



Minnesota Department of Transportation Traffic Safety Analysis Software State of the Art

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Executive Summary

The Minnesota Department of Transportation (Mn/DOT) is working on developing a replacement product for the Transportation Information System (TIS), a mainframe database management system whose purpose is the maintenance, retrieval, and reporting of roadway and railway data, including roadway accident or crash data. The TIS is capable of data management, data queries, and producing reports. Ultimately, the core functionality of the existing TIS will need to be recreated in a new environment that interacts with a new TIS platform that will include modern traffic safety or crash analysis tool functionality. The objective of this research was to identify and assess existing crash analysis software tools currently being used in other states and to identify safety analysis capabilities that should be considered when replacing the existing TIS.

An Internet search and state Web site review was conducted to determine crash analysis systems currently being employed at other state agencies, as well as the vendors that supply the appropriate software. Initial results found 39 states with an identifiable crash analysis system, in most cases the information available was not extensive and in the case of 11 states only the mention of a system was found, with no further details. To further the information gathering process an interactive poster was presented at the 2010 ATSIP Traffic Records Forum with the goal to stimulate discussion as to the completeness of the information from the Web review as well as to document systems that were unknown at the time. Feedback from crash analysis experts in both the public and private sector at the ATSIP Traffic Records Forum poster session formed the basis for a follow-up email survey regarding the success and functionality of each state system. Twenty-two states replied out of 50 contacted, providing information that was then synthesized for review to determine what features and capabilities best matched Mn/DOT's goals.

Information gathered from these efforts was then used as the basis for the creation of a request for information (RFI) to vendors, in order to determine the type and functionality of modern Crash Analysis System (CAS) software that could be developed and to assist Mn/DOT in their preparation of a request for proposals (RFP) to procure services for developing a modern CAS. Information on the RFI is included in this report, including the methods and potential questions for vendors, and may provide other agencies with ideas for their own RFI for crash analysis software.

The products of this study include a listing of features and capabilities identified by the Web review and/or survey. This list can be used by Mn/DOT or other states when considering the development of a state of the art crash analysis system.

Chapter 1: Introduction

Background

The Minnesota Department of Transportation (Mn/DOT) is working on developing a replacement product for the Transportation Information System (TIS), a mainframe database management system whose purpose is the maintenance, retrieval, and reporting of roadway and railway data, including roadway crash data. The TIS is capable of data management, data queries, and producing reports. Ultimately, the core functionality of the existing TIS will need to be recreated in a new environment that interacts with a new TIS platform that will include modern traffic safety or crash analysis tool functionality. The objective of this research was to identify and assess existing crash analysis software tools currently being used in other states and to identify safety analysis capabilities that should be considered when replacing the existing TIS.

The face of crash analysis is changing. Crash analysis systems (CAS) now allow users to better identify problem areas and therefore contribute to the provision of safer roads. Some trends and developments include:

- Systemic Procedures (or mass actions) – are necessary when specific locations (black spots/high crash locations) are not statistically identifiable due to low site specific frequencies or rates.
- Road Classification – is the identification of roads by the occurrence and expected probability of crashes, allowing the user of those roads to decide upon alternative routes. usRAP is one such program that provides information to drivers and has been piloted in select states based on the successful programs euroRAP and ausRAP.
- Data Management – is aimed at creating more comprehensive and accessible sources of data with regards to crash history, and roadway information. The benefits of data management are that the information can be accessed from its home database, with use of a relational database structure, allowing updates to be easily made on multiple data sets and departments.
- Jointly Developed Systems – the Federal Highway Administration (FHWA) has been developing multiple crash tools with the assistance of other states, in order to offer a comprehensive and collaborative tool at the state level. With multiple parties involved in the development of systems such as *Safety Analyst*, the capabilities of the system may include the synergies of thought and development specialties from amongst the agencies involved.
- Types of Analysis – are increasing thanks to the depth of the data sources. Crash analysis can be performed to provide information of trends, sources, countermeasure effectiveness, and locations with greater accuracy due to the increased use of electronic police reports. Coupled with roadway and geometric data, greater types of analysis are possible.

These trends and developments in crash analysis are allowing more to be accomplished than in the past. Thanks to the way the system and data are designed, further capabilities are possible that allow crash management professionals to better identify areas of concern or provide a solution. Technology is allowing this advance, which compared to ten years before would only be available at a greater cost in design of the system today.

Report Organization

This report is organized in order of the research activities as outlined below. Primary and supplemental information has been gathered and is documented in appendices and referenced to in the appropriate sections of the report. The goal of the project was to identify crash analysis tools that could or should be considered and as such these considerations are listed in the Conclusions and Recommendations chapter of the report.

The research included the following activities:

1. Software web site review: identify and review Internet sites describing crash analysis and software. Identify software packages (and agencies that use them). Identify the subset of commercial, federal, and pool fund (CFPF) software related to highway safety analysis. Compile a list of available software and vendor contact information, and identify basic functionality of each package.
2. Agency web site review: search the Internet for highway agencies reporting use of highway safety analysis software. Compile a list of agencies with links to example applications or pages discussing use of such software. Search the Internet for request for proposal (RFP) and request for information (RFI) examples related to highway safety analysis software.
3. Survey of State Safety Engineers: survey state safety engineers or offices on crash analysis system(s) currently employed or being developed. Synthesize information to determine the most popular features as well as difficulties experienced by state agencies.
4. RFI: Develop draft RFI that can be used to solicit additional information from vendors and program/software developers/providers.
5. Recommendation: Develop recommendation for Mn/DOT based on survey and Internet-derived information.

Chapter 2: Internet Review

Crash Analysis Systems

Seven key steps are generally included in crash analysis (Smith & McIntyre, 2002):

- A. Define the domain or scope of the system to be studied (e.g., state roads)
- B. Quantify crash trend(s) at locations or on parts of the highway system.
 - a. Estimate AADT and re overrepresented.
 - b. Determine the source of the problem(s).
- C. Decide if high crash location or mass action is required.
- D. Evaluate types of improvements to address the crash problem(s).
- E. Obtain an expert opinion about safety improvement(s).
- F. Obtain funding to implement a safety improvement.

These steps may be considered performance criteria for crash analysis software capability. It should be noted that these key steps focus on the identification and mitigation of high crash locations. Systemic (or mass action) approached are now considered to be important components of any comprehensive highway safety program. Crash analysis software should be examined for the ability to support systemic analysis. For example, even though in step B, the “part” of the highway system chosen may be specified over larger areas or systems (systemic assessment), some software packages may be limited in ability to practically manage these types of queries for large extents.

A web review was conducted to identify commercially available software for crash analysis. Thirteen available commercial, federal, and pooled fund (CFPF) crash analysis software products were identified. CFPF software packages include software developed by private vendors as well as software developed through federal or state agencies. For each of the thirteen identified CFPF software packages, Table 1 summarizes the number of states reporting via the Internet the acquisition or use of the software. Details on the identified CFPF systems can be found in Appendix A. Some states utilize proprietary and state-specific crash analysis software that is not available for purchase “off the shelf.”

Table 1: CFPF Software Packages/Systems Accessed by State Agencies

Software	# of states that report acquisition or use
Accident Information Management System: AIMS (JWM Engineering)	3
Alabama DOT - Critical Analysis Reporting Environment (CARE)	2
Crash data records management systems (CDMS) – Tindale-Oliver & Associates, Inc.	1
FHWA/AASHTO - Safety Analyst	27
FHWA - GIS Safety Analysis Tools	9 *
FHWA - Interactive Highway Safety Design Model (IHSDM)	Unknown *
FHWA - Pedestrian & Bicycle GIS Safety Analysis Tools	Unknown *
Highway Safety Analysis Software (HAS)	Unknown
Intersection Magic (Pd' Programming)	14
Iowa DOT - Crash Mapping Analysis Tool (CMAT)	2
Michigan Technological University – Center for Technology and Training ROADSOFT	1
Pedestrian & Bicycle Crash Analysis (Pedestrian and Bicycle Information Center) (PBCAT)	Unknown
Traffic Collision Database: TCD (Crossroads Software)	4

* All states have free access to these federal software products

The CFPF software packages listed in Table 1 were assessed for functionality using the Smith & McIntyre criteria. Table 2 presents a cursory summary of the capabilities¹ of twelve of the thirteen identified CFPF crash analysis software packages in terms of these key steps. The summary is not meant to be exhaustive, as product literature would have to be obtained (or communication with the developers/ vendors) to fully determine the extent these CFPF system capabilities, such as would be anticipated in response to an RFI.

¹ Steps F and G are omitted as outside the scope of analysis software expectations.

Table 2: CFPF Crash Analysis Capabilities

Software	Key Steps Crash Analysis					Total Key Steps
	A	B	C	D	E	
Accident Information Management System: AIMS (JWM Engineering)	Y	Y	Y	U	U	3
Alabama DOT - Critical Analysis Reporting Environment (CARE)	Y	Y	Y	U	U	3
\	Y	Y	U	U	Y	3
FHWA/AASHTO - Safety Analyst	Y	Y	Y	Y	Y	5
FHWA - GIS Safety Analysis Tools	Y	Y	Y	Y	Y	5
FHWA - Interactive Highway Safety Design Model (IHSDM)	U	Y	Y	U	U	2
Pedestrian & Bicycle GIS Safety Analysis Tools	Y	Y	Y	U	Y	4
Highway Safety Analysis Software (HAS)	*	*	*	*	*	*
Intersection Magic (Pd' Programming)	Y	Y	Y	U	U	3
Iowa DOT - Crash Mapping Analysis Tool (CMAT)	Y	Y	U	U	U	2
Michigan Technological University – Center for Technology and Training ROADSOFT	Y	Y	Y	Y	Y	5
Pedestrian & Bicycle Crash Analysis (Pedestrian and Bicycle Information Center) (PBCAT)	Y	Y	Y	Y	U	4
Traffic Collision Database: TCD (Crossroads Software)	Y	Y	Y	U	U	3

'Y' = Yes

'U' = Undetermined

* = web site in Japanese

State Use of Crash Analysis Systems

A web review was also conducted for the fifty states and the District of Columbia for their reported acquisition or use of crash analysis software (or crash analysis “methodologies”). Primarily, websites of the state department of transportation (DOT) were searched, but other state agencies such as the department of public safety (DPS) were included where appropriate.

Table 3 summarizes the findings by state. Both commercially available and state-specific software/methodologies (in bold) are included. Details for each state system can be found in Appendices B1 (states using named software), B2 (states using software not named or name not reported), and B3 (states not reporting use of any software).

Table 3: State Software Packages

ST	System	ST	System	ST	System
AL	Critical Analysis Reporting Environment (CARE)	AK	Highway Analysis System (HAS), Transportation Data Management System (TDMS)	AZ	Arizona Local Government Safety Project Analysis Model (ALGSP), Traffic Collision Database (TCD), Intersection Magic, Safety Analyst, Transportation Data Management System (TDMS)
AR	No results from WEB search	CA	Traffic Collision Database (TCD), GIS Safety Analysis Tools, Safety Analyst, Traffic Crash Location System (TCLS)	CO	Safety Analyst
CT	Intersection Magic	DE	Criminal and Highway Analysis Mapping for Public Safety (CHAMPS)	FL	Crash Reduction Analysis System Hub (CRASH-1), Safety Analyst, Traffic Crash Location System (TCLS)
GA	Safety Analyst, Georgia Electronic Accident Reporting System (GEARS), Transportation Data Management System (TDMS), DHR Oasis	HI	No results from WEB search	ID	No results from WEB search
IL	GIS Safety Analysis Tools, Intersection Magic, Safety Analyst, Transportation Data Management System (TDMS), Traffic Crash Location System (TCLS)	IN	Safety Analyst, ARIES	IA	Safety, Analysis, Visualization, and Exploration Resources (SAVER), Crash Mapping Analysis Tool (CMAT), Critical Analysis Reporting Environment (CARE)
KS	Safety Analyst	KY	Collision Report Analysis for Safer Highways (CRASH-2), Intersection Magic, Safety Analyst, Kentucky Open Portal System (KyOPS)	LA	Intersection Magic, Safety Analyst
ME	Transportation Information for Decision Enhancement (TIDE), GIS Safety Analysis Tools	MD	Maryland Safety Crash Analyst Network (MSCAN),	MA	Crash Data System (CDS), Intersection Magic, Safety Analyst, Transportation Data Management System (TDMS)

ST	System	ST	System	ST	System
MI	RoadSoft, GIS Safety Analysis Tools, Safety Analyst, Transportation Data Management System (TDMS), Traffic Crash Location System (TCLS)	MN	Transportation Information System (TIS), GIS Safety Analysis Tools, Intersection Magic, Safety Analyst, Crash Mapping Analysis Tool (CMAT)	MS	Intersection Magic, Safety Analyst Management System (SAMS)
MO	Transportation Management System (TMS), Accident Information Management System (AIMS), Safety Analyst	MT	Montana Safety Management System (SMS), Intersection Magic, Safety Analyst	NE	Intersection Magic
NV	Nevada Safety Management System (SMS), Intersection Magic, Safety Analyst, Critical Analysis Reporting Environment (CARE)	NH	Crash Reporting Management System (CRMS), Safety Analyst	NJ	Plan4Safety, Accident Information Management System (AIMS), Traffic Collision Database (TCD)
NM	No results from WEB search	NY	Accident Location Information System (ALIS), Safety Analyst, Traffic Crash Location System (TCLS)	NC	Traffic Engineering Accident Analysis System (TEAAS), GIS Safety Analysis Tools, Safety Analyst
ND	Intersection Magic	OH	GIS Crash Analysis Tool (GCAT), GIS Safety Analysis Tools, Safety Analyst	OK	No results from WEB search
OR	No results from WEB search	PA	No results from WEB search	RI	No results from WEB search
SC	No results from WEB search	SD	No results from WEB search	TN	Tennessee Integrated Traffic Analysis Network (TITAN)
TX	No results from WEB search	UT	GIS Safety Analysis Tools	VT	Safety Analyst
VA	The Highway Traffic Records Information System (HTRIS), Accident Information Management System (AIMS), Safety Analyst	WA	Traffic Collision Database (TCD), GIS Safety Analysis Tools, Safety Analyst, Statewide Collision Reporting (SECTOR)	DC	No results from WEB search
WV	No results from WEB search	WI	Safety Analyst	WY	Intersection Magic, Critical Analysis Reporting Environment (CARE)

Chapter 3: Analysis Methods

Background

Two principal scopes are available for addressing the highway safety problem – black spot (aka, high crash location), and systemic (aka mass-action) wherein treating individual or spot locations is not feasible due to poor expected rate of return for mitigating measures.

Systemic Treatments

Systemic Treatments are preventative measures to prevent crashes over entire routes, counties or other roadway systems. The intent of this scope, as it was for black spot analysis, is to reduce the number and frequency of fatal and non-fatal crashes. What is unique about a systemic treatment is that, there is not a predictable pattern to determine needed action; therefore the solutions put in place must be cost effective as the return on investment (ROI) is hard to determine due to the unpredictability of crashes. Systemic treatments are typically low-cost in nature. It is possible that a large portion of the road network may be treated for the price of one large black spot solution. Examples of this include the use of rumble strips, median separation features, high visibility signage, or similar apparatus that can be made as stock or boilerplate devices.

This identification primarily relates to rural highways, such as in Minnesota and Iowa or other states that have many miles of rural roads (Preston, Stein, Maze, & Souleyrette, 2010). These rural roadways account for the majority of fatalities in Iowa and Minnesota and follow the pattern of why black spot analysis may not identify treatment areas due to low density and frequency. An example of this is cited in the Preston report with Minnesota experiencing density of fatal road departure crashes of 0.002/mile, a low number much influenced by the large rural road network.

Other results shown by the Preston document include that in 29 states 50% or more highway deaths occur on rural highways, and in 20 of the same states 70% or more occurred on rural roads. Out of the 51 states and District of Columbia, 39 had a predominately rural fatal crash trend, while 12 had a majority of urban, and one state with an even split between the two. Minnesota reports 69% rural and 31% urban, indicating that systemic treatments must be a consideration to help address the fatal highway crash trend. The Preston paper investigated select states in a case study, describing activities in both black spot and systemic treatments underway. A synopsis of state allocations to rural systemic mitigation is included in Table 4.

Table 4: NCHRP Project 17-189, Task 19 Case Study Synopsis

State	Systemic Treatment Actions
Iowa	90% of HSIP funds are spent on rural applications, such as paved shoulders, & shoulder rumble strips.
Minnesota	60% of HSIP funds are spent on rural applications, such as cable median barrier, shoulder rumble strips, & target speed enforcement.
Missouri	75% of HSIP & HRRR funds are spent on rural applications, such as shoulder improvements & edge line rumble strips.
North Carolina	10% of HSIP funds are spent on rural applications, such as cable median barrier & shoulder rumble strips

Preston reports: “The national statistics are very clear: well over one-half of fatal crashes are in rural areas and approximately one-half of these are on the local system—locations with little or no history of safety investments because for all practical purposes there are no black spots” (Preston, Stein, Maze, & Souleyrette, 2010). Because of this, systemic treatments are essential, as they account for a large number of accidents in the state road system. If a state were to continue the current policy of black spot only emphasis, then a large source of fatal accidents will never be proactively addressed. Examples of common Systemic treatments are discussed below. The list is not exhaustive.

