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E-Crash: The Model Electronic Crash Data Collection System

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16. Abstract

Existing State electronic crash data collection systems (E-Crash) were reviewed in order to develop a description of current capabilities. Using these functions along with additional quality assurance capabilities, a Model E-Crash system description was developed that integrates data from initial dispatch of officers to the scene, field data collection, data quality assurance, data management processes, and data query capabilities. The Washington Statewide Electronic Collision and Ticket Online Records (SECTOR) E-Crash system is compared to the model. The report concludes with a discussion of possible ways a State may work on E-Crash system improvement and ways that the Federal Government may assist in the effort.

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Acronyms

AAMVA	American Association of Motor Vehicle Administrators
ANSI	American National Standards Institute
AOC	Administrative Office of the Courts
ARIES	(Indiana's) Automated Reporting Information Exchange System
AVL	Automatic Vehicle Locator
BOLO	Be on the lookout (for)
CAD	Computer-aided dispatch
CIS	Crash Information System
CJIS	Criminal Justice Information System
CMV	Commercial motor vehicles
CODES	Crash Outcome Data Evaluation System
COTS	Commercial off-the-shelf software
DHS	Department of Homeland Security
DOJ	Department of Justice
DOT	Department of Transportation
DPS	Department of Public Safety
DVS	Driver and Vehicle Services
EDR	Event data recorder
EMS	Emergency Medical Services
ERD	Entity Relationship Diagram
eVCRS	(Indiana's) Electronic Vehicle Crash Records System
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
ftp	File transfer protocol
GIS	Geographic information system
GPS	Global positioning system
HIPAA	Health Insurance Portability and Accountability Act
JINDEX	Washington State Justice Information Network Data Exchange
LACRASH	Louisiana Crash System - electronic field data collection tool
LEITSC	Law Enforcement Information Technology Standards Council
LETS	Law Enforcement and Traffic Safety, Division of Alabama's Dept. of Economic and Community Affairs
MCR	Mobile Capture and Reporting System
MCRS	Maine Crash Reporting System
MDC	Mobile data computer
MMIRE	Model Minimum Inventory of Roadway Elements
MMUCC	Model Minimum Uniform Crash Criteria
MSP	Michigan State Police
NCHRP	National Cooperative Highway Research Program

NCIC	National Crime Information System
NIEM	National Information Exchange Model
NEMSIS	National EMS Information System
NHTSA	National Highway Traffic Safety Administration
OST	Office of the Secretary of Transportation
OWI	Operating while intoxicated
PDF	Portable document format
PMBOK	Program Management Body of Knowledge Guide
REJIS	Regional Justice Information Service
RFID	Radio frequency identification
RITA	Research and Innovative Technology Administration
RMS	Records management system
SaDIP	FMCSA's Safety Data Improvement Program
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users
SAFETYNET	SAFETYNET is an FMCSA system designed to manage and provide access to crash data, roadside inspection history and data, and motor carrier and shipper identification information
SDK	Software development kit
SHSO	State Highway Safety Office
SECTOR	Statewide Electronic Collision and Ticket Online Records
STARS	Statewide Accident Reporting System
SQL	Structured query language
TCRS	Traffic Crash Reporting System
TRA	Traffic Records Assessment
TraCS	Traffic and Criminal Software
TRCC	Traffic Records Coordinating Committee
USDOT TRCC	U.S. Department of Transportation Traffic Records Coordinating Committee
VCRS	Vehicle Crash Reporting System
VIN	Vehicle identification number
XML	Extensible Markup Language

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Executive Summary

States vary widely in their ability to collect crash data electronically in the field and transmit that data to the statewide crash system. There are a small number of States that have achieved (virtually) 100 percent electronic field data capture and electronic transmission of crash data. These success stories, however, are not the full story when it comes to E-Crash systems. Several systems are in operation that, while they do not achieve the high rates of electronic submission, make use of state-of-the-art methods and technologies for field data collection. This report documents a project sponsored by the National Highway Traffic Safety Administration to learn about electronic crash (E-Crash) data collection systems.

State personnel reading this report for ideas or guidance should recognize the fluid nature of state-of-the-art or current practices. Not many years ago, a 90-day lag between a crash event and data entry into a centralized crash reporting system was considered normal, and a 60-day lag was excellent. Today, many systems achieve day-current data entry and have essentially no backlog. This level of system performance is now considered normal. The last few years have seen a major expansion in error checking the data both at the point of collection (the officer at the scene) and during central processing of the crash database. The once rare practice of returning erroneous reports to the law enforcement agency for correction has now become routine for many States. In the future, we anticipate that error checking will go beyond the simple single- and cross-field edit checks to become much more comprehensive, including routine audits of the data to ensure that the narrative, diagram, and coded data all tell a consistent story. The future is likely to see systems with data-aware diagramming tools, narratives available for text searching, and much more extensive tools for edit- and error-checking.

From a policy standpoint, there has been a clear winner: flexibility. States have recognized law enforcement agencies' desire to field comprehensive data collection systems that work seamlessly with their computer-aided dispatch and internal records management systems. Fitting a field data collection system for crash reporting into that context requires some flexibility on the part of State decision-makers. Law enforcement agencies that have invested in a full suite of reporting software for the field do not need or want a single-function application for crashes. They want to collect data electronically and send it to the State in a way that meets the State's needs, but without having to add a stand-alone piece of software to their field data collection systems. States have successfully found ways to accept data from multiple systems, while still offering a crashes-only solution to those agencies that don't have the resources to purchase or field software on their own.

Along with the policy to accept data from multiple sources – State-supplied software, third-party vendor software, etc. – States have adopted methods to ensure the data received from these various sources meets a uniform standard for content and quality. The National Information Exchange Model, in particular, has been adopted by States to standardize the way data are defined, submitted, and transferred from the source agency to the central crash database. NIEM is an outgrowth of the Global Justice Extensible Markup Language Data Model, abbreviated as Global JXML, and inherits that project's focus on law enforcement data exchange, of which crash reporting is one component. By specifying a NIEM-compliant data exchange model, States can assist internal developers and third-party vendors to develop a standard method for sharing data electronically. NIEM-compliant data definitions include some edit-checking features and thus

may help to ensure that the electronic data meet at least some of the requirements for entry into the centralized crash database.

Remaining flexible has also helped States respond to emerging needs for data, especially as new topics or concerns arise in the States' traffic safety programs. Data systems that are easily modified and do not require high-cost programming efforts give the States the ability to analyze existing data and collect new data.

Finally, it must be recognized that the care and diligence of law enforcement officers responding to crashes and writing reports are the keys to improving data quality. Achieving and maintaining high quality in a crash records system primarily requires training and promoting a proper attitude among the people responsible for collecting the data at the scene. If the law enforcement officers do a good job and understand why the data is important for highway traffic safety decision-making, the result will be high quality, useful data. If that understanding is lacking, even the best electronic tools will be ineffective in assuring high-quality data.

Methodology

States were selected based on the project team's knowledge of existing systems and on States' submissions under the Section 408 grant program. Traffic records assessment reports were used as an adjunct resource in this selection. Selected States were surveyed in order to gauge their willingness to participate in the project and to ensure that their systems were advanced enough in some aspects to be worthy of inclusion as an example of an E-Crash system. From this list, several States were selected for follow-up surveys and on-site visits.

Examples of E-Crash Current Practice

The information-gathering efforts resulted in a detailed description of the E-Crash system capabilities and practices in Delaware, Illinois, Indiana, Iowa, Kansas, Louisiana, Maine, Michigan, Minnesota, Mississippi, Missouri, Tennessee, Washington, and Wisconsin. The report documents the detailed descriptions of these States' E-Crash systems. Based on the results, the report then presents a series of conclusions about what the state-of-the-current-practice is in the United States; i.e., those features that work best and make positive differences in the success of the overall E-Crash effort.

Summary of E-Crash Current Practice

Successful E-Crash systems come in many configurations and are developed and maintained through many different methods in the United States. Some States have adopted commercial off-the-shelf software that is used to develop a custom set of forms and databases. Other States have developed crash applications using in-house resources. Some applications are entirely Web-based. Others are strictly designed for use in the field. Still others serve as field, local office, and statewide crash records systems. At least one State has given complete control of its crash reporting system to a commercial vendor.

The more important determinants of success appear to be how well the system works for the law enforcement agencies that collect the data and the timeliness, accuracy, and accessibility of the data for users. These measures of success in turn depend on the levels of cooperation among agencies and the system development and management processes that have been put in place.

Findings Based on the Review of E-Crash Systems

States make decisions about designing and implementing E-Crash systems in the context of some very practical considerations and limitations. Each implementation had good aspects worth considering in future systems as well as some limitations that might cause concern for a State looking for a model. This is not news. Even the most successful system implementations that have achieved consistently high (close to or at 100%) electronic reporting of crashes have drawbacks or features that make automatic copying by another State less than certain of success.

In terms of features and business practices, the systems that were reviewed provide some very clear lessons learned, and some support for the notion that multiple paths to success exist. States would do well to review the successes of others, borrow those aspects that most closely meet their needs, and remain flexible when it turns out that their State's needs require a different solution than the ones already presented.

Model E-Crash Data Collection System

An E-Crash data collection tool ideally would be integrated with all other services and information that the law enforcement officer needs. However, this level of integration generally is not achieved in most law enforcement field systems. The E-crash component, in particular, remains generally stand-alone or integrated with one or two other forms; e.g., usually citation and contacts. This segregated process, even with a citation data collection tool included, can generate resistance to implementing an E-Crash system. Oftentimes a large community has already developed a system that coordinates with its local agency or city computer-aided dispatch system and with its records management system. The law enforcement agencies do not want their officers to have to deal with a separate crash process when all of their other reports are integrated. Law enforcement agency IT personnel are often reluctant to support a separate application running on the mobile data computers. Ideally, an E-Crash system would be a component of a suite of software that an officer can use for all reporting. The report presents an E-Crash system overview, including dispatch and data collection processes, system functions, and system quality assurance.

Comparison of E-Crash Model with Current Practice

Using the basic E-Crash system functions and quality assurance, the model system is compared to the Statewide Electronic Collision and Ticket Online Records (SECTOR) system currently used in Washington State.

Recommendations

The report ends with a discussion of possible ways that a State may work on electronic crash data collection improvement and how they might be helped by the Federal Government. Recommendations include staying current with the constantly evolving E-Crash systems and providing technical assistance to those States. Issues include the updates to the Traffic Records Program Advisory; State systems evaluation procedures; Go Team requirements; marketing, training, and outreach; and action plans.

Introduction

The National Highway Traffic Safety Administration and the other modal representatives of the U.S. DOT Traffic Records Coordinating Committeeprovide technical guidance and assistance to federal, State, and local traffic records programs. NHTSA initiated this project to assist agencies who are responsible for the original collection of data at the scene of a motor vehicle crash by suggesting methods of electronically collecting and transferring that data to their agencies and to the State's centralized crash database.

In July 2004, NHTSA published *Initiatives to Address Improvement of Traffic Safety Data* (commonly referred to as the *Data IPT Report*).[1] This report provides an overview of initiatives to improve traffic safety data and makes recommendations in the following areas:

1) Coordination and leadership;
2) Data quality and availability;
3) Electronic technologies and methods;
4) Uniform and integrated data; and
5) Facilitated data use.

The TRCC's *Implementation Plan for Traffic Records Improvement*[2] calls for prioritization of the specific area of electronic data collection and reporting. This project encourages the use of electronic technologies and methods as they pertain to electronic crash (E-Crash) data collection systems. The TRCC members (NHTSA, FHWA, FMCSA, OST, and RITA) and various State highway safety offices have identified a need for technical support, training, and reference material for E-Crash systems design and implementation.

This report includes a description of several existing E-Crash data collection systems and their use of current technology and practices. It is hoped that States that are considering developing new E-Crash systems or enhancing current systems can evaluate the recommended features and decide how best to approach their own E-Crash system design and implementation.

Published work relating to data collection systems in the public safety arena was reviewed including reports from the Transportation Research Board, NHTSA, FHWA, and FMCSA. Recent National Cooperative Highway Research Program synthesis reports also address issues related to crash reporting and technology and have relevance to the sections on technology and system capabilities, in particular.

NCHRP Synthesis 350, *Crash Records Systems*,[3] for example, is based on information provided by 26 States about their crash records systems. The synthesis report covers all aspects of crash records systems being used at that time including field data collection, or E-Crash tools. The report includes descriptions of several levels of technological advancement for field data

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[1] NHTSA. (2004, July). *Initiatives to Address Improvement of Traffic Safety Data*. Washington, DC: National Highway Traffic Safety Administration. Available at http://www.nhtsa-tsis.net/workshops/pdfs/_Q_Data_IPT_Report.pdf

[2] Traffic Records Coordinating Committee. (2008). *Implementation Plan for Traffic Records Improvements, 2008.* Washington, DC: Department of Transportation.

[3] DeLucia, B. H., & Scopatz, R. A. (2005). NCHRP Synthesis 350, Crash Records Systems: Washington, DC: Transportation Research Board.

collection of crashes, from minimal uses of technology similar to word processing applications to statewide systems that integrate with other law enforcement applications.

NCHRP Synthesis 350 presents information on the high-end of automated crash data collection tools, systems such as TraCS used in several States and ARIES used in at least two States at the time of this report. Depending on the level of implementation in a given State, these systems allow crash data entry in the field with validation edits, use of maps to pinpoint locations, and electronic transfer of data to other systems. More important, these crash data collection systems either allow access through the State telecommunications network for verifying driver and vehicle data or provide the tools to scan information from the vehicle identification number, registration papers, vehicle plate, and driver license. This ability to communicate with other systems while in the field reduces data entry by automatically filling data fields and better ensures linkage to these data files in the future for analysis and reporting.

At this level of sophistication, examples of tools that can improve the efficiency or effectiveness of field crash data collection include those that:

- Read barcodes or magnetic stripes from the driver license and the vehicle identification number and/or vehicle plate;
- Collect coordinates of the crash location using GPS or GIS locator routines to link to data in a statewide GIS;
- Automatically populate data fields whenever possible; and
- Share information among the various reports that the officer has to complete.

NCHRP 350 includes a set of recommendations for improving crash records in general and field data collection of crash reports in particular. These were summarized in a statement about the value of using technology to simplify the task of field data collectors:

> "The most successful crash records systems have come out of efforts to simplify field data collection. Examples of efforts to do this have included providing software and hardware tools for data collection, training, and support, linkages to other data sources to reduce the number of data elements collected, and the use of non-sworn officers for crash investigation."

NCHRP Synthesis 367, *Technologies for Improving Safety Data*,[4] discussed the technologies that may be used to collect, manage, and analyze a range of highway traffic safety data. The report is based on information provided in three surveys by 34 States. In the crash data collection section, the report highlights three statewide crash reporting systems (the TraCS system, the Crossroads system, and the MCR system). The common features that led the authors to judge each of these systems a success include:

- Widespread acceptance of the software by law enforcement in the State;
- Elimination of duplicate data entry;
- Shorter time from event to availability of the data on the statewide system; and
- Improved accuracy of the data due to extensive edit checks.

[4] Ogle, J. H. (2007). NCHRP Synthesis 367, Technologies for Improving Safety Data. Washington, DC: Transportation Research Board.

The report also includes a review of available technologies that can be added to a field data collection system to streamline data collection, reduce the number of keystrokes, and improve linkage between crash reporting and other data sources. These additional technologies include:

- GPS receivers;
- Magnetic stripe and barcode readers;
- Radio frequency identification (RFID) readers;
- Laser measurement and digital photography; and
- Event data recorders (EDR) in vehicles.

NCHRP Synthesis 367 provides a series of recommendations relevant to field data collection of crash information. The most critical need they saw was for States to adopt more modern methods of data transfer:

> "Advances in wireless communications and mobile computing allow for ease of mobile data capture and reporting; however, paper and pen remains a top medium for crash data collection. In a time when it is possible to send a package across the country in less than 24 hours and receive immediate e-mail confirmation of delivery with an attached digital signature, it is feasible to upgrade and expedite our crash records systems. Several States have begun to deploy business-like systems for the capture and delivery of this critical safety data. Not only are these States able to recoup the costs of the data system, but they are also able to recoup costs for damage to infrastructure owing to the timeliness of the data."

On a five-year cycle, NHTSA works in cooperation with each State to assess the State's traffic records systems. These assessments are based on the *Traffic Records Program Advisory* which was most recently updated in 2006.[5] [6] The 2006 update includes a series of review items related to crash data quality and technology used to improve the timeliness, accuracy, consistency, accessibility, linkage, and completeness of the data. The Strategic Planning section says that the States are expected to review applicable technologies and identify ways to implement those technologies that would improve their traffic records system in a cost effective manner. The Advisory also recommends that data quality should be quantified by a set of specified performance measures.

This message is backed up with funding through the Section 408 grant program established within the SAFETEA-LU legislation.[7] The grant application process requires States to provide information about their traffic records systems, including any new technology deployments. For

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[5] DeLucia, B. H., et al. (1998). *Traffic Records Advisory and Traffic Records Assessment Workbook.* Washington, DC: National Highway Traffic Safety Administration.

[6] DeLucia, B. H., et al. (in review). *Traffic Records Advisory and Traffic Records Assessment Workbook – 2006 update.* Washington, DC: National Highway Traffic Safety Administration.

