy-in and support from the community
- Feedback
- Data System Design

Collection of “Near-Miss” Data

Project Approach

- Voluntary Reporting
 - Target areas
 - Modal participation
 - Methods
 - Draft guidelines
 - Pilot testing
 - Final guidelines
 - Modal implementation

Collection of “Near-Miss” Data

Project Approach

- Automated Reporting
 - Technology & Unsafe Situations
 - Advantages of Automated Data Collection
 - Marine Traffic Patterns Study
 - Truck Headway Study

Collection of “Near-Miss” Data

Conclusion

- Value of Unsafe Situation Data in Transportation Safety
- (Self-reports + Recorded Data) = Success
- Identification of Contributing Factors
- Trend Analysis
- New Remediation Strategies

Research Project #9

Exploring Options for Using
Technology in Data Collection

Using Technology in Data Collection

Objectives

- Improve timeliness
- Improve accuracy
- Improve usefulness
- Improve cost-effectiveness
- Establish or increase utilization of technology across transportation modes

Using Technology in Data Collection

Project Plan

- Review Existing Technologies
- Identify New Technologies
- Apply Technologies to Needs
- Develop Pilot/Demo Project Descriptions

Using Technology in Data Collection

Background

- FAA - 7 current technology projects
- FRA - 6 current technology projects
- MARAD/USCG - 13 current technology projects
- NHTSA - 5 current technology projects
- FMCSA - 8 current technology projects
- FHWA - 7 current technology projects
- RSPA - 7 current technology projects
- FTA - 8 current technology projects

Using Technology in Data Collection

Overall Method

- Technology Transfer Opportunities
- Identify “New” Technologies
- Map Technologies to Needs

Using Technology in Data Collection

Prioritization Attributes

- Cost-effectiveness
- Feasibility
- Likely Impact
- Anticipated Cost
- Maintainability
- Potential for Expansion
- Accessibility
- Strategic Importance
- Adaptability
- Cross-Functional Application
- Industry Buy-in

Using Technology in Data Collection

Eight Technologies

- Smart Cards
- Performance Monitoring
- Hands-Free Operation
- Vehicle Usage Monitoring
- Imaging
- Voice Activation
- Automated Control
- Pattern Recognition

Using Technology in Data Collection

Smart Cards

- Licensing Applications
- Highway Data
- CDL
- Security
- Qualifications
- Certifications



Using Technology in Data Collection

Performance Monitoring



- Driver Control
- Commercial Vehicles
- Shipping
- Traffic Control
- Security Personnel

Using Technology in Data Collection

Hands-Free Operation

- Law Enforcement
- CMV Inspection
- Pipeline Inspection
- Bridge & Tunnel Inspection
- Highway Data
- Ship Inspection