Cable Median Barrier [CMB] is a series of multiple horizontally mounted cables that divide two bi-directional roadways. The purpose is to prevent any vehicle from entering into the oncoming lane, thereby eliminating or slowing any movements that may cause crashes in the opposite lane. CMBs can be seen in service with medians of varying sizes and surfaces. The crash stopping power of the design is in the metal mounts that the multiple cables are run along, and create a netting that causes a vehicle to stop, or reduce its speed and angle that otherwise would endanger the opposite flow of traffic. The pros and cons of CMBs are that they are less expensive and cumbersome compared to other options, but are not as strong as other options and do not guarantee that traffic will not breach the barrier. In terms of replacement, work is required for upkeep, especially when there is a crash, which might not be the case in instances with heavier systems like concrete dividers. CMBs can also be used on the outside of lanes doing the same job, but preventing traffic from moving off of the shoulder. (AASHTO Technology Implementation Group). See figure 1 for illustration.



Figure 1 (AASHTO Technology Implementation Group)

Rumble Strips are defined by the FHWA as “...a longitudinal design feature installed on a paved roadway shoulder near the travel lane. It is made of a series of indented or raised elements intended to alert inattentive drivers through vibration and sound that their vehicles have left the travel lane” (Federal highway Administration). The primary crash type that is most negated by rumble strips are Run-off-road crashes, which account for almost 1/3 of traffic related deaths and serious injuries each year in the US (Federal highway Administration). Rumble strips are an

easy and relatively low cost systemic treatment. They provide a sound and vibration warning to a driver and are pro-active treatment as opposed to other treatments that result in at least some property damage, such as crash barriers. Rumble strips and CMBs are somewhat interchangeable, depending on the situation and danger to be avoided. Installation of the strips can be made during road construction/resurfacing at less cost due to scale economies. See figure 2.



Figure 2 (Federal Highway Administration)

Safety Edge – is a road edge treatment that interfaces an easy angled grade change between the road and the shoulder, thus easing shoulder drop-offs. The purpose is to safely allow vehicles to reenter the roadway at speed, in case the driver moves on to the shoulder. The significance is that without a safety edge depending on the road, a vehicle that may try to correct its course back onto the road may result in an uncontrollable movement potentially resulting in a crash (Lindley, 2008). See figure 3.



Figure 3 (Lindley, 2008)

High Friction Road treatments create a non-skid surface. Constructed with an aggregate rock surface bonded in resin, the road texture allows wheels to grip tighter in the case of heavy braking or on horizontal curves, resulting in the potential reduction in especially run-off and rear-end crashes (Transtec Group, Inc, 2010). See figure 4.

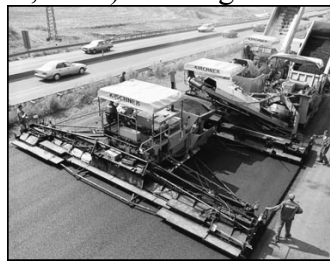


Figure 4 (Ingrim et al., 2004)

Clear Zones are unobstructed spaces on either side of the road. In the case of a departure, instead of traveling into obstacles, or natural elements, an open space increases the likelihood that a vehicle will be able to regain control and resume travel. The cost involved in this action would be minimal, with mainly a onetime clearing or movement of obstacles or natural effects and then

continued routine grounds keeping, i.e., moving and cutting (Federal Highway Administration). See figure 5.



Figure 5 (Federal Highway Administration)

Chevron Signage – For the application in horizontal curves, chevron signage can be used to give visual clues to the driver as to the nature of the road ahead. Chevron signage points in either direction allowing a driver to view the route that must be taken. The use of these signs is especially useful during night when sight distance is limited and therefore reaction times will be shortened (McGee & Hanscom, 2006). See figure 6.



Figure 6 (Missouri Department of Transportation)

Breakaway Signage – Are traffic sign poles that are designed to break or bend in the event of contact with a vehicle. One example of this would be a sign pole attached to a mount with a bolt, and in the case of an accident the bolt is broken, laying the sign down, allowing some of the impact force to dissipate and allow for cheaper and easier reinstallation of the sign (Federal Highway Administration). See figure 7.



Figure 7 (Federal Highway Administration)

Sign Retro-reflectivity is provided with a surface of reflective material that reflects light back to its origin, concentrating light redirection. The common interaction can be seen in figure 8 where head lights on a sign make the sign appear brighter and more visible sooner (Federal Highway Administration).



Figure 8 (Federal Highway Administration)

Systemic treatments are generally low in unit cost and ideal for widespread applications. However, only a relatively few systemic treatment offices are provided in this report.

Black Spot Analysis

High crash or black spot analysis is useful for identifying locations with unexpectedly high frequency of crashes. Black spot analysis is performed based on crash history, first to identify these areas and then to analyze appropriate countermeasures and effectiveness. Crash history can determine a location to be a black spot based on criteria such as the following, the severity of the crash (fatal, injury, property damage only), the type of traffic movement (left-hand turn, head-on, etc.), as well as other contributing factors (i.e., weather, alcohol, etc.).

There are varying types of Black Spot analyses, some enabling the user to query the system for specific reasons or patterns, while others might give crash locations without further refinement, each type dependent on the capabilities of the system. One such form of analysis is the plotting of crash information for only specific criteria (i.e., left hand turns) which can help to determine specific causes of the black spots. Black Spot analysis in some form or another is usually considered the basic form of analysis that a crash analysis system can perform, be it manually or automatically. Examples of software with black spot analysis capabilities include Roadsoft and FHWA's Safety Analyst.

Chapter 4: Survey

In order for Mn/DOT to determine the appropriate technology needed in a new crash analysis system, it was determined that direct communications with the appropriate state representatives would be helpful. Due to the limited amount of information found on the internet from the web search, several tasks were undertaken to identify information on current safety tool practice in North America.

Poster Session

At the 2010 ATSIP Traffic Records Forum held in New Orleans July 2010, an interactive poster was presented. The poster listed all crash analysis systems identified in the web search for each state, in order to promote discussion and gather further information.

The poster, "*Crash Analysis Methodologies*" listed for each state, current crash analysis methodologies, including software, process, technique, or any programs that identify or predict crash locations and concerns. State representatives were receptive to discussing the content that had been discovered, as well as additional information. Software providers and public agencies that visited the interactive poster session are included Table 5:

Table 5: ATSIP Forum Gathered Software Vendor and Agency Information

Agency/Company	DOTs served	System	Website
Agile Assets®	DE, MN, NM, NC, OR, PA	Agile Assets Safety Analyst: Safety Management System	www.agileassets.com/html/safety.htm
FHWA	N.S.	Model Minimum Inventory of Roadway Elements – MMIRE	www.mmire.org
FHWA	N.S.	Digital Highway Measurement System – DHM	Lincoln.cobb@dot.gov
FHWA	N.S.	Highway Safety Manual – HSM	www.highwaysafetymanual.org
FHWA	N.S.	Bicycle Countermeasure Selection System – BIKESAFE	www.bicyclinginfo.org/bikesafe
FHWA	N.S.	Interchange Safety Analysis Tool – ISAT	www.tfhrcc.gov/safety/pubs/07045/index.htm
FHWA	N.S.	Surrogate Safety Assessment Module – SSAM	www.fhwa.dot.gov/safety/pubs/08049/index.htm
GeoDecisions	MS	Safety Analysis Management System – SAMS	www.geodecisions.com/sams/index.htm
IT IS	NV	Transportation Safety	www.itis-corp.com
Midwestern Software Solutions	AK, AZ, GA, IL, MA, MI	Transportation Data Management System	www.ms2soft.com
Midwestern Software Solutions	MI, IL, FL, CA, NY	Traffic Crash Location System	www.ms2soft.com
Open Portal Solutions	GA, KY, TN, WA	NE Crash	www.openportalsolutions.com/results.html
Visual Statement	MS, VA, WV, WY	Report Beam	www.reportbeam.com
University of Michigan – TRI	MI	Transportation Data Center	www.umtri.umich.edu/divisionPage.php?pageID=3
Accident Support Services International LTD	ON		www.accsupport.com/

N.S. = Not Specified

Georgia, Idaho, Indiana, Kentucky, Maryland, Mississippi, Nevada, Utah, Washington and Wyoming provided additional information on their crash analysis systems.

Nationwide Email

Following the Traffic Records Forum, a formal nationwide email survey was emailed to state safety engineers. The survey contained questions regarding the current system, year implemented, developer, operational capabilities and functionality. Questions were also asked regarding the benefits and disadvantages of the systems, which elicited responses related to interconnectivity with other systems, reporting, and maintenance of the systems. The survey return rate was 44 percent (twenty-two states responded, as shown in Figure 9). The survey questionnaire and tables of selected results are available in Appendix C.

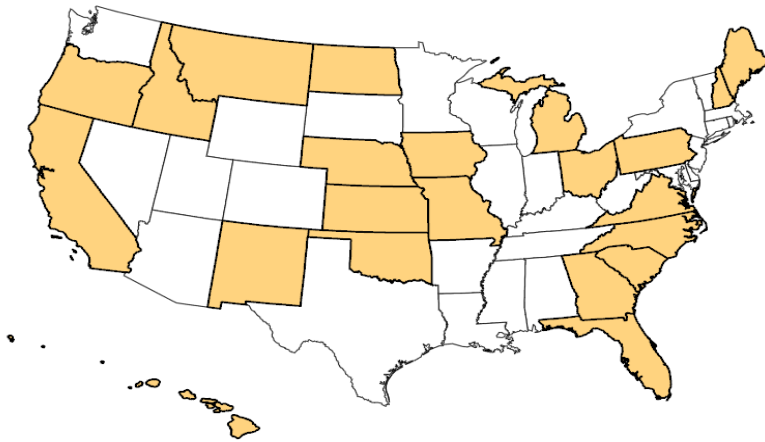


Figure 9: Survey Participant States, shaded states are respondents

Names of the systems were also obtained from most respondents in the questionnaire and have been included in Table 6.

Table 6: Survey Response System Name Summary

State	System(s) Names
California	Traffic Accident Surveillance, Analysis System/Transportation System Network (TASAS/TSN0)
Florida	Crash Analysis Reporting System (CAR)
Georgia	Accident Information System (AIS), CARE, Safety Analyst
Hawaii	Not Specified
Idaho	WebCARS
Iowa	Crash Mapping Analysis Tool (CMAT), SAVER, Crash Magic (near future)
Kansas	High Accident Location System (HAL), now Safety Analyst
Maine	Not Specified
Michigan	Crash Processing System (CPS), Safety Management System (SMS), Roadsoft
Missouri	Safety Management System with Safety Analyst
Montana	Not Specified
Nebraska	Hazardous Location Program
New Hampshire	Safety Analyst
New Mexico	Not Specified
North Carolina	Not Specified
North Dakota	No system, currently GIS and manual work
Ohio	Ohio Crash Location Analysis Tool, soon to be Safety Analyst
Oklahoma	Not Specified
Oregon	Not Specified
Pennsylvania	Crash Data Analysis and Retrieval Tool (CDART)
South Carolina	Not Specified
Virginia	Road Network System

Five State Follow-Up

A short list of states with successful systems was selected for follow-up. Four of these states, Michigan, South Carolina, Maine, and Virginia participated in the survey. In addition, Maryland was identified at the Traffic Records Forum. These states are depicted in Figure 10. These states' internet sites were studied in depth. The information presented is intended to provide a better understanding of the state's experience with crash analysis software, as well as to suggest states with which further dialog might be productive. Information from web sites and the survey

is presented below (survey information is in quotes). Questions and complete answers are available in Appendix D.

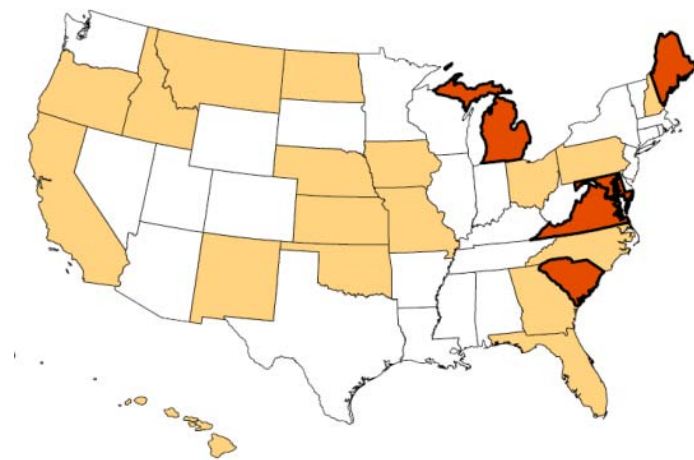


Figure 10: Highlighted state systems

Virginia

Virginia DOT (VDOT) was chosen for further study as its survey response was one of the most positive in regards to the current system. Stephen W. Read, P.E., Highway Safety Improvement Programs Manager answered the Mn/DOT survey. His comments are paraphrased below.

Virginia DOT utilizes a system called the *Roadway Network System (RNS)*, which interfaces with the state data warehouse Traffic Records Electronic Data System (TREDS). RNS is a custom program that does not integrate, but rather interfaces with roadway and traffic information via a linear referencing system (LRS). The interface is geo-spatially referenced on the center line of roughly fifty-seven thousand miles of VDOT maintained roads. While urban areas of Virginia do not currently have an LRS, work is being conducted to provide that capability. Currently the principal network analysis (i.e., crash rates for types of roads, types of intersections, etc.) continues to be provided from Virginia’s old mainframe system. Much of this capability is being built into the developing crash module of RNS that will allow ad hoc reports to be completed. Certain metrics are provided by the RNS: Crash Frequency, Crash Rate, Crash Density, and Comparison of jurisdictions. Certain metrics are computed outside of the RNS, such as the Crash Differential which is being deployed, using Safety Analyst and Crashes per other measure is possible in a GIS. The interface of the RNS includes map based, tabular based, and look up tables-based systems.

In response to the pros and cons of the system Mr. Read wrote the following:

What are the characteristics of your current system that you most like?

“Ability to display crashes on a map or LRS and retrieve information on the crash Reduce manual input Ability to query crash information in multiple ways”

What are the characteristics of your current system that you most dislike?

“Currently we have a process going on that does not have adequate hardware to maintain speed necessary to code the location on the LRS (this is being addressed)”

What capabilities are missing from your current system that you would like to have?

“Per Number 5 answer, we are in the building phase for the geo-spatial functionality and are requesting more mapping capabilities. Further, we are working to display the Safety Analyst output on our LRS.”

Additional WEB research was conducted to find documentation on the *Roadway Network System*. One of the developers, GeoDecisions was a partner in the creation of some of the modules, notably the straight line diagram (SLD), which was deployed for VDOT allowing view and analysis of roadway, crash, and cultural features and events (GeoDecisions). The interface of the SLD is direct with RNS, to enable better location referencing data and accessibility.

Available online at the Virginia Information Technologies Agency, the “*Roadway Network System (RNS) Project Charter Version 2.0*” discusses the RNS as a Oracle database that incorporates GIS tools and spatial analysis technologies (McCombe, 2004). In addition, further detail is given to the subsystems of the former HTRIS system and is listed in TABLE 7.

Table 7: VDOT RNS Project Charter Version 2.0 continued RNS functions

Subsystem	Functionality
<u>Accident Subsystem (ACC)</u>	<u>Capability to locate traffic accidents from the CAP System to allow analysis of data by route and or county.</u>
<u>Pavement Subsystem (PAV)</u>	<u>Describes the materials and maintenance on pavements</u>
<u>Traffic Subsystem (TCA)</u>	<u>Processing of traffic data for raw and AADT data</u>
<u>Traffic Controls Subsystem (TCI)</u>	<u>Tracks an inventory of control devices on networks</u>
<u>Structures and Bridges Subsystem (STI)</u>	<u>Tracks an the inventory and inspection of all bridges in the network</u>
<u>Railroad Crossing Inventory Subsystem (RRX)</u>	<u>Tracks the inventory of railroad crossings in the network</u>
<u>HPM Subsystem (HPM)</u>	<u>Ensures accuracy and completeness of the data submitted to the FHWA</u>
<u>Central Subsystem (CEN)</u>	<u>Is the administrative system of HTRIS, including maintenance and security</u>
<u>Straight Line Diagram Subsystem (SDL)</u>	<u>Links information from subsystems as a visual display of road characteristics and data.</u>

South Carolina

The South Carolina survey and system was selected due to the positive nature of the response, as well as the capabilities of the current system. Joey Riddle of the South Carolina DOT answered the Mn/DOT survey and his comments are paraphrased below. The name of the system is not mentioned in the survey, therefore will be referred to as “the South Carolina System.”

The South Carolina crash analysis system was developed five years ago and is entirely a custom developed project by Intergraph and PMG Pro. The system interfaces with a LRS and although

not internal, allows easy data export for network analysis (i.e., crash rates, etc.) in a spreadsheet application. The system allows for the production of the following metrics; Crash Frequency, Crash Rate, Crash Differential, and Comparisons, such as rankings of each location based on roadway or crash metric characteristics. The basis of the user interface is based on look-up tables, but crash data once plotted can be searched for with a map view.

In response to the pros and cons of the system Mr. Riddle wrote the following:

What are the characteristics of your current system that you most like? “One advantage of having a custom designed software is that it’s dynamic. It can easily be changed to meet our current needs and enhanced to add new features. Although SCDOT owns the code, we typically solicit the vendor to modify or enhance the software to meet our needs.”

What are the characteristics of your current system that you most dislike? “The accuracy of the analysis of the system obviously is heavily dependent upon receiving accurate crash location information. Currently, crash data is captured in the field by law enforcement using a paper crash form which is then entered by hand into the master crash file which allows for a multitude of errors. However, this is currently being improved through a joint project with SCDOT and SCDPS to implement an electronic data capture system which is expected to be fully implemented within the next year.”

