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South Dakota
Department of Transportation
Office of Research

U.S. Department of Transportation
Federal Highway Administration

SD2000-14-F

Unified Reporting of Commercial And Non-Commercial Traffic Accidents

Study SD2000-14
Final Report

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Disclaimer

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16. Abstract

This report documents the current business processes, forms, and data used for accident reporting in South Dakota's and applicable national databases; the functional requirements for a single system that can record, manage, and track accident information; a logical data architecture to address the single system to record, manage, and track accident information; a migration plan to design and implement an upgraded/new Accident Reporting System, and a “preliminary” re-design of South Dakota’s Traffic Accident Report Form. These objectives were accomplished by a) reviewing existing systems, documentation, and initiatives currently in place, b) holding workshops to gather stakeholder input on functional requirements, data element requirements, and form design ideas, and c) having periodic reviews to gain approval of findings and deliverables produced to date. Some key findings are: a) form re-design will be inherently challenging, b) use of the TraCS system will save time and money, c) a new client server database is required to achieve stated goals of a new system. The main recommendation from this study is to use TraCS as a key component to the migration plan. The use of a client/server-based architecture with a relational database is needed to support the data storage and analysis needs of the users. Additional data for SAFETYNET, FARS, and MMUCC needs to be collected and stored in the electronic accident records database.

This report also contains a preliminary design of the combined South Dakota Traffic Accident Report Form, a detailed data model, a detailed process model, a Process/Entity Usage Matrix (CRUD), a data dictionary, the approved data elements, and many other project deliverables listed in the Appendix document.

17. Keywords	18. Distribution Statement
Accident Reporting, Crash Reporting, Accident Analysis, Accident Diagramming, Commercial Vehicle Reporting, Data Model, Process Model, MMUCC, SAFETYNET, FARS, TraCS, GIS,	No restrictions. This document is available to the public from the sponsoring agency.

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Executive Summary

Traffic accident information is an important resource to State, Federal, County, and City governments. This information is used to identify problem areas, evaluate the effectiveness of solutions, and track historical trends concerning traffic on our country's roadways. There are multiple databases and systems whose purpose is to capture, distribute, and analyze this information. The scope of the Accident Reporting business area includes the functional areas of Accident Recording, Accident Reporting, and Accident Analysis. The primary objective of this project is to analyze these functional areas to determine a migration plan that will upgrade or replace the current computer systems. The existing system is not well integrated with national databases and initiatives and lacks the flexibility desired by the system users. This project has produced a vision for the future accident reporting system. The new system will be more integrated, have greater analysis capabilities, will reduce the time/effort to manage accident information, and will result in accident information being more accessible. Another objective is to merge the many different forms used in the accident information collection process into one unified accident report form.

This project reviewed all of the existing databases and systems in an effort to incorporate them into a migration plan and provide detailed functional requirements for a new Accident Reporting System for the State of South Dakota.

The deliverables and results of this research project are intended to serve as the input into the next project phase for Accident Reporting, which will comprise detailed design, development and implementation of new systems, architecture, processes, and forms. These deliverables do not represent a detailed design from which coding can begin. In this project the functional requirements for a new system have been determined, a logical data architecture has been developed, and a migration plan has been created for developing the new accident reporting system.

Project Objectives

1. To document the current business processes, forms, and data used for accident reporting in South Dakota's and applicable National Databases.

2. To determine functional requirements for a single system that can record, manage, and track accident information.

3. To define a logical data architecture to address the single system to record, manage, and track accident information.

4. To develop a migration plan for designing and building an updated accident reporting system including costs, resource requirements, phasing, training needs, and time frames.

Significant Findings and Conclusions

NOTE: Additional findings and conclusions can be found on page 45 of the Final Report.

1. Re-designing the crash report form has many inherent challenges

Finding: There are conflicting constraints and outstanding issues to be decided concerning the accident report form design.