[7] State Traffic Safety Information System Improvement Grants." (2006, February 2) National Highway Traffic Safety Administration. in Federal Register, Vol. 71, No. 22, pps 5729-34.

each of the major components of a State traffic records system, applicants provide a point of contact and some information about the system's current operation and overall data quality. Of key importance for the current project, the grant applications include the status and plans for crash records and field data collection of crash information.

In addition, FHWA and FMCSA are both involved in efforts aimed at improving crash data quality. FHWA has been particularly interested in technology solutions, including an early adoption of pen-based computers and expert systems to improve accuracy of data collected in the field.[8] The FMCSA provides to States grants aimed at improving crash data quality – the Safety Data Improvement Program (SaDIP). That program funds a variety of areas including E-Crash implementations or improvements. In addition to the technology focus, NHTSA, FHWA, and FMCSA have placed a priority on performance measurement as part of all their crash data quality improvement efforts. The current project is no exception. This report includes a section on performance measures for the new Model E-Crash System.

[8] Thielman, C. Y. (1999). *Expert Systems for Crash Data Collection*. FHWA-RD-99-052. Washington, DC: Federal Highway Administration.

Methodology

Several methods were used to identify those States with particularly well advanced E-Crash systems and to develop a detailed description of the features and management of those systems. Sources of information included the Section 408 grant applications, current traffic records assessments, published presentations or projects, and recommendations from other States.

Review of Section 408 Grant Applications

As part of the Section 408 (Traffic Records Improvement) grant application process, NHTSA asked States to supply detailed information on their existing crash data collection capabilities and any plans. NHTSA's Section 408 monitoring program also included more general system descriptions and contact information for the crash systems' managers. Initial information was gathered for this project by reviewing these State grant applications for projects to improve their traffic records systems.

For grant requests that addressed either new or continuing projects in the area of electronic crash data collection, the State's project director was contacted for additional information. In some cases, the project director identified one or more State contacts to provide additional information. In this first round of identifying potential E-Crash projects, contacts were made with 32 States, 2 Territories, 3 Tribal Nations, and 4 large cities that were recommended as potential sites for further review.

Traffic Records Assessment Reports

To supplement existing information, traffic records assessment reports were reviewed for additional information concerning each State's crash records systems. Reports that were used throughout the project as adjunct resources are shown in Appendix B. When there was conflicting information in the survey response and the assessment report, the conflict was resolved through additional personal contact with the State.

Additional Contacts

In addition to the 32 States initially identified, another 14 States were contacted for additional information. In total, 46 States/District of Columbia, 2 Territories (Guam and Virgin Islands), 3 Tribal Nations (Navaho, Cheyenne, and Crow), and 4 cities (Portland, Oregon; Loveland, Colorado; Nashville, Tennessee; and Wichita, Kansas) provided some degree of input for this study.

Screening Contacts

Each of the 41 jurisdictions identified through the initial Section 408 grant application review and the additional 14 States identified through other means was screened to help the project team determine if further detail about its E-Crash systems would be needed. The initial screening questions included:

1) Primary owner or manager of the subject electronic crash system;
2) Scope of effort (e.g., number of users, geographic coverage, size of data collection effort);
3) Status of effort (e.g., planning, implementing, completing project or system);
4) Reason for selecting specific format of initiative (e.g., commercial software, locally developed software, shareware);
5) Problems encountered and how were they resolved/outcome;

6) Lessons learned from the effort; and
7) Are GIS, HIPAA, or ersonally dentifiable information collected.

Detailed Information Gathering

Based on the initial screen, 17 States and 4 cities were contacted for additional information and documentation about their E-Crash data collection systems. The types of information that were pursued about potential E-Crash systems are listed in Appendix A. Additional systems documentation was gathered directly from the States, from their recent traffic records assessments (see Appendix B), from recent publications and presentations, from additional email or telephone contacts, and, in a few cases, through on-site system reviews. All information gathered about a State's E-Crash system was used to develop as complete a systems functional description as possible. Where there were gaps in that understanding or conflicting information from numerous sources, a follow-up contact or site visit was used to clarify the information.

Summary

In *Figure 1*, those States shaded only in yellow could not provide documentation of an existing E-Crash Systems in their States or were too early in their E-Crash project to provide applicable information. Those States highlighted in blue or green were the 17 States identified as potential States with E-Crash systems. These States, along with the four identified cities, were asked to provide additional documentation about their systems. The four States highlighted in blue have had on-site visits for additional information, as well. Appendix C provides a list of personnel who were able to provide detailed information about their E-Crash systems or projects.

Additional contacts were made with agencies responsible for systems within the Indian Nations. These contacts included the National Highway Traffic Safety Administration, Federal Highway Administration, Bureau of Indian Affairs, the Office of Federal Lands Highway, representatives of various tribal groups (e.g., Indian Health Service, the Tribal Transportation Program Committee, and tribal law enforcement). More in-depth discussions were held with the Navaho Indian Nation.

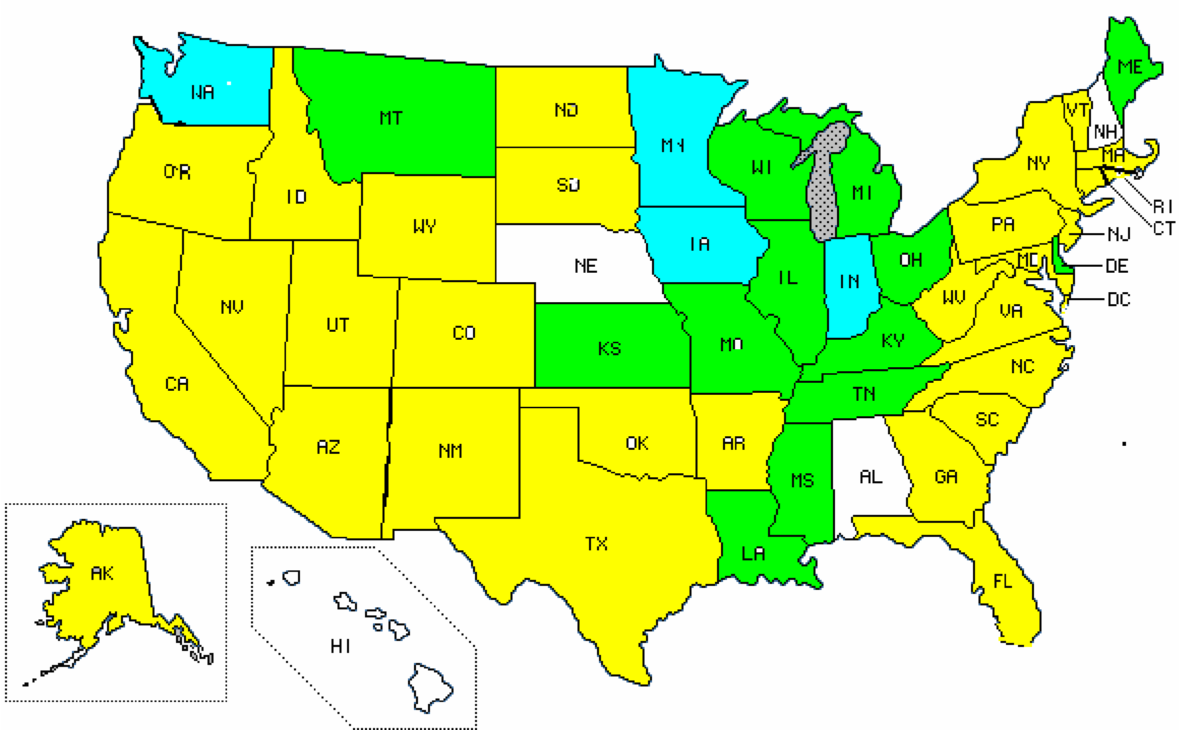


Figure 1. E-Crash Contacts

Map Color Key:

White: Information was not obtained from the 4 States shaded as white.

All Colors: 47 States/District, 2 Territories, 3 Tribal Nations, and 4 large cities were screened for possible E-Crash systems using various sources of information:

1. Section 408 grant monitoring system;
2. Recent traffic records assessments;
3. Conference presentations/proceedings; and
4. Published articles or research findings.

Yellow: States that indicated that they did not have an existing E-Crash system or were in the process of extensive revisions.

Green or Turquoise: 17 States and 4 cities were asked for additional information and documentation about their E-Crash data collection system.

Turquoise: Based on the more detailed documentation that was provided, on-site visits were conducted in 4 States to see the E-Crash system in operation and talk to the developers.

E-Crash Current Practice

Information was gathered from selected States identified as having particularly advanced E-Crash systems. This section of the report describes the capabilities of the existing systems along with the States' plans for future enhancements of the various systems. Where possible, States have been grouped under the particular software package that they use, however, the reader should be aware that the implementation of even the same software might vary from State to State. Important differences are highlighted in the text.

It should be noted that individual State names have been avoided in this report. The list of State contacts at the end of the report gives the reader a way to contact individual States for more information.

Traffic and Criminal Software: TraCS

Several States have implemented the TraCS software to some extent. Four States were chosen for this review as examples of its use.

1) One State was chosen because 100 percent of the State's law enforcement agencies using TraCS.
2) One State was chosen for its lead role in developing and maintaining TraCS.
3) One State was chosen as an example of a recent implementation involving customization of the TraCS software.
4) One State was chosen for its ambitious plan for 2008 to move from a low (24%) to a high (80%) level of electronic reporting to the Statewide crash records system.

Together, these four States provide good examples of the strengths and flexibilities of the TraCS model.

Highlighted Concept: Multiple, linked modules with a contact/incidents base

The TraCS model includes a software development kit that affords a means for the software to be modified or expanded to meet the varying needs of any particular user community (a State, a law enforcement agency, etc.). A State seeking to adopt TraCS for the first time may obtain the core software and the SDK at no cost. States may then adapt the existing forms (e.g., crash or citation) to their own needs and create new forms or reports using the SDK, using their own staff, or through the use of a vendor. The core software is in the final phase of a multiyear migration from Visual Basic to .NET.

TraCS is built around the concept of a common contact/incident structure, which allows officers to enter data once and share that basic information with any of the report forms programmed in their State's version of the software. For example, an officer might respond to a crash scene and need to complete a crash report and several citations. The information on the drivers and vehicles involved can be entered once into the TraCS database and then used to populate the various other reports as needed. TraCS organizes common information into four basic categories: individuals, vehicles, commercial carriers, and locations.

Scale: Field data collection to centralized reporting

TraCS functions as two related applications: a mobile or an office-based data collection tool. The TraCS Office Database is used to store data at the local agency level. The TraCS Office Database has been designed to send data to a statewide, centralized repository (such as the State crash records system). It is at least feasible that the TraCS Office Database could also serve as the statewide central repository, although this was not the original intent behind that application.

The data collection application is designed to work on mobile data computers (MDCs) in the field and on an office-based machine, depending on the needs of the law enforcement agency. Thus, agencies that do not have MDCs or sufficient communication capabilities can still take advantage of the automated reporting tools and create an agency-level repository using TraCS Office and TraCS Office Database.

For agencies with limited computing capabilities and which do have Internet access, a Web-based version of TraCS is scheduled for development sometime in 2009.

Data Transfer Procedures

From the outset, TraCS was designed to support multiple methods of transfer from the field to the local agency TraCS Office Database. These methods include any wireless communication system supported by the local agency, file transfer protocol (FTP), portable memory media (floppy disc or memory stick), direct connect/network, and dial-in servers. TraCS can also accommodate multiple methods to transfer crash data from the local agency servers to the statewide repository. For example, a law enforcement network is used by the State Patrol and all other users use FTP or dial-in to a system managed by the Department of Public Safety. Crash reports are routed to the DOT's mailbox where they are then uploaded to the central repository.

TraCS uses an XML transfer protocol, but individual States are free to program and support other transfer formats if they prefer.

TraCS is capable of transmitting updates wirelessly to field units (MDCs). Not all States are making use of this capability at present, but it is possible to send out new program updates without requiring the machine to be brought in to a central location.

Report Images

Crash report images are generated automatically in TraCS. The system is designed to capture images of each generation of a report so that the original and any amended versions are available for retrieval, viewing, and printing.

Hardware and Software Aids to Field Data Collection

Location tool:

The location tool was first implemented in 2001. It allows an officer to pinpoint the crash location by clicking on an automated map. If the officer's computer is connected to a GPS, the location tool will use the GPS readings to keep the map centered on the officer's current location. The ultimate input of a specific location still requires the officer to point and click on the map. This helps to reduce GPS-induced errors in the location coding.

Magnetic stripe and barcode readers:

TraCS supports the AAMVA standards for driver license data encoding and can be modified to read non-standard State-specific codes. The barcode reader function can be programmed to read codes from printed forms (e.g., a citation number, a vehicle registration or title document) and can function as a signature scanner to add a motorist's or officer's signature to a report). The input from these sources can be used to auto-populate fields in multiple report forms.

Diagramming, digital image capture, and other attachments:
TraCS has a native diagramming tool and an image capture feature. The software also supports third-party diagramming tools such as Visio, Easy Street Draw, and Quick Scene. Image capture is available in all modules so photographic evidence may be added to any report. Files other than images may also be attached to reports in TraCS. For example, breath test results are added automatically to OWI reports in TraCS through a direct connection with the testing machine.

Data Sharing: Third-party vendors and other traffic records components
TraCS implementations are not automatically set up to accept data from non-TraCS data collection tools, but there are no serious barriers to doing so. For example, a complete data field and record description can be provided to third-party vendors so that the data in TraCS Office Database can be exported to local agency records management systems. A data transfer from a local system into the statewide repository could be similarly processed to provide data as an automated electronic upload. In most TraCS implementations, however, TraCS has become the only software supported by the State for use in the field. If local agencies want to use their own preferred software package, the burden is on them to develop the interfaces to TraCS.

TraCS can share data with other components of a State's traffic records system. Through the "external search engine," a State may customize its implementation to pull data from a driver history file, a vehicle registration and title database, or other data sources to populate fields in a report form. The system may also be designed to pass specific pieces of information back to external systems. Not all implementations have this level of data sharing, however. In one State, for example, the DPS currently makes driver photos available through an Internet download. Eventually, the photos and other driver information will be available through the law enforcement network and then TraCS will pull that information into a report automatically.

User Reporting and Analysis Support
TraCS has migrated to a structured query language (SQL) database. The SQL database supports users who wish to develop their own reports using a variety of SQL reporting tools. TraCS users that have implemented the location tool also have the option of generating reports using the incident-mapping tool. That tool is capable of generating non-mapped output as well, such as cross-tabulations. A Web-based variant of the incident-mapping tool is planned for the future.

Quality Control
TraCS has a two-tier edit check system that issues both "warnings" and "fatal errors" based on a review of the data input by the officer. The edit checks are programmable and can be modified as required. Each State decides for itself whether to implement edit checks and, if so, how many. One State, for example, uses a subset of the edit checks that are present as part of the data validation checks used in its centralized crash reporting system. This does mean that some reports are accepted by TraCS only to be rejected by the centralized system. The State-level managers of the system are considering adding even more validation checks to TraCS. The State maintains a data entry staff that generally fixes errors in reports rather than return them to the originating officer for correction. Its centralized crash records system is designed to ensure that errors corrected by the central staff are not overwritten in the event that an updated report is

received. Including more validation checks in the data collection software would reduce this concern by ensuring that the reports did not fail the central system's edit checks after passing the field data checks. TraCS supports a supervisory or department-level review of crash report data to ensure that the local agency makes the final decision of which crash reports to send forward to the State repository.

Automated Reporting Information Exchange System

The ARIES family of software is in use in two States at the time of this writing. It should be noted, however, that the software in the two States is substantially different and could be considered as two completely separate software products. The software is highly customized to each State. The newer of the two implementations has more capabilities than the older version. Throughout the following discussion, the most recent (as of this writing) ARIES implementation is described.

Highlighted Concept: Focus on crash data

The State has seen a dramatic change over the past three years in level of reporting and level of accuracy of crash reporting. In 2005, 35 percent of crash reports were submitted electronically to the statewide repository. In 2008, 97 percent of all crash reports statewide were received electronically. There are multiple factors behind this rapid improvement but at the most basic level, the State's focus on improving crash reporting is the single most important change.

This State has chosen a unique strategy – that of making its software vendor responsible for operating the entire crash reporting system, including data entry, management, and quality control. To recoup operating costs, the vendor can sell crash report copies at a profit, which is shared with the State. It is in the vendor's best interest for crash data to be available in the system as quickly as possible with minimal manual data entry at the central location. In addition, a recent upgrade of equipment in the State police agency has meant that several hundred laptop computers became available as salvage that could be used by local law enforcement agencies.

Scale: Field data collection to centralized reporting

The ARIES software works in a tightly linked manner with the State's centralized crash data repository: the Vehicle Crash Reporting System. In fact, ARIES is a significantly enhanced second generation of software originally called the Electronic VCRS, which was designed specifically to be a field implementation of the centralized crash data system managed by the ISP. ARIES handles all electronically submitted data from the field, even from reports not originally collected using the ARIES software. Thus, ARIES serves as the filter for electronic data between law enforcement agencies and the VCRS. Law enforcement agencies are given ARIES free of charge, but may choose to use other software as long as their data passes a defined set of validation checks.