What capabilities are missing from your current system that you would like to have? “Because our system is custom built it can be changed at any time to include any capabilities we deem necessary.”

Further WEB research was conducted to document any further data on the current South Carolina system. Of the two developers, only PMG Pro has direct mention of their participation in the project, citing the titles “Highway Performance Management System” and “Roadway Inventory Management System” (PMG Pro, 2009) . Searches for these titles on at South Carolina websites did not produce any results.

Maine

Maine DOT has been highlighted as their survey response was also very positive. Greg Costello and Eric Erskine answered the Mn/DOT survey and their comments are paraphrased below. The name of the system is not mentioned in the survey, therefore will be referred to as “the Maine System.”

The Maine crash analysis system has been used since 2007 and is an entirely custom product from LedgeLight Technologies and Deepriver LLC. The system integrates with a LRS, GIS, and the Maine data warehouse TIDE. It has the ability to conduct network analysis and produces the following metrics; Crash Frequency, Crash Rate, Crash Differential, Crashes per City/Town or County, among others. The system is also a tabular and lookup table based user interface.

In response to the pros and cons of the system Mr. Costello and Erskine wrote the following:

What are the characteristics of your current system that you most like? “The ability to respond to crash data requests electronically. We use much less paper, response times are much better. Most requests are answered using email.”

What are the characteristics of your current system that you most dislike? “Because our crash system and our roadway network system (off the shelf and very hard to get customized) are two systems sometimes there is a disconnect. The Synchronization between the network system and the crash system is not as automated as it should be.”

What capabilities are missing from your current system that you would like to have? “Ad-hoc query tool, map based location tool, and map based reporting tool. These were all in the first proposal by the vendor, but were removed due to funding.”

Further research was conducted regarding Maine’s crash analysis system, but only minor details were found, including some information from Ledge Light Technologies.

Michigan

Michigan DOT was selected for follow-up at the request of Mn/DOT. Dale Lighthizer and Jack Benac answered the Mn/DOT survey and their comments are paraphrased below. Michigan utilizes several systems, Crash Processing System (TCRS), Crash Analysis System and Roadsoft from the Center for Technology and Training at Michigan Technical University.

The CPS has been in use since 2003 and was developed during a phased approach that removed the crash data and application from a mainframe system. The CPS is an Oracle database and allows users to generate standard reports and queries, some available via the web. Information is also transferred in and out to other interfacing applications, or even authorized external organizations. Crash location functionality is held within the CPS via the Traffic Crash Locating System (TCLS), as well as Traffic Crash mapping System (TCMS) which enables crash locating via a mapping tool. A public web-based interface is available for UD-10 image acquisition for a fee, utilizing a credit card processing application, CEPAS. This application is referred to as Traffic Crash Purchasing System (TCPS).

The second system is the Crash Analysis System that includes multiple tools for statewide safety partners, which utilize the Traffic Crash Reporting System (TCRS). The Safety Management System (SMS) is a server system developed in the 1990’s and supports daily safety analysis and support. Currently it is slated to be updated for web browser functionality with expanded capabilities.

The third system, Roadsoft is utilized at the State, County, and City levels that provide network analysis and mapping analysis capabilities.

Each system developed is a custom product; the Crash Processing System (TCRS) were developed by HP/EDS, Roadsoft by the MTU Michigan’s LTAP Center, and the crash analysis systems in house by their respective agencies.

Between these systems, integration of roadway and traffic information is accomplished by LRS, GIS, and Crash/Roadway data by both LRS and GIS processes. Network analysis is possible in

the SMS and Roadsoft, but currently local road volume data is not accessible. Safety Analyst is being deployed to allow trunkline roadway analysis. The following analyses are possible with the portfolio of systems, Crash Frequency, Crash Rate, Crash Differential, Crash Density, Crash per other measures, and comparison outputs. User interface is tabular and map based with the use of two state LRS tools.

In response to the pros and cons of the system Mr. Lighthizer and Mr. Benac wrote the following:

What are the characteristics of your current system that you most like?

1. “Mapping capabilities
2. Timely and accurate crash data
3. Highway alignment data statewide
4. Additional data elements as specified for various HSM analyses”

What are the characteristics of your current system that you most dislike?

- “The Lack of Roadway Information off the State System.
- The number and redundancy of analysis systems.
- The Lack of point of change safety asset data.”

What capabilities are missing from your current system that you would like to have? “*See the above.*”

Further research was conducted on the reported systems and is listed below.

The Safety Management System (SMS) is documented in a Michigan publication entitled “Safety Management System (Michigan DOT). The SMS is a decision-support tool for analyzing vehicular crashes/roads that provides identification of high crash locations. The system requires complete partnerships with other state and local agencies to ensure total coordination of responsibilities. SMS is part of the TMS application, that organizes safety analyses into road segment, intersection, and interchanges, where crashes and roadway features can be accessed for analysis.

Roadsoft is a widely used tool in the state of Michigan, as well as the FHWA (Training, 2006). Per the Roadsoft website, Roadsoft offers a variety of solutions, the Safety Analysis Tools in question help to identify and rank intersections for improvement needs when integrated with crash and roadway inventory data. Specific crashes or criteria can be used to help identify patterns and countermeasures including a link to NCHRP documentation regarding countermeasure implementation.

Maryland

Maryland did not take the quiz; interest in their system is from conversations and a presentation at the Traffic Records Forum by Tom Earp the Project manager at Towson University Center for GIS and Doug Mowbray a Traffic Records Coordinator at the Maryland Highway Safety Office (Earp & Mowbray, 2010). Maryland Safety and Crash Analysis Network (MSCAN) is the

statewide Maryland Crash Database. MSCAN utilizes crash, speed limit and police station data for crash reduction analysis. MSCAN is an oracle based network aimed at serving the needs of planning, engineering, and enforcement agencies through collaborative data management to ensure up to date information access.

Desired System Functionality

After reviewing the survey returns, a short list of desired functionalities was synthesized to determine functions that may be considered for new system functionality.

- GIS or spatial analysis – the ability to analyze information as selected via a GIS, or to be able to display the results of an analysis have been common desired traits. Of the 22 systems surveyed, 13 are said to have this capability. GIS analysis or display can be determined as a positive feature for various reasons, including but not limited to, ease of use and creation of visual tools.
- Reporting Capability – the ability to analyze data and summarize it into a report directly from the crash system. Responses generally had a mix of ad hoc reports or standard reports within the system. A few surveyed states mentioned the need to export information in order to perform analysis, a feature that was also considered an area for improvement. As a consideration, reporting capabilities may become constrained by design during development, due to that, ad hoc reporting and or external analysis should always be capabilities, while standard reports should be built into the system capabilities for ease of use. Five of the twenty-two respondents mentioned this as an area where improvement should be had.
- Relational database – due to the multiple datasets that are often maintained including crash, segment, and other traffic or crash sources, information must be linked together to allow analysis with real time updates of the information sources. This ability to keep data management care for outside department or agency databases is essential to keep personnel focused on the main purpose of the system without great work required for maintenance.
- Linear Referencing System – the ability to assign information to a point or segment is very helpful is essential to the inclusion of GIS capability, as well as data storage. Data storage needs can be minimized with future updates if the information on crashes or attributes are recorded spatially. Fourteen of the twenty-two states reported integrating road and traffic data via LRS.
- Network Analysis – the ability to perform system wide analysis for the identification of improvement areas. Systems that are capable of working with the entire network rather than one specific area, allow the system to determine areas that might otherwise not be recognized by the operator. Seventeen of the twenty-two states surveyed answered ‘yes’, but some did report having limited capabilities due to the lack of information for specific types of roads.
- Metric Creation – the ability to analyze information for specific metrics that are descriptive of the road or intersection in question. Examples of this include crash density, crash frequency, and crash rate, all of which help to relate crash data into meaningful statistics for comparison of sites in deciding the severity of issues. Sixteen of the twenty-two respondents mentioned having at least two of the five listed metrics available with their current system(s).

- Record Entry – an entry of crash data that is timely and has minimal mistakes. Hand keyed information from police reports, requires longer waiting times for data to be entered as well as an increase in typed mistakes. The basis of crash analysis is the crash report, when that information is not available or has been entered incorrectly, the results of an analysis is incorrect. Whether using a specific police report software package or a custom build module to a crash analysis system, the storage of complete and ready information is essential to accurate analysis. While only two of the twenty-two respondents mentioned record entry as an issue, as this is at the very core of successful use and design of a system, it must be listed as desired system functionality.
- System Integration – is the ability of the multiple systems that house needed datasets to have reliable connectivity to the crash system. As most agencies have different locations for data, the availability of that data to the crash system ensures that up to date access is possible, leading to accurate analysis. Crash records integrated with road and segment information allow the crash system user to easily perform duties, where possibly before, different sources of data, without integration would require manual updates of information that might not be the most accurate.

Each state that participated in the forum discussion and/or the survey provided information that may be considered as candidate features for inclusion in a state of the art system.

Chapter 5: Request for Information Draft

As part of the current project, InTrans developed a draft request for information (RFI) for potential use by Mn/DOT. The RFI was based on previous RFI's that Mn/DOT has used, and is customized based on information identified in the current study. Following is the draft RFI:

Introduction

The State of Minnesota (hereinafter "State") Department of Transportation (Mn/DOT) is soliciting information regarding current products, services, and interests of private and/or public agencies specifically related to deployment of a state-of-the-art crash analysis system.

Mn/DOT is currently considering developing and releasing a Request for Proposals (RFP) to procure the services of one or more contractors to develop the crash analysis system. The intent of this Request for Information (RFI) is to solicit information from the industry to assist in finalizing the RFP. The release of this RFI does not guarantee that Mn/DOT will release the RFP; this RFI is strictly for informational purposes.

Background

The Minnesota Department of Transportation (Mn/DOT) seeks input from vendors, R&D companies or universities (hereafter: vendor) interested in providing information about developing a state-of-the-art Crash Analysis System (CAS) to replace its existing mainframe Transportation Information System.

The new CAS should interface with existing mainframe database tables or a new system that converts or imports the existing mainframe database tables for use in CAS. Vendors should provide information on how their CAS product will interface with new and/or existing data formats.

A computerized CAS integrates crash data with roadway inventory and traffic operations data in order to identify potential safety problem locations and assess the effectiveness of potential countermeasures designed to mitigate crash risk and/or crash severity. A state-of-the-art CAS will also be integrated with or include geographic information system (GIS) capabilities in order to facilitate a powerful, user-friendly crash analysis and graphical display of results.

Functional Requirements

Mn/DOT has identified essential current capabilities of its mainframe system which should be continued in the new CAS, and form a "minimum" set of functional tools for the CAS. Three capabilities are considered important for the functionality of the CAS: Data analysis, management, and analysis.

A. Data Analysis Capabilities

1. Calculation of Crash Metrics, by location (see item #2). Includes the following: (capable of being disaggregated by crash severity, crash type, etc...):
 - Total number of crashes over a given time period

- Crash frequency (# crashes per time period)
 - Crash rate – roadway segment (# crashes per 100-million vehicle-miles traveled)
 - Crash rate – roadway intersections (# crashes per 10-million entry vehicles)
 - Crash density - # crashes per length of roadway
2. Identification of locations with potential safety/crash issues. This includes:
 - “Black-Spot” analysis of crash clusters – evaluation of individual roadway segments or intersections over the entire network
 - “Systemic” evaluation of subsets of the roadway network (e.g. all 2-lane, rural roads)
 3. Statistical Analysis of Crash Metrics
 - Descriptive/summary statistics at individual locations;
 - Comparisons between:
 - Individual locations
 - Individual locations and the entire network or subsets of the network
 - Subsets of the network
 - Identification of locations or subsets of the network have higher-than-average crash metrics
 4. Diagnosis of Crash Issues
 - Generate collision diagrams
 - Identify the distribution of “crash type” (e.g., rear-end, head-on; left-turn, etc..) or other crash attributes by location
 5. Countermeasure Selection
 - Assist user in appropriate selection of predefined countermeasures
 6. Economic Analysis
 - Estimate cost-effectiveness of safety countermeasure
 - Other metrics of economic analysis (benefit-cost ratio, net-present value)
 7. Priority Ranking
 - Based on locations with worst crash metric
 - Based on locations with best economic metric

B. Data Management/Database Design Issues

1. Conversion/Importing Of Existing Mainframe Database Tables (or Interface With Data Tables in Mainframe) for Use in the New CAS
2. Database Tables or Entities Will Consist of Crash (Accident) And Non-Crash Tables
3. All Database Tables Can Be Linked (When Appropriate) With A Multiple-Field Primary Key

4. The Multiple-Field Primary Key Will be Based on a Route-System Based Linear Referencing Method (LRM) consisting of:
 - Route Reference Post Number Plus Or Minus Distance From Reference Post
 - Route System Designation – Interstate; U.S. Hwy, etc...
 - Route Number
 - Or other appropriate method suitable for integration with the Mn/DOT LRS.

5. Types Of Routes:
 - Roadway/Highway Route
 - Coincident Routes on Same Roadway
 - Freight Rail Route
 - Public Transit Route
 - Coincident to roadway or freight route
 - Exclusive Route

6. Crash Tables Or Entities will Consist of Sub-Tables. Each sub-table will contain a Secondary Key Field (Crash ID Number) that can be used to link these sub-tables:
 - Crash Details Data
 - Vehicle Details Data
 - Person Details Data
 - Person details table can be linked to vehicle details table via Vehicle ID field

7. Non-Crash Tables Or Entities will Include but not be Limited to:
 - Roadway Route - Segment Details Data
 - Roadway Route - Intersection Details Data
 - Overall Intersection
 - By Intersection Approach or Intersection Leg
 - Roadway Route - Roadside Details Data
 - Roadway Route - Pavement/Surface Condition Details Data
 - Roadway Route – History Data
 - Roadway Route – Geometric, Signing and Pavement Markings Design Details Data
 - Roadway Route - Traffic Data
 - By Road Segment
 - By Intersection Approach or Intersection Leg
 - Roadway Route - Bridge/Grade-Separation Data
 - Roadway Route - Coincident Routes
 - Street Name Data
 - Jurisdictional Identification Data (Local, City, County, State, Federal)
 - Freight Rail Route – Segment Details Data
 - Freight Rail Route – At-Grade/Above-Grade Crossing Data
 - Freight Rail Route - Station Data
 - Transit Route – Segment Details Data
 - Transit Exclusive Route – At-Grade/Above-Grade Crossing Data
 - Transit Route - Station Data

8. Off-Site Access To The CAS
9. Data Input Quality Control
 - Electronic Collision Reports – Possible Option ???
 - Manual Input of Data
10. User-Friendly Error Messages
11. Data Security Protects Against:
 - Data Destruction (accidental or malicious)
 - Unauthorized access to sensitive data
12. Modular Design Of Database For Maintenance
13. Import and Export Of Data Files – Inputs and Outputs
 - For example, export outputs of data queries for use in statistical analysis packages
14. Authorized-Only User Editing Of Data Tables
15. Capability Of Viewing Scanned Crash Reports and Collision Diagrams
16. Video-Log Viewer Capability
 - Ability to access video images of locations based on user-input of multiple-field primary key information:
 - Route Linear Referencing System – Reference Post Number Plus Or Minus Distance From Reference Post
 - Route System Designation – Interstate; U.S. Hwy, etc...
 - Route Number
 - Or location is specified via graphical user interface or GIS-type of interface

C. Data Queries/Analysis Issues

1. Structured Query Language (SQL) Capabilities
 - Pre-Built SQL “Toolboxes”
 - Manual SQL “Command-Line” Option
2. Graphical User-Interface Selection
3. Cross-Tabulation Matrix Option
4. Statistical Analysis/Summaries
5. Structured Query Language (SQL) Capabilities
 - a. Pre-Built SQL “Toolboxes”: GUI windows with pull-down menus of data tables with pre-defined attributes, in conjunction with user-selected values, which accomplish

specific types of queries. In General, The User Should Have The Options Of Being Able To:

- SELECT Field(s) or Attribute(s), In Conjunction With Aggregate Functions Of Attribute(s)
- FROM Any Given Data Table(s) (Crash Tables and Non-Crash Tables)
- WHERE Specified Attribute(s) Have A Specified Value Or Range Of Values Selected By The User
- ORDERED BY Specified Attribute(s) In Ascending or Descending Order
- GROUPED BY Specified Attribute(s)
- HAVING The Result Of The Aggregate Function Satisfy Some Criteria

Examples of Pre-Built Toolboxes:

- “Summarize crashes” grouped by the attribute “crash type” for the entire roadway network, excluding crashes at intersections; “Summarize Crashes” could mean:
 - summing total number of crashes over x-number of years;
 - calculating average crash frequency (#crashes per year) over x-number of years;
 - calculating average crash rate (#crashes per 100-million vehicle-miles of travel) for roadway segments over x-number of years;
 - calculating average crash rate (#crashes per 10-million entering vehicle) for roadway intersections over x-number of years;
 - Above example but only for crashes located at intersections;
 - Above example but only for a particular Route System designation (e.g. U.S. Hwy) or only for roadways with a specified number of lanes;
 - Select the top x% of y-mile long sections of roadway (excluding intersections) in the entire network with the highest Annual Crash Rate;
 - Find Crash Clusters Or “Hot-Spots” within a user-specified segment length along a roadway(s):
 - capable of specifying either a “floating window” that slides along a route at a given increment or specify a “fixed window”;
 - Find crashes within a specified radius around a designated feature type such as rail at-grade crossings for the entire roadway network or subsets of the network;
- b. Manual SQL “Command-Line” Option - User-Supplied SQL Statements

6. Graphical User-Interface Selection

- With GIS integration capabilities, the user will have the ability to graphically select roadway locations/areas for analysis via graphical circular-radius selection tool or “polygon” selection tool;

7. Cross-Tabulation Matrix Option

- See Example: Behavioral Risk Factor Surveillance System; WEAT: Web Enabled Analysis Tool
http://apps.nccd.cdc.gov/s_broker/htmsql.exe/weat/freq_analysis.hsml?survey_year=2005

8. Statistical Analysis/Summaries

In addition to the above three capability categories, the following information, obtained from a previous Mn/DOT RFI may provide some useful questions for incorporation into the RFI:

Off-the Shelf Web Based Data Sharing Software

- a. Does your company offer an off-the-shelf product(s) that could serve as the Web Based Data Sharing Program (with or without modifications)?
- b. Can your product interface with other off the shelf Web Based Data Sharing Programs and/or ingest data from CAD systems (please list which products)?
- c. Requirements for the Web Based Data Sharing Program are included in the following section. Please indicate based on the background information provided in the previous sections and the requirements in Section 5 of this RFI :
 - a. What is the typical cost for your software package? What does this include?
 - b. What is the average maintenance and support cost to support your software? Is support provided 24/7?
 - c. Which requirements in the following section are not included in your base software package?
 - d. Are there any requirements you would not be able to meet?
 - e. Please estimate the additional cost to support those requirements not supported by your base software.
 - f. Are there comments/additions/deletions you have to the requirements included in the following section that you feel would improve the project?
- d. Would you be able to provide a temporary trial of your product to Mn/DOT?