Using Technology in Data Collection

Vehicle Usage Monitoring



- Driver Control
- Commercial Vehicle

Using Technology in Data Collection

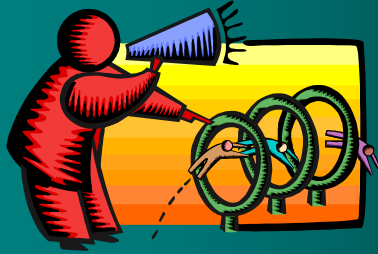
Imaging

- Traffic Monitoring
- Pipeline Incidents
- 3-D X-ray
- Millimeter Wave



Using Technology in Data Collection

Voice Activated Data Input

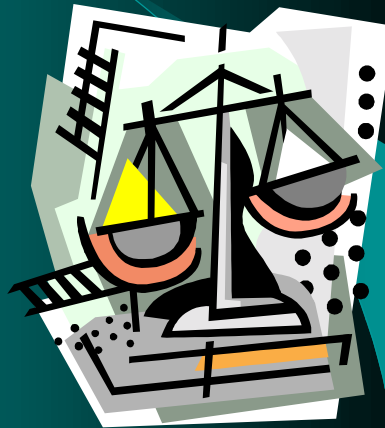


- Vehicle Interlock
- Secure Operation
- Shipping

Using Technology in Data Collection

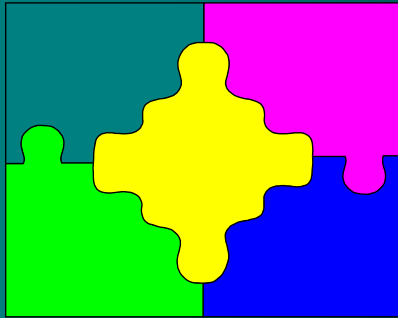
Automated Control Device

- Aircraft Monitoring
- Telemetry
- Hazard Identification



Using Technology in Data Collection

Pattern Recognition



- Security
- Scent Detection
- Pipeline Incidents

Using Technology in Data Collection

Conclusion

- Top 3 Technologies for Field Testing:
 - Electronic Identification/Security (Smart Cards)
 - Operator Performance Monitoring
 - Hands-Free Operation
- Develop Several Pilots/Demonstrations



Safety in Numbers
Using Statistics to Make the Transportation System Safer

Research Project #10

Expand, Improve, and Coordinate Safety Data Analysis

Expand, Improve, and Coordinate Safety Data Analysis

Goal

- Increase the extent to which analyses of transportation safety data help to save lives and prevent injuries from hazards in all modes of transportation.

Expand, Improve, and Coordinate Safety Data Analysis

Objective

- Report on Transportation Safety Data Analysis
- Promote intermodal interchanges of information on data analysis

Expand, Improve, and Coordinate Safety Data Analysis

Process

- Identify and index leaders in transportation safety data analysis and research
- Conduct a transportation safety data analysis survey
- Construct an analysis methods inventory

Expand, Improve, and Coordinate Safety Data Analysis

Process

- Develop a DOT safety data analysis improvement plan
- Formulate an outreach strategy
- Produce the Transportation Safety Data Analysis Report

Expand, Improve, and Coordinate Safety Data Analysis

Data Analysis Survey

- Survey methodology and questions developed
- 15 respondents identified and interviews scheduled
- Will code results, analyze and summarize findings

Expand, Improve, and Coordinate Safety Data Analysis

Safety Data Analysis Improvement Plan

- Performance standards
- Recommendations for developing new analytic methodologies

Expand, Improve, and Coordinate Safety Data Analysis

Safety Data Analysis Improvement Plan

- Recommendations for technology applications
- Best practices and benchmarking
- Training guidelines