Data Transfer Procedures

All electronically submitted data comes into the ARIES Web portal managed by the State police agency's crash reporting vendor. All access by law enforcement agencies to individual crash reports, images, data extracts, and analyses is also available via the ARIES Web portal.

Report Images
The ARIES Web portal gives law enforcement and other legitimate users access to images of the individual crash reports.

Hardware and Software Aids to Field Data Collection
Location
The State has investigated the use of GPS and has elected not to deploy these units for field collection of crash location coordinates. A plan is under consideration to provide a clickable map to aid officers in pinpointing the crash location. Even without these aids to location coding, however, the State is able to "land" the crash location within its roadway inventory 75 percent of the time.

Barcode readers
Barcode readers are used to read data from driver licenses and vehicle identification numbers.

Diagrams
The ARIES software has a built-in diagramming tool. Users of non-Aries software must supply a diagram in a standard format for inclusion in the crash report image archive.

Data Sharing: Third-party vendors and other traffic records components
The State decided early in development of its electronic crash-reporting project to ensure that software other than eVCRS (and later ARIES) could supply data electronically to the statewide repository. There are law enforcement agencies doing this now. The only requirements are that they supply their data in the prescribed record layout and that it passes the edit checks required for entry into VCRS. The ARIES Web portal is used to manage all data transfers from law enforcement to the central repository.

ARIES/VCRS crash data is well integrated with the State DOT's roadway inventory file using automated location coding tools. The methods currently in use have achieved 75 percent linkage of crash locations to locations defined in the roadway inventory file. Improvements are expected once the clickable map tool is developed for use in the field.

The field data collection component is not well linked with driver and vehicle records maintained by the State's Bureau of Motor Vehicles. There are some ongoing discussions between the various stakeholders to plan and develop these linkages.

User Reporting and Analysis Support
Users can access individual crash reports and perform aggregate analyses through the ARIES Web portal. This portal can be used by law enforcement agencies to generate data extracts that can then be loaded into local records management systems. The access through the portal does not include all fields on the report (e.g., the narrative and diagram are not available in data extracts at this time).

Quality Control
ARIES includes a full complement of edit and validation checks so that crash data collected in the field are virtually guaranteed to pass the final edit checks imposed prior to entry of electronic data

into VCRS. The ARIES portal manages the process of data validation for electronically submitted data and reports containing errors are sent back to the originating department for correction.

Mobile Capture and Reporting System

The Mobile Capture and Reporting software was developed for use in a single State by that State's DOT to be distributed freely to law enforcement agencies, thus enabling them to submit data electronically to the statewide Crash Information System (CIS).

Highlighted Concept: In-house development by onsite contractors

The development philosophy used for MCR ensured that the contractors worked closely with State DOT personnel, as well as State and local law enforcement throughout the process.

Scale: Field data collection to centralized reporting

MCR is used for crash data collection only. There is little support for easy integration of crash data with a local agency's RMS. As a result, many agencies (including a major municipal police department and its surrounding counties, which are responsible for about a fourth of all crash reports submitted annually in the State) opt for a different software package.

Data Transfer Procedures

A recent change in CIS has allowed for electronic transfer of data. For users of software other than MCR, the DOT is able to provide an XML standard transfer description and file layout. Until recently (following the 2006 Traffic Records Assessment) electronically received reports were being printed out and hand-entered into the CIS. This situation has been resolved and it is expected that the State will benefit in terms of both timeliness and accuracy of data as a result. At present, however, only data from MCR is being accepted electronically into CIS. Data collected using third-party vendors' software (or anything other than MCR) is not accepted electronically in CIS at this time.

Report Images

Through 2006, the State DOT created images based on paper reports or printed copies of electronically submitted reports. With the ability to accept MCR reports electronically into CIS, the need for printing these reports has been eliminated. The image archive is now created electronically for those reports.

Hardware and Software Aids to Field Data Collection

Diagrams

The MCR software has a built-in diagramming tool. There are a number of other tools under consideration for location coding and scanning of license documents.

Data Sharing: Third-party vendors and other traffic records components

Illinois has not supported electronic transfer of crash data from third-party vendors' reporting software or to local agency RMSs.

User Reporting and Analysis Support

MCR is strictly designed as an E-Crash data collection tool. The State DOT supports data extraction and analysis through other methods.

Quality Control
Traditionally, the State DOT has done most data quality control as a back-end process following data entry with a second set of detailed validations at the end of a calendar year. With MCR, the CIS data entry edit checks have been implemented in the field data collection software.

LACRASH
LACRASH is an electronic field data collection tool developed by a highway research center within the host State's university system. The university team worked in close cooperation with law enforcement agencies and engineering partners under sponsorship of the State's DOT and the Highway Safety Commission. The software is available to all law enforcement agencies statewide.

Highlighted Concept: In-house development by university-based team
The cost of the software development was significantly lowered by using a university-based team, who retain the rights to license the software. The university covered all but $40,000 of the initial development.

Scale: Field data collection to centralized reporting
The LACRASH software is designed for use on laptop computers in the field and office-based desktop machines at the law enforcement agencies. The same university-based group that designed LACRASH is also responsible for management of the statewide crash database. LACRASH feeds directly into the statewide database, eliminating manual data entry.

Data Transfer Procedures
Electronic data transfer is supported through a variety of mechanisms. The State Police statewide radio network is used for wireless transfers.

Report Images
An image archive is available to capture all versions of a crash report (original, supplements, and amended reports). Reports may be produced in PDF format for viewing and printing.

Hardware and Software Aids to Field Data Collection
Location
GPS receivers are used by law enforcement to collect coordinate information. The GPS units are connected to the laptop computers in the field and the location coordinate data elements on the crash report form auto-populate based on the GPS output. The State DOT reports 98 percent accuracy for location coding using the GPS coordinates.

Magnetic stripe readers
The LACRASH data collection system includes the capability to read the magnetic stripe from a driver's license, thus reducing the amount of manual key entry that the officer has to perform and reducing the possibility for errors.

Diagramming
LACRASH was developed to include licensed copies of Easy Street Draw to facilitate officers' drawings of crash scenes.

Data Sharing: Third-party vendors and other traffic records components
The State's crash data entry contractor also accepts electronic data from software other than LACRASH. The hope is that most of the large law enforcement agencies will adopt LACRASH, but some of the major municipal departments have implemented other software. The system does not currently link to other traffic records system components, but a project has been submitted for funding as a Section 408 grant application.

User Reporting and Analysis Support
Support for users is provided by the university-based research team.

Quality Control
The software provides edit checks to ensure that the officers are collecting the most reliable data. The software also has an embedded messaging system that allows officers to submit their reports to their supervisors for approval electronically. This feature decreases the communication time between an officer and supervisor, and allows for corrections to be made and for the report to be locked and placed in the database more quickly.

Maine Crash Reporting System
This State contracted with a vendor to provide a statewide solution for electronic data collection of crash reports. Today 100 percent of all crash reports are received electronically by the State. A major upgrade is in process that will modernize the software to .NET and add several features and functions.

Highlighted Concept: High-level vendor support for State-owned software
The State is particularly pleased with the support it receives from its chosen vendor. The vendor wrote the software to the State's specifications and the State owns the source code, thus allowing the State to offer the software to law enforcement agencies at no cost. The MCRS vendor was instrumental in achieving 100 percent electronic data transfer to the central repository by also working with the agencies that are not using MCRS.

Scale: Field data collection to statewide central crash repository
The MCRS functions as a field data collection tool and as the central repository for crash data housed within the State Department of Public Safety, within the State Police.

Data Transfer Procedures
All data is transmitted to the State repository electronically. It does not accept paper reports. Many agencies transmit the data directly to the MSP from the laptops in the field. Some agencies are using MCRS on office-based machines.

Report Images
An electronic record is stored for each crash. Report images are created on an as-needed basis only. When a customers choose to purchase crash reports, they have an online search-and-purchase function that allows someone to enter information about operators, owners, crash dates, etc., and a notification will be sent to them when the crash report enters the system. A customer can then purchase a PDF version of the report.

Hardware and Software Aids to Field Data Collection

Location

A GPS unit and an onscreen map-based locator tool are used in the field to pinpoint the location of crashes in MCRS. The State is pursuing ways to improve location accuracy, but this is mostly a concern for data submitted by agencies that are not currently using MCRS and thus do not have access to the locator tool. The need to translate coordinate-based location codes to the State's link/node system causes some concerns over accuracy of the data as well.

Barcode readers

Technology for reading the barcodes on driver licenses is included in MCRS field applications, but the State has not issued enough of the more modern driver licenses with this technology to have this feature be considered very useful at this time.

Data Sharing: Third-party vendors and other traffic records components

Included in the initial development of MCRS was support for the vendor to ensure that electronic data from other sources of crash information (including other vendors' software) were accepted by the central crash reporting system. At present, 85 percent of law enforcement agencies use MCRS with the remaining 15 percent using a variety of other software.

The crash data in MCRS is directly linked to the roadway inventory file maintained by the State DOT. There are no direct links to other traffic records components at present, but automated links with the driver and vehicle databases are included in the newly issued RFP for upgrades to the system. Crash reports are downloaded from the State Police into a State DOT data warehouse – where crash data is linked to a detailed road inventory data set. This data can be custom-queried and mapped from a desktop. There is bulk manual loading of crash/road data for use in probabilistic matching of crash and injury data – providing some linked data for analyses. All other data linkages would be created manually from the various systems. The aim of the State's TRCC is to better automate these linkages and make general crash data more readily accessible to general public and other users.

User Reporting and Analysis Support

User reporting and analysis is handled through the State Police and DOT. MCRS is capable of generating reports and data extracts.

Quality Control

The State DOT performs quality control reviews of the location information in MCRS. The MSP performs periodic audits of data quality and addresses problems through training. There is a reluctance to add many edit checks to the field data collection software.

Traffic Crash Reporting System

The Traffic Crash Reporting System is its State's name for its centralized crash repository – that is, unlike the other systems described in this section of the report, it is not a tool for electronic crash data collection. There is no single preferred E-Crash software in the State. The reason this system is highlighted is that it does represent one possible statewide solution to the need for electronic data collection and transmission, but the focus is on open design rather than picking a single field data collection system for implementation.

Highlighted Concept: Open to any vendor meeting the State's certification requirements
The State discontinued its exclusive contract with a vendor supplying the State Police with a field data collection solution. Instead, the State decided to pursue a solution that allows any vendor's software to be certified for transmission of crash data electronically to the central repository. There is no single preferred software solution in the State for field data collection of crashes.

Each vendor seeking certification is provided with a copy of the TCRS Vendor Certification Process Guide, including test data. This document provides a complete description of the file formats, data definitions, and edit/validation rules for each field in the crash report.

Scale: Field data collection certifies to centralized reporting
There are a number of vendors each serving a segment of the law enforcement and engineering communities in the State. At present, four of these vendors have completed certification and their client agencies are able to send data electronically to the TCRS. The TCRS serves as the central repository at the State Police.

Data Transfer Procedures
Data transfers are specified in the Vendor Certification Process Guide. Electronic transfers are via ftp. At present approximately 20 percent of crash reports are received electronically, but more vendors are reviewing the certification procedures and the overall percentage of electronic reports is expected to grow.

Report Images
The Vendor Certification Process Guide includes a template and information on generating a copy of the crash report form for viewing or printing. Any images created at the local level, however, are not transmitted to the VCRS central repository. That repository is capable of generating images from the data supplied.

Hardware and Software Aids to Field Data Collection
Location
Vendors that are able to provide their client law enforcement agencies with approved mapping tools can submit latitude/longitude coordinates as part of the crash reports. This is not required of all vendors, however.

Other aids
The use of other software or hardware aids to data collection depends on the individual software products in use.

Data Sharing: Third-party vendors and other traffic records components
The electronic data submission process to VCRS is based entirely on the concept of working with third-party vendors to obtain the needed information. Vendors certify based on a set of requirements put forth by the State Police.

The level of integration between individual vendor's software products and other sources of traffic records information varies. Some vendors provide a product that is part of an overall law enforcement-reporting package including computer aided dispatch and records management.

Other vendors provide stand-alone crash data collection solutions that may or may not link with other data sources.

User Reporting and Analysis Support
User reports and support for analyses are handled at the centralized level through the State Police. The various vendors' software packages may also include support for locally produced analyses.

Quality Control
The Vendor Certification Process Guide includes extensive data edits and "business rules" for quality validation of crash data before it is submitted to VCRS. The data arrive already certified as complete and accurate and passing the same edit checks as are used for paper reports entered by the State police agency's staff.

Web-Based Crash Reporting
This State implemented dual Web-based reporting systems for police-reported and driver-reported crashes. At present approximately 62 percent of crash reports are received via the Web-based system used by law enforcement agencies. The system intended for use by drivers is not used extensively but may see an increase in use once the agency markets it. The remaining reports (whether written by officers or drivers) are manually entered into the central crash database managed by the State's Driver and Vehicle Services agency.

Highlighted Concept: Web-based reporting with ability to accept electronic data from other sources
The Web-based crash reporting system for law enforcement was implemented initially in 2003. It was designed as a way to avoid the costs and delays associated with implementing field data collection systems throughout the State. Since that time, costs for mobile data computers have dropped and capabilities of the systems have expanded. The State Patrol has developed a new records management system with capabilities to handle most of the troopers' reporting requirements, including crash reporting. As a result, the State Patrol is due to move away from the Web-based reporting of crashes to implement direct submission to the DVS crash database. This will serve as a model for other law enforcement agencies that may wish to deploy field data collection systems in lieu of using the Web-based system.

Scale: Web-based reporting transfers to central crash records
The Web-based system is designed to feed data directly to the DVS crash records database. Other than efforts by individual agencies (most notably the State Patrol), there is no statewide standard for electronic field data collection of crash reports.

Data Transfer Procedures
The Web-based system connects to the DVS crash database directly. When the State Patrol's RMS is implemented, data from that system will be transmitted electronically to the DVS crash database.

Report Images
Information was not available at the time of this report on the processes used to generate crash report images from electronic data.

Hardware and Software Aids to Field Data Collection
The State Patrol's field data collection system will include automated access to GPS coordinates. Other technologies are under consideration.

Data Sharing: third-party vendors and other traffic records components
The State Patrol's RMS linkage to the DVS crash database will be the first test of accepting data electronically from a third-party source. Once that is successful, it will serve as a model for other law enforcement agencies who wish to develop field data collection and RMS projects.

There is no current linkage between the Web-based system and other components of the traffic records system. The State Patrol's RMS will have several active linkages through the law enforcement networks available to troopers in the field. As with the manual data entry process at DVS, troopers in the field will have access to driver and vehicle databases in order to auto-populate report fields.

User Reporting and Analysis Support
Report generation is handled centrally for statewide data and there is limited access (under State law) to the data once it is part of the statewide crash database. The Office of Traffic Safety and DVS staff responds to requests for analyses. There is no reporting facility built into the Web-based crash application. Local agencies with their own RMS are not able to get their data out of the current Web-based system. This is one consideration behind the State Patrol's move to create a separate crash reporting system. Other agencies are likely to follow suit as long as they will be able to send the data electronically to DVS.

Quality Control
The Web-based system includes edit checks that match those used for manual data entry into the DVS crash database. When it is implemented, the State Patrol's RMS and field data collection units will have the same set of edit checks. That system also includes support for supervisory review – a process that is not supported on the Web-based system.

ReportBeam
This software is vendor-based and one State in particular has completed an extensive implementation. Since 2004, the system has been made available to all law enforcement agencies in the State under an unlimited license agreement with the vendor. Approximately 80,000 crashes per year are entered into the system.

Highlighted Concept: Single vendor with access for all law enforcement
The vendor-based software is made available to all law enforcement agencies in the State. It now collects virtually all crash reports using this single software package. Only about 5 percent of crash reports are entered manually.

Scale: Field data collection to centralized reporting
The vendor software serves as a field data collection tool and as the statewide crash repository.

Data Transfer Procedures
The laptop computers in the field connect to the central database via the Internet.

Report Images
A PDF version of the report is generated on demand for each crash. A recent upgrade has allowed for storage of digital images so that an image archive may be created.

Hardware and Software Aids to Field Data Collection
Information was not available at the time of this report.

Data Sharing: Third-party vendors and other traffic records components
Information was not available at the time of this report.

User Reporting and Analysis Support
The State has implemented an analysis package including mapping of crash locations.

Quality Control
The field collection software has built-in edit checks for completeness and logical consistency of the data. Latitude and longitude coordinates are verified to ensure that they match the county as recorded. Some of the fields in the crash report are defined as mandatory for report submission.

Regional Justice Information Service OneForm
This State has two main electronic field data collection software packages in use. The Highway Patrol, under a statewide contract with a vendor, has used the OneForm form generating software to develop a crash reporting system for use by State troopers. Local law enforcement agencies in a major metropolitan area use the Regional Justice Information Service software provided through the Law Enforcement Tracking System.

Highlighted Concept: Statewide contract for forms software
A single contract in the State covers State and local government users for the form-builder software. Under this contract, agencies are able to obtain the software and develop whatever forms and databases they need. The Highway Patrol has used the same contractor to develop its crash reporting system. The Highway Patrol is also responsible for the Statewide Accident Reporting System that serves as the central repository for crash data. STARS is separate from the system used internally by the Highway Patrol.