Web Based Data Sharing Software Development

- a. If you do not offer an off-the-shelf product, would your company have an interest in building custom software that meets the requirements of this RFI?

If yes, please answer the following questions:

- a. How long would it take your company to build a web based data sharing program based on the requirements provided in the following section and the background information provided in the previous sections?
- b. Please provide an estimated cost for developing a web based data sharing program based on the requirements included in the following section and the background information in the previous sections.
- c. Would you consider making the software developed for the Web Based System Open Source and not proprietary?
- d. Would you be able to write the Open Source software in java?

General Questions

- a. Please feel free to make any comments or suggestions you feel would assist the software development.

What would limit your interest in participating in this project?

Chapter 6: Conclusions and Recommendations

Conclusions

Using interviews, research, and surveys, this project identified up-to-date features that comprise a crash analysis system. The survey concluded that the following were critical features or capabilities of a crash analysis system:

- GIS Analysis
- Reporting Capability
- Relational Database
- Linear Referencing System
- Network Analysis
- Metric Creation
- Record Entry
- System Integration

There are also roles that a crash analysis system should play (according to Smith & McIntyre as discussed in Chapter 2).

- Define the domain or scope of the system to be studied (e.g., state roads)
- Quantify crash trend(s) at locations or on parts of the highway system.
 - Estimate AADT and assemble crash data.
 - Determine if sections are overrepresented.
- Determine the source of the problem(s).
- Decide if high crash location or mass action is required.
- Evaluate types of improvements to address the crash problem(s).

Regarding system statistical and analytical capabilities, the following are suggested as important features of a state of the art system:

- Calculation of Crash Metrics, by location (see item #2). This includes the capability of being disaggregated by crash severity, crash type, etc.
- Identification of locations with potential safety/crash issues. This includes:
 - “Black-Spot” analysis of crash clusters – evaluation of individual roadway segments or intersections over the entire network
 - “Systemic” evaluation of subsets of the roadway network (e.g. all 2-lane, rural roads)
- Statistical Analysis of Crash Metrics
 - Descriptive/summary statistics at individual locations;
 - Comparisons between individual locations, networks, and subsets.
- Diagnosis of Crash Issues
 - Generate collision diagrams
 - Identify the distribution of “crash type” (e.g. rear-end, head-on; left-turn, etc..) or other crash attributes by location
- Countermeasure Selection

- Assist user in appropriate selection of predefined countermeasures
- Economic Analysis
 - Estimate cost-effectiveness of safety countermeasure
 - Other metrics of economic analysis (benefit-cost ratio, net-present value)
- Priority Ranking
 - Based on locations with worst crash metric
- Based on locations with best economic metric

Recommendations

It should be considered that the recommended features and capabilities of a system might not have to be found entirely within the new system. Due to the quality and availability of other CFPPF systems, the system of choice for Mn/DOT might in fact be a combination of systems, where the main functionality is based around a CFPPF system, with a sister system custom developed to be integrated with that CFPPF system. This plan might result in a cheaper cost, as the development of the CFPPF system would not be total whereas a custom system most likely would. In the case of the CFPPF system, support will be available outside of the organization, allowing customized support when needed. Also there is an advantage of synergy in the case of a CFPPF system that is currently being used by other states, so that teething problems may be reduced and updates would be more frequent. In the case of which CFPPF systems are capable of performing current Mn/DOT TIS duties, one may refer back to Chapter 2 and the Smith & McIntyre key steps for crash analysis. The synthesis of those steps in regards to the CFPPF systems gives an indication of how current systems might be able to fill current needs.

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Appendix A – Crash Analysis Software

AIMS

<http://www.jmwengineering.com/aims00/aims.html>

Information from website:

“AIMS displays accidents on GIS map with our patented 3-dimensional stacked symbol plot. It plots accidents on GIS map with symbols corresponding to the locations where the accidents occurred. It plots mid-block accidents according to distances or mileposts. If a location has two or more accidents, it stacks the symbols on top of each other, creating a 3-dimensional view. Locations with a higher stack of symbols mean more accidents.”

Main Features:

- “GIS mapping”
- “collision diagrams”
- “input, edit, print, and delete collision, citation, and DUI records”
- “records management”
- “street name verification”
- “read to and from external databases”
- “queries by location, primary collision factor, collision type, reporting district, highest degree of injury, and other factors”
- “reports for intersection historical and high incidence, midblock historical and high incidence, and other collisions”
- “graph and chart functions, customizable for time period, collision type, and other factors”
- “data analysis of highest degree of injury, collision type & involved with, weather & lighting conditions, and much more”
- “complete editing capabilities”
- “full customization”
- “automatic upgrades, which update the software to the latest version”

Crash Data Management Systems (CDMS)

http://www.tindaleoliver.com/CDMS_WEB.pdf

“TOA will begin providing the web-based CDMS services in November 2010. This system will leverage cutting edge GIS mapping technology to provide the needed functionality for crash data records management, analysis, and safety project development. The web-based CDMS is a turn-key service that includes data management and the conversion of historical crash data to the new DHSMV 2010 crash form. TOA is in the process of developing both a CDMS web-service hosted by TOA as well as enterprise CDMS sites for select clients.”

“WebCDMS Core Functions:

- “Selecting Crashes by:
 - Location on Map
 - Attribute
 - Geographic Area and Corridor”
- “Mapping Crashes by:
 - Node
 - X,Y Coordinates”
- “Collision Diagramming/Analysis
 - Before and After Analysis
 - Editing of Crash Type
 - Editing of Location”
- “Corridor Collision Diagrams on the Map

- Link to Scanned Crash Report Images
- Advanced Reporting
- Reporting based from crash types
- Reporting based from countermeasure
- Reports based on over-represented types of crashes
- Reporting by geographic areas, corridors and intersections”
- “Exporting Data
 - Export to Excel
 - Export to Word”
- “Secure Log-In and Security Features”

FHWA GIS Safety Analysis Tools

<http://www.hsisinfo.org/hsis.cfm?num=8&page=1>

- “Computerized crash analysis systems in which crash data, roadway inventory data, and traffic operations data can be merged are used in many state and municipalities to identify problem locations and assess the effectiveness of implemented countermeasures. By integrating this traditional system with a geographical information system (GIS), which offers spatial referencing capabilities and graphical displays, a more effective crash analysis program can be realized. The analysis tools include five separate programs to evaluate crashes:”
 - “Spot/Intersection Analysis“
 - “Strip Analysis“
 - “Cluster Analysis“
 - “Sliding-Scale Analysis“
 - “Corridor Analysis”

FHWA Pedestrian and Bicycle GIS Safety Analysis Tools

- <http://www.hsisinfo.org/hsis.cfm?num=9&page=1>
- “Geographic Information System (GIS) software turns statistical data such as accidents and geographic data such as roads and crash locations into meaningful information for spatial analysis and mapping. In this suite of pedestrian and bicycle safety tools, GIS-based analytical techniques have been applied to a series of pedestrian and bicycle safety issues. The tools included in this suite can be used to develop the following:”
 - “high pedestrian crash zones “
 - “safe routes for walking to school “
 - “safe bicycle routes “

FHWA Resurfacing Safety Resource Allocation Program (RSRAP)

- <http://www.rsrp.org/>
- “The Resurfacing Safety Resource Allocation Program (RSRAP) software has been developed to allow highway agencies to implement a process that selects a program of safety improvements, to be made in conjunction with resurfacing projects, that maximizes traffic safety and operational benefits resulting from the program. RSRAP selects this optimal safety improvement program within a user-specified budget constraint representing the agency's available improvement budget.

RSRAP uses an optimization process based on integer programming to determine the most cost-effective set of safety enhancements that achieve the optimal benefits for a specified set of candidate resurfacing projects. In this way, RSRAP can maximize the systemwide safety benefits for a given set of resurfacing projects as a whole, rather than maximizing the benefits at any particular site. RSRAP incorporates the best available estimates of the safety effectiveness of specific geometric design and safety improvements.”

Highway Safety Analysis (HAS) Software

- Currently the published website is inactive.

Interactive Highway Safety Design Model (IHSDM)

- <http://www.tfhrc.gov/safety/ihsdm/modules.htm>
- Not necessarily crash analysis from own data inputs, but rather a road design evaluation program
- Information from website main page:
- “The IHSDM suite of software analysis tools for includes six evaluation modules:”
 - “Crash Prediction Module: estimates the expected frequency crashes on a highway using geometric design and traffic characteristics. “
 - “Design Consistency Module: estimates the magnitude of potential speed inconsistencies to help identify and diagnose safety concerns at horizontal curves “
 - “Intersection Review Module: performs a diagnostic review to systematically evaluate an intersection design for typical safety concerns.“
 - “Policy Review Module: checks highway segment design elements relative to design policy.”
 - “Traffic Analysis Module: estimates operational quality-of-service measures for a highway under current or projected future traffic flows. “
 - “Driver/Vehicle Module: estimates a driver’s speed and path along a highway and corresponding measures of vehicle dynamics. “
 - “The 2009 Crash Prediction Module Beta Release includes capabilities to evaluate two-lane rural highways, multilane rural highways and urban/suburban arterials. The 2008 Public Release – which includes all six evaluation modules – is only applicable to two-lane rural highways.”

IMAT – Incident mapping analysis tool

- <http://www.ctre.iastate.edu/research/detail.cfm?projectID=1534177638>
 - “**Abstract:** IMAT is analysis software for analyzing location- referenced data collected using Traffic and Criminal Software (TraCS) and Incident Location Tool (ILT) software. IMAT is similar in look and feel to the ILT software, leveraging approximately 75 percent of the same source code libraries. IMAT supports the same-day analysis of incident data collected by law enforcement officers, a central objective of the TraCS project. IMAT supports a collection of simple query tools, allowing a user unfamiliar

with SQL to easily filter and chart collected safety and citation data attributes. It is similar in functionality to the Crash Mapping Analysis Tool (CMAT).”

Intersection Magic – Vendor developed collision diagramming software

- <http://www.pdmagic.com/im/>
- “Intersection Magic is an MS Windows based PC application for crash records analysis. It generates automated collision diagrams, pin maps of high accident locations, high accident location lists, frequency reports, presentation graphics, (such as crashes by time of day or month of year) and much more.”
- “Intersection Magic has been used by [jurisdictions across the country](#) to reduce their accident counts, accident severity and exposure to lawsuits.”
- “Pd' Programming has been producing and distributing Intersection Magic for the past 14+ years. This is more than twice as long as any of our competitors. It is by far the most widely used crash records analysis package of its type in the World.”

PBCAT - Pedestrian & Bicycle Crash Analysis

- Tool <http://www.walkinginfo.org/facts/pbcats/index.cfm?pc/pbcats.htm>
- Information from the main page.
 - “The Pedestrian and Bicycle Crash Analysis Tool (PBCAT) is a crash typing software product intended to assist state and local pedestrian/bicycle coordinators, planners and engineers with improving walking and bicycling safety through the development and analysis of a database containing details associated with crashes between motor vehicles and pedestrians or bicyclists.”
- Technical Brief
 - http://www.walkinginfo.org/facts/pbcats/techbrief_HRT-06-090_print.pdf

Roadsoft

- <http://www.roadsoft.org/>
- “Network Screening”
 - “Identify and rank intersections with crashes for a safety improvement plan.”
 - “Run the intersection analysis tool to interactively focus on intersections with specific crash criteria. “
 - “Sort a list of intersections with criteria like severity of crash (property damage, fatal, serious injury, etc.) and other factors such as pedestrian involvement, school bus, intoxicated driver, and any other variables reported by your public safety agency.”
- “Diagnostic Tools”
 - “With RoadSoft’s diagnostics tools, you can analyze individual crashes and patterns to help identify areas where possible engineering changes might reduce the frequency and

- severity of crashes. Once you've identified problem areas, the built-in links to NCHRP documentation help you implement countermeasures”
- “Intersection Tool”
 - “The Intersection module keeps information about the configuration and features of your intersections and is fully integrated with your jurisdiction’s crash data. This allows you to quickly identify intersections with high numbers of severe crashes, run our diagnostic tools, and look for solutions to reduce the frequency and severity of crashes.”
- “Trend Analysis”
 - “Determining trends in crash frequency and severity is another key to identifying where it is best to spend scarce resources. The Trend Analysis tool gives you a graphical representation of crash trends on segments with multiple modifiable variables. It will be of great benefit to you if you are trying to decide where to invest in safety improvements even when all other factors seem equal.”

Safety Analyst

- <http://www.safetyanalyst.org/>
- System that provides analysis of a number of areas. Information from main page:
 - “Provide state-of-the-art analytical tools for use in the decision-making process to identify and manage a system-wide program of site-specific improvements to enhance highway safety by cost-effective means.”
- Reported Benefits: <http://www.safetyanalyst.org/benefits.htm>
- “Network Screening “
 - “State highway agencies generally have automated procedures for network screening to identify potential improvement sites, often known as high-accident locations. Typically, these procedures use threshold values of observed accident frequencies or accident rates, at times combined with an accident severity index.”
- “Diagnosis and Countermeasure Selection”
 - “A basic collision diagramming capability is included within **Safety Analyst**, but the Diagnosis Tool can also interface with selected commercially available collision diagramming software packages, including collision diagramming software with interactive capabilities.”
- “Economic Appraisal and Priority Ranking”
 - “**Safety Analyst** permits users to conduct economic appraisals of the costs and safety benefits of any countermeasures selected for implementation. The economic appraisal results can be used to compare alternative countermeasures for a particular site and to develop improvement priorities across sites. **Safety Analyst** includes an optimization program capable of selecting a set of safety improvements that maximizes the system-wide safety benefits of a program of improvements within a specific improvement budget.”
- “Evaluation of Implemented Improvements”
 - “**Safety Analyst** gives users the ability to conduct evaluations of improvements after they are implemented. The statistical approach to before/after evaluations is based on the EB approach and, thus, is able to compensate for regression to the mean. Evaluations use accident and traffic volume data from existing highway agency records together with the same regression relationships between accident frequency and traffic volume used in the network screening tool.”

Traffic Collision Database

- <http://www.crossroadssoftware.com/products/traffic/tcdframes.htm>
 - “Crossroads Software's Traffic Collision Database is a powerful yet simple, solid yet flexible program for data input and management, queries and reports, and data analysis for traffic collisions, citations, and DUIs. Used by cities and counties throughout California, as well as in Washington, Arizona, and New Jersey, the Collision Database system is quickly setting standards in the industry.”
 - “The Traffic Collision Database provides data input and management for collisions, citations, and DUIs; queries and reports, including historical, high incidence, and monthly, as well as collision reports by day and hour and other parameters; graphs and charts for such categories as highest degree of injury, collision type, weather and lighting conditions, and much more.”
 - “Not just a tool to keep track of collision data in cities, the Collision Database also helps analyze that data, query it, and produce reports so that city traffic engineering departments, police departments, and city managers can fully understand collisions in their city and, ultimately, take measures to prevent them.”

usRAP – United States Road Assessment Program

- http://www.aaafoundation.org/pdf/usRAPII_Overview.pdf
 - usRAP Benefits on page 3 of the pdf:
 - “Both highway agencies and road users will benefit from the information provided by usRAP. Agencies responsible for road safety can use the usRAP maps to see how well their road system is performing and to direct resources rationally toward systematic improvement of their road system. usRAP maps can also help individual road users to understand the risks involved in traveling on roads of different types and the safety performance of the specific roads that they travel. Risk-aware motorists may select lower risk routes such as freeways and will be more likely to adapt their driving behavior to reduce their risk of crash.”
- http://www.aaafoundation.org/pdf/usRAP_brochure.pdf
 - Brochure for usRAP.