Expand, Improve, and Coordinate Safety Data Analysis

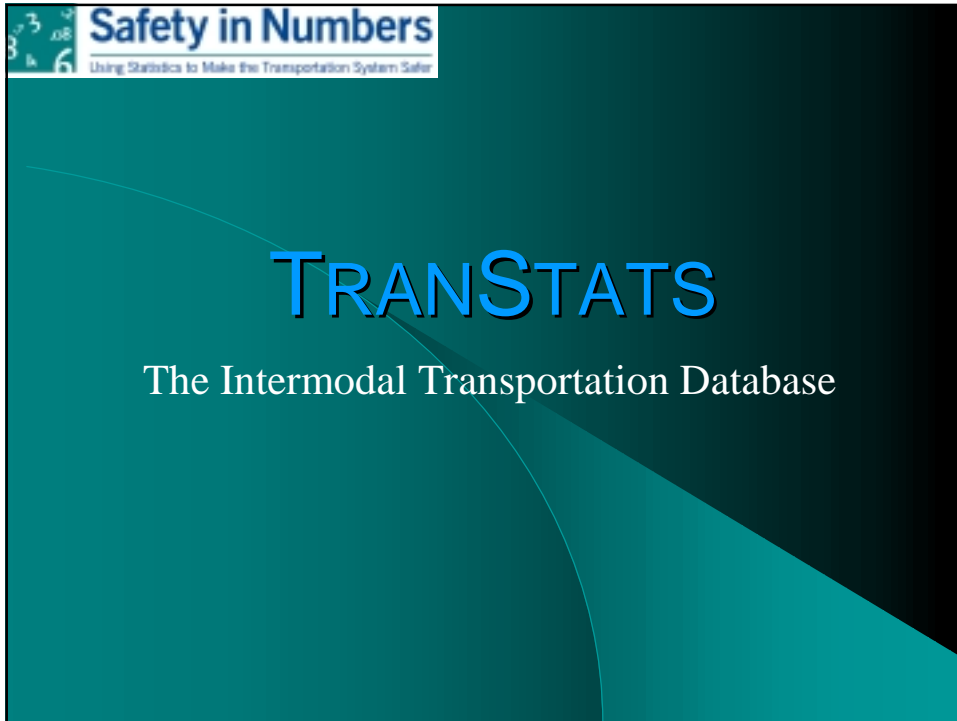
Outreach Recommendations

- Sponsorship of a safety data analysis “strike force”
- Presentations for national and international conferences and other fora

Expand, Improve, and Coordinate Safety Data Analysis

Outreach Recommendations

- Curriculum for estimating
- Estimating transportation safety risks
- Cost analysis and Management
- Web site and publication program



TRANSTATS – What is it?

- Web-based
- Intermodal
- Easy access

The screenshot shows the TranStats website interface. At the top, it says "TranStats Bureau of Transportation Statistics" and "The One Source for Intermodal Transportation Data". Below this is a search bar and a navigation menu with "Home", "Contact Us", and "About". The main content area is divided into three sections: "Data Library", "Mapping Center", and "Data Library" (repeated). The "Data Library" sections have sub-menus for "Explore by Mode" (Aviation, Highway, Rail, Maritime, Transit, Pipeline) and "Explore by Subject" (Safety, Passenger Travel, Economic/Financial, Infrastructure, Social/Demographic, Freight Transport, Environment, National Security). The "Mapping Center" section has a sub-menu for "View Data Geographically: Social/Factor".

Search this site:

April 3, 2002 Bureau of Transportation Statistics

TRANSTATS – What can you do with it?

- Access Data
 - By Mode (Aviation)
 - ❖ Refine by subject (Safety)
 - By Subject (Safety)
 - ❖ Refine by mode (Aviation)
 - Search *safety*

Search Results on: safety		All Records Shown
Table Name	Description	
Boating Accident Report Database - Deceased	Information on Deceased Due to the Accident	Details Download
Boating Accident Reporting Data - Injury	Injuries Related to Boating Accident	Details Download
Boating Accident Report Data - Primary	Information on Boating Accidents	Details Download
Boating Accident Report Data - Vessel	Information on Vessel Involved in Accident.	Details Download
	Information on Rail-Equipment Involved Train Accidents.	Details Download
RAIL-EQUIPMENT ACCIDENTS II	Subset of Rail-Equipment Train Accidents and Highway Rail Crossing Databases.	Details Download
HAZCON	Container Information from Hazardous Materials Incident Report (Form F5800.1).	Details Download
HAZMAT	Hazardous Materials Incident Report (Form F5800.1) filed by carriers.	Details Download
HAZARDOUS LIQUID	Hazardous Liquid Accident Data File.	Details Download

April 3, 2002

Bureau of Transportation Statistics

TRANSTATS – What can you do with it?

- Explore Metadata
 - Table Summary
 - Table Details
 - Lookup Tables

April 3, 2002

Bureau of Transportation Statistics

TRANSTATS – What can you do with it?

- Perform Interactive Analysis : Analysis Tables
 - Start Analysis
 - Filter Selection
 - ❖ Filter Statistics
 - ❖ Filter Variables
 - ❖ Filter Years
 - Analysis Summary
 - ❖ Ranks
 - ❖ Percent of Total

April 3, 2002

Bureau of Transportation Statistics

TRANSTATS – What can you do with it?

- Perform Interactive Analysis : Time Series
 - Analysis Types
 - Filter Selection
 - ❖ Filter Statistics
 - ❖ Filter Variable
 - Analysis Summary
 - ❖ Ranks
 - ❖ Percent of Total

April 3, 2002

Bureau of Transportation Statistics

TRANSTATS – What can you do with it?