Scale: Field data collection to centralized reporting
The two primary field data collection systems in the State are capable of functioning as a complete law enforcement RMS including all forms required by the various departments. These capabilities are growing from an initial start in the crash and citation areas first (for REJIS) and crash only for the Highway Patrol's system. The centralized crash system, STARS, is not tied directly to either system but accepts data electronically from both.

Data Transfer Procedures
Crash reports collected using REJIS are sent to the LETS database and then on to the STARS database. Reports collected by Highway Patrol are forwarded electronically to the agency's traffic division and then on to STARS.

Report Images
Report images are created in PDF files and stored in an archive.

Hardware and Software Aids to Field Data Collection
GPS units are used by the Highway Patrol to collect location coordinates. No other technologies are used as field data collection aids at present. There is an effort underway to allow data sharing between the field and motor vehicle databases.

Data Sharing: Third-party vendors and other traffic records components
The STARS system is able to accept data electronically from the two main sources of electronic crash data. There are some automated links to the State DOT's roadway inventory file, but links to other components of the traffic records system are not present.

User Reporting and Analysis Support
Crash data reporting is handled by the statistical analysts in the Highway Patrol working from STARS. Neither of the data collection systems supports analysis of the data.

Quality Control
At present, there are no edit checks activated in the field data collection software. The errors are being noted in a database for use in future training and eventual activation of error checking in the field.

Statewide Electronic Collision & Ticket Online Records
The host State implemented a crash and citation system, SECTOR, in 2007. Because SECTOR includes electronic citation issuance, the system's rollout was in part determined regionally by cooperation with the courts. The software application is owned and operated through a tri-agency agreement that includes the State DOT, the State Patrol, and the State Administrative Office of the Courts. SECTOR is made available free-of-charge to law enforcement agencies throughout the State.

Highlighted Concept: Multi-agency cooperation and joint development of citation and crash reporting
SECTOR was designed from the beginning to support both crash reporting and citation issuance in the field. The major stakeholder agencies participated in its design and funding and as a result, no one agency controls the system. The DOT remains the crash data custodian for the State and is responsible for reporting and analysis, but the tri-agency group manages development and implementation of SECTOR.

Scale: Field data collection linking to centralized reporting
SECTOR is designed specifically as a field data collection tool, with electronic links to the court records and statewide crash records databases.

Data Transfer Procedures
The system uses Web services to move tickets and collision reports between the field and the centralized databases. These Web services require messages to be packaged using an XML schema. The system is "always on" allowing for instantaneous transmission, i.e., once a ticket or collision report is sent from an officer's laptop to the back-office database, that database constantly pings the message broker to move those tickets (using XML) to the State DOT, the driver licensing agency, and the courts.

Report Images
SECTOR renders the report into the State-established collision report form and stores the image electronically.

Hardware and Software Aids to Field Data Collection
A map-based location tool is under development for planned deployment in 2009.
The SECTOR software is designed to work with an in-vehicle computer equipped with printer and bar-code scanner. The printers and barcode scanners are being made available through law enforcement associations.

Data Sharing: Third-party vendors and other traffic records components
The statewide system was designed to allow for electronic submission from third-party vendors. As long as other electronic ticketing and collision reporting applications can incorporate the established business edits, data packaging standards (XML schema), collision scene diagramming tool, and connect to the State's messaging broker these applications should be able to send data to the appropriate State repositories just as SECTOR does. One large county chose to develop its own SECTOR-like application and expects to implement the crash portion of its local software shortly. While the system can accommodate third-party software, the State is discouraging this approach because of the effort required for multiple different agencies to test and validate data coming from applications other than SECTOR.

User Reporting and Analysis Support
The State DOT's data analysts are responsible for reporting based on information in the statewide crash database. The SECTOR system does not include reporting features.

Quality Control
There are hundreds of edits built into SECTOR for the collision report, fewer for the ticket. During one stretch in January, of approximately 500 SECTOR-generated collision reports only one was returned to the investigating officer for correction. This compares favorably with the normal 11 percent rate of return for paper reports. Any non-SECTOR application desiring to send electronic collision reports or tickets to the State repositories must also incorporate all of these edits.

Summary of E-Crash Current Practice

Successful E-Crash systems come in many configurations and are developed and maintained through many different methods in the United States. Some States have adopted commercial off-the-shelf software that is used to develop a custom set of forms and databases. Other States have developed crash applications using in-house resources. Some applications are entirely Web-based. Others are designed strictly for use in the field. Still others serve as field, local office, and statewide crash records systems. At least one State has given complete control of its crash reporting system to a commercial vendor.

In terms of measuring success to date, some States have achieved complete electronic reporting of crashes and others are working toward goals that are more modest. Although it is clear that the different States have met with more or less success to date, there is no sense that one particular set of software solutions is *the right one* for all States.

The more important determinants of success appear to be how well the system works for the law enforcement agencies that collect the data and the timeliness, accuracy, and accessibility of the data for users. These measures of success in turn depend on the level of cooperation among agencies, and the system development and management processes that have been put in place.

Scale of the Systems

The existing E-Crash systems range from specific applications designed solely for field data collection to systems that work on multiple levels: field, office-based, Web-based, and as a statewide data repository and analysis system. There appears to be a gap in coverage when systems only operate on mobile data computers because small agencies that lack funding for MDCs are not able to use the system. Fully Web-based systems make crash reporting available to all, but lack the convenience of dedicated in-vehicle data collection solutions and only work when the connection to the Internet is available. The States that seem most able to achieve and maintain a high-level of electronic data collection in the field have developed multiple data collection points (i.e., not just in-vehicle MDCs, but also office-based and/or Web-based report completion tools). It does not seem to matter very much whether the same system used in the field also serves as the statewide crash data repository.

Another interesting common theme is support for small agencies. Some States have hit upon the idea of supporting these agencies through desktop computer versions of the field data collection software. Others have developed a Web-based system for entering crash reports specifically as a way to support the smaller agencies. Both solutions seem to work well for the numerous, low-volume data providers and avoid the costs associated with trying to equip every law enforcement vehicle in the State with a MDC and necessary communications. At least one State has opted to support small agencies by continuing to process manually a small percentage of paper-based crash report forms. In this case, the State has determined that it is more cost effective to continue entering a few paper reports than it would be to equip all of the small agencies with a minimum level of computerization.

Data Transfer Procedures

Despite the recent promotion of XML, especially in the justice and law enforcement software communities, it is surprising that data transfer standards are extremely variable among the States. The reasons for this are the practical considerations of how best to serve a variety of law enforcement agencies that have vastly different technological capabilities. Because of the limitations and the desire to avoid manual data entry whenever possible, most States have arrived at data transfer solutions that include multiple methods. Use of the Internet and secure ftp sites is the most common method, but, as mentioned, most States support more than one method and plan to continue this practice in the future.

On an interesting note, some of the systems support supervisory review of crash reports prior to submission to the statewide database and some do not. Those that do not support supervisory review have run into some problems; for example, in at least one case this shortcoming was cited as a reason for a major agency adopting a different software solution than the one the State provides.

Report Images

The majority of the E-Crash systems have at least the capability of generating a PDF version of the crash data presented on an electronic version of the State's official crash report form. It is somewhat surprising how few of the systems include maintenance of an image archive showing all official versions of a crash report (original, amended, appended, etc.). The legal requirement for such an archive varies from State to State, but the value of maintaining that chain of evidence seems prudent in terms of sales of crash report images, evidence for legal cases, and support for road users and engineers. At least one of the systems described above that currently lacks an image archive is planning to create one.

Hardware and Software Aids to Field Data Collection

Location

GPS receivers in the field are one way to collect latitude/longitude coordinates that can be translated to mapped locations in the statewide GIS. This has drawbacks, but several States have made good use of the technique. A more reliable and intuitive method involves the use of a map-based location tool that officers can click on to indicate the precise place where a crash occurred. This method has the additional advantage of working even if the officer is completing the crash report somewhere other than the crash scene (say, back in the office or at home) or when working where the GPS signal is inaccessible. The goal of collecting coordinates for location of crashes is tied to the ability to bring the crash data into a statewide GIS. The GIS typically, at a minimum, contains data on roadway locations (the roadway inventory) so that, in addition to mapping crash locations, the linked crash and roadway data can be used to support geospatial analysis of highway safety for various roadway features.

Diagramming tools

The majority of the systems include support for at least one, and sometimes several, diagramming tools. Such tools aid the officer in completing a clear, professional-looking graphic depiction of the crash events, relationships among involved vehicles, and people. It is a limitation of many centralized data systems that diagrams are often excluded from the data available centrally for users of the crash file.

Other aids

Aids to field data collection of crashes, other than the location coding and diagramming tools, do not seem to be as critical or as difficult to accomplish as once believed. While the ability of an officer to avoid typing long names and addresses with potential errors is useful, a more desirable feature may be one that allows the officer to enter information only once and reuse it whenever it is required by the crash or other software applications (citation, incident reporting, etc.). A magnetic stripe reader may be the most common other aid used in crash applications, but bar-code readers are gaining in popularity since AAMVA has issued guidelines for bar coded data on license and registration documents. Automated linkage to statewide driver and vehicle databases is useful to validate information and, in some systems, auto-populate multiple fields and forms. In addition, obtaining information from these statewide databases facilitates later linkage among the databases for analysis and reporting. Many of the most advanced systems have these types of aids (e.g., hardware and/or software links to online resources), but systems without such aids are being judged by their users to be just as satisfactory.

Data Sharing: Third-party vendors and other traffic records components

Several States have opted to accept crash data only from the single data collection tool specifically endorsed by the crash data custodial agency. This has worked well in some States, especially those that are small or had little automation in the field before the State established the standard statewide system. This policy can be an obstacle when a statewide crash system was developed after the point when several larger cities had already automated their own crash reporting system. When even a single large agency is unable or unwilling to submit its crash data electronically, there is an adverse effect on the timeliness, accuracy, and availability of the entire State's crash data.

It is not surprising, then, that so many of the statewide crash software solutions are now incorporating features to support the acceptance of electronically submitted crash data from other, third-party sources. This gets to the heart of the user acceptance issue. Many large law enforcement agencies have committed significant resources to the development and implementation of field data collection systems that are tied to an agencywide or even a citywide or countywide RMS. The agencies rely on these systems to have up-to-date access to their own information and for sharing information among public safety agencies locally or regionally. When a statewide implementation of crash data collection software duplicates capabilities that are already available for these other agencies, it is difficult to get agreement to incorporate a non-compatible piece of software into what is already (for them) a perfectly workable and locally controlled system. Under these circumstances, flexibility at the State level to accommodate electronic data submission is essential to ensuring that the data contributed by the large agencies is not lost or must be entered manually even though it originates as electronically collected data.

Location data continue to be a problem in terms of quality, specificity, and the amount of post-processing effort required to link crash data with a State's roadway inventory system. The use of a common location coding method for the crash and roadway data is key to achieving automated matches between these two sources. The obvious solution of the past was to use location codebooks and require the officers in the field, or someone in an agency's records management office, to manually look up the location and provide the correct code on the crash report and to enter that code in the crash database. The move to GIS at the State level has provided a more reliable and less labor-intensive way to automate this linkage. Still, the most effective crash systems include a post-processing quality control step to verify that locations are reasonable and match the roadway characteristics described in the report.

User Reporting and Analysis Support

There are a number of ways that States provide analytic support to users of the crash data. For the most part, these are centralized efforts designed to work with the statewide crash records database, rather than at a local level or with office-based or field-based portions of an E-Crash system. Map-based reporting tools with support for user-specified cross-tabulations are the current state-of-the-practice. Making these tools available on the Internet with few restrictions (i.e., easy access to data that have been purged of personal identifiers) is the method that meets with the greatest user satisfaction.

Quality Control

Quality control measures are obviously required to ensure that crash data are reliable for enforcement, engineering, and other users in the highway safety community. Most of the more mature E-Crash software implementations include the same edit checks in the field that would be required if the data were being entered manually into the statewide crash database. Those data validation checks have typically been developed over a long history of experience with the kinds of things that have gone wrong with crash data entry in the past. Most States have extensive lists of edit checks that must be passed before data can be saved into their central crash records systems. When those same edits are performed on crash data as it is entered in the field, there is an assurance that the officer has had a chance to review any problems and correct them while the information is fresh.

Some States have stopped short of requiring that electronic data pass the full complement of (or even any) edit checks prior to submission. This is particularly true for newly implemented systems and is generally done so that officers are not forced to go back over a report repeatedly to get it right. These States choose a middle-ground approach of only stopping the submission of reports with the most serious errors, and letting through those reports that have less serious errors or warnings. Most States consider this a temporary tactic while the officers are being trained and are learning the level of quality that is expected. Some States have found, however, that such temporary measures become permanent and data quality improvement remains the job of central records staff at the State level who are tasked with cleaning up the many remaining minor errors.

Findings Based on the Review of E-Crash Systems

States make decisions about designing and implementing E-Crash systems in the context of some very practical considerations and limitations. The current research did not identify a specific E-Crash implementation that would serve as the one best model for all States to emulate. Each of the implementations had good aspects worth considering in future systems as well as some limitations that might cause concern for a State looking for a model. This is not news. Even the most successful system implementations that have achieved consistently high (close to or at 100%) electronic reporting of crashes have drawbacks or features that make automatic copying by another State less than certain of success.

With this in mind, it is certainly worth noting that two States have achieved remarkable progress in a very short time frame – attaining virtually total electronic reporting – by contracting out a large portion of their crash data management at little or no cost to the States. In one case, a vendor was selected and given the right to charge enough for crash report copies to make the system self-supporting. In other State, a university-based team has developed the system at practically no cost to the State and maintains both the statewide crash records system and the electronic field data collection system. These (at or near) zero-cost approaches are rare among the States at present, but may soon be copied elsewhere, especially if the system is found to generate revenue rather than *merely* remain cost-neutral.

In terms of features and business practices, the systems that were reviewed do provide some very clear lessons learned, and some support for the notion that multiple paths to success exist. States would do well to review the successes of others, borrow those aspects that most closely meet their needs, and remain flexible when it turns out that their State's needs require a different solution than the ones already presented. The lessons from this research that can be considered as current State of the practice include:

System Scaling to Meet the State's Needs

There are some States that may need a new centralized crash records system and some that will not. Implementing E-Crash in the context of a larger need for a replacement to the central statewide system is vastly different from implementing a similar E-Crash system when the centralized system is working well. In the first case, a State might do best to find a single solution that works for field use as well as serves as a replacement to the centralized system. In the latter case, such scaling is not necessary and may be wasteful. Thus, there is no clear demarcation between systems with regard to scaling – success depends on the State's needs at the time.

It is clear, however, that States should attempt to support as many law enforcement agencies as possible. A system that allows for both field data collection and office-computer based input of crashes will serve more users than one that requires that all data be collected on an MDC in the vehicle, even if the State has the resources to purchase and maintain the required number of in-vehicle computers for all agencies.

Data Transfer Supporting Multiple Methods

The Internet is a free and accessible transfer medium. Most States are making use of it in one way or another. Secure FTP is the most reliable and safe method, but even e-mail data transfer has worked well in several States. States that implement their data transfer system using the statewide law enforcement network may find that this solution works well for them as they expand to other types of electronic data collection (such as electronic citations, arrest reports, DUI tracking systems, etc.) where the data are useful for multiple purposes and may require the level of security inherent in those limited-access networks.

Report Images are Essential and Relatively Inexpensive to Maintain

The systems that fail to create a crash report image archive are missing a potentially important source of historic information on each crash. This may not seem important to a State that is struggling just to get the crash data collected and into its systems in a timely manner, but eventually the image archive will prove crucial for a variety of uses. The cost of creating and storing images from electronic data is low, especially when compared to the process required for scanning paper forms. An image archive should part of the processing of every E-Crash system, maintaining an image record of every approved version of a crash report.

Hardware and Software Aids

Location:

Most States have implemented or are considering implementation of some form of tool that aids officers in collection of location data. The effective use of such tools has generated major improvements in location data quality and has a direct impact on the ability to link crash and roadway data automatically. This avoids the labor intensive and error prone processes of the past. The best of these tools appears to be one that uses GPS *sparingly* – that is, the GPS receiver (when available) is used only to call up a relevant map view or keep a map centered on the officer's location, rather than to actually supply coordinates upon which the location data is based. The map-based tools that allow an officer to click on the true location of the crash work best, whether GPS is used or not. Ultimately, the best tool is going to be the one that makes the translation between physical locations and location codes as used in the statewide roadway inventory and other roadway databases.

Diagramming tools:

The ability to create and store a graphic image of the crash scene is critical. All States should support at least one diagramming tool option in their E-crash systems. Once this information is available in digital format, it should become easier for States to make it available, along with the officer's narrative description, to users of the crash data file.

Other Aids:

The value of other aids to E-Crash data collection depends largely on the capabilities of other traffic records components. For example, if the driver and vehicle databases are accessible in real time, this can serve as a quick way to access accurate data will be useful to officers. If the drivers license and vehicle registration documents include encoding of data (such as magnetic stripes or bar codes), then officers with the appropriate readers can electronically access these data to save key strokes and reduce errors.