Appendix B1 – States Using Crash Analysis Software with *Known* Name

Alabama

- Website <http://www.dot.state.al.us/docs>
- Website <http://www.dps.state.al.us/Default.aspx>
- Software CARE – Critical Analysis Reporting Environment.
- Source: CARE – Critical Analysis Reporting Environment. Center for Advanced Public, 2010. Accessed February 2010. Website:- <http://caps.ua.edu/care.aspx>.
- “Hotspot Determination. A hotspot is a location that has a particularly high crash history, sometimes of a particular type of crash (e.g., hotspots for selective enforcement might be defined as those with excessive crashes caused by speed or alcohol). CARE uses a variety of techniques for identifying hotspots. As an example, for mileposted routes, one method is for users to specify a length of the segment and the number of crashes within the segment for it to qualify. For example, in the display given below, the criteria specified was a minimum of 20 crashes in 0.4 miles (note that this is over a four-year period). A map is given along with the strip map to assist engineers in locating the hotspots.”
- “Report Generation. There are many options for producing various helpful reports with just the click of the mouse. Of course, the major reason for identifying hotspots is so that some countermeasure can be applied. Note the “Reports” icon in the upper right corner of the display above. This button leads to a very large number of reports that officers or engineers can take to the location in order to run down just exactly what the problems are. These reports range from overall summaries to detailed information on a per-crash basis. Any of the outputs discussed above can be exported to Microsoft Office products, including Word and Excel, enabling them to be formatted for reports or processed further.”
- “Collision Diagram Generation. Intersection Magic is a collision diagram generator that has been integrated into CARE to automatically draw collision diagrams for any location specified by CARE. This avoids the issues of having to understand all of the database ramifications of collision diagram generation, since once the location is defined within CARE the collision diagram is generated at the click of the mouse. A separate license must be obtained from Pd’ Programming in order to use this feature; Alabama has obtained a statewide license for the use of Intersection Magic.”
- “GIS Integration. Quite analogous to the collision diagram integration, ESRI/ArcGIS has been integrated into CARE enabling analysis results from CARE to be mapped using ArcView with the click of the mouse. In addition, the GIS map can be used to create a filter so that a subset of the mapped crashes can be further analyzed in CARE. For more information on this aspect of CARE’s capabilities, see [Crash Mapping Flyer](#).”

Arizona

- Website www.azdot.com
- Software: ALGSP – Arizona Local Government Safety Project Analysis Model.
- Source: *High Risk Crash Analysis*. ATRC Research Notes December 2005. Date accessed: January 2010. Website: http://www.azdot.gov/TPD/ATRC/publications/research_notes/PDF/558RN.pdf.
- Page 1 quotes:
- “The current Arizona Local Government Safety Project Analysis Model (ALGSP), which was developed by Carey (2001) with funding from the Arizona Department of Transportation (ADOT), is intended to facilitate conducting these procedures by providing an automated method for analysis and evaluation of motor vehicle crashes and subsequent remediation of ‘hot spot’ or ‘high risk’ locations.”
- “The software is user friendly and can save lots of time for local jurisdictions and governments such as Metropolitan Planning Organizations (MPOs), counties, cities, and towns. However, its

analytical core is based on the simple ranking of crash statistics, where the user is offered choices of crash frequency, crash rate, crash severity, or crash cost (severities associated with average costs per crash severity type). Although this method has the benefit of straightforwardness, the efficiency of identifying truly high-risk sites leaves some room for improvement.”

- Source: Date Accessed; January 2010. Website:
http://www.dot.state.az.us/TPD/ATRC/publications/project_reports/PDF/AZ504.pdf

Alaska

- Website: <http://www.dot.state.ak.us/>
- Software: HAS – Highway Analysis System
- Source: Motor Vehicle Crash Data. Transportation Data Services, 2010. Date accessed, January 2010. Webpage: <http://www.dot.alaska.gov/stwdplng/transdata/crash.shtml>.
- “The Highway Analysis System (HAS) contains the most complete statewide database of vehicle crash data in the State. But it includes only those accident reports that DMV sends to Transportation Data Services. Some crashes may go unreported, and some accident reports may never get sent to DMV. The crash data system also only contains data for crashes that occurred in the road right-of-way.”
- Each crash report is analyzed and processed individually. For every crash that occurred on a public road, it is:
 - “checked for completeness, consistency, and correctness”
 - “located on the Highway Analysis System (HAS) road network : staff review a crash's location information from the street location, collision narrative, and collision diagram on the report form and carefully assign a Coordinated Data System (or CDS) route number and milepoint for the crash (*Milepoint* is not to be confused with *milepost*)”
 - “entered into HAS for permanent storage and analysis”
 - “is analyzed extensively by traffic and safety engineers as part of highway planning, design, construction, and maintenance”

Delaware

- Website: <http://ohs.delaware.gov/information/cps.shtml>
- Software: CHAMPS – Criminal and Highway Analysis Mapping for Public Safety
- Source: *FY 2010 Highway Safety Plan*. State of Delaware Office of Highway Safety, 2010. Date accessed, January 2010. Website:
http://ohs.delaware.gov/Reporting%20Forms/HSP/Final_FY_2010_HSP_web.pdf.
 - Page 21 of pdf. “In addition to utilizing the paper and electronic reports prepared by the above data sources, the Office of Highway Safety relied heavily on the mapping capabilities provided by our GIS based crash analysis and mapping system, CHAMPS (Criminal and Highway Analysis Mapping for Public Safety). All the identified priority area crashes were mapped to determine if there were any clusters or location consistencies for various types of crashes, including unrestrained fatalities, low seat belt use areas, aggressive driving-related fatal and injury crashes, alcohol-related fatal and injury crashes, pedestrian fatal crashes, and motorcycle fatal crashes. All maps compared three to five years of crash data as well.”
 - Page 21 of pdf. “In January 2008, the Office of Highway Safety took delivery of the GIS based mapping system, CHAMPS, which allows for both mapping and analysis of crashes on the user’s desktop. This web-based tool has allowed for comprehensive crash analysis within the Office of Highway Safety that had not been previously been available.”

Florida

- Website: <http://www.flhsmv.gov/index.html>
- Software: Crash Analysis Reporting System
- Software: CRASH
- Source: *House Bill 1465 Enhanced Penalty Zone Report*. Florida, March 25, 2010. Date accessed, March 2010. Website: <http://www.flhsmv.gov/html/EPZR.pdf>.
 - Report mentions the system on page 4 of pdf
 - “The Department of Transportation Safety Office’s Crash Analysis Reporting System provided the information for crashes that occurred within the three Enhanced Penalty Zones.”
- Source: *Crash Reduction Analysis System Hub (CRASH) .– Version 1.0*. Lehman Center for Transportation Research at Florida International University. Date accessed, February 2010. Website <http://lctr.eng.fiu.edu/CRASH.htm>.
 - “CRASH (Crash Reduction Analysis System Hub) is a web-based application developed for the Florida Department of Transportation (FDOT) [Safety Office](#). The system runs on the FDOT Intranet and is designed to update and apply crash reduction factors (CRFs) for Florida.”
 - “CRASH includes the following six functional components (front-end) that work with the above databases (back-end):”
 - **“Project Analysis:** This functional component allows one to perform the following functions:
 - Start New Project: To perform a new benefit-cost analysis for a project.
 - Edit Projects: To make changes to one or more previously saved analysis projects.
 - View Projects: To view one or more previously saved analysis projects. “
 - **“Historical Projects:** This functional component allows one to perform the following functions:
 - Add Project: To enter information for an existing project of which analysis has been performed.
 - Edit Projects: To add post-construction information for projects that have been completed or are under construction.
 - View Projects: To view projects that have been completed or are under construction.
 - Generate HSIP Report: To generate the standard Highway Safety Improvement Program (HSIP) report.
 - Before-After Analysis: To generate before-and-after statistics for selected projects to evaluate their effectiveness.”
 - **“Future Development:** This functional component is reserved for future development in support of FDOT application of SafetyAnalyst, a new system currently under development by the Federal Highway Administration. For more information about the project, please visit the SystemAnalyst homepage at <http://www.safetyanalyst.org>”

Iowa

- Website: <http://www.iowadot.gov/>
- Software:
 - SAVER – Safety, Analysis, Visualization, and Exploration Resources.
 - IMAT – Incident Mapping Analysis Tool.
- Source: *Iowa Comprehensive Highway Safety Plan*. Iowa Department of Transportation, 2007. Date accessed; January 2010. Website: http://www.iowadot.gov/traffic/chsp/pdfs/chsp_final_20070420.pdf
 - Page 7 of pdf. “The Iowa DOT's Office of Traffic and Safety staff developed Safety, Analysis, Visualization, and Exploration Resources (SAVER) as a powerful traffic safety analysis resource which facilitates in-depth crash analysis with geographic information system (GIS) mapping capability. SAVER utilizes statewide data from the Iowa DOT plus integrates other records such as roadway features and rail, river and corporate limits which are vital to highway safety analysis.”
 - Page 7 of pdf. “Incident Mapping Analysis Tool (IMAT) provides law enforcement and other local agencies with access to their own crash data as soon as they submit the electronic form...developed at Iowa State University Center for Transportation Research and Education (CTRE) with support from Iowa DPS and DOT.”

Kentucky

- Website: <http://transportation.ky.gov/>
- Software:
 - CRASH – Collision Report Analysis for Safer Highways.
 - HPMS – Highway Performance Monitoring System.
- Source: *Analysis of Traffic Crash Data In Kentucky (2004-2008)*. Kentucky Transportation Center, Sept 2009. Date accessed; January 2010. Website: http://www.ktc.uky.edu/Reports/KTC_09_16_KSP2_09_1F.pdf
 - Pages 1 and 2 has mentions of the “Collision Report Analysis for Safer Highways” CRASH program and the “Highway Performance Monitoring System [HPMS]”.

Maine

- Website: <http://www.maine.gov/mdot/index.php>
- Software: TIDE
- Source: *Safety Management System*. Maine Department of Transportation. Date accessed: February 2010. Webpage <http://www.maine.gov/mdot/safety-programs/hepselection.php>
 - Main page: “Determining the High Crash Locations requires some statistical analysis of the crash data. Each year, MDOT calculates statewide average crash rates for the most recent and complete three year period by road classification and urban/rural setting. All crash locations are compared to the statewide average crash rate for the road classification of the location being evaluated.”
 - Main page: Desktop Analysis
 - “A Desktop Analysis is performed on the candidate locations to determine if a crash pattern exists. By using the crash locations and querying the data in the MDOT TIDE database, detailed information about specific crashes is returned. Information about the crashes such as time of day, weather conditions, contributing factors and pre-crash actions are used to determine if patterns exist. If patterns are identifiable, collision diagrams are developed by the Traffic

Records Section to determine traffic behaviors and to further understand the data. Approximately 50 locations are thus determined to warrant further analysis each year.”

- Source: *Safety Management*. Maine Department of Transportation. Date accessed: January 2010. Website: <http://www.maine.gov/mdot/safety-programs/maine-crash-data.php>.
 - Website information on TIDE;
 - “**TIDE** combines the strengths of data warehousing and Geographical Information Systems (GIS).”
 - “Provides users with an easy-to-use desktop system for accessing, analyzing, and reporting data”
 - “Enables users to generate tables, reports, maps, or even to pass results from the system to an external application (e.g., a spreadsheet)”
 - “Allows historical analysis in comparing data from different years”
 - “**TIDE Components:**”
 - “GQL Query Software - an easy-to-use querying and reporting tool”
 - “ArcView GIS - a customized Geographic Information System where users can display the results of their queries for mapping or for performing additional analyses.”

Maryland

- Website: <http://www.mdot.state.md.us/>
- Software: MSAC - Maryland Spatial Analysis of Crashes
- Source: *Spatially Referenced Crash Data System For Application To Commercial Motor Vehicle Crashes*. Morgan State University, May 2003. Date accessed: February 2010. Website: http://www.morgan.edu/Documents/ACADEMICS/SOE/ntc/Spatially_Bapna_0203.pdf.
 - Page 5 of pdf. “The Maryland Spatial Analysis of Crashes (MSAC) project involves the design of a prototype of a geographic information system (GIS) for the State of Maryland that has the capability of providing online crash information and statistical information for commercial vehicle crashes. MSAC is deployed over the Internet. The system is capable of displaying crash data such as specific geographic locations, period and time of crash, crash severity including the number of fatalities, contributing factors, and the cost per crash, among others”

Massachusetts

- Website <http://www.massdot.state.ma.us/Highway/>
- Software CDS – Crash Data System
- Source: *Commonwealth of Massachusetts Traffic Records Assessment* March 16-20, 2009. Date Accessed: January 2010.
 - Page 3 of document: “The statewide Crash Data System (CDS) is maintained by the RMV and is populated by crash reports sent to the RMV both electronically and on hard copy forms. While users have good access to RMV data and rely on it for their programming and planning needs, the State nevertheless is facing serious challenges in its attempts to provide crash data to users throughout the highway safety community. The current condition of the crash file renders it very unreliable as a source of data to drive decisions in program planning and policy-setting by the State’s highway safety managers. “

Michigan

- Website: <http://www.michigan.gov/mdot/>
- Software: Roadsoft
- Source: *What is the Local Safety Initiative?* Michigan Department of Transportation. Date accessed: January 2010. Website: http://www.michigan.gov/mdot/0,1607,7-151-9615_11261_45212-161513--00.html.
 - “Our involvement begins with a complete crash analysis of your local road system. Our main tool for analysis is RoadSoft; however, we use other tools to gather the most up-to-date information.”
 - “Based on our analysis, we’ll compile a list of intersections and roadway segments we would like to visit in the field with your agency representative.”
 - “We may do an engineering study or other types of analysis as needed.”
 - “We also will generate potential High Risk Rural Road (HRRR) locations for your use as that call for projects comes up. (The HRRR program is managed by MDOT Local Agency Programs.”
 - “We make suggestions for potential improvements. Many of these will be low-cost fixes. Projects we identify may be eligible for funding through LSI.”
 - “LSI personnel may conduct a before-and-after analysis.”
- Source: *Roadsoft GIS*. Roadsoft. Date accessed: January 2010. Website: <http://www.roadsoft.org/>
 - Network Screening: <http://www.roadsoft.org/safety-analysis/network-screening>
 - “The Safety Analysis tools in RoadSoft give (sic) you very powerful resources to help you identify areas where safety improvement investments will give the best results.”
 - “Identify and rank intersections with crashes for a safety improvement plan.”
 - “Run the intersection analysis tool to interactively focus on intersections with specific crash criteria.”
 - “Sort a list of intersections with criteria like severity of crash (property damage, fatal, serious injury, etc.) and other factors such as pedestrian involvement, school bus, intoxicated driver, and any other variables reported by your public safety agency.”
 - Diagnostic Tools: <http://www.roadsoft.org/safety-analysis/diagnostic-tools>
 - “With RoadSoft’s diagnostics tools, you can analyze individual crashes and patterns to help identify areas where possible engineering changes might reduce the frequency and severity of crashes. Once you’ve identified problem areas, the built-in links to NCHRP documentation help you implement countermeasures.”
 - Trend Analysis: <http://www.roadsoft.org/safety-analysis/trend-analysis>
 - “Determining trends in crash frequency and severity is another key to identifying where it is best to spend scarce resources. The Trend Analysis tool gives you a graphical representation of crash trends on segments with multiple modifiable variables. It will be of great benefit to you if you are trying to decide where to invest in safety improvements even when all other factors seem equal.”

Missouri

- Website: <http://www.modot.mo.gov/safety/index.htm>
- Software: TMS – Transportation Management System

- Source: *New Software Will Help Identify Crash Patterns*. Missouri Department of Transportation. Date accessed: January 2010. Website: <http://contribute.modot.mo.gov/ExpressLane/Software.htm>
 - General note on software;
 - “New computerized collision diagram software will soon help MoDOT districts more efficiently identify intersection crash patterns, which will increase safety and save the department valuable time and resources.”
 - “Minimal training is needed to use the new program. When creating a collision diagram with the new system, a user simply selects an intersection and an icon will appear in TMS to automatically create the collision diagram.”

Mississippi

- Website <http://www.dps.state.ms.us/dps/dps.nsf>
- Software Safety Analysis Management System (SAMS)
- Source – *Applications, Safety Analysis Management System (SAMS)*. Geodecisions . Date Accessed: January 2011. Website: <http://www.geodecisions.com/sams/index.htm>.
 - “SAMS provides powerful and flexible crash analysis tools to support the identification and elimination of hazardous locations and conditions. SAMS enables users at the Mississippi Department of Transportation to effectively access, visualize, and analyze vehicle collision information to make more informed decisions about managing roadways and preventing traffic-related injuries and deaths.”

Montana

- Website <http://www.mdt.mt.gov/>
- Software SMS – Safety Management System, being integrated with new system.
- Source: *Traffic Records*. Montana Department of Transportation. Date accessed: February 2010. Webpage <http://www.mdt.mt.gov/safety/safety-initiatives/traffic-records.shtml>
 - Basic discussion on the collection of data for use in a system bigger than itself.
 - “Traffic Records
 - Concurrent with the development of the Comprehensive Highway Safety Plan, the State of Montana developed [Montana's Traffic Records Strategic Plan \(MT-TReSP\)](#). This plan provides Montana's Traffic Records Coordinating Committee (TRCC) with a basis for moving forward in upgrading and integrating the data systems used to conduct highway safety analyses in the state.
 - **Objectives**
“Develop and implement a comprehensive, coordinated transportation records and crash reporting, data management, and analysis system, accessible to all stakeholders, to manage and evaluate transportation safety.”
- Source: *State of Montana Traffic Records Strategic Plan*. Montana Department of Transportation State Highway Traffic Safety Office, June 2, 2006. Date accessed: February 2010. Website: http://www.mdt.mt.gov/safety/docs/2006_traffic-records-safety-plan.pdf
 - Report outlines the needs and reasons for the management of data including references to analysis of crash statistics.