- There is a very strong desire by the law enforcement officials that use the traffic accident report form to limit the size of the main form as well as any supplements (i.e. the truck/bus form) to one double-sided piece of standard sized paper. (During the Technical Panel Final Report Draft review meeting on July 25, 2001, the law enforcement officials present expressed flexibility on this point. The impact of the one-page form constraint on the form design was discussed.).
- We did not find a State that accomplished 100% MMUCC (Model Minimum Uniform Crash Criteria) compliance on a one-page form that was designed to allow the use of an overlay. There were one page forms, but none that matched the desires of law enforcement in South Dakota and the "approved" functional requirements of the new accident reporting system determined by this research project.
- The officials are also concerned about not spending any additional time coding more information than what they already do today.
- There are also conflicting requests among the various law enforcement agencies concerning witness information and design layout.
- The manner in which certain law enforcement and project team members requested to see data physically displayed on the form conflicts with our recommended layout of the form, which is a "normalized" approach. In general, normalization refers to the concept of grouping related data elements together and not inter-mixing non-related elements (such as data on vehicles mixed with data about people).
- Some MMUCC-compliant data is subjective and may not be reasonable to collect.
- It needs to be decided whether color will be used in the printing process of the new form. This has a large impact on the usability of a single form for both wild animal hits and all other accidents.
- The accident report must be designed to allow the use of an overlay for codified boxes due to the limited size of the form and as a direct request of all parties involved to use this technique.

- There are conflicts between MMUCC and FARS (Fatal Analysis Reporting System) regarding the same or similar data elements with respect to their definitions and number of occurrences. MMUCC has priority when a conflict arises between MMUCC and FARS. There are still some data element coding definitions to be approved prior to the completion of final design.

These constraints taken together produce a very difficult task to undertake.

Conclusion: Although we have a preliminary form design, more time needs to be devoted to form design.

10. Inefficient use of resources exists in the current business processes

Finding: There are several manual, paper-based and/or inefficient processes in the current accident reporting business area. Examples include:

- FARS forms and data handling
- SAFETYNET forms and data handling
- Truck/bus supplemental forms handling
- Crash report forms handling
- Report imaging
- Report generation and distribution
- Data inquiry/access

Conclusion: These processes can be relatively easily addressed and made much more efficient through the implementation of a new data and systems architecture. Taken together, the automating of these manual processes will result in reduced workload requirements, freeing up state, county, local, and private personnel to spend more time on value-added processes (traffic accidents, analysis of traffic problems, analysis of unsafe drivers, etc). The new system will capture the accident data electronically once, effectively eliminating the time consuming manual movement of data via paper and keyboard entry.

11. State-level processes and policies are not being adhered to across all jurisdictions

Finding: Not all of the law enforcement agencies apply the crash reporting policies and procedures in a uniform manner. For example, the BIA (Bureau of Indian Affairs) does not currently report accidents unless they are "very serious or fatal". Many accidents that meet the state-reportable criteria go unreported as a result. The BIA Technical Panel representative expressed interest in implementing the state standards. Another example of inconsistent application of procedures is that the truck/bus supplemental form is not always filled out. Some of these issues are simply a matter of training, while others result from a conflict in policy between agencies.

Conclusion: The training effort for the rollout of the redesigned crash report form and data collection system needs to include a review of certain state policies and procedures. The training effort should include training on ANSI D16.1-1996 – Manual on Classification of Motor Vehicle Traffic Accidents. Through better education, adherence to policies will be more likely.

17. FARS Issues

Finding: The FARS system does not have an electronic interface through which a new accident reporting system could automatically transfer data into the FARS system. The only interface into the FARS system is via manual data entry into the FARS system. As the FARS data collection process is performed today, there is ample room for human error. First, additional accident data is corrected weeks after the accident has occurred. There are a total of six forms that the FARS analyst transfers data from to four other forms. After this manual movement of data to the four forms, the data is manually entered into the FARS system. Additionally, the FARS system and forms are updated annually. The updates to the FARS system are not in place until February or March each year.

Conclusion: Automating data movement from the accident reporting system into the FARS system will be less than what was desired, because there will still be one manual data entry step in the process. What the new system can do is to automatically create the FARS coding sheets. These are the sheets from which the data is manually keyed into the FARS user interface. Doing this will reduce one leg of the manual movement of data, and thus decrease the risk of human data entry errors. Due to the annual system updates of the FARS system, there will be difficulty in entering the data for the first 3 months of each year.