Data Sharing and Third-Party Field Data Collection Software

States that do not accept electronic data from approved third-party software should consider the business case for doing so. If the State's law enforcement agencies have all adopted a single, statewide solution for field data collection and are unlikely to want to change that decision, there is no problem. However, if the State has large agencies that want to use software provided by their own RMS vendors, then achieving or maintaining a high level of electronic reporting without accommodating submissions from third-party sources is unlikely. States need to evaluate continuously any decision that limits flexibility and this decision, in particular, is crucial to the long-term success of an E-Crash initiative. Fortunately, most modern systems are capable of sharing data in multiple formats. The biggest hurdles are usually in making sure that third-party vendors can adhere to a set of data quality and reporting standards. Imposing a single data transfer protocol is a comparatively simple requirement easily met by most vendors.

User Analysis
Users' ability to analyze crash data or create crash data extracts is determined by the custodial agency with control over the statewide crash records system. The most well accepted systems make the data available on the Internet with personal identifiers redacted. Whether the user needs a data extract, a map, or a set of data tables, the same system is used for support. Some States have a requirement to control who has access to the data, and for what purpose. In those cases, the result likely will be less accessible than what the users want and need.

Quality Control
The state-of-the-art systems all include data edits, validations, business rules, etc. in the field data collection system that match those historically required in the centralized crash data for manual data entry. The State may opt for a two-tiered system of *fatal errors* and *warnings* that requires that a report be free of the most critical errors, but provides feedback to officers on all errors or potential errors in the report. Systems that lack front-end edit checks should implement them.

Costs
Information on the costs of E-Crash systems, specifically, and the cost-per-crash of data collection and data management, in general, is difficult to obtain. This research effort is the third one in recent years to attempt to gather consistent and reliable information on crash system costs. The difficulty of collecting this information regarding statewide systems is compounded when costs at the local level are brought into the equation. As just one example of the complexities involved in trying to compare among States' projects, if an E-Crash system is part of a larger law enforcement field data collection package, how much of the cost should be apportioned to "crash"? Can a fully developed law enforcement-reporting package be reasonably compared to stand-alone crash reporting software? If portions of the software are developed "in-house," does the agency include or exclude those costs from its final tally?

In the current project, States generally did not have an answer to the questions on costs, either for the cost of their E-Crash systems, or of the per-crash cost of collecting the data. The earlier NCHRP syntheses reported similar difficulties in obtaining cost information. NCHRP 367 had crash system costs for one State only. NCHRP 350 included costs for several States, but noted that the costs may not be directly comparable.

For the current project, we found that costs varied widely, including one State that reported zero costs (and perhaps a net revenue gain) by having a vendor responsible for all crash data collection and sales. At last report, several States are examining this model to see if it fits within their States' laws and practices. Other States have limited the use of State government funds through partnerships with university researchers. One State agency spent only $40,000 while the university developed and implemented a statewide crash data collection and management system. Several States have adopted a model for State ownership of software originally developed by a vendor. After the initial cost of development and purchase of distribution rights, the State then is able to provide that software free to agencies within the State. Other States have used their vendors in a more traditional manner – licensing the software for use in the State, and paying for ongoing support and maintenance. Finally, some States have adopted a decentralized approach under which each agency is free to purchase and use whatever software it likes best, as long as the data can be sent to the State in an acceptable format and pass the required edit checks.

Each of these models of doing business has trade-offs, and each has a different cost structure. One key concern as some of the systems now are entering their second or later versions is how States pay for the life-cycle costs of software upgrades and, when needed, new equipment. Only one State was able to provide an estimate of the cost of a new version – a conversion to .NET for its vendor-based software was budgeted for $850,000. This is comparable to the average cost of statewide crash records system purchase as estimated in the NCHRP 350 project based on 13 States. Two outliers with multimillion dollar costs, however, affected that average. The field data collection systems, that are licensed and provided to all law enforcement agencies in the State, are a different type of purchase and so these costs may not be comparable. NCHRP 367 lists the cost of one State's field data collection software at just under $1.5 million – the lifecycle costs and equipment costs were not reported.

Two things are clear from the discussions with States and from prior reports – there is very little consistency in the cost of the software for field data collection of crashes, and the lifecycle costs of the hardware and software are, typically, an afterthought. The best, most maintainable approaches appear to be those that:

1) Minimize or eliminate the monetary contributions required from the State agencies;

2) Build life-cycle costs into the plan for the system by putting as many of those costs off onto the vendor (where possible);

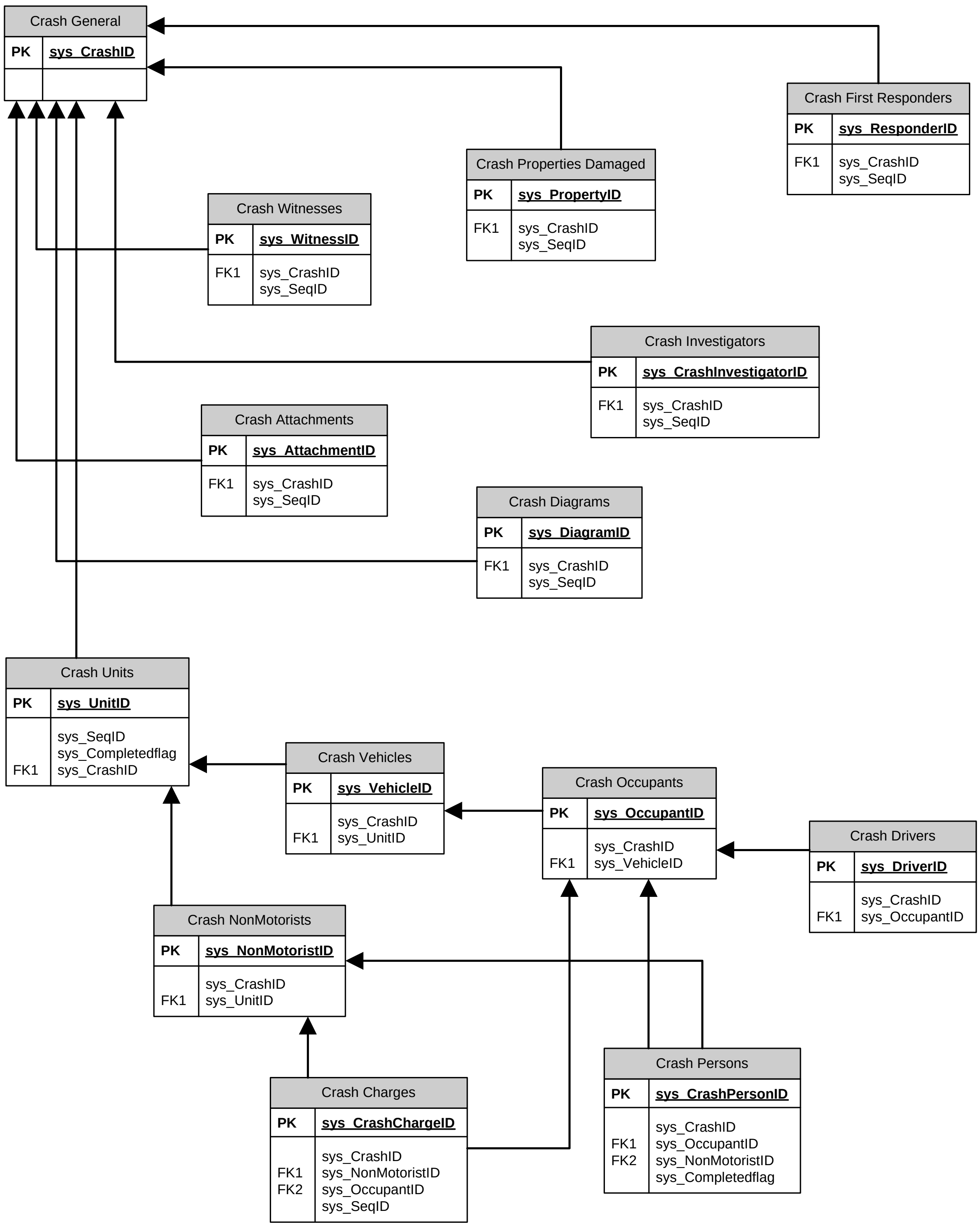
3) Build equipment purchases and a replacement cycle into the purchase of vehicles (i.e., bundle the laptop computer purchase with the police cruiser purchase and replacement);

4) Take advantage of multiple grant funding sources, including NHTSA, FMCSA, FHWA, DOJ, DHS, and others to pay for one-time costs; and

5) Do not rely on grants to fund the life-cycle costs; that is, have a solid budget and plan for replacements and upgrades.

Model E-Crash Data Collection System

Figure 2 is an Entity Relationship Diagram providing an overview of a basic E-Crash data collection system.



E-Crash System Overview

The ERD in figure 2 illustrates an independent crash records system. An E-Crash data collection tool (and the resulting database), would ideally be integrated with all other services and information that the law enforcement officer needs. However, this level of integration is generally not achieved in most law enforcement field data collection systems. The E-crash component, in particular, remains generally stand-alone or integrated with one or two other forms – usually citation and contacts. This segregated process, even with a citation data collection tool included coupled with it, can generate resistance to implementing an E-Crash system. Oftentimes a large community has already developed a system that coordinates with its local agency or city computer-aided dispatch system with its records management system. The law enforcement agencies do not want their officers to deal with a separate crash process when all of their other reports are integrated. Law enforcement agency IT staff is often reluctant to support a separate application running on the mobile data computers. It should be recognized, then, that the ERD presented for a stand-alone E-crash system would, ideally, be part of a suite of software that the officer uses for all reporting.

While acceptance of the basic E-Crash data collection tool has become more common, there are police agencies also starting to use their CAD/RMS as a way to link the crash record to other types of data to help the officer and streamline the crash data collection process. For E-Crash systems that are statewide, rather than local, a management process could be developed, to provide the similar capability of the CAD/RMS. The following description of the officer's actions when responding to a crash will illustrate how a CAD/RMS or related management system can be an effective aid to the officer. Furthermore, this process will improve the ability to link these crash data with other components of the traffic records system. References to the operation of a CAD/RMS are primarily derived from publications of standard data specifications developed by the Law Enforcement Information Technology Standards Council for CAD[9] and for RMS.[10]

Crash Data Collection Process

The following is a description of law enforcement activities associated with a typical crash scene. This information is presented to show the points at which field data collection systems such as an E-Crash system would fit into the overall process. It provides an overview of the interactions that might need to take place between an E-Crash system and the other automated information presented to or coming from the officer in the field.

When a crash occurs, there are several ways for dispatch to be made aware of the event. They include:

1. Those involved in the crash will contact dispatch by telephone.
2. A witness will contact dispatch by telephone. Witnesses could be:
    a. Those at the crash scene; and
    b. Transportation center staff observing video surveillance cameras.

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[9] LEITSC. (2003). Standard Functional Specifications for Law Enforcement Computer-Aided Dispatch (CAD) Systems. Washington, DC: Bureau of Justice Assistance. Available at http://www.leitsc.org/Files/LawEnforcementCADSystems.pdf.

[10] LEITSC. (2005). Draft Standard Functional Specifications for Law Enforcement Records Management Systems (RMS) V.1. Washington, DC: Bureau of Justice Assistance. Final Version II available at http://www.leitsc.org/Files/LawEnforcementRMSv2.pdf.

3. A passer-by witness will later flag down and contact a law enforcement official who will then contact dispatch.
4. Safety services such as OnStar that are built into vehicles and can detect such events such as air bag deployments; vehicle occupants can also contact services to report their own emergencies. These types of safety services contact emergency services (911, police, etc.) when they detect an event such as a crash.
5. Law enforcement or other public safety personnel happen upon the crash scene and contact dispatch.

Dispatch will gather as much information as possible about the crash concerning location, number of vehicles, injuries, environment, and caller information. Once enough basic information about location and injuries has been collected, the dispatcher will assign the event to one or more law enforcement units. Dispatch will contact the units by voice radio, in-vehicle computer-aided dispatch computer, or both. Automated vehicle locator systems in the police cruisers help to ensure rapid response. All further details gathered about the event are relayed by the dispatcher to the responding units while en route to the scene. The dispatchers will also assign emergency medical personnel to the event if there is a possibility of injury to people involved in the crash.

If vehicle registration numbers (license plates) can be determined by dispatch, those vehicles will be checked immediately with local and State vehicle databases for additional information that may be useful to the responding units. Also important is determining if any involved vehicles or people have departed the crash scene. Sometimes people will be driven by private vehicles to obtain medical treatment instead of waiting for law enforcement or medical personnel to arrive. Unfortunately, a more common problem is the hit-and-run crash event; this type of crash constitutes a criminal offense regardless of the issues that may have caused the crash to occur.

If a hit-and-run vehicle is involved, dispatch will broadcast any known information to all law enforcement units as a BOLO (be on the lookout) for that vehicle. In many cases, there is very little information from the scene about a hit-and-run vehicle's registration number or a clear description of make and model of the vehicle. However, in other cases, the hit-and-run vehicles will leave identifying evidence at the crash scenes, like license plates, fenders, side mirrors, and other evidence that can be used by investigators to identify specific vehicle information or even the registered owner of that vehicle.

The officer should treat the crash scene as a crime scene. Some crash scenes are of a nature that the dispatcher can determine that the severity of the crash does not meet the State's threshold requirements requiring investigation. When this happens, the drivers are told their options, one of which is that an officer can respond to the low-priority call when available or the drivers can use self-reported crash forms.

A crash scene that usually requires a response from an officer is one involving a person being injured, a vehicle having more than a minimum amount of damage (e.g., $1,000 damage amount), a vehicle is not drivable from the scene, or an involved vehicle belonging to a public agency (e.g., law enforcement, State agency, public utility, other public safety). When law enforcement units arrive at this type of crash scene, the officers will confirm with dispatch and other responding units what the scene looks like and will try to position their units around the scene to warn other traffic and to protect the scene and involved people.

Determining the extent of a crash scene is usually simple and involves a small, distinct area of a public roadway; however, some crash scenes can span across larger areas of roadway and private property (e.g., train/vehicle crashes, crashes involving more than three vehicles). There are instances when what appears to be a single crash scene can actually have several different crash scenes and investigating officers must perform multiple crash scenes investigations and write multiple crash reports. An example of multiple crash scenes involving the same vehicle is one where a drunk driver strikes a parked vehicle, continues driving down the road for several hundred feet, then loses control of the vehicle and strikes a telephone.

At a crash scene where there are no injuries and the vehicles can still be driven, the officer will have the vehicles moved to a safe place off the roadway for investigation. The investigation may determine that the injury and vehicle damage thresholds have not been met to require the State to report the crash. If this is the case, the officer will give the drivers information that helps them report the crash to their insurance carriers and to the State as a driver-reported crash if they desire to do so.

The officer will check the injuries of the involved people. If any injuries are fatal or are possibly of a nature to prove fatal, the officer will usually request that dispatch send a traffic investigation unit if the agency has such a unit. Fatality crashes are generally investigated at a much more detailed level, including sophisticated crash reconstruction techniques and equipment, to obtain as much information as possible for later investigational use. It is always important to observe each vehicle for trapped people and leaking fluids (fuel and other hazardous material) as well as anything that creates a danger to anyone else at the scene (e.g., dangling electrical wires, damaged and unstable light and electrical poles, etc.). The area immediately surrounding the crash scene should be observed for people possibly ejected from involved vehicles. All of this information is relayed to dispatch as required to obtain more resources for the event (additional law enforcement for scene security, investigation, and traffic control, rescue and fire suppression equipment, more ambulances, public utility crews, hazardous material cleanup crews, coroners, etc.).

The officers ensure that all people are in a safe place away from dangerous areas and that injured people are receiving treatment. Concurrently, traffic control for the scene is implemented as necessary and all involved people are identified and interviewed. The officer will relay the drivers' identification to dispatch to confirm that the involved drivers have driver licenses and liability insurance and are not wanted by law enforcement for other reasons. The officer also confirms the vehicle registrations for all involved vehicles and request tow trucks as required from dispatch. If the crash involves a hit-and-run vehicle, the officer will gather as much information at the scene about that vehicle and relay that information to dispatch and other enforcement units.

Once the interviews are completed with all involved drives and witnesses, the officer decides if further investigation is required, if citations will be issued for traffic violations, or if arrests may be required (intoxicated drivers and other arrestable offenses). As injured people are transported for medical treatment, the officer must know where those people are being taken in case immediate follow-up interviews are required. As tow trucks arrive, the officer must ensure the correct tow trucks tow the correct vehicles and that the towed vehicles are properly searched for property indexing.

After the crash scene is investigated appropriately, cleared of debris and vehicles, and all pertinent information has been collected, the officer will reopen the crash scene to normal traffic. Next, the officer will ensure any arrested people are transported to jail, will go to locations of injured people (hospitals, clinics, etc.) as needed to perform follow-up interviews or to confirm the well-being of the injured, particularly those injured to an extent that the person may expire. Last, the officer will begin the process of completing the official State crash report or go back in service for other calls and complete the State crash report later in the shift.