- Page 11 of PDF: “A Traffic Records Strategic Plan lays out the goals, objectives, and actions needed to improve the timeliness, quality, completeness, integration, and accessibility of data used in traffic safety analyses. It is meant to answer the basic questions of: what do we want to achieve and how do we get there? Its domain covers the entire data stream, from beginning to end:
 - Data collection;
 - Data processing (quality control, editing, aggregation, and transformation);
 - Data integration;
 - Data use in safety analyses:
 - Problem identification
 - High-crash locations; and
 - Crash typologies.
 - Countermeasure effectiveness; and
 - Predictive model building.”
- Current system described on page 31 of pdf;
 - **2.8 Montana’s Safety Management System (SMS)**
 “MDT developed the SMS for conducting safety analyses. It currently uses crash and traffic data as its sources. It is structured to provide a series of cross-tabulations (frequency tables) which the Highway Traffic Safety Office uses in its annual trend report (Traffic Safety Problem Identification). It also is used by the Traffic and Safety Bureau for two main purposes. First, it has a procedure for identifying high-crash locations (annually). Second, it provides crash characteristics (cross-tabulations) on sections of highway that are undergoing improvements as an input for highway designers to consider. GPS location referencing for crashes is still not available, but should start to appear on crash records thanks to in-vehicle mobile data terminals used for data entry.

Outside of the SMS, the commercial package Intersection Magic can be used for urban intersection crash patterns (within city limits).”

Nevada

- Website <http://www.nevadadot.com/>
- Software Crash Analysis System
- Source: Nevada Traffic Crashes 2006. Nevada Department of Transportation, 2006. Date accessed: January 2010. Website: http://www.nevadadot.com/reports_pubs/nv_crashes/2006/pdfs/2006_CrashBook.pdf.
 - The only reference to the system is in the Introduction, page 6 of the pdf.
 - “The 2006 Nevada Traffic Crashes Book was solely produced from data extracted from NDOT’s Crash Analysis System. The fatal crash data represented within may not be consistent with data produced from the Fatal Analysis Reporting System (FARS). The two systems were developed independently and are used for different purposes.”

New Hampshire

- Website: <http://www.nh.gov/dot/>
- Software:

- CRMS – Crash Reporting Management System
- Source: *New Hampshire Strategic Highway Safety Plan 2008 Report Update*. New Hampshire Department of Transportation, 2008. Date accessed: February 2010. Website: http://www.nh.gov/dot/org/projectdevelopment/highwaydesign/documents/shsp_2008.pdf
 - Included the following details on page 11 of the pdf.
 - “The State’s traffic crash report (forms DSMV-159, DSMV-160, and DSMV-161) were enhanced to meet national guidelines (Model Minimum Uniform Crash Criteria), meet user needs, and better integrate with other safety systems. The Research Computing Center @ the University of New Hampshire contracted with Ledge Light Technology to facilitate a working group to develop a new crash reporting form (See Appendix C), as part of their Crash reporting Management System (CRMS) contract with the Department of Transportation.”

New Jersey

- Website
- Software:
 - Plan4Safety
- Source: -. *New Jersey Department of Transportation wins National award*. State of New Jersey Department of Transportation, Commissioner’s Report Archive, January 2010. Date accessed: February 2010. Website: <http://www.state.nj.us/transportation/newsletter/2009/nov/award.shtm>
 - Article reads in main body:
 - “**Plan4Safety** is an online comprehensive crash analysis software application that supports traffic safety teams in making critical decisions based on data. **Plan4Safety** offers 144 distinct pieces of data including crash types, injury levels, cell phone use, alcohol impairment, seatbelt use, property damage, driver information, etc.”
- Source: *Plan4Safety*. Rutgers Center for Advanced Infrastructure and Transportation, Transportation Safety Resource Center. Date accessed: February 2010. Website: <http://cait.rutgers.edu/tsrc/plan4safety>.
 - **Main page summarizes:**
 - “**Plan4Safety** is a decision support tool created for the New Jersey Department of Transportation (NJDOT) and is a multi-layered decision support program for transportation engineers, planners, enforcement, and decision makers in New Jersey's transportation and safety agencies to analyze crash data in geospatial and tabular forms.”
 - “More than identifying crash hot spots which merit further investigation, Plan4Safety integrates statewide crash data, roadway characteristic data, calculates statistical analyses, incorporates network screening layers and models, and includes visual analytical tools (**GIS**).”

New Mexico

- Website <http://www.nmshtd.state.nm.us/>
- Software
 - PBCAT - Pedestrian & Bicycle Crash Analysis
 - CRCS - Crash Records Capture System
- Source: *Crash Records Section*. New Mexico Department of Transportation. Date accessed: February 2010. Website: <http://nmshtd.state.nm.us/main.asp?secid=11481>

- “The Crash Records Section located in the Transportation Statistics Bureau. We collect data from the New Mexico Uniform Crash Reports (UCR) from all law enforcement agencies (state police, municipal police, tribal police, campus police, and county sheriffs). The total number of reports analyzed is approximately 70,000 annually. Due to our guidelines approximately 49,000 reports are inputted in the master database annually. The data is analyzed, referenced with codes, compiled into a master crash database (Crash Records Capture System (CRCS)). The completed UCR's are scanned and imaged for future referencing. Summary reports are provided from the CRCS database for editing and quality control.”

New York

- Website <https://www.nysdot.gov/index>
- Software ALIS (Accident Location Information System)
- Source: Lewis, David. *New York State Accident Location Information System – Analyzing the Past to Provide a Safer Future*. Date accessed: March 2010. Website: <http://www.gis-t.org/files/x1TXJ.pdf>.
 - “A multi-agency collaboration to develop a GIS-based Accident Location Information System (ALIS) is combining several state organizations’ information systems to improve the location accuracy and streamline the processing of traffic accidents.”
 - “The resulting accident location data is available for highway safety applications in New York State. Traffic Engineers from various local and state agencies leverage the data to conduct detailed studies, and produce reports to identify high accident locations or unusual concentrations of a particular type of accident. Once locations are identified, mitigation action such as roadway improvements (better signage, lighting, or drainage), or behavioral changes (increased law enforcement) may be taken.”
- Source: 2009 Annual Evaluation Report – Highway Safety Improvement Program – Five Percent Report, August 2009. New York Department of Transportation Office of Modal Safety and Security, August 2009. Date accessed: March 2010. Website: <https://www.nysdot.gov/divisions/operating/osss/highway-repository/2009%20Five%20Percent%20Report.pdf>.
 - Page 3 of Pdf. “Improvements to the accident data system under the Accident Location Information Systems (ALIS) enabling DMV to provide GIS-based accident coding of all accidents became fully operational in 2008.”

North Carolina

- Website: <http://www.ncdot.gov/>
- Software:
 - TEAAS – Traffic Engineering Accident Analysis System
 - North Carolina Crash Data Query
- Source: *Traffic Engineering Accident Analysis System (TEAAS)*. North Carolina Department of Transportation, Transportation Mobility and Safety Division. Date accessed: March 2010. Website: <http://www.ncdot.gov/doh/preconstruct/traffic/safety/Resources/>.
 - TEAAS – Traffic Engineering Accident Analysis System.
 - On website: “The Traffic Engineering Accident Analysis System (TEAAS) contains information on all traffic crashes occurring in North Carolina. TEAAS is a software system downloadable from the internet and is available free of charge to state government personnel, municipalities, law enforcement agencies, planning organizations, and research entities.”

- Source: TEAAS. Date accessed: March 2010. Website: <https://dmvcrashweb.dot.state.nc.us/TEAAS/>
- Source *North Carolina Crash Data*. Date accessed: March 2010. Website: <http://buffy.hsrrc.unc.edu/crash/>.
 - From website. “This site provides a data analysis tool that will create tables reflecting crash, vehicle, and person information for crashes in North Carolina in 2001-2008.”

Ohio

- Website <http://www.dot.state.oh.us/Pages/Home.aspx>
- Software GIS Crash Analysis Tool (GCAT).
- Source: *GIS Crash Analysis Tools Resources*. Ohio.gov. Date accessed: March 2010. Website: <http://www.dot.state.oh.us/Divisions/TransSysDev/ProgramMgt/CapitalPrograms/Pages/GCAT.aspx>
- Source: *Notes on the GIS Crash Analysis Tool (GCAT)*. Date accessed: February 2010. Website: <http://www.dot.state.oh.us/Divisions/TransSysDev/ProgramMgt/CapitalPrograms/Documents/Safety/New/GCAT%20Help%20File.pdf>
 - “The tool includes both state system and local system crash data that is spatially located (valid lat/long).”
 - “The purpose of the tool is to provide a convenient highway safety crash analysis tool for ODOT, MPOs, and county engineers.”

Tennessee

- Website <http://www.tdot.state.tn.us/>
- Software – TITAN (Tennessee Integrated Traffic Analysis Network)
- Source: *TITAN*. Tennessee Department of Safety. Date accessed: February 2010. Webpage : <http://tennessee.gov/safety/titan.html>
 - Tennessee DOT software for accident management and analysis.
 - “TITAN, or Tennessee’s Integrated Traffic Analysis Network, is a suite of tools developed for the electronic collection, submission and management of all crash data in Tennessee. It consists of a centralized data and document repository for public safety information managed by the Department of Safety.”
 - “TITAN has been designed to accept reports submitted by law enforcement agencies, validate the data contained within the report for completion and accuracy and then store the statistically valid information. The TITAN repository also creates document images of submitted reports and retains them for future access and records retention requirements.”

Utah

- Website <http://www.sr.ex.state.ut.us/main/?p=100:1:0>
- Software – ISMP – “Integrated Safety Management Process”.
- Source: *Utah Comprehensive Safety Plan*. Utah Safety Leadership Team. Date accessed: March 2010. Website: <http://www.sr.ex.state.ut.us/main/uconowner.gf?n=916062825047006861>
 - ISMP is mentioned on page 6 of the pdf;
 - “With the formation of the Utah Safety Leadership Team and the development of the Utah Comprehensive Safety Plan, Utah has formally accepted the challenge of utilizing the Integrated Safety Management Process (ISMP). Simply, the ISMP begins with crash data, and proceeds to fully integrated safety action plans.

The process follows six steps: review crash data, establish emphasis area goals, develop strategies to address the emphasis areas, develop comprehensive strategies, develop detailed action plans, implement the action plans, and evaluate the performance of the plans.”

- Discussion at the ATSIP Forum:
 - System has been rewritten to Oracle
 - Utilizing a in-house LRS

Virginia

- Website http://www.virginiadot.org/default_flash.asp
- Software:
 - VDOT Crash Database
- Source: *VDOT Crash Analysis Procedures for Roadway Safety Assessments*. Virginia Department of Transportation. Date accessed: February 2010. Website: http://www.virginiadot.org/business/resources/traffic_eng_hsip/VDOT_Crash_Analysis_Procedures_for_RSA.pdf.
 - The site discusses the process of setting up and using the VDOT Crash Database.
- Source: *Commonwealth of Virginia's Strategic Highway Safety Plan 2006.-2010*. Virginia Surface Transportation Safety Executive Committee. Date accessed: February 2010. Website: http://www.virginiadot.org/info/resources/Strat_Hwy_safety_Plan_FREPT.pdf.
 - Page 36 of pdf: “No central data warehouse is available to record the location of crashes on the non-VDOT system for automated and systematic evaluation. More is known about fatal intersection crashes due to the intense assessment for the Fatality Analysis Reporting System (FARS). FARS identifies intersection crashes as occurring within the “box” described by the edges of the intersecting roads.”

Washington

- Website <http://www.wsdot.wa.gov/>
- Software Possibly “Collision Reduction Program”
- Source: *2007-2026 Highway System Plan of 2007: High Benefit Low Cost*. Washington State Department of Transportation, December 2007. Date accessed: February 2010. Website: <http://www.wsdot.wa.gov/NR/rdonlyres/B24AC1DA-8B9A-4719-B344-B083BB3F10FB/0/HSPweb.pdf>.
 - On page 51 mentions use of The Collision Reduction program...
 - “The Collision Reduction program reactively addresses crashes based on history at a specific location. There are two elements to this program’s approach: High Accident Locations (HAL), where collisions occur at a spot location such as a specific intersection, and High Accident Corridors (HAC), where collisions may occur within several areas of a corridor section.”
 - “The Risk Prevention program addresses locations with a higher risk of collisions, including cross centerline and run-off-the road incidents. This program allows WSDOT to proactively address locations with a higher than average potential for collisions based upon traffic volumes, shoulder widths, speed, vertical and horizontal curves, etc.”
- Source: *Traffic Analysis*. Washington State Department of Transportation. Date accessed: March 2010. Website: <http://www.wsdot.wa.gov/Design/Traffic/Analysis/>

Appendix B2 – States Using Crash Analysis Software of *Unknown* Name

Arkansas

- Website <http://www.arkansashighways.com/>
- Software Unknown
- Source: *Arkansas' Strategic Highway Safety Plan. Arkansas State Highway and Transportation Department, July 2007. Date accessed: January 2010. Website: http://www.arkansashighways.com/planning_research/traffic_safety/strategichighwaysafetyplan.pdf*
 - No specific information given, but the below mentions the upgrading for more accurate analysis, found on page 37 of the pdf.
 - “Strategies
 - Expand the TraCS program for use by local law enforcement agencies for automated crash reporting, as appropriate
 - Incorporate Global Positioning Systems and other Intelligent Transportation Systems to more accurately identify crash locations
 - Utilize new crash analysis programs and techniques to determine the cost benefit of selected improvements, where appropriate”

Colorado

- Website <http://www.coloradodot.info/programs/research>
- Software Unknown
- Source: *Colorado Department of Transportation Highway Safety Improvement Program (HSIP). Colorado Department of Transportation, August 2007. Date accessed: February 2010. Website: http://www.dot.state.co.us/Traffic_Manuals_Guidelines/HSIP/HSIP_20070831.pdf?searchterm=crash+analysis*
 - Report reviews a flow chart for data on page 5 of the pdf.
 - Other information or specifics on the program was not found.

Georgia

- Website <http://www.dot.state.ga.us/Pages/default.aspx>
- Software Unknown
- Source: *Research: Traffic Operations and Safety research Projects. Georgia Department of Transportation. Date accessed: February 2010. Website: <http://www.dot.state.ga.us/doingbusiness/research/projects/Pages/TrafficOperations.aspx>*
 - The website references the type of analysis being conducted at GA DOT, but no reference to the software of capabilities. Example studies showing utilizing software are;
 - “Examination of Crash Trends in the Southeastern U.S.: Analysis of Fatal Crashes (RP 07-01)”
 - “Motor Vehicle Crash Analysis: Descriptive Trend Analysis and Assessment of Potential Data-Driven Approaches for Prioritizing Improvements to Georgia Roadways (RP 07-15)”

Illinois

- Website <http://www.dot.state.il.us/>
- Software Name unknown, but under development

- Source: Jang-Hyeon Jo, Jong-Sung Lee, Yanfeng Ouyang, and Zongzhi Li. *Crash Data Analysis and Engineering Solutions for Local Agencies*. Illinois Center for Transportation, September 2009. Date accessed February 2010. Website: <http://ict.illinois.edu/Publications/report%20files/FHWA-ICT-09-057.pdf>
 - Report documenting the development of an Illinois crash analysis tool.
 - Page 3 of the pdf.
 - “This report introduces the development process of an Internet-based, GIS compatible software tool for Illinois local road crash analysis. This state-of-the-art tool is capable of performing crash information query, trend analysis, statistical analysis, color-coded mapping, and other safety information display within the web-based GIS compatible environment. The Internet-accessible user interface allows users to inquire detailed information on vehicle crashes associated with road segments and intersections for any geographical regions or jurisdictions in the state of Illinois via query forms or zoom-enabled interactive maps. In addition, users can specify a data aggregation type, time range, and information type to display crash information in formats of tables, charts, or maps. This system helps the state and local transportation agencies in Illinois to screen dangerous highway segments, diagnose safety performance of the selected roads, and identify the most cost-effective countermeasures for safety improvements.”

Indiana

- Website <http://www.in.gov/indot/2707.htm>
- Software [Internal]
- Source: *Program Development*. Indiana Department of Transportation. Date accessed: February 2010. Website: <http://www.in.gov/indot/2711.htm>
 - Discusses the program activities including the following from the website;
 - “Safety Management System Unit”
 - “Cooperates with agencies and organizations to reduce the number and severity of traffic crashes.”
 - “Identifies and investigates hazardous locations, ensuring early consideration of highway safety in projects.”
 - “Identifies safety needs of special users. * Performs routing maintenance and upgrades safety hardware, highway elements, and operational features.”
 - “Crash Analysis Unit”
 - “Provides collision diagrams and various crash summaries by location upon request. These reports aid in determining project improvements and priorities.”

Kansas

- Website: <http://www.ksdot.org/#>
- Software: [Internal, also developing]
- Source: *Kansas Strategic Highway Safety Plan*. Kansas Department of Transportation, . 2006. Date accessed: February 2010. Website: <http://www.ksdot.org/burTrafficSaf/KSSHSP.pdf>
 - Page 11 of PDF. “A system for locating crashes on highways owned and maintained by the Kansas Department of Transportation (KDOT) is currently in place. Crashes are assigned a milepost that corresponds to a unique point on the State highway system.

Thus crash patterns can be detected and road sections can be compared to identify potential safety problems.”

- Page 11 of PDF. “But a similar system is not yet in place for the approximately 100,000 miles of streets and roads not maintained by KDOT. A network database of these roadways is being developed, but administration of that roadway information will be a continual challenge as cities continue to develop and add streets.”