20. There is confusion and inability to properly collect correct commercial vehicle information

Finding: The commercial vehicle information (carrier name, carrier identification, etc.) is not completely standardized across the commercial industry and is not always obtainable from the drivers. Therefore, the law enforcement officers cannot always obtain the information. Additionally, not all officers are completely aware of how to obtain the correct information. This results in a lack of or incorrect information at the state and national levels and results in manual effort to try and resolve the problems. While the solutions to some of these issues are out of our control (such as lack of consistent carrier identification numbers), some are resolvable. Additionally, a national initiative is underway to use a common USDOT (United States Department of Transportation) number for all commercial vehicles, which will eliminate the identification problem. Also the use of PRISM (Performance and Registration Information Systems Management) will help resolve the problem of correctly identifying the "responsible" carrier.

Conclusion: By clarifying the data fields on the new crash report form and through proper training, the implementation project team can successfully address some of these issues.

22. Law enforcement training needs are much broader than just how to use a new form

Finding: There are multiple problems regarding accident data collection caused by human error, confusion, or lack of knowledge. For example, accident locations can be miscoded, not all state-reportable accidents are reported, codes are entered as "other" with no explanation, and commercial vehicle identification is confusing and often wrong/missing Research participants identified law enforcement training as a means to address these issues.

Conclusion: The training for law enforcement officers that results from the eventual accident data collection system implementation project should include more than just "how to use the new form/system". Policies should be reinforced and methods for properly capturing correct and useful data should be taught.

Implementation Recommendations

Migration Plan

The following recommendation describes the recommended approach for accomplishing a migration to a new accident reporting system.

1. Migration Plan

We recommend that the research project's documented migration plan be approved in order to proceed to the next phase in the accident-reporting project.

The Migration Plan to design, construct, test, and implement a new Accident Reporting System that supports the functional requirements as determined by this research project is described in the following pages.

There are three migration alternatives:

- **(Modify Existing System)** Modify or Use the existing South Dakota Accident Reporting System.
- **(Construct New System)** Build a new Accident Reporting System.
- **(Purchase System & Customize)** Buy a packaged Accident Reporting System and customize it. Note: The software package may be free; i.e. TraCS. This option may also refer to the use of software that has already been purchased by the SD DOT (South Dakota Department of Transportation), but is not currently being used for the stated function. An example of this is the use of Seagate Crystal Reports. The software is owned by the DOT, but is not used for accident reporting.

As we considered each of the alternatives, the distinction between the three choices became less defined. The recommended plan is actually a hybrid combination of all three and is as follows:

- For the front-end "Accident Data Collection" use TraCS (the Iowa system). **(Purchase System & Customize)**
- For the "Accident Data Repository", build a new database structure to centrally store the data collected using TraCS. This Accident Reporting database should use a RDBMS (Relational Database Management System). The State standard RDBMS is Microsoft SQL (Structured Query Language) Server, which would serve as the "master" database for the Accident Reporting data. All other systems would get data from this database. Note: The old accident reporting database (not the old accident reporting programs, just the data) on ADABAS will still need to be populated with data from the new system to support other existing non-accident reporting legacy systems

that expect to find data in this file, such as RES, Drivers License, dROAD, etc. But from the new accident reporting system's perspective this database no longer exists, and is not required for the accident reporting system to function. Keeping the "old" accident reporting database populated with data is an interim solution to keep old legacy systems running until such time that and (Bureau of Information Telecommunications) puts in place the "new" middleware solution that is currently under development. When this "new" middleware solution is put in place, then each legacy systems should be prioritized and scheduled for migration to the middleware solution. Once all legacy systems have migrated to the middleware solution, the "old" accident database will be entirely removed from the production system and not accessible. **(Construct New System)**

- For "Accident Reporting" buy/use existing reporting software packages. There are many commercial reporting tools readily available, including: Seagate Crystal Reports (State Standard) and Microsoft Access, among others. **(Purchase System & Customize)**
- For "Collision Diagramming" continue to use Intersection Magic. **(Modify Existing System)**
- For "Geographic Information System" (GIS) use the existing State standard. ArcInfo/ArcView is already in place and is the market leader in this area. **(Modify Existing System)**
- For "Statistical Analysis and Online Analytical Processing" use both the existing State standard "SAS" and supplement it with either Microsoft OLAP (Online Analytical Processing) Services or Hyperion Essbase. **(Modify Existing System** & **Purchase System & Customize)**

Discussion of the three migration alternatives

At this point we must take a moment to address an issue. The issue/question is "Where is the side-by-side comparison of the three separate migration alternatives?" The answer to this question is that the side-by-side comparison resulted in plans that looked almost identical. (For your reference, the comparison we did create is in Appendix E of the appendix document). We started by developing a migration plan to "modify the existing State system" (the "modify" plan) and then proceeded to develop a migration plan to "construct an entirely new system" (the "new" plan). What we found while developing the "new" plan was that both plans had basically the same components required to support the functional requirements of the new system. In essence, the same components would have to be built for both the modify plan and the new plan.