The information collected by the officer at the crash scene may be entered into the in-vehicle computer, in a computer at the agency, or filled out by hand. If entered into a computer by the officer, that data is used to generate a hard copy of the State crash report as needed. In some cases, that data is sent to the State electronically in States that support that capability. If no electronic upload is possible, the hard copy version of the report is sent by mail to the State,

Regardless of how the data is sent to the State, the officer must first complete the agency's crash report processing requirements. These requirements generally include completing the crash report and submitting it to a supervisor for review and approval. Depending on the severity of the crash and level of injuries, the approval process may take several days particularly if a fatality is involved. Crashes involving fatalities involve more stringent investigation and data gathering.

Simple crash scenes involving no injuries and drivable vehicles usually take a minimal amount of the investigating officer's time. However, more severe crashes can involve one or more officers and other resources (special investigators, public utility crews, etc.) can be assigned to the event for many hours and sometimes days.

Model E-Crash System Functions

Model E-Crash System Functions			Y/N
Computer-Aided Dispatch			
1.0	Law Enforcement Dispatch to Crash Scene		
	1.1	BOLO	
	1.2	Dispatch units to scene	
	1.3	Unit status management	
	1.4	Call management	
	1.5	Supplemental resources tracking	
		(tow truck, ambulance, etc.)	
	1.6	Call disposition	
2.0	Computer-Aided Dispatch System Administration		
	2.1	Geo-file maintenance	
	2.2	Security	
	2.3	Logging activities	
	2.4	Configuration	
	2.5	Table management	
3.0	Support Services		
	3.1	NCIC	
	3.2	BOLO	
	3.3	Emergency operations center	
	3.4	Contact database names and details	
4.0	Interfaces		
	4.1	Add identifiers, alarm, RMS generate case number, etc.	
	4.2	Location systems interface	
		(e.g., AVL, GIS, mobile mapping, real-time mapping)	
	4.3	Administration	
	4.4	Communication interfaces	
		(e.g., Internet call, messaging system, paging, e-mailing)	
	4.5	Public messaging	
		(Amber Alert, Reverse 911, individuals, or agencies, utilities, hospitals, transportation department, etc.)	
	4.6	Emergency operations interface	
	4.7	Additional potential interfaces	
		(e.g., DMV, EMS, fire, MCSAP, special investigators, other agencies)	
Crash Report Field Data Collection			
1.0	Create New Crash Report		
	1.1	Open form, auto-complete officer and agency information	
	1.2	Push and load into form the initial data from dispatch (CAD), call number, time, preliminary location	
	1.3	Create auto-save record for recovery from system (automatic every X minutes)	
2.0	Collect Crash-Level Variables		
	2.1	Collect data	
	2.2	Run field-level validation checks	

Model E-Crash System Functions			Y/N
	2.3	Create crash template for # units, # CMV, # injured/fatal, etc. (optional)	
3.0	Collect Location		
	3.1	Check common geo-file for available completed location data	
	3.2	Access GPS coordinates	
	3.3	Pre-select map view (optional)	
	3.4	Collect map-click for precise location (optional)	
	3.5	Auto-complete location code, roadway names, and offsets	
	3.6	Prompt for review of auto-completed elements	
	3.7	DOT validation (optional)	
	3.8	Override for unrecognized location	
4.0	Collect Unit (Vehicle)-Level Variables		
	4.1	Check common for available completed unit/vehicle data	
		(optional link to motor vehicle database for data)	
	4.2	Unit type and create template	
	4.3	Validation check unit 1 = motor vehicle (optional)	
	4.4	Read bar code registration	
	4.5	DMV validation	
	4.6	Auto-complete owner, VIN, vehicle make/model, etc.	
	4.7	Owner address over-ride, DMV notification (optional)	
	4.8	Complete remaining unit-level fields	
	4.9	Prompt for completion of required CMV fields	
	4.10	Create occupant record templates	
	4.11	Run field-level validations	
	4.12	Repeat for all units in crash	
5.0	Collect Person-Level Variables		
	5.1	Check common for available completed person data	
		(optional link to driver database, driver history, and contact database)	
	5.2	Person type and template	
	5.3	Read bar code (or magnetic stripe) driver license	
	5.4	Department of motor vehicle validation	
	5.5	Auto-complete fields for driver records	
	5.6	Address override and DMV notification (optional)	
	5.7	Complete driver records	
	5.8	Complete occupant records	
	5.9	Complete nonoccupant records	
	5.10	Run field-level and person-to-unit level validations	
6.0	Common/Shared Element Storage/Retrieval		
	6.1	Save/update person data to common	
		(for contact database, citations, or other forms pre-fill)	
	6.2	Save/update vehicle/unit data to common	
	6.3	Save/update location data to common	
7.0	Narrative and Diagram		
	7.1	Open diagram and narrative utilities	
	7.2	Preselect roadway diagram template matching location data	
	7.3	Insert unit and nonoccupant diagram elements	

Model E-Crash System Functions			Y/N
	7.4	Record placement of diagram elements	
	7.5	Validate final diagram versus location and unit-level data	
	7.6	Generate suggested narrative to match diagram, (optional)	
	7.7	Prompt for additional narrative (optional)	
	7.8	Validate narrative versus diagram and unit-level data (optional)	
	7.9	Store narrative and diagram	
8.0	Save Form		
	8.1	Interim save without final edit checks	
	8.2	Digital signature (based on State and local requirements)	
	8.3	Final save with edit checks	
	8.4	Correction of fatal errors	
	8.5	Issue warning-level errors	
	8.6	Save report data	
	8.7	Create PDF (if needed in field)	
9.0	Transmit Data		
	9.1	Set report ownership flag to block local changes	
	9.2	Apply data output format/schema	
	9.3	Transmit data	
	9.4	Validate transmission received	
	9.5	Flag record as sent successfully	
10.0	Create Driver Receipt and Driver Exchange Form (optional)		
	10.1	Create PDF driver receipt/exchange form	
	10.2	Print	
	10.3	Record delivery of receipt/exchange form	
Crash Report Review, Correction, and Update			
1.0	Supervisory Review		
	1.1	Report ownership assignment to supervisor	
	1.2	Supervisor annotations	
	1.2	Report status update (complete, return for correction, pending)	
	1.3	Report data routing and ownership assignment	
	1.3	Create PDF (optional)	
2.0	Error Correction		
	2.1	Report ownership assignment to officer	
	2.2	Open report in edit mode	
	2.2	Present supervisor annotations	
	2.3	Present edit check warnings and serious errors if any	
	2.3	Prompt for correction of data in annotated fields	
	2.4	Run edit checks	
	2.4	Save corrected report	
	2.8	Report data routing and and ownership assignment supervisor	
3.0	Data Transfer to Agency Records Management System		
	3.1	Ownership assignment to records staff (optional)	
	3.2	Run error/validation checks for RMS acceptance	
	3.3	Return rejected reports to supervisor	
	3.4	Assign agency crash report number (if not done earlier)	

Model E-Crash System Functions	Y/N
3.5 Add report to official agency repository	
3.6 Create PDF for image archive (optional)	
3.7 Lock report to view-only and print-only access	
3.8 Update event log in CAD/RMS	
3.9 Update officer activity log (optional)	
4.0 Data Transfer to Statewide Crash Repository	
4.1 Data conversion to standard format/schema	
4.2 Electronic data transmission	
4.3 Verify transmission success	
4.4 Flag record as sent	
4.5 Receive correction requests from statewide crash repository	
4.6 Accept incoming error notifications	
4.7 Flag report with errors in agency RMS	
4.8 Change report status to “edit”	
4.9 Assign ownership to officer (or optionally to supervisor)	
4.10 Notify supervisor (unless supervisor assigned ownership)	
4.11 Set response tickler	
4.12 Send reminder notice (if tickler times out)	
4.13 Collect corrected report	
4.14 Reset ownership and completion flags	
4.15 Send data to statewide repository	
4.16 Verify transmission success	
4.17 Flag correction as sent.	
5.0 Manage Crash Report Update	
5.1 Officer opens existing crash in “update” mode	
5.2 Compete officer updates	
5.3 Run edit checks and save	
5.4 Supervisory review	
5.5 Transfer to agency RMS	
5.6 Generate next-generation PDF for archive	
5.7 Transmit data to statewide crash repository	
5.8 Verify transmission success	
5.9 Flag updated record as sent	
Software Update Process	
1.0 Minor Update Release	
1.1 Schedule update	
1.2 Send notification	
1.3 Send update to field units electronically	
1.4 Store update on network for download	
1.5 Send physical media to non-connected units’ users	
1.6 Set edit checks to verify updates	
1.7 Send message to non-updated users/units	
2.0 Major Update Release	
2.1 Schedule update	
2.2 Send notification	

Model E-Crash System Functions		Y/N
2.3	Send update to field units electronically	
2.4	Store update on network for download	
2.5	Send physical media to non-connected units' users	
2.6	Track update processing on field units	
2.7	Send deadline warnings	
2.8	Flag non-updated units for attention	
2.9	Set edit checks to reject reports from non-updated units (if necessary)	
User Aids, Embedded Help, Tutorials, Etc.		
1.0	User Assistance Modes	
1.1	Embedded help file and help file index	
1.2	Crash reporting instruction manual	
1.3	Context-sensitive help on data fields	
1.4	Step-by-step system function assistance (show me how)	
1.5	Function completion wizards (do it for me)	
1.6	Interactive tutorials	

E-Crash System Quality Assurance

System Development Process

The 2000 Program Management Body of Knowledge Guide[11] provides an overview of project management for system development efforts. The section on quality assurance (Chapter 8) is relevant to the electronic collection of crash data. It presents information on how to ensure that a project is designed to deliver quality products (in this case, crash data) from the start – quality is planned in, not inspected in – meaning that for traffic records systems, a good system design can produce higher quality data and help to avoid the need to correct data after it is submitted.

PMBOK breaks the project quality management process into three parts:

- Quality Planning: selecting standards and how to meet them;
- Quality Assurance: evaluations during project development; and
- Quality Control: monitoring project results and improving performance as needed.

In the case of an E-Crash system development, quality planning would involve deciding what level of quality to expect in the final system – what percentage of crash reports with fatal errors, warnings, crashes that cannot be located, and so on, are to be tolerated in the system. These become the standards for the system and will be planned into the design of the system from the earliest possible point in the design cycle. As part of the quality planning effort, the design team would also conduct a benefit/cost analysis for achieving the desired level of quality. Assessing the downside of increased quality can be a difficult task for designers unfamiliar with crash reporting in general, or for those on the client side who are unfamiliar with system development. It is important, therefore, that the system design team include personnel from IT and the crash

[11] Project Management Institute. (2000). A Guide to the Project Management Body of Knowledge (PMBOK Guide), 2000 Edition. ANSI/PMI 99-001-2000. Newtown Square, PA: Project Management Institute, Inc.

reporting management functions so that decisions of how high to set the quality bar can be made in an informed manner, and the resulting system is sustainable in the long run.

The next step, the quality assurance process is, in essence, the techniques used by the development team to ensure that the system meets expectations. At this point in development, the design is complete and the system is being developed and tested before it is implemented. quality assurance continues after implementation as well. The measurements that apply to the system's performance may not seem familiar to those used to managing data quality, but they are very important for making sure that the system itself is not causing data problems. For example, to support electronic data transfer from law enforcement to the central crash repository, many system designs require 24/7 operation. A measure of what percentage of the time the system is unavailable for receipt of new electronic crash reports is a quality assurance metric. It tells system managers if there is a problem with the data transfer facility in the program. Such "down time" may not have a measurable impact on more traditional data quality measures (timeliness, accuracy, completeness, etc.) but they can have a major impact on how well the system is perceived by users and thus, how willing they are to continue using it. Post implementation, the system developers and managers are the primary users of the quality assurance measures. They track how well the hardware and software are performing, and let managers know if there is problem that needs to be addressed. They can serve as an early warning of problems that could affect data quality – the bottom line for most of the users of the system.

Finally, for crash data managers and users, quality control is the most familiar part of the project planning process. Quality control is the set of measurements and procedures put in place to ensure that the data quality is meeting expectations. The measures of data quality can cover a wide variety of issues at a wide range of "levels" – from global indicators of overall quality to micro-level indicators of the validity of data in one particular field of the crash report form. Quality control processes are the responses of the system (the software and the people working with it) to quality problems that arise. For example, in an E-Crash system, the data quality metrics would show if location data were not meeting expectations (e.g., too many crashes cannot be matched to a location in the State roadway inventory file). The quality control processes are the response – what do the data managers and collectors do about the problems.

Data Quality Metrics

The same data quality issues that have been raised in relation to crash reporting overall in the NHTSA Advisory for Traffic Records System Improvement apply to the E-Crash component. A list of proposed data quality metrics that is used to measure the statewide system should also be applied to the electronically obtained data. This will ensure that the (potentially expensive) E-Crash system is yielding data quality improvements, especially in terms of timeliness, accuracy, and completeness of the crash reports.

The following are examples of typical data quality metrics that could be useful in measuring the quality impact of an E-Crash implementation.

Timeliness:

- Number of days from the crash event to entry of the data on the statewide system
- Number of days from completion of the report to entry on the statewide system

- Percentage of reports older than 10 days, 30 days, 60 days, and 90 days upon receipt by the system

Accuracy:

- Percentage of reports received that contain at least one *fatal* error
- Percentage of reports received with more than five non-fatal errors
- Percentage of reports with errors returned for correction
- Percentage of reports returned for correction that go uncorrected
- Most common errors
- Percentage of reports where the location cannot be coded in an automated or manual fashion

Completeness:

- Percentage of reports with one or more required fields left blank
- Percentage of reports with one or more fields marked “Unknown,” “Missing,” or “Other” (excluding cases of hit-and-run or phantom vehicles/drivers)
- Percentage of reports with missing or inadequate diagrams or narratives

Linkage:

- Percentage of crashes that fail to link to the statewide roadway inventory file
- Percentage of crashes that have incorrect or invalid driver or vehicle data
- Percentage of crashes that cannot be linked to medical data (through direct or probabilistic linkages)

Note that not all of the quality attributes listed in the NHTSA advisory are included. Some attributes (such as accessibility) are a matter of post-processing and policy at the centralized crash reporting management level. These would not have relevance for measuring the quality attributes of an E-Crash system.

System Performance Metrics

The two most desired types of system-level performance measures for crash data are those that would relate the availability of crash data to lives saved; and those that would accurately track the costs of the system. In other words, measurements of the benefits and costs associated with maintaining a complete and accurate record of crashes in a State.

It would seem at first blush that the cost per crash report entered into the system would be an easy metric to define and obtain. As has been discussed in NCHRP synthesis reports 350 and 367, unfortunately in many systems, especially those with distributed databases and thus distributed costs, it is nearly impossible to obtain a reliable cost estimate per crash report. This makes it difficult to obtain numbers that would be comparable among the States and thus be useful to State-level decision makers who might want to compare the efficiency and value of their current systems to other systems.

In addition, there is no agreed-upon standard for the cost components that should be included or excluded in the crash reporting cost metric. Should the officer’s time be included or not? What about the cost of supervisory review? If a crash report is rejected, should the cost of its correction be counted as part of the overall cost of running a crash reporting system?

Since, with this model system, we are mostly concerned with the electronic field data collection (E-Crash) component of a State's crash system, the definition of costs and benefits may be somewhat less problematic. A standard method for explicitly tracking the cost of electronic crash reporting might include the following cost components:

1) Time spent creating the reports;
2) A cost for data transmission;
3) Costs of initial software purchase and implementation;
4) Costs for annual maintenance including licensing and support;
5) Separate line items for life-cycle costs of the hardware and software; and
6) Tracking of the total number of crashes obtained electronically and the percentage that represents of total reports received by the central system.

On the benefits side of the benefit/cost ratio, we do not propose at this time a new definition for metrics of the safety benefits of having crash data. However, States may wish to measure the impact of s E-Crash system on delivery of service to the users of the crash data. Customer service, in particular may be affected by the switch to E-Crash reporting and a State may wish to also measure how much better able it is to meet customers' needs for data once the data are available electronically. For example, the proportion of data requests met via a Web portal (thus requiring little or no direct staff time) could be measured. The time it takes to deliver data following a customer request could also be measured. States wishing to show the full impact and utility of their E-Crash systems would do well to measure customer service as well as costs.

In addition, to prove that there are some cost savings associated with field data collection and electronic transfer, it is advisable that States collect data that would support a comparison of costs for manual and electronic data capture. The per-crash cost of manual data entry is calculated, typically, based on the fully loaded labor costs for the staff that perform this function for the statewide crash repository.

Comparison of E-Crash Model with Current Practice

Figure 3 is an overview of the Washington State eTRIP and the Statewide Electronic Collision and Ticket Online Records system.

SECTOR is a field data collection system for crash and citation information, deployed on mobile data computers in the enforcement vehicles (labeled SECTOR CLIENT in the diagram) placed in each of the law enforcement agencies and prosecutors offices. SECTOR is part of a larger statewide initiative known as eTRIP that combines projects from law enforcement, the courts, the Department of Transportation, and the Department of Licensing to support the data flows shown in the figure. The SECTOR clients throughout the State all connect to a single SECTOR Microsoft BackOffice Server software package that resides at the Washington State Patrol.

In the field, the SECTOR software supports all of the processes of electronic issuance of citations and coding of crash reports. Printers and bar code readers are added to the data collection hardware so that officers may print forms (citations or driver exchange forms) and capture driver license and vehicle registration data automatically.