Louisiana

- Website <http://www.dotd.state.la.us/>
- Software [Internal and developing]
- Source: *Highway Safety*. Louisiana Department of Transportation. Date accessed: February 2010. Webpage: http://www.dotd.la.gov/planning/highway_safety/
 - Gives options to users to utilize the on screen analysis tool: “This website is designed for local agencies to analyze their community's highway safety data”
- Source: *Engineering and Related Services May 1, 2009. State Project No. 737-99-1003 Engineering and Technical Assistance Statewide*. Louisiana Department of Transportation and Development. Date accessed: March 2010. Website: [http://webmail.dotd.louisiana.gov/agrestat.nsf/6e0a8b2ac100345a862571780059ad2e/11696f4ee52db270862575a80074ed68/\\$FILE/737-99-1003.pdf](http://webmail.dotd.louisiana.gov/agrestat.nsf/6e0a8b2ac100345a862571780059ad2e/11696f4ee52db270862575a80074ed68/$FILE/737-99-1003.pdf)
 - Page 1 of pdf. “The selected Consultant will provide technical support to DOTD to improve the analysis and application of transportation, highway safety and related data in their efforts to improve the effectiveness of the transportation system and to reduce motor vehicle crashes and the results of these crashes.”

Oklahoma

- Website <http://www.okladot.state.ok.us/index.php>
- Software Unknown
- Source: *Crash Data and Statistics*. Oklahoma Highway Safety Office. Date accessed: March 2010. Website: http://www.ok.gov/ohso/Crash_Data_and_Statistics/index.html
 - Information given on data collection but no mention of back end analysis system.
- Source: *Oklahoma Strategic Highway Safety Plan*. TetraTech, Cambridge Systematics, Inc. September 2007. Date accessed: March 2010. Website: http://www.okladot.state.ok.us/oshsp/pdfs/OSHS-Plan_Final.pdf
 - Limited information found on page 11 of pdf.
 - “Objective: Improve Crash Data and its Availability”
 - “Facilitate the availability of crash data and its utilization to identify and prioritize high-crash corridors and locations.”
 - Information on potential system found on page 15 of pdf.
 - “Specific Requirements for the SHSP”
“SAFETEA-LU establishes a clear set of process and content requirements for the SHSP.”
“The plan must:”
 - “...Establish a crash data system with the ability to perform problem identification and countermeasure analysis;”

South Dakota

- Website <http://dps.sd.gov/>
- Software Unknown
- Source: 2008 South Dakota Motor Vehicle Traffic Crash Summary. South Dakota Department of Public Safety, June 9, 2009. Date accessed: February 2010. Website: http://dps.sd.gov/enforcement/accident_records/documents/2008FactsBook.pdf
 - Report documents the use of the “South Dakota Crash Data System” on page 9 of pdf;
 - “Information collected from crash reports is merged into a central computerized crash database. This data provides the basic information necessary for developing effective highway and traffic safety programs. The crash data is used by local, state and federal agencies to:”
 - “Identify highway and traffic safety problem areas.”
 - “Initiate and evaluate the effectiveness of laws and policies intended to reduce deaths, injuries, injury severity and costs.”
 - “Assess the relationship between vehicle and highway characteristics, crash propensity, and injury severity to support either the development of countermeasures or their evaluation.”

South Carolina

- Website http://www.scdps.org/ohs/stat_services.asp
- Software Unknown
- Office of Highway Safety. South Carolina Department of Public Safety. Date accessed: March 2010. Website : http://www.scdps.org/ohs/stat_services.asp
 - “The Statistics Section maintains the South Carolina traffic collision database and is the core of data analysis within the Office of Highway Safety.”
 - “Mention of the system is the only information to be found.”

Wisconsin

- Website <http://www.dot.state.wi.us/>
- Software Unknown
- Source: 2008 Annual Report Highway Safety Program Wisconsin Department of Transportation. Date accessed: February 2010. Website: <http://www.dot.wisconsin.gov/library/publications/topic/safety/hwysafetyrpt.pdf>
 - On page 37 of pdf, discussion and figures on CODES – Crash Outcomes Data Evaluation System Data Linkage, which may be used for analysis purposes.”

Appendix B3 – States Not Reporting Use of Crash Analysis Software

California

- Website <http://www.dot.ca.gov/research/operations/roadsidesafety/index.htm>
- Software Unknown
- Source: *Crash Reduction Factor (CRF) Update*. January 12, 2009. Date accessed: February 2010. Website: http://www.dot.ca.gov/research/researchreports/preliminary_investigations/final_crf_update_pi_02-17-09.pdf
 - This report is a review of current research tools available from the FHWA and other organizations that would be appropriate for use by California DOT.
 - Page 12 of pdf.
 - “Interactive Highway Safety Design Model”
<http://www.tfhrc.gov/safety/ihsdm/ihsdm.htm>”
 - Page 13 of pdf.
 - “SafetyAnalyst”
<http://www.safetyanalyst.org/>”
 - Page 14 of pdf.
 - “CRASH (FDOT)”
<http://lctr.eng.fiu.edu/CRASH.htm>”

Connecticut

- Website <http://www.ct.gov/dot/site/default.asp>
- Software Unknown
- Source: *State of Connecticut Strategic Plan for Traffic Records: Part 1 – Deficiency Analysis and Major Strategies*. InfoGroup, Inc, March 2006. Date accessed: March 2010. Website: http://www.ct.gov/dot/lib/dot/documents/dtransportation_safety/pr1_review/traffic_records_strategic_plan_2006.pdf
 - Page 4 of the pdf states one of the “Goals and Objectives” for Connecticut;
 - “The State’s TRCC (refer to Appendix E) has accepted the challenge to take a more active role in the improvement of Connecticut’s traffic records/safety data system. Highlighting the goal for a more comprehensive and effective traffic records system to accurately identify safety problems, develop countermeasure programs, and evaluate their effectiveness, is an objective to move from paper-laden, labor-intensive traffic records processes to electronic field data capture of motor vehicle crash, traffic citation, emergency medical services, and other information.”
 - Page 5-6 of the pdf discusses the report recommendations, including Program Area 14;
 - **“Recommendations** The following recommendations are presented in priority order, determined by a ranking of priorities by a two-thirds representation of the TRCC. Estimates for costs and timeframes for implementation are included in the body of the report, where appropriate.”
 - **“Program Area 14: Data Analysis – Problem Identification:** Install CARE, or comparable software for data analysis of traffic records and crash data system. Provide desktop as well as Web-based data access/data analysis tools to all authorized users. Data selection, ad hoc analysis, high hazard location/section analysis, bivariate analysis, form and image printing, data exchange and sharing. Develop a Problem Identification Manual. Conduct a Training Needs Assessment for users of traffic safety program information.”

- Overall the information portrayed for CT, suggests a similar position 2006 as MN is right now.

Hawaii

- Website <http://hawaii.gov/dot/highways/about/hwy-v/mvso.htm>
- Software Unknown
- Website: Research Development & Technology Transfer – Hawaii Department of Transportation. <http://www.hawaii-rdt.com/>
 - No direct mention of crash or vehicle accident analysis methods or programs.

Idaho

- Website <http://itd.idaho.gov/>
- Software Unknown
- Website Office of Highway Safety website. <http://itd.idaho.gov/ohs/>
 - NOTES: Discussion at ATSIP forum:
 - Idaho’s system is an in house development
 - Webcare system
 - Sequel based
 - GIS capable

Nebraska

- Website <http://www.dor.state.ne.us/>
- Software Unknown
- Source: Highway Safety Accidents Records. Nebraska Department of Roads. Date accessed: March 2010. Website: <http://www.nebraskatransportation.org/highway-safety/>.
 - Site documents limited information, but does reference duties as:
 - “Analysis Unit”
 - “Responsible for analysis of accident data. This includes the production of standard reports, such as the annual Nebraska **Traffic Accident Facts** booklet, published each year for the preceding year, the "Standard Summaries of Nebraska Motor Vehicle Traffic Accidents", the production of specialized reports from the database when requested by sources within the Department of Roads, other agencies, or the general public, and the completion of accident studies at specific locations. The Location Analysis Unit does accident studies for all highway projects, and regularly monitors the state highway system to identify accident trouble spots. This information is used by department engineers to develop highway projects and safety improvements.”

North Dakota

- Website <http://www.dot.nd.gov/>
- Software Unknown
- Source: 2010 Highway Safety Plan. North Dakota Department of Transportation, Date accessed: March 2010. Website: <http://www.dot.nd.gov/divisions/safety/docs/2010-hsp-final-report.pdf>
 - No mention of backend system, but front end system mentioned on page 6 of pdf

- “Data collection is an important first step in the process of developing the HSP. Crash data from the NDDOT’s Crash Reporting System (CRS) are analyzed annually and used to establish an historical trend line for identified traffic safety problems using the previous ten years of available crash data.”

Oregon

- Website <http://www.oregon.gov/ODOT/>
- Software Unknown
- Source: *Trans Data – Crash Data*. Oregon Department of Transportation. Date accessed: March 2010. Website: http://www.oregon.gov/ODOT/TD/TDATA/car/CAR_Main.shtml
 - Webpage with information on front end collection, including links to files documenting requirements, but not information of mention of analysis system.

Pennsylvania

- Website <http://www.dot.state.pa.us/>
- Software Unknown
- Source: *Drive Safe PA*. Highway Safety & Traffic Engineering Home. Date accessed: March 2010. Website: <http://www.dot.state.pa.us/Internet/Bureaus/pdBHSTE.nsf/BHSTEHomepage?OpenFrameset>
 - Website for the safety department includes info on data collection and reports, but no analysis or systems use.

Rhode Island

- Website <http://www.dot.state.ri.us/programs/safety/>
- Software Unknown
- Source: *Rhode Island Strategic Highway Safety Plan, September 2007*. Rhode Island Department of Transportation. Date accessed: March 2010. Website: <http://www.dot.state.ri.us/documents/trafmgt/RISHSPFinal.pdf>
 - Page 18 of pdf talks about the planning of strategic plans to counter the sources of accidents, but had no mention of an analysis system to help with those initiatives.
 - “Over the coming months, teams will be meeting to work on detailed action plans for each strategy. These plans include action steps, performance measures, determination of the responsible agency/organization; identification of needed resources (staffing, equipment, materials); partners; funding; and time line. The action step performance measures along with a data review will enable Rhode Island to track progress on an annual basis and make course corrections when necessary.”

Texas

- Website <http://www.dot.state.tx.us/>
- Software Unknown
- Source: *Crash Data Analysis and Statistics*. Texas Department of Transportation. Date accessed: February 2010. Website: http://www.dot.state.tx.us/drivers_vehicles/crash_records/data.htm
 - Website explain role of organization, mainly for front end analysis
 - “TxDOT is responsible for the collection and analysis of crash data submitted by law enforcement on form [CR-3, Texas Peace Officer's Crash Report](#). We

maintain a statewide automated database for all reported motor vehicle traffic crashes since 2003. Data tables reflecting crash, vehicle and person counts are available.”

Vermont

- Website <http://www.aot.state.vt.us/>
- Software Unknown
- Source: *Strategic Highway Safety Plan*. Agency of Transportation. Date of access: February 2010. Website: <http://highwaysafety.vermont.gov/SHSPplanLayout.htm>
 - Webpage has information on the 2006 Strategic Highway Safety Plan and does mention analysis and information, but only as front end collection and basis trend analysis.

Washington, D.C.

- Website <http://www.wmata.com/>
- Software Unknown
- General information was found on security and operations, but not of crash analysis.

West Virginia

- Website <http://www.transportation.wv.gov/Pages/default.aspx>
- Software Unknown
- Source: *West Virginia Strategic Highway Safety Plan September 2007*. West Virginia Department of Transportation. Date accessed: March 2010. Website: <http://www.transportation.wv.gov/communications/Documents/WestVirginiaStrategicHighwaySafetyPlan.pdf>
 - On page 28 of the pdf there is documentation of the system and requirements, but nothing really considered back end analysis of crashes.
 - **“Crash & Roadway Files**
 - 1. Revise Uniform Traffic Crash Report
 - 2. Institute electronic crash data collection
 - 3. Establish a crash form/electronic crash data collection help desk
 - 4. Develop plan to ensure data continuity while implementing the new crash form and electronic crash software
 - 5. Revise highway databases as necessary to enable ease of linking with crash data to enhance correlation of crash data with roadway inventory elements
 - 6. Establish GIS as roadway data platform and latitude/longitude coordinates as primary location reference method
 - 7. Develop statistical reports and data query capabilities that allow easy access to appropriate information for the public and other data users potentially through web based applications
 - 8. Provide an appropriate level of data user training for effective utilization of the new crash data and system capabilities
 - 9. Expand and facilitate the procurement of GPS locator equipment for enforcement”

Wyoming

- Website <http://www.dot.state.wy.us/wydot/safety>
- Software Unknown
- Limited info found on page above.
- Source: *Wyoming Strategic Highway Safety Plan Sept 2006*. Wyoming Safety Management System (SMS) Committee. Date accessed: February 2010. Website: http://www.dot.state.wy.us/webdav/site/wydot/shared/Highway_Safety/Strategic_Highway_Safety_Plan.pdf
 - On page 23 of the pdf mentions that a future goal is for the creation of a;
 - **“Traffic Records System”**
 - **“Challenge**
The collection and analysis of traffic data is the foundation of a comprehensive system to improve safety. Current systems must be reviewed and improved.”
 - **“Direction**
Achieve the conversion of the traffic records data systems to fully electronic formats to allow for greater access to information.”
 - **“Strategies**
 - 1. Identify and implement advanced technologies to collect, analyze, and report meaningful data.
 - 2. Develop multi-agency data quality control and quality assurance standards.
 - 3. Report useable information to safety partners.”

Appendix C – State Survey

The following survey was sent to all state highway safety engineers. A summary of responses is included.

Email survey text:

The Minnesota Department of Transportation has plans on replacing its crash analysis system when the current mainframe system is modernized. We are very interested in hearing from you regarding the crash analysis system that you are currently using. This information will be very useful for our development of a replacement system in the next 24- 36 months. Listed below are a few questions I would like you to answer. If you are not the correct person to answer these questions please feel free to pass it on to the appropriate person within your agency. I would like to get responses by September 14th, 2010.

I will provide a summary of the responses I receive to anyone that completes the survey. If you feel the survey is too long to complete via email please let me know and I'll conduct the survey over the telephone. Thank you in advance for participating in this survey.

1. *How long have you been using your current crash analysis system?*
2. *How much of the package is "Commercial off the shelf" [COTS] versus custom development?*
3. *What vendor?*
4. *How does your system integrate roadway and traffic volume information? (see pick list below)*
 - a. *It does not integrate these data components*
 - b. *It interfaces with a LRS*
 - c. *It interfaces with a GIS*
 - d. *It interfaces with another system []*
5. *Does your crash analysis system have the ability to conduct network wide analysis (i.e., crash rates for specific types of roads, specific types of intersection, statewide or district wide averages, etc.)?*
6. *What metrics does your crash analysis system produce? (see pick list below)*
 - a. *Crash frequency Y/N*
 - b. *crash rate Y/N*
 - c. *crash differential (number of crashes – expected number of crashes) Y/N*
 - d. *crash density Y/N*
 - e. *crashes per other measure (population, area, etc.) Y/N (please give examples)*
 - f. *outputs that offer a comparison Y/N (please give examples)*
7. *What is the basis of your user interface? E.g., Do you use a map based system, tabular based system, look up tables, etc.*
8. *What are the characteristics of your current system that you most like?*
9. *What are the characteristics of your current system that you most dislike?*
10. *What capabilities are missing from your current system that you would like to have?*
11. *Do you have a technical expert that we can contact with follow up questions?*

Summary of responses:

States that **responded to the survey:**

SC, OR, FL, GA, KS, NM, HI, PA, OK, ND, ID, ME, IA, CA, MO, MT, NE, VA, NH, MI, NC, OH,
44% [22 of 50]

1. How long have you been using your current crash analysis system?

Time Span	Count	Percentage
2010 - 2008	2	9%
2007 – 2005	6	27%
2004 – 2001	2	9%
2000 – Older	8	36%
Not Specified	4	18%

2. How much of the package is “Commercial off the shelf” [COTS] versus custom development?

Category	Count	Percentage
All COTS	2	9%
All Custom	13	59%
Mix	5	23%
Not Specified	2	9%

3. What Vendor?

State	Vendor/Developer
California	NS
Florida	Florida Office of Information Services Division, Business Systems Support Office
Georgia	CARE, AASHTO
Hawaii	The Lange Group
Idaho	Contract Programmers
Iowa	Pd’ Programming
Kansas	AASHTO, Midwest Research Institute for Support
Maine	Ledgelight Technologies for Phase 1, Deepriver LLC for all others
Michigan	CPS & TCRS by HP/EDS, Roadsoft by the Michigan Technical University LTAP Center
Missouri	ESRI, Cognos, AASHTO
Montana	Pd’ Programming
Nebraska	GeoDecisions and internal programmers
New Hampshire	AASHTO
New Mexico	NS
North Carolina	Internal programmers
North Dakota	NS
Ohio	Goodell-Grivas, Inc
Oklahoma	University of Oklahoma
Oregon	NS
Pennsylvania	Crystal Reports
South Carolina	Intergraph & PMG Pro
Virginia	NS

NS – Not Specified

4. How does your system integrate roadway and traffic volume information?

Category	Yes	No/NS	% Yes
LRS	14	8	64%
GIS	11	11	50%
Another	6	16	27%
No	1	21	5%

5. Does your crash analysis system have the ability to conduct network wide analysis (i.e., crash rates for specific types of roads, specific types of intersection, statewide or district wide averages, etc.)?