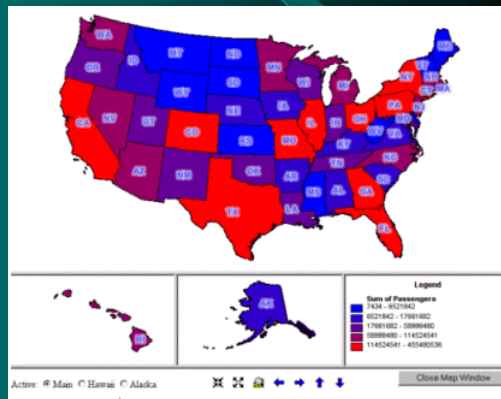
- Perform Interactive Analysis : Charts
 - Charts for One Year
 - ❖ Filter Selection
 - ❖ Ranks
 - ❖ Percent of Total
 - Time-Series Charts
 - ❖ Chart
 - ❖ Change table
 - ❖ Drill Down

April 3, 2002

Bureau of Transportation Statistics

TRANSTATS – What can you do with it?

- Perform Interactive Analysis : Maps
 - Mapping Center
 - ❖ Predefined areas
 - ❖ Filter selection
 - ❖ Mapping tools
 - Map Analysis
 - ❖ Perform Analysis
 - ❖ Create ad-hoc maps



April 3, 2002

Bureau of Transportation Statistics

TRANSTATS – What can you do with it?

- Download Data
 - Locate table
 - Use Filters
 - ❖ Filter time/period
 - ❖ Filter geographical location
 - Select fields
 - Start download

April 3, 2002

Bureau of Transportation Statistics

TRANSTATS – What can you do with it?

- Access data
- Explore metadata
- Interactive analysis
 - Analysis Table
 - Time Series
 - Charts
 - Maps
- Download Data

April 3, 2002

Bureau of Transportation Statistics

TRANSTATS – Where do you get help?

- Online Support
 - Page-sensitive help
 - Getting Started
 - Keyword Search
- Contact Information
 - Data source contact
 - Contact BTS

Contact Us	
Mail	
Bureau of Transportation Statistics Attn: TranStats Customer Support Room 3430, K-20 400 7th Street, S.W. Washington, DC 20590	
Phone	
Customer Support (Monday-Friday 8:00am-5:00pm)	(202) 366-9259
Fax	
Attn:TranStats Customer Support (Monday-Friday 8:00am-5:00pm)	(202) 366-3640