The components that were common between both plans are:

- Front-end accident data collection
- Web access
- Ability for end-users to create customized queries
- Automating the SAFETYNET and FARS interfaces

- New end-user initiated and customized reports
- Use of OLAP for analysis

The major difference between the two plans is where the database resides, whether on a mainframe platform using ADABAS or on a client/server platform using Microsoft SQL Server. Below is a comparison of this difference.

The "Modify" Plan (ADABAS database on a mainframe platform)

1. The current implementation of the Accident Reporting database is not relational and does not support the functional requirements of the new system (i.e. Web access, user customized query access, easily enhanceable, etc). To meet these functional requirements, the existing database must be completely redesigned and re-implemented. The database would no longer exist in its current form.
2. Currently, third party middleware is used to provide Web access to existing ADABAS databases. This access only provides static HTML pages without query capabilities. Web browser access to ADABAS is not a skill set readily found in the programming marketplace.
3. The ADABAS database environment has been used exclusively in mainframe environments for approximately 20 years. It does not have the functions or features normally required to support a Web based application.

The "New" Plan (SQL Server database on a client/server platform)

1. This database will be designed and implemented to meet the functional requirements of the new system. This is essentially the same process that would occur in the modify plan (see bullet #1 above).
2. The expertise to utilize SQL Server for Web access is possessed by the State, and SQL Server Web expertise is a common skill set found in the programming marketplace.
3. SQL Server is designed for Web-enablement, is fully integrated with the Microsoft WEB Server environment, and is a market leader in Web system deployment in the United States and the world.
4. Microsoft SQL Server is a component within the Bureau of Information and Telecommunication's strategic technical architecture.

Given this single difference between the modify plan and the new plan, clearly the implementation of SQL Server on a client/server platform is the best choice. The cost of building a new ADABAS database is approximately the same as the cost to develop a new SQL Server database. We have estimated the detailed design and construction of the "physical database" to be approximately $14,400. However, there is a significant difference between the costs to develop a Web interface to the ADABAS database versus the Microsoft SQL Server database. The ADABAS interface would rely on using middleware, which would require additional development effort versus Microsoft's integrated development environment, which requires minimal development effort.

Finally, we evaluated the third alternative - “purchase and customize” a system. This is easy to answer. There is no package in the marketplace that includes all three functional areas of accident reporting (Accident Recording, Accident Reporting, and Accident Analysis). Therefore, this alternative was not a viable solution. However, what does exist is TraCS for the Accident Recording function. Our recommendation, already stated elsewhere in this report, is that TraCS be obtained from Iowa. There is no purchase cost for the software, it has been implemented in Iowa it is being pilot tested in several other states, and it meets the vast majority of the functional requirements for the front-end data collection process.

Discussion of the Migration Plan Project Plan

The objective of the migration plan is to provide a roadmap and vision for the implementation of a new Accident Reporting Form (manual and electronic), a central database, electronic interfaces, and enhanced reporting capabilities, all within a reasonable timeframe. As such, the approach used to accomplish this objective is to have project team members working on as many tasks concurrently as possible. The project plan reflects this approach in that the Accident Report Form design is completed, printed, and tested while the design and construction of the Accident Records Database is underway, and the customization of the TraCS system is in progress.

When these three phases are complete, the project enters a "pilot" phase where one office will receive the new form, TraCS system, training, and mentoring to "test" the new system. When the initial "pilot" phase is complete, the results are evaluated, the system modified as needed, and the system re-installed at the first site and also a second site for the second "pilot" phase. Again, at the end of the second pilot, the results are evaluated, modifications are made and the system is re-installed in both "pilot" sites. However, the system would then be installed in two additional sites to perform final testing over a one-month period. Upon completion of this "beta test", the system may again be modified and is now ready for general distribution.