Answer	Count	Percentage
Yes	9	41%
No	4	18%
Partially	9	41%
Not Specified	0	0

6. What metrics does your crash analysis system produce?

State	Yes	No/NS	% Yes
Crash Frequency	17	5	77%
Crash Rate	18	4	82%
Crash Differential	6	16	27%
Crash Density	7	15	32%
Crashes per Other	7	15	32%
Other	12	10	55%

7. What is the basis of your user interface? E.g., Do you use a map based system, tabular based system, look up tables, etc.

Category	Count	Percentage
Tabular	2	9%
GIS	5	23%
Web	3	14%
Mainframe	2	9%
Lookup Table	1	5%
Mix	6	27%
Not Specified	3	14%

8. What are the characteristics of your current system that you most like?

Category	Yes	% Yes
Analysis	10	46%
Ease of use	7	32%
Support & Customization	3	14%
Speed	3	14%
Reports	1	5%
Learning	1	5%
Maintenance & Enhancement	1	5%

9. What are the characteristics of your current system that you most dislike?

Category	Yes	% Yes
Analysis	9	41%
Ease of use	6	27%
Speed	3	14%
Learning Curve	4	18%
Reports	2	9%
Maintenance & Enhancement	1	5%

10. What capabilities are missing from your current system that you would like to have?

Category	Yes	% Yes
Further Data	6	27%
GIS Capability	6	27%
Analysis	7	32%
Other System Integration	2	9%
Speed	2	9%
Quicker Updates	2	9%

Appendix D – Detailed Survey Responses from Five State Systems

Virginia

1. **How long have you been using your current crash analysis system?**
"VDOT is in its second year in collaboration with the Departments of Motor Vehicle and State Police of converting its legacy systems and collecting data electronically. The DMV is the custodian of the new work flow from officer to data warehouse called Traffic Records Electronic Data System (TREDS). Phase two is adding the citations data entry and database. TREDS crashes are sent to VDOT where the location (lat/long and description/sketch) is QA/QC and tied to our Roadway Network System data warehouse (inventory etc - see below)."
2. **How much of the package is "Commercial off the shelf" [COTS] versus custom development?** *"There were no COTS used."*
3. **What vendor?**
"N/A"
4. **How does your system integrate roadway and traffic volume information? (see pick list below)**
 - a. *"It does not integrate these data components"*
 - b. *"It interfaces with a LRS All VDOT RNS systems - inventory, traffic, crash, pavement, bridges etc are tied into a LRS and are also geo-spatially referenced."*
 - c. *"It interfaces with a GIS Virginia has center line data that has been geo-referenced on VDOT maintained roads (~57k miles) but the urban city streets do not have a LRS. A new project is tackling that development in the cities."*
 - d. *"It interfaces with another system [see above]"*
5. **Does your crash analysis system have the ability to conduct network wide analysis (i.e., crash rates for specific types of roads, specific types of intersection, statewide or district wide averages, etc.)?**
"This functionality is on the old mainframe system. Many of these capabilities are being built in to the RNS crash module. Once complete, VDOT will query and create any adhoc reports necessary."
6. **What metrics does your crash analysis system produce? (see pick list below)**
 - a. **Crash frequency** Y/N – "Y"
 - b. **crash rate** Y/N – "Y"
 - c. **crash differential (number of crashes – expected number of crashes)** Y/N – "Y – we are deploying SafetyAnalyst"
 - e. **crash density** Y/N – "Y"
 - f. **crashes per other measure (population, area, etc.)** Y/N (please give examples) – "Y outside of RNS when we export to GIS and use Planning pop'n, area etc data"
 - g. **outputs that offer a comparison** Y/N (please give examples) *"Compare jurisdictions, Compare like roadways throughout the state"*
7. **What is the basis of your user interface? E.g., Do you use a map based system, tabular based system, look up tables, etc.**
"All of the stated examples"
8. **What are the characteristics of your current system that you most like?**
"Ability to display crashes on a map or LRS and retrieve information on the crash Reduce manual input Ability to query crash information in multiple ways"

9. What are the characteristics of your current system that you most dislike?

“Currently we have a process going on that does not have adequate hardware to maintain speed necessary to code the location on the LRS (this is being addressed)”

10. What capabilities are missing from your current system that you would like to have?

“Per Number 5 answer, we are in the building phase for the geo-spatial functionality and are requesting more mapping capabilities. Further, we are working to display the SafetyAnalyst output on our LRS.”

South Carolina

1. **How long have you been using your current crash analysis system?** *“5 years”*
2. **How much of the package is “Commercial off the shelf” [COTS] versus custom development?** *“All of our system is custom development”*
3. **What vendor?** Intergraph and PMG Pro.
4. **How does your system integrate roadway and traffic volume information? (see pick list below)**
 - b. *“It interfaces with a LRS”*
5. **Does your crash analysis system have the ability to conduct network wide analysis (i.e., crash rates for specific types of roads, specific types of intersection, statewide or district wide averages, etc.)?** *“It does not compute these values on its own, but they are easily attainable by exporting the data and using Excel to analyze.”*
6. **What metrics does your crash analysis system produce? (see pick list below)**
 - a. *Crash frequency Y/N – “Yes”*
 - b. *crash rate Y/N – “Yes”*
 - c. *crash differential (number of crashes – expected number of crashes) Y/N – “Yes”*
 - d. *crash density Y/N – “NO”*
 - e. *crashes per other measure (population, area, etc.) Y/N (please give examples) – “No”*
 - f. *outputs that offer a comparison Y/N (please give examples) – “Yes, our system “ranks” each location (based on type (intersection or section, rural or urban, two lanes or multi-lane). We can also compare locations based on crash frequency and the crash differential.”*
7. **What is the basis of your user interface? E.g., Do you use a map based system, tabular based system, look up tables, etc.** *“The basis of our interface is look up tables but all crash data is also plotted so it can be searched using a map view.”*
8. **What are the characteristics of your current system that you most like?** *“One advantage of having a custom designed software is that it’s dynamic. It can easily be changed to meet our current needs and enhanced to add new features. Although SCDOT owns the code, we typically solicit the vendor to modify or enhance the software to meet our needs.”*
9. **What are the characteristics of your current system that you most dislike?** *“The accuracy of the analysis of the system obviously is heavily dependent upon receiving accurate crash location information. Currently, crash data is captured in the field by law enforcement using a paper crash form which is then entered by hand into the master crash file which allows for a multitude of errors. However, this is currently being improved through a joint project with SCDOT and SCDPS to implement an electronic data capture system which is expected to be fully implemented within the next year.”*
10. **What capabilities are missing from your current system that you would like to have?** *“Because our system is custom built it can be changed at any time to include any capabilities we deem necessary.”*

Maine

1. **How long have you been using your current crash analysis system?** *“June 2007”*
2. **How much of the package is “Commercial off the shelf” [COTS] versus custom development?** *“0% off the shelf/100% custom”*
3. **What vendor?** *“Ledgelight Technologies for Phase I. Deepriver LLC for all other Phases. They are currently updating our system because of a total revision of the states police form.”*
4. **How does your system integrate roadway and traffic volume information? (see pick list below)**
 - a. *It does not integrate these data components*
 - b. *It interfaces with a LRS YES*
 - c. *It interfaces with a GIS*
 - d. *It interfaces with another system [also our data warehouse TIDE]”*
5. **Does your crash analysis system have the ability to conduct network wide analysis (i.e., crash rates for specific types of roads, specific types of intersection, statewide or district wide averages, etc.)?** *“YES”*
6. **What metrics does your crash analysis system produce? (see pick list below)**
 - a. *Crash frequency Y/N “YES”*
 - b. *crash rate Y/N “YES”*
 - c. *crash differential (number of crashes – expected number of crashes) Y/N “YES”*
 - d. *crash density Y/N “NO”*
 - e. *crashes per other measure (population, area, etc.) Y/N (please give examples) “City/Town or County”*
 - f. *outputs that offer a comparison Y/N (please give examples) “Yes see attached summary in PDF.”*
7. **What is the basis of your user interface? E.g., Do you use a map based system, tabular based system, look up tables, etc.** *“Look up tables and Tabular”*
8. **What are the characteristics of your current system that you most like?** *“The ability to respond to crash data requests electronically. We use much less paper, response times are much better. Most requests are answered using email.”*
9. **What are the characteristics of your current system that you most dislike?** *“Because our crash system and our roadway network system (off the shelf and very hard to get customized) are two systems sometimes there is a disconnect. The Synchronization between the network system and the crash system is not as automated as it should be.”*
10. **What capabilities are missing from your current system that you would like to have?** *“Ad-hoc query tool, map based location tool, and map based reporting tool. These were all in the first proposal by the vendor, but were removed due to funding.”*

Michigan

1. **How long have you been using your current crash analysis system?**

Brad, I'm going to try to answer your questions in the context of the "Crash Processing System" and Michigan's Crash Analysis Systems which are housed within the various agencies and made available to statewide safety partners.

First, the "Crash Processing System", which has been in production starting in December of 2003. It was developed using a phased approach over a number years. The following table gives you an idea of the functionality and how that functionality was implemented:

Release	Description
Release 1 CPR Phase 1	<ul style="list-style-type: none"> • Migrated the Crash application from the MSP Mainframe to an MDOT server. • Migrated the Crash data from the MSP mainframe to an Oracle database on an MDOT server. • Allow users to generate standard reports and perform queries. • Send and receive data from interfacing applications. • Develop TCRS web application for report generation and viewing of UD10 reports.
Release 2 CPR Phase 2	<ul style="list-style-type: none"> • Replaced the old scanning/imaging hardware and software with the latest technology. The handling of the UD-10 form was streamlined so that imaging and scanning of the form is accomplished in one step vs. the two steps that were previously required. • Created a process to certify vendors who wish to supply electronic UD-10 forms to the Crash application. • Develop data entry performance reporting to identify where bad data is coming from. • Made some reports available via the Web. • Created an interface with MDOS to provide driver and vehicle lookup capabilities.
Release 3 CPR Phase 3	<ul style="list-style-type: none"> • Improved and simplified the SafetyNet Interface. • Allow an authorized external organization to request sanitized or un-sanitized extracts on demand. • Processed USDOT code table updates automatically. • Provided code maintenance screens for all code tables. • Allowed users to extract a group of UD-10 images. • Made additional reports available via the Web.

Release	Description
Release 4 CPR Phase 4	<ul style="list-style-type: none"> • Brought the MALI Crash Location System (MCLS) in-house to an MDOT server, converted it to Oracle PL/SQL and modified and added functionality. The in-house system is referred to as the Traffic Crash Locating System (TCLS). • Created a mapping tool to be used by officers for crash locating and by CJIC for 'Protest' processing. This tool is referred to as the Traffic Crash Mapping System (TCMS) • Created an automated process that accepts/retrieves new location information from Framework, converts it into the layout needed by TCLS and updates the TCLS tables. • Streamlined the process for sending un-located crashes from the CRASH database to 'Protest' Processing by bypassing the file build and calling the TCMS tool directly from TCRS. • Provided TCRS users the ability to request a real time response from the TCLS locating tool. • Enhanced TCRS locating to include GIS information when requesting crash locating from TCLS. • Add functionality to allow public access to a Web application that would provide a copy of the UD-10 image for a fee. Interfaces with the State of Michigan's credit card processing application, CEPAS. This web application is referred to as the Traffic Crash Purchasing System (TCPS).
Release 5 CPR Phase 5	<ul style="list-style-type: none"> • Created the Crash Mapping Report for the TCRS Web application which incorporated mapping capabilities into both the criteria selection and data returned to the requestor. • Added High Crash by Segment reports to the TCRS Web application. • Made available, additional criterion attributes on existing TCRS Web reports. • Created the Data Analysis Tool for the TCRS Web application which provides ad-hoc query capabilities to the web user. • Redesigned the electronic UD-10 report and included it in requested image extract files.
Release 6 PDRP	<ul style="list-style-type: none"> • Added functionality to allow the creation and tracking of a property damage reclamation record from its inception based on the UD-10 crash report to the point where it is turned over to finance for recovery. • Migrated existing property damage records from FoxPro Database into Crash Oracle Database. • Provided report generation capabilities to PDRP users of the TCRS application.
Release 6.2	<ul style="list-style-type: none"> • Added the generation of Sanitized (redacted) UD10 documents. • Provided the means to retrieve Sanitized or Un-Sanitized UD10 documents based on security groups for TCRS Client/Server, TCMS, and TCRS Web.
Release 7	<ul style="list-style-type: none"> • Added an image retrieval web service, for use by external organizations via the public internet. • Modified Motor Carrier screens in the TCRS Client/Server application to be more like the SafetyNet screens that Motor Carrier personnel currently use. Also, changed the exported file of motor carrier data to XML format, as FMCSA will now only support XML for uploads to SafetyNet. • Added the ability to receive crash data in XML format from agencies collecting crash data electronically.

Release	Description
	<ul style="list-style-type: none"> • To better understand how the web applications are being used, TCRS Web, TCPS and Web Service usage will be logged and reported. • Data edits were reviewed and modified. Data edit definitions were removed from code and placed into tables so that the user has more control over edit definition changes. <p>Note: Not yet released into production.</p>

Second the crash analysis system, which includes a number of tools available to statewide safety partners, all of which use crash data from the Traffic Crash Reporting System (TCRS) through either a direct link to the TCRS datamart or data extracts:

1. MDOT uses the Transportation Management System's (TMS) Safety Management System (SMS). This product is a client/server system developed in the early 90's through the ISTEA requirement. It is used throughout the state by the MDOT regions and Transportation Service Centers to support day to day safety analysis and support statewide safety programs. It is somewhat dated and has been identified for upgrading to a browser based technology and to provide expanded analysis and mapping capabilities.
2. MDOT, counties, and cities also use RoadSoft a product developed by our LTAP center at Michigan Technological University (MTU) to support MDOT's Local Safety Initiative. This initiative provides MDOT traffic engineering resources and funding to counties to support off state system safety programs. The system provides extensive network analysis and mapping analysis capabilities.
3. Statewide law enforcement, some counties, and cities use the TCRS Web site for supporting their daily safety analysis, program support, and grant application support. This system provides network analysis, high crash analysis for cities and counties and mapping capabilities.
4. The University of Michigan Transportation Research Institute is contracted by our Governor's Highway Safety Office to support Michigan's Crash Facts web site to provide general safety data to the public and other statewide safety partners.
5. Southern Eastern Michigan Council of Governments (SEMCOG) and the Traffic Improvement Association of Oakland County (TIA) provide extensive safety analysis capability to their safety stakeholders.

2. How much of the package is *Commercial off the shelf* [COTS] versus custom development?
"All of the systems mentioned above have been custom developed."

3. What vendor?
"The "Crash Processing System" (TCRS) and TCRS Safety Analysis Web site were all developed by HP/EDS. The other crash analysis systems were developed in house by staff of the respective agencies. RoadSoft was/is being developed by MTU Michigan's LTAP center."

4. How does your system integrate roadway and traffic volume information? (see pick list below)

- a. *It does not integrate these data components*
- b. *It interfaces with a LRS*
- c. *It interfaces with a GIS*
- d. *It interfaces with another system []*
Crash and Roadway data are integrated by both the state's LRS and GIS processes."

5. Does your crash analysis system have the ability to conduct network wide analysis (i.e., crash rates for specific types of roads, specific types of intersection, statewide or district wide averages, etc.)?

“Some of this functionality exists in the TMS and RoadSoft systems noted above. At MDOT we have access to statewide crash data but we do not have access to volume data for local roadways. We are presently deploying SafetyAnalyst for analysis of our trunkline roadways about 10% of the total road mileage.”

6. What metrics does your crash analysis system produce? (see pick list below)

- a. *Crash frequency “Y”/N*
- b. *crash rate “Y”/N*
- c. *crash differential (number of crashes * expected number of crashes) “now with safetyAnalystY/N”*
- d. *crash density “Y”/N*
- e. *crashes per other measure (population, area, etc.) Y/N (please give examples) “these can be/have been generated but not on a routine basis.” “In RoadSoft there are a number of ranking reports that can be reviewed including rates, severity rates, density, EPDO, etc. Samples could be provided.”*
- f. *outputs that offer a comparison Y/N (please give examples)*

“Michigan has the ability to generate systematic analysis using crash frequency, crash density and crash rates. Michigan also is participating in the national effort to implement SAFETYANALYST. Much more comprehensive analysis capability is available on the state system because of more complete data. \”

7. What is the basis of your user interface? E.g., Do you use a map based system, tabular based system, look up tables, etc.

“Michigan is fortunate to have a statewide map base for all roads that is updated by our Center for Shared Solution (CSS) formerly our Center for Geographic Information (CGI). This system is called the Michigan Geographic Framework (MGF) and provides statewide tabular and map based data which conflates Michigan’s two LRSs to map coordinate based systems. These interfaces provide the ability to do extensive mapping and tabular analysis using either coordinate or LRS based systems.”

8. What are the characteristics of your current system that you most like?

1. *“Mapping capabilities*
2. *Timely and accurate crash data*
3. *Highway alignment data statewide*
4. *Additional data elements as specified for various HSM analyses”*

9. What are the characteristics of your current system that you most dislike?

- *“The Lack of Roadway Information off the State System.*
- *The number and redundancy of analysis systems.*
- *The Lack of point of change safety asset data.”*

10. What capabilities are missing from your current system that you would like to have?

See the above.