Ongoing and proposed projects are designed to enhance some of the capabilities of the SECTOR software. Most notably, a point-and-click mapping tool is scheduled for implementation in 2009. This tool will assist officers in collecting and validating location information and thus improving the accuracy of crash location coding in the future.

The State agencies responsible for crash and citation/adjudication information access the data through the Statewide message broker, the Justice Information Network Data Exchange abbreviated as JINDEX. They also may use the message broker to send out updates to the law enforcement agencies as well. All data transfers into and out of JINDEX adhere to the Justice XML standard. The diagram shows another planned enhancement that will add interfaces between JINDEX and departmental RMSs. The system will also add support for users of field data collection software other than SECTOR.

In comparing the SECTOR application with the E-Crash model, it should be noted that the sections of the model dealing with CAD are not directly addressed. As in all States, the capabilities of dispatch systems vary greatly across the State and even within a given area within the State. County law enforcement agencies may have vastly different dispatch systems than the local municipalities in the same county, and those will both differ from the system deployed by the State law enforcement agency (highway patrol, State police, etc.). Thus, the comparison below is limited to the features of the actual field data collection system (SECTOR) and, where relevant, the features of the central message broker, JINDEX. SECTOR does not yet integrate directly with a dispatch system that pushes data from the CAD to the crash or other report forms.

Model E-Crash System Functions Compared to Washington State System

Computer-Aided Dispatch

Not currently available though one county interfaces with the local CAD/RMS

Crash Report Field Data Collection

1.0 Create New Crash Report

- **1.1** Open form, auto-complete officer & agency information
- **1.2** Push and load into form the initial data from dispatch (CAD), call number, time, preliminary location
- **1.3** Create auto-save record for recovery from system (automatic every X minutes)

SECTOR does not capture data from the CAD systems. It also does not have an auto-save feature to avoid loss of data in case of system errors or crash in the field units. However, the system does allow officers to save their work while leaving the crash report open for continued editing.

The system will open a new crash report on command and each user can establish default data values (such as agency and officer name) that will then auto-populate the appropriate fields whenever a new form is opened.

2.0 Collect Crash-level Variables

- **2.1** Collect data
- **2.2** Run field-level validation checks
- **2.3** Create crash template for # units, # CMV, # injured/fatal, etc. (optional)

SECTOR supports collection of the crash-level (environment) variables on the crash report form. It has some field-level quality control at this level in that users are constrained by pick lists and prompted for input on each field of the form as the application steps through the form. SECTOR runs validation edit checks at the end of the form completion process.

3.0 Collect Location

- **3.1** Check common geo-file for available completed location data
- **3.2** Access GPS coordinates
- **3.3** Pre-select map view (optional)
- **3.4** Collect map-click for precise location (optional)
- **3.5** Auto-complete location code, roadway names, and offsets
- **3.6** Prompt for review of auto-completed elements
- **3.7** DOT validation (optional)
- **3.8** Override for unrecognized location

SECTOR does not have GPS or map-click capability for collection of location information at present. A project slated for 2009 completion will give the officers a map-based location selection tool that will then auto-complete the location information on the crash and citation forms. This project, called SmartMap, integrates best-available location information from the Washington DOT. It will auto-complete the location data on the form when the officer clicks the map.

4.0	**Collect Unit (Vehicle)-Level Variables**	
	4.1	**Check common for available completed unit/vehicle data (optional link to motor vehicle database for data)**
	4.2	**Unit type and create template**
	4.3	**Validation check unit 1 = motor vehicle (optional)**
	4.4	**Read bar code registration**
	4.5	**DMV validation**
	4.6	**Auto-complete owner, VIN, vehicle make/model, etc.**
	4.7	**Owner address override, DMV notification (optional)**
	4.8	**Complete remaining unit-level fields**
	4.9	**Prompt for completion of required CMV fields**
	4.10	**Create occupant record templates**
	4.11	**Run field-level validations**
	4.12	**Repeat for all units in crash**

SECTOR units equipped with bar code readers can use them to capture information on bar-coded registration documents. This feature adds the vehicle and owner information automatically to the crash or citation form. There is no real-time link to the Department of Licensing databases or CJIS at this time, however. A project to add this functionality is under consideration but has not yet been added to the overall SECTOR/eTRIP plan.

5.0	**Collect Person-Level Variables**	
	5.1	**Check common for available completed person data (optional link to driver database, driver history, and contact database)**
	5.2	**Person type and template**
	5.3	**Read bar code (or magnetic stripe) driver license**
	5.4	**Department of motor vehicle validation**
	5.5	**Auto-complete fields for driver record(s)**
	5.6	**Address override and DMV notification (optional)**
	5.7	**Complete driver records**
	5.8	**Complete occupant records**
	5.9	**Complete nonoccupant records**
	5.10	**Run field-level and person-to-unit-level validations**

SECTOR units equipped with bar code readers can use them to capture driver information on bar-coded driver licenses. This feature adds the person information automatically to the crash or citation documents. There is no real-time link to the Department of Licensing databases or CJIS at this time, however.

6.0	**Common/Shared Element Storage/Retrieval**	
	6.1	**Save/update person data to common (for contact database, citations, or other forms pre-fill)**
	6.2	**Save/update vehicle/unit data to common**
	6.3	**Save/update location data to common**

SECTOR applications share data among all available forms so that the officer only enters the names, addresses, and other repeated information once.

7.0	**Narrative and Diagram**	
	7.1	**Open diagram and narrative utilities**

7.2	Preselect roadway diagram template matching location data
7.3	Insert unit and non-occupant diagram elements
7.4	Record placement of diagram elements
7.5	Validate final diagram versus location and unit-level data
7.6	Generate suggested narrative to match diagram, (optional)
7.7	Prompt for additional narrative (optional)
7.8	Validate narrative versus diagram and unit-level data (optional)
7.9	Store narrative and diagram

SECTOR crash reports include both narratives and diagrams. These do not have the data-aware features described in the model. The diagram is stored as an image and the narrative is stored as a text field in the database.

8.0	**Save Form**
8.1	Interim save without final edit checks
8.2	Digital signature (based on State and local requirements)
8.3	Final save with edit checks
8.4	Correction of fatal errors
8.5	Issue warning-level errors
8.6	Save report data
8.7	Create PDF (if needed in field)

SECTOR runs extensive edit checks as the form as part of the form save and close operations. The officer is prompted with any errors requiring correction. PDFs of the crash report are not needed in the field.

9.0	**Transmit Data**
9.1	Set report ownership flag to block local changes
9.2	Apply data output format/schema
9.3	Transmit data
9.4	Validate transmission received
9.5	Flag record as sent successfully

SECTOR resides on a central Microsoft BackOffice Server system at the Washington State Patrol. That server communicates with the central message broker, JINDEX. All SECTOR clients send data to the central SECTOR server, and the DOT obtains the data from the SECTOR server via the JINDEX message broker.

10.0	**Create Driver Receipt and Driver Exchange Form (optional)**
10.1	Create PDF driver receipt/exchange form
10.2	Print
10.3	Record delivery of receipt/exchange form

Because SECTOR implementations include a printer in the field, it supports distribution of the Driver Information Exchange form to all parties involved in a collision. Printing of crash reports in the field is not supported, as the officers are not allowed to distribute copies, by law.

Crash Report Review, Correction, and Update

1.0	**Supervisory Review**
1.1	Report ownership assignment to supervisor
1.2	Supervisor annotations

1.3	Report status update (complete, return for correction, pending)
1.4	Report data routing and ownership assignment
1.5	Create PDF (optional)

Supervisory review of crash reports (and citations) is supported. The supervisors review data stored in the central SECTOR server.

2.0	Error Correction	
	2.1	Report ownership assignment to officer
	2.2	Open report in edit mode
	2.1	Present supervisor annotations
	2.2	Present edit check warnings and serious errors if any
	2.3	Prompt for correction of data in annotated fields
	2.4	Run edit checks
	2.5	Save corrected report
	2.6	Report data routing & and ownership assignment supervisor

The error rate on electronic crash reports received by the centralized system is extremely low**.** In 2008, 74 of 10,506 electronic reports were returned to the officer for correction **(**0.7% error rate). By contrast, in 2008, 17,498 of 115,616 paper reports were returned for correction (over 15% error rate).

3.0	Data Transfer to Agency Records Management System	
	3.1	Ownership assignment to records staff (optional)
	3.1	Run error/validation checks for RMS acceptance
	3.2	Return rejected reports to supervisor
	3.3	Assign agency crash report number (if not done earlier)
	3.4	Add report to official agency repository
	3.5	Create PDF for image archive (optional)
	3.6	Lock report to view- and print-only access
	3.7	Update event log in CAD/RMS
	3.8	Update officer activity log (optional)

SECTOR does not currently handle communication with law enforcement agency RMSs, but this capability is slated for implementation by the end of 2009.

4.0	Data Transfer to Statewide Crash Repository	
	4.1	Data conversion to standard format/schema
	4.2	Electronic data transmission
	4.3	Verify transmission success
	4.4	Flag record as sent

Transfer from SECTOR to the JINDEX message broker is handled automatically**.** The statewide crash repository is able to bring in data from the JINDEX message broker. No direct connection between the various local SECTOR servers and the crash records system at DOT is required.

5.0	Receive Correction Requests from Statewide Crash Repository	
	5.1	Accept incoming error notifications

	5.2	Flag report with errors in agency RMS
	5.3	Change report status to "edit"
	5.4	Assign ownership to officer (or optionally to supervisor)
	5.5	Notify supervisor (unless supervisor assigned ownership)
	5.6	Set response tickler
	5.7	Send reminder notice (if tickler times out)
	5.8	Collect corrected report
	5.9	Reset ownership and completion flags
	5.10	Send data to statewide repository
	5.11	Verify transmission success
	5.12	Flag correction as sent.

Based on the low frequency of data quality problems, the State reports not having a significant issue with correction requests.

6.0	Manage Crash Report Update	
	6.1	Officer opens existing crash in "update" mode
	6.2	Compete officer updates
	6.3	Run edit checks and save
	6.4	Supervisory review
	6.5	Transfer to agency RMS
	6.6	Generate next-generation PDF for archive
	6.7	Transmit data to statewide crash repository
	6.8	Verify transmission success
	6.9	Flag updated record as sent

Crash report updates are submitted through the normal SECTOR/JINDEX process. Update reports are indicated as such in the data and are handled appropriately at the statewide crash repository.

Software Update Process

1.0	Minor Update Release	
	1.1	Schedule update
	1.2	Send notification
	1.3	Send update to field units electronically
	1.4	Store update on network for download
	1.5	Send physical media to non-connected units' users
	1.6	Set edit checks to verify updates
	1.7	Send message to non-updated users/units

Updates to the SECTOR clients are distributed through the JINDEX message broker.

2.0	Major Update Release	
	2.1	Schedule update
	2.2	Send notification
	2.3	Send update to field units electronically
	2.4	Store update on network for download
	2.5	Send physical media to non-connected units' users

2.6 Track update processing on field units

2.7 Send deadline warnings

2.8 Flag non-updated units for attention

2.9 Set edit checks to reject reports from non-updated units (if necessary)

Updates to the SECTOR clients are distributed through the JINDEX message broker.

User Aids, Embedded Help, Tutorials, Etc.

1.0 User Assistance Modes

1.1 Embedded help file & help file index

1.2 Crash reporting instruction manual

1.3 Context-sensitive help on data fields

1.4 Step-by-step system function assistance (Show me how)

1.5 Function completion wizards (Do it for me)

1.6 Interactive tutorials

SECTOR includes some embedded help and user aids. Not all of the user assistance methods described in the model system are implemented, but the user aids are sufficient to help officers navigate through the system and complete the necessary steps to complete a crash report.

Recommendations

As States make progress in developing and upgrading their E-Crash systems, there are process items that may prove especially useful to the State to improve their systems. These include:

1) Traffic Records Program Advisory Updates;
2) State System Evaluation Procedures;
3) Go Team Requirements;
4) Marketing, Training, Outreach; and
5) Action Plan.

Traffic Records Program Advisory Updates

Periodic updates are made to the Traffic Records Program Advisory as new technologies, policies, and processes emerge in the field of traffic records improvement. The advisory provides a benchmark of what capabilities are needed in a state traffic records system. The detailed procedures required to conduct a traffic records assessment are derived from the advisory and must be updated subsequently to an Advisory update.

State System Evaluation Procedures

A NHTSA traffic records assessment is required at least every five years to qualify for grant funds to improve traffic records systems. The TRA takes stock of the status of all of the related traffic records system components, the environment in which the system operates, and considers the current service provided. An assessment is conducted objectively and in accordance with the *NHTSA Traffic Records Program Advisory* to identify system strengths, weakness, and areas of potential improvements.

The most common type of assessment is conducted by NHTSA and States are requesting these peer reviews with greater frequency than the mandatory five years. The TRCC can also take advantage of other assessments or audits conducted within the NHTSA Traffic Injury Control divisions, through the Federal Highway Administration, and through the Federal Motor Carrier Safety Administration. If an organization or group other than NHTSA conducts a TRA, the team members must be knowledgeable about highway safety data and traffic records systems and be independent from any of the organizations involved in the State's administration, collection, or use of the highway safety data and traffic records systems. Once an assessment is completed, the review provides a practical focus on identifying the various goals to be pursued to improve the State systems. .

The TRCC should ensure that the State has conducted an objective assessment of its traffic records system a minimum of every five years. It is the TRA that supports potential goals and projects to be included in the State's *Strategic Plan for Traffic Records Improvements.*

Go Team Requirements

The purpose of establishing Go Teams for E-Crash systems improvement is to enable more States to successfully implement high-quality, sustainable E-Crash systems. The Go Teams are intended to provide assistance to the States that:

1) Is at a minimal cost to the States;
2) Includes subject matter experts that are experienced with various aspects of E-Crash system design, implementation, management, and quality assurance; and
3) Is flexible in providing specifically what the States need, when they need it.

Go Team Vision
In order to accomplish these goals, the Go Teams will need to be constructed on an as-needed basis, drawing on experts in the field who have the specific knowledge and experience needed for a particular project. Descriptions of the example team member attributes are provided in Appendix D. Team member skill sets might include the following:

1) Database administration;
2) Crash system design;
3) Data communications and transfer;
4) Data translation and linkage;
5) User needs assessment;
6) Data analysis and performance measurement;
7) Procurement and lifecycle cost estimation;
8) Grant writing and grant program management;
9) Strategic planning;
10) System implementation; and
11) Training and law enforcement liaison.

It is clear that States might need any of these skills and that the needs may occur at different points in a project, from initial conception through design, to testing and implementation, and finally throughout the system lifecycle maintenance. Thus, to be truly effective, the Go Team will need to be flexible in both the timing of its assistance to the State and in its composition throughout the lifetime of a particular project.

Methods of Interaction
The Go Team need not conduct all of its work with a State in person, nor does that work necessitate a group site visit in all circumstances. Team members may actually work individually with different groups within a State, at different times, and through a variety of methods of interaction including:

1) Site visits;
2) Telephone;
3) E-mail; and
4) Webcast, Web meetings, etc.

The Go Team is a means to give the State the assistance it needs, when it needs it. Flexibility in delivery is crucial to the success of the endeavor. This flexibility helps to reduce the costs of providing Go Team assistance, making it more likely that the program can be continued in the future and that teams can be assembled to assist several States in a year.

Example of Go Team Use
To illustrate this concept, assume that a State has decided to pursue development of a new E-Crash system and they have no automated system to start with. The State would like to have its current processes and systems evaluated, in order to ensure that it will be ready to receive electronic data. The State also feels it will need assistance in developing plans for funding, testing, and implementation. Working through its NHTSA regional office, the State could ask for Go Team assistance and negotiate the following with the Go Team project manager:

1) An initial site visit by the Go Team project manager and, if needed, designated experts who can evaluate the current systems;
2) Assistance to plan upgrades to the current systems in order to be ready to accept electronic data;
3) Review of the State TRCC's *Strategic Plan for Traffic Records Improvement* and potential funding sources for the project (e.g., Section 408 grants);
4) Coordination with FHWA and FMCSA division and headquarters staff, as appropriate;
5) Assist in developing budget justifications, performance measures, and lifecycle cost planning; and
6) Review the project plan or proposal.

The Go Team project manager, will assemble a team with the required skills and an initial meeting will be scheduled by phone or on-line to discuss the project manager's findings, to suggest potential contacts, and to make team assignments. Go Team members will then collect information and interview agency representatives involved in the E-Crash effort. Team members may split up to work with technical staff in IT, crash data management, and other areas, and to interview FHWA and FMCSA division personnel. A second meeting of the Go Team will be conducted to discuss the findings and recommendations and to determine with the project manager and other team members if an on-site review will be required to complete its evaluation.

Recommendations, for sake of this example, might include follow-up contact with selected team members or other known subject matter experts, but may also suggest that the State hire outside assistance for certain aspects of the project. For example, if the team determines that a State needs to restructure its crash database, it might recommend that a local technical employment agency provide a skilled database administrator for 40 hours of initial assistance and up to 20 hours each quarter to fine-tune the system. The project manager or a designated team member could continue to provide input to the State through follow-up phone calls, e-mail, or Web-based conferences.