When developing the migration plan, the following assumptions were made:

1. Scheduled availability of Accident Reporting Department staff and other stakeholders involved (i.e. Highway Patrol, Sheriff Departments, City Police, Trucking Association, etc)
2. Availability of three consultants with the requisite development skills to work on the project as scheduled

3. Scheduled availability of hardware and technical support staff to perform the TraCS hardware and software installations as planned during the system development project
4. Timely approval of the paper and electronic accident reporting form layout and codes
5. Availability of adequate hardware resources for development and testing
6. Availability and "buy-in" of the initial pilot agencies to use the system in a "test" mode
7. Availability of a Technical Panel or DOT sponsor who can resolve issues and facilitate the decision making process
8. An additional project would be required to develop a GIS/GPS (Global Positioning System) system.

General distribution of the system will be accomplished in two phases. The first phase will be the training and general implementation of the new paper form to those agencies that do not opt to install the hardware and software required to use TraCS. The training and installation of the Accident Reporting Database system will also occur in this phase. The second phase will be the installation and training for the TraCS implementations. Both phases can occur simultaneously. The issue with any implementation plan resulting from this project is the unknown number of TraCS installations, which directly affects the cost and installation timetable. May need to have a contractor handle the installation of hardware and software for local agencies, because BIT typically does not do work for non-state entities.

Benefits to be realized from the implementation of this Migration Plan

The proposed migration plan is designed to provide for the implementation of a system and architecture that will provide benefits such as:

1. Eliminate manual re-keying of data, resulting in saved work time, and elimination of human data entry errors in the following areas:
    a. FARS
    b. SAFETYNET
    c. Paper form and notes to final form sent to the State
    d. Sending paper forms from the State to local agencies to collect additional data
2. Provide more complete, accurate, and timely accident data that can be easily accessed and used
    a. Eliminates the reliance on the Office of Accident Records to handle and process all reporting and data requests

    b. Allows users to produce their own customized reports and queries that answer the questions they need answered - (no longer dependent on existing pre-defined reports that must be manually analyzed)
3. Store all accident data electronically, which:
    a. Eliminates time needed to find all current documents that are either paper or electronic
    b. Eliminates lost information
    c. Provides timely availability of information
    d. Ultimately allows for the new system to be entirely paperless
    e. Allows for the easy transport of data regardless of geographic location
4. Verify data/codes at time of electronic entry at the accident scene rather than after the fact in the office
5. Provide a high level of compliance with MMUCC
6. Automate the follow-up of outstanding reports and incomplete reports
7. Eliminate relying on a single source (Office of Accident Records) for data querying and reporting
8. Provide a system that is consistent with BIT's strategic technical direction and standards
9. Tighter integration to existing and proposed systems, i.e. GIS
10. A separate project to support converting existing accident location coordinate data to GPS coordinates is necessary. Without a GIS system the use of GPS coordinates cannot be fully utilized. Without GIS system there will still need to be analysis of accident data via state coordinate system. The GIS/GPS information will be necessary to develop plot maps that document accident information currently utilized by LGA (Local Government Assistance) and the Office of Road Design.

The diagrams on the following pages illustrate the current and envisioned systems architecture.