April 3, 2002

Bureau of Transportation Statistics

TRANSTATS

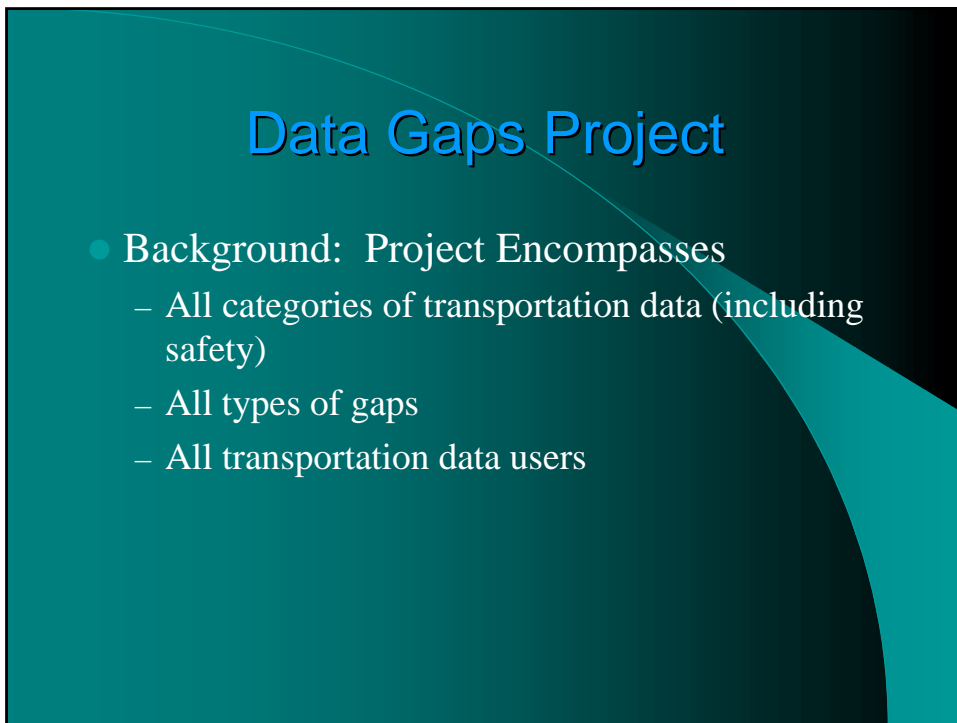
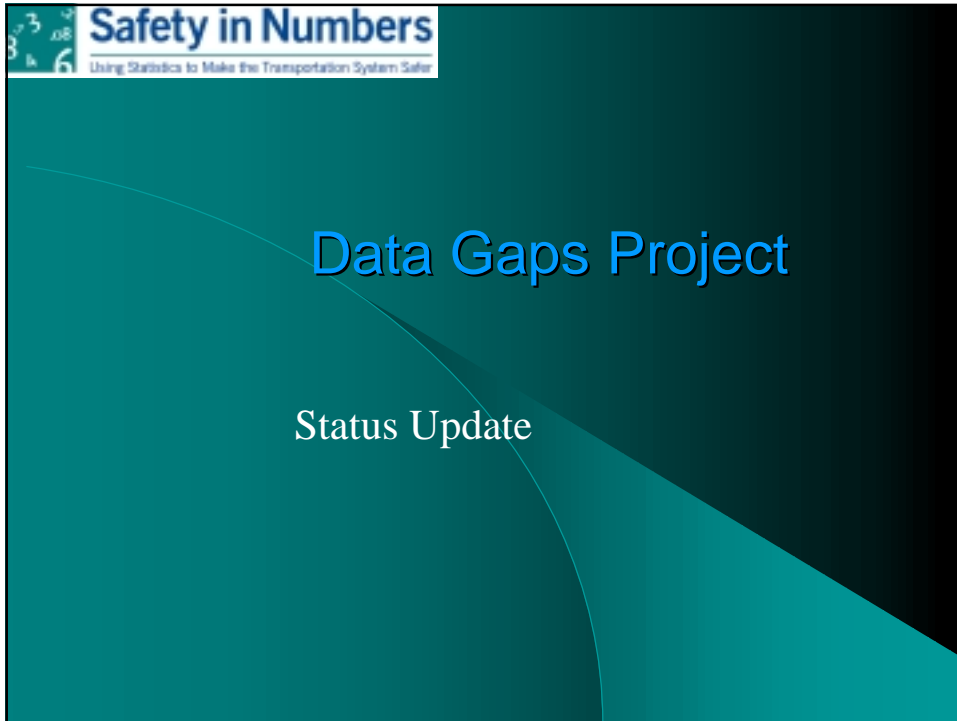
The Intermodal Transportation Database

End of Presentation

Thank You!

April 3, 2002

Bureau of Transportation Statistics



Data Gaps Project

- Efforts to date
 - Literature searches
 - Meetings & workshops
 - Web-conferencing
 - On-line questionnaire
 - On-line database
 - “Expert” review
 - Preliminary findings
- What’s next?
 - Web-conferencing
 - Risk/benefit assessment
 - Solution development
 - Cost estimation
 - Implementation responsibility
 - Final report

Data Gaps Project

- How you can help?
 - Visit Web site: www.bts.gov/datagaps/
 - Fill out questionnaire
 - Send e-mail comments
 - Participate in web-conference focus group
 - Encourage associates to participate

Data Gaps Project

- Contact Information

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