Another recommendation may be to purchase multiple servers to run concurrently so one can be taken off-line for service while not interfering with an officer's access to the system. The Go Team would recommend specifications for a Web server environment so hardware budgets can be justified.

Continuing this example, the State has established a procedure for a temporary database administrator to come onboard once a quarter, has the specifications to go out to State bid for needed hardware, and can begin the process of contracting for software developers.

A second request may be made by the State with the Go Team project manager to assist in planning the testing and implementation of the system and advising the State on training needs that are likely to arise during implementation. The Go Team project manager pulls together a team with the requisite expertise to assist the State specifically on these items. Since these may not be the same experts as initially needed, the new team will begin with an initial conference call meeting and work through the same steps as listed above. Team members have flexibility to plan their contacts with involved parties in the State at the appropriate times to assist with a particular phase of testing and rollout. The Go Team project manager and other team members will communicate often enough to ensure no duplication or overlap is occurring. Continuing the example, only one of this set of team members requires an onsite visit.

In the final phase of the project, the State again contacts the Go Team project manager and asks for assistance in reviewing performance measures and lifecycle cost plans that are being finalized for the agency's budget proposal. The Go Team manager assigns two individuals to review the performance measures and budget proposals that have been sent to them via e-mail. If their recommendations are not consistent, a third individual is asked to review the material. No site visits are required. The project is now in its maintenance phase and no further Go Team involvement is needed.

This brief example shows how costs for the team's involvement might be minimized by reduced travel and by changing the composition of the team over time, depending on the needs of the State and the phases that an IT project like this would go through. The example also shows that Go Team involvement may not be needed continuously throughout the project. A State might need only some of the skill sets represented by the overall pool of Go Team talent at certain points of the project.

Coordinator/Go Team Project Manager
This is a crucial role for the success of this project. The Go Team project manager must be able to match accurately the State's needs for the various skill sets in the Go Team talent pool. Ideally, this person will:

1) Have a background in traffic records from a system development and management perspective;

2) Be able to identify potential problems or perceived needs from State personnel who may not have an IT or planning background; and

3) Select the appropriate team members with the skill sets needed to address the specific E-Crash system issues needed by the State.

Example E-Crash Go Team Members
States need to know where they are in terms of their traffic records systems, where they are going, and how to get there. A part of upgrading the system also can be addressed by using the E-Crash Go Teams. Again, the Go Teams consist of selected specialists in numerous areas of expertise working through the coordinator/Go Team project manager. Go Team members can suggest an action plan that enables the State to develop a more effective and efficient E-Crash system. This action plan can be the State's roadmap from where it is now to where it would like to be with its system. Descriptions of example Go Team members in four functional areas are shown in Appendix D.

Marketing, Training, Outreach
Training, marketing, and outreach are long-standing traditions for the modal agencies in the U.S. DOT. NHTSA's traffic records and safety training consists of courses, on-site training in the State, and training courses through the Transportation Safety Institute. In 2002, NHTSA added Internet-based training delivery to support training that is more accessible and less expensive. Generally, the target audience for a State's traffic records and safety training includes:

State Highway Safety Office personnel
Program managers and others within SHSOs are a primary focus of training because of their need to use traffic records in a data-driven decision process. Whether a new employee or an experienced staff person taking on new areas of responsibility, the Web-based training is a tool the employee can use to gain exposure to the concepts, vocabulary, and techniques needed to make effective decisions.

Other State and local agency personnel with traffic safety responsibilities
These personnel may have long experience in their specific line of work, but take on new responsibilities that require learning about uses of traffic records for data-driven decision making.

Other stakeholders
In addition to the top-focus users, the State should market its systems and data to an even broader audience of interested parties both in and outside of government. This broader audience includes those who serve on a State's Traffic Records Coordinating Committee charged with making decisions about safety issues. These potential users may use the training to learn what data is available and how this data is used to improve safety decision-making.

Training must consistently promote data-driven decision-making especially among State Highway Safety Offices and in those State and local government agencies responsible for decisions related to traffic records and transportation systems improvements.

Action Plan
States should continuously update their action/implementation plans that arises from their strategic planning. Example themes to address (as modified from the USDOT TRCC Action Plan) may include:

Performance Measurement
This theme includes the plan elements related to metadata describing the timeliness, consistency, accuracy, completeness, accessibility, and integration of traffic records information. The primary focus of these elements is to ensure that the State measures and provides reports to allow the USDOT to use the quality metrics to assess State progress, make funding decisions, and identify areas needing improvement.

Direct Data Improvement
This theme includes plan elements related to efforts that will affect data quality in a direct fashion. It focuses on programs designed to identify and address data deficiencies by implementing or funding data improvement efforts at the Federal and State levels.

Training and Technical Support
This theme includes plan elements aimed at identifying needs at the State level for increased knowledge or skills and addressing those needs through training and technical assistance. The plan includes elements for identifying existing training, and assessing training needs.

Coordination and Planning
This theme includes plan elements aimed at improving the intermodal cooperation within USDOT, between USDOT and the States, and among the various stakeholders within the States. A major focus of this theme's elements is on the Traffic Records Coordinating Committees at USDOT and in the States.

Within each goal will fall specific action items defined by the State. The following are two brief examples.

Goal: Performance Measurement

1) Develop the ability to exchange and share data among agencies
    a. Use standards for data exchange
    b. Use standards for data linkage
    c. Use standards for data access

2) Establish standards for data management
    a. Develop data confidentiality, security, and access control standards
    b. Develop data archival storage, retention, and disposition standards
    c. Develop data integrity standards

3) Increase stakeholder compliance with data standards, including MMUCC, MMIRE, NEMSIS, NITS, SAFETYNET, NIEM

4) Include the FHWA Safety Data Initiative as a resource for performance measurement ideas

Goal: Data Improvement

1) Coordinate agencies' data activities
    a. Brief new administrators (on TRCC and MOU) when agency management changes

2) Identify projects that impact across agency boundaries and monitor progress on those projects
    a. Develop a process for determining which projects to report to the TRCC and allow the TRCC to decide whether it needs to hear about. Submit project status report periodically
    b. Establish a mechanism for reporting to the TRCC

3) Sponsor/support new studies and data improvement efforts

4) Improve Section 408 Grant Program applications
    a. Establish performance measures for the six main data characteristics established in the Traffic Records Program Advisory
    b. Establish a simple composite measure of how the State is doing with respect to data quality performance
    c. Establish, through cooperative agreements, a traffic records coordinator.
    d. Increase the frequency of traffic records assessments to every three to four years
    e. Establish a minimum frequency of meetings for the State TRCC

Appendix A

E-Crash System Information

Policy, Systems, and Linkages

1) What have been your most successful programs in building E-Crash systems? Who do you feel are the innovators in these areas?

2) What is your vision for the future in regards to creating better E-Crash systems?

3) Who maintains crash databases -- the primary user or a central data collection agency? If the primary user, has sharing data with the central database or other users been a problem? If yes, how was this resolved?

4) What methods do you have in place to ensure the quality of the crash data? How do you measure quality? What could you do to improve quality in your E-Crash system?

5) In what way have you been successful in encouraging owners of different safety data systems to share information and allow each other access rights, etc.? Can a user transfer crash data electronically to another agency's system?

6) What laws, regulations, or incentives exist to encourage local agencies to dedicate their resources to using E-Crash data collection along with integrated safety and roadway features databases?

7) In what way have you been able to balance crash data needs and interests from the traffic safety community (e.g., a traffic engineer or safety research scientist) with the concerns of those who first respond to the crash site and use an E-Crash system to collect data?

8) What kind of linkages does your system have between the crash database and other safety-related databases, such as roadway inventory, traffic flow, medical (emergency medical services, hospital, rehabilitation, etc.), driver licensing/history, vehicle registration, and other databases? When a crash occurs, what are the reporting linkages, if any, between police, emergency medical response crews, tow companies, hospitals, insurance companies, and citizen self-reporting?

9) What do you consider the primary considerations or challenges in effectively linking roadway feature inventories with crash data when it is collected electronically on site?

10) How do you ensure accurate location data on your E-Crash report?

11) How are data users' needs addressed in the system? How were management and use of crash data assessed and addressed in the E-Crash system design process?

12) If you could start over rather than having to retrofit what you have now, what would you do differently with your E-Crash system to make it better? What are lessons you have learned?

Crash Data

1) What agencies collect E-Crash data in your State? What types of training are provided to them?

2) Who determines which variables appear on the E-Crash report form (e.g., police agency, engineering department, TRCC)? In developing your E-Crash report form, how have you been able to balance the interest for more data with the practical aspects of collecting and reporting the data in a timely and accurate manner? What is your State's threshold for collecting crash data?

3) What type of information is collected about a traffic crash? (Please provide an example of your crash form or a listing of the data that are collected about the crash.) Does your current E-Crash form comply with the Model Minimum Uniform Crash Coding guidelines?

4) What technology (types of computers, GIS or GPS, on-board telemetry, barcode reader, etc.) used to collect E-Crash data? What would require using a paper crash report form versus the E-Crash system? How often would a paper form be needed?

5) Does the E-Crash system contain forms tailored to specific crash situations (a different form for property damage only crashes, an "expert" form that tailors later questions to the responses of earlier questions, etc.)?

6) What successes and failures have you experienced with various technologies in collecting E-Crash data?

7) What criteria are used to decide whether a crash is reported or not? Have there been recent changes in these reporting criteria? How is your agency dealing with pressure to collect data about fewer crashes? How do you handling these pressures; e.g., do law enforcement agencies take reports on property damage only (PDO) crashes? Do the reporting criteria for the State crash system differ from that used in local agencies (e.g., the State data only reflect fatal and injury crashes while local systems also contain data on PDO crashes)?

8) What methods are used to accurately establish the location of each crash? How accurate is this location information? Are there special programs or methods used to increase the location accuracy? Are coordinates used to identify locations? If so, how are these coordinates captured (e.g., using GPS receivers in the vehicles, using the GIS to pinpoint locations during data entry)?

9) Are there technologies or techniques you employ to speed up the process of crash investigation when the crash occurs during a heavy traffic period?

10) For investigations of especially severe crashes or for special analytic studies, what types of technologies are used over and above routine investigations? Does the use of these technologies result in a more efficient investigation, save time in data collection, or have other advantages?

11) How much does it cost on an average to collect E-Crash data in your jurisdiction? How much does it cost to add a new field to your E-Crash report form (i.e., to collect and process that additional variable)? How much does it cost to implement a completely new or updated E-Crash report form?

12) Is there an annual budget for upgrading and/or maintaining the E-Crash data collection system?

Appendix B

State Traffic Records Assessment Reports Reviewed

State	Year
Alaska	2007
Arkansas	2006
Colorado	2004
Connecticut	2004
Delaware	2002
Georgia	2004
Illinois	2006
Indian Nations	2006
Indiana	2008
Iowa	2005
Kansas	2005
Kentucky	2007
Louisiana	2005
Maryland	2005
Massachusetts	2005
Michigan	2004
Minnesota	2005
Missouri	2004
Nevada	2008
New Jersey	2006
North Carolina	2006
Ohio	2004
Oregon	2006
South Carolina	2007
South Dakota	2006
Tennessee	2004
Texas	2007
Virginia	2005
Washington	2009
West Virginia	2001
Wyoming	2005

Appendix C
Personal Contacts

Pat Abeyta, Indian Highway Safety Program, Bureau of Indian Affairs

Ron Beck, Program/Analyst Manager, Missouri State Highway Patrol

Lt. John Carrico, Criminal Identification and Records Branch, Traffic Division, Kentucky State Police

John Dunn, General Manager, Transportation Data Office, Washington State Department of Transportation

Scott Falb, Research and Statistical Analysis, Office of Driver Services, Motor Vehicle Division, Iowa Department of Transportation

Martha Florey, Assistant Director, Bureau of Transportation Safety, Wisconsin Department of Transportation

Tina Folch, Traffic Records Coordinator, Office of Traffic Safety, Minnesota Department of Public Safety

Tony Harris, Electronic Field Reporting, Portland Police Bureau, Portland, Oregon

Captain Craig Hendrickson, Director of Information Services, Minnesota State Patrol

Tom Hollingsworth, Chief of Data Services, Ohio Department of Public Safety

Jeff Holt, Principal, Holt/Sheets & Associates, for the State of Indiana

Mary Jensen, Program Manager, TraCS Program, Office of Driver Services, Motor Vehicle Division, Iowa Department of Transportation

Nils King, Traffic Records Coordinator, Indiana Traffic Safety Division

Dennis Kleen, TraCS Team, Office of Driver Services, Motor Vehicle Division, Iowa Department of Transportation

Chris Madill, State Traffic Records Coordinator, Washington State Traffic Safety Commission

Dan Magri, Traffic Safety Manager, Louisiana Department of Transportation and Development

Patricia McCallum, Section Chief, Bureau of Transportation Safety, Wisconsin Department of Transportation

Trooper John Olsen, Information Services Division, Minnesota State Patrol

Sgt. Marty Pollock, Commercial Vehicle Crash Analysis Reporting Systems Grant Program Manager, Tennessee Department of Safety

Leon Sander, Traffic Safety Coordinator, Bureau of Indian Affairs

Ron Sennett, Traffic Records Coordinator, Mississippi Office of Highway Safety

Chris Sheets, Principal, Holt/Sheets & Associates for the State of Indiana

Jana Simpler, Traffic Records Coordinator, Office of Highway Safety, Delaware Department of Safety and Homeland Security

Mary Wickman, Manager, Traffic Crash Reporting Section, Michigan State Police

Appendix D
Example Go Team Members

Transportation Safety Specialist
Can describe system capabilities to support analysis. Experience in crash data analysis at local, State, and national levels is crucial.

- Identifies data needs of users.

- Identifies required or essential fields such as those from; Model Minimum Uniform Crash Criteria, Model Minimum Inventory of Roadway Elements, National EMS Information System, American National Standards Institute (ANSI) -D20.1 and ANSI-D16.1, Federal Motor Carrier Safety Administration’s SAFETYNET, and others.

- Develops methods to evaluate data quality and suggests training techniques or programs for E-Crash data collectors to improve data consistency and reliability.

- Suggests predefined crash reports for field users to support their countermeasure identification and implementation plans.

- Suggests manner of data collection that best meets the State needs.

- Identifies data linkage that will increase effectiveness of the crash and other files and serves as an efficient strategy for expanding the data available, while avoiding the expense and delay of new data collection.

Strategic Planning Specialist
Provides guidance for detailed strategic planning for traffic records as it concerns development of an E-Crash system. Specific experience is required facilitating traffic records strategic planning efforts.

- Confers with the State’s TRCC to identify responsibility for the strategic plan and new E-Crash system.

- Suggests methods for development of a self-sustaining E-Crash system, including lifecycle cost estimates, equipment replacement cycles, and methods of reducing the cost to State and local government for system operation.

- Outlines a periodic review process of data needs at the local, State, and Federal levels and provide an update process that will include tasks to meet those needs as they are identified.

- Identifies ways to capture program baseline, performance, and evaluation data in response to changing traffic safety program initiatives.

- Suggests additional or missing crash data that will aid in establishing and updating countermeasure activities.

- Identifies and addresses data quality problems, especially as they relate to training needs assessments and training implementation.

- Suggests methodologies for linkage with location-based information such as roadway inventory databases and traffic volume databases at the State level to identify and address safety needs through their various maintenance and capital improvement programs.

Database Administrator
Identifies physical changes required to the current crash database to make it a fully functional E-Crash database. Experience in managing a statewide centralized crash records system or other comparable large system is crucial.

- Understands and can explain how proposed changes will affect the physical database, produce data element descriptions, and describe methods for data capture, maintenance, storage, retrieval, output, and linkage.

- Estimates optimum values for database parameters such as computer memory and storage capacity; external communications for data capture, output, and linkage; and lifecycle costs for planning purposes.

- Suggests user access to various levels of the database and functions that each level of user can perform for each field of the data.

- Gives guidance on testing for and correcting errors, as well as refining changes to database.

- Gives direction to programmers and analysts to make changes to database management system.

- Questions State database workers to determine impact of E-Crash database changes on other systems and estimates resources required for making changes to the database.

- Suggests alterations to database programs to improve system performance.

- Identifies centralized access to linked data and develop a traffic records clearinghouse to serve as the gateway for users.

- Suggests quality control metrics to insure crash data are timely, accurate, complete, and consistent.

Crash Systems Analyst

Must be familiar with user requirements analysis, data collection and management procedures, and other issues related to automated processing and field data collection. Specific experience in field data collection systems for law enforcement is crucial.

- Identifies and surveys organizational units involved with current crash system operational procedures.
- Identifies current crash system problems, and learns specific input and output requirements for collectors and users of the data.
- Reviews computer system capabilities, workflow, and scheduling limitations to determine if an E-Crash program or program change is possible within existing system.
- Writes detailed descriptions of user needs, program functions, and steps required to develop a full E-Crash system from existing system capabilities.
- Evaluates effectiveness of current crash system and identifies E-Crash system components to improve production or workflow.
- Prepares a report for the State that outlines suggestions for an E-Crash program system.
- Document the current and proposed steps for crash reporting from initial crash event to final entry into the statewide crash data system in process flow diagrams.

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U.S. Department
of Transportation

**National Highway
Traffic Safety
Administration**

NHTSA
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