Figure 1. Accident Reporting System Diagram – Current

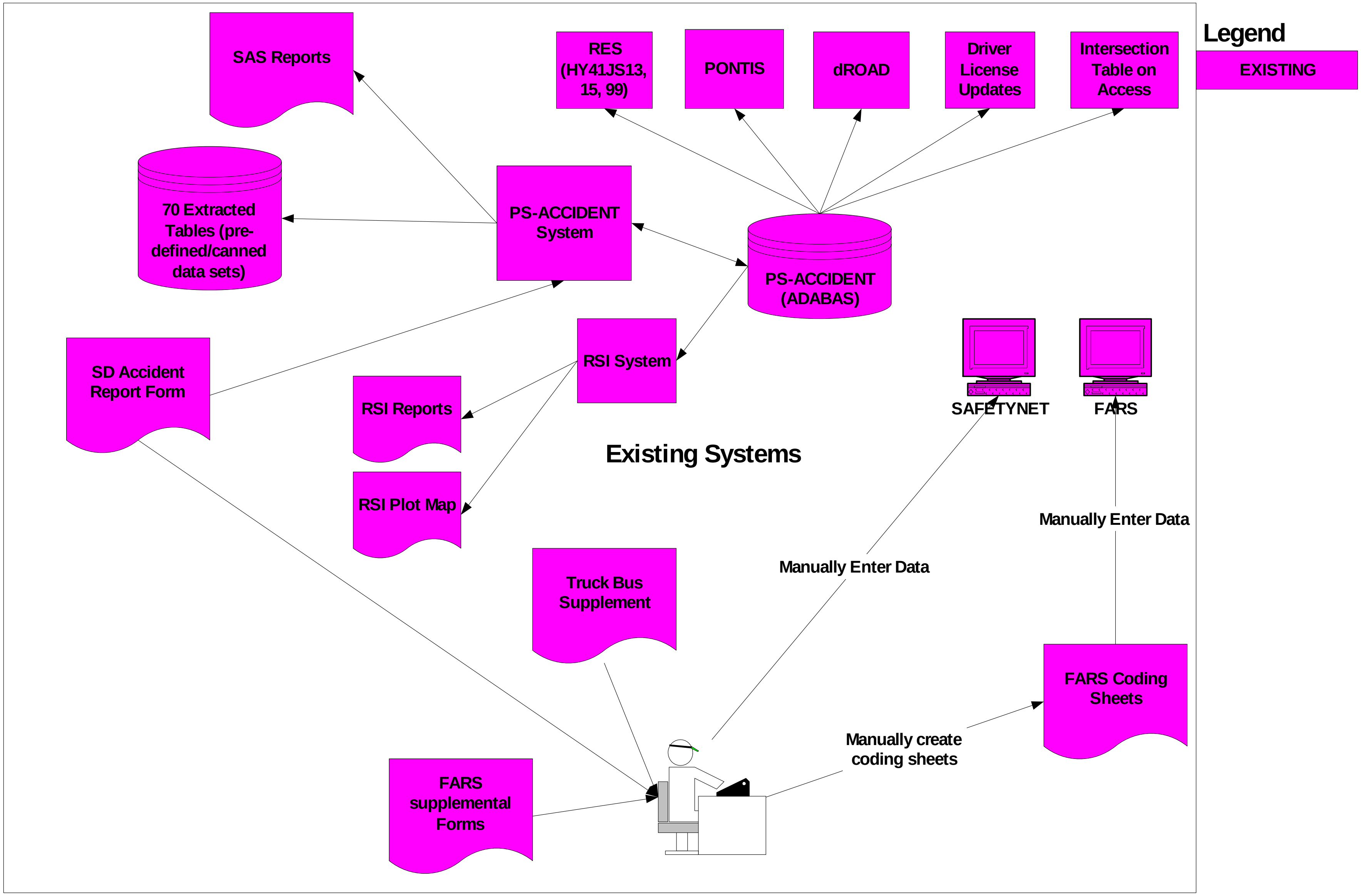
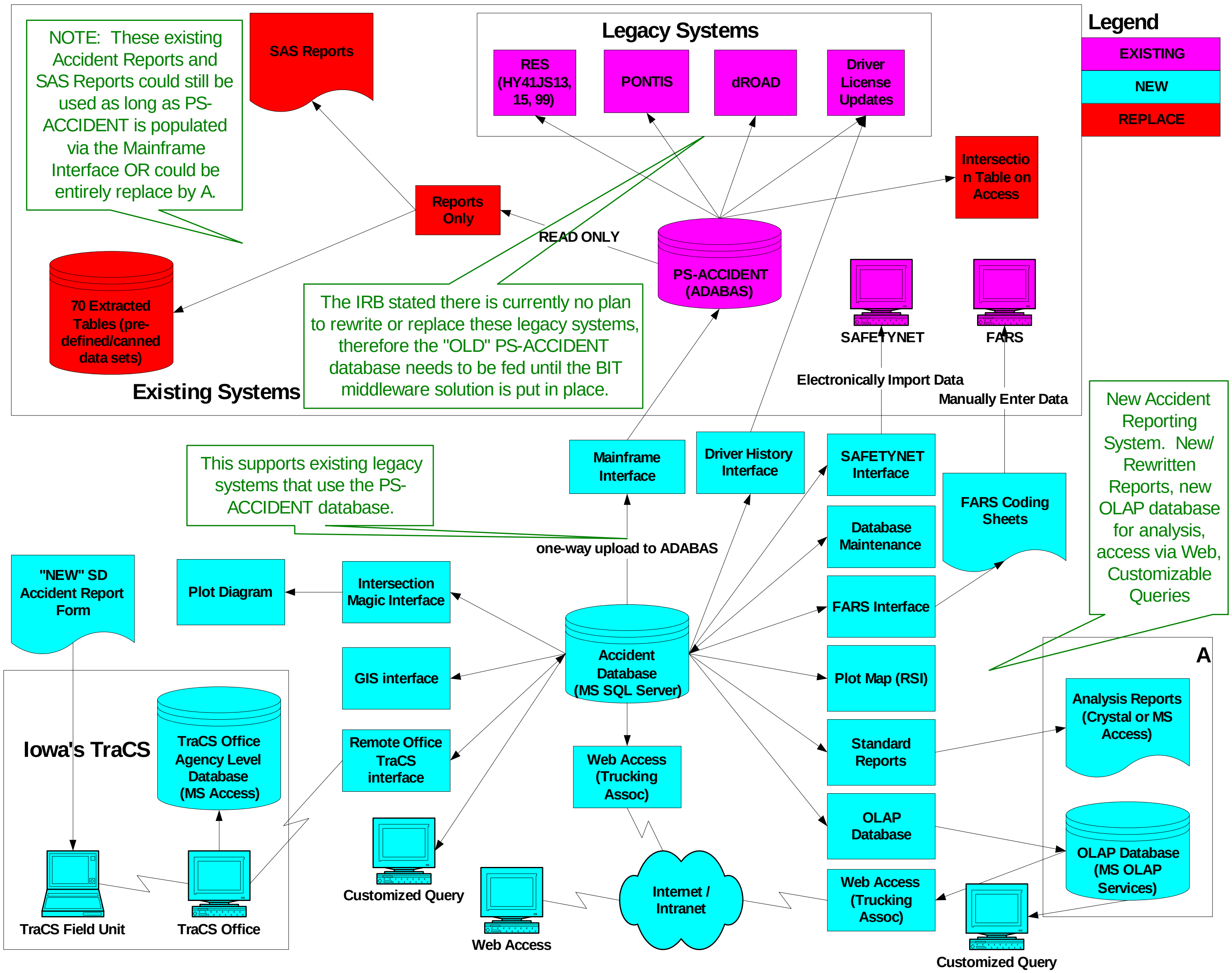


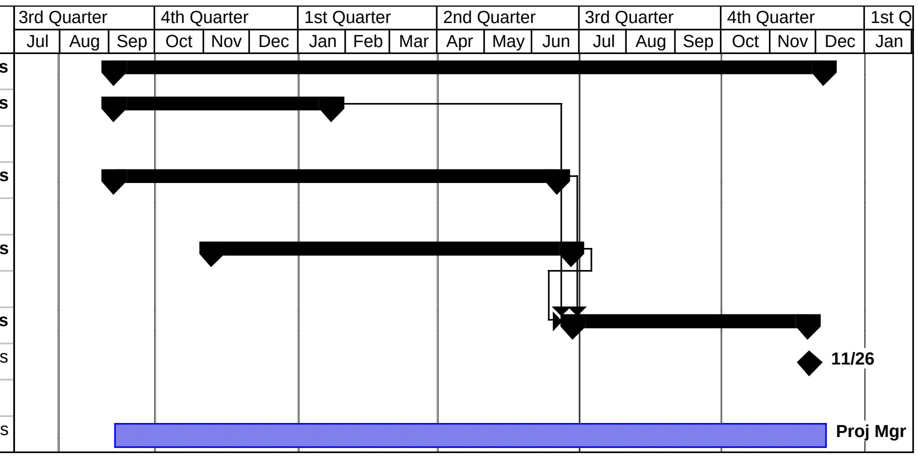
Figure 2. Accident Reporting System – New



The following figure illustrates phasing, cost, resource requirements, and time frame for the migration plan at a summary level. This is the project plan for the estimated amount of effort to design, construct, test, and implement an Accident Reporting System as defined by the functional requirements that were determined during the course of this research project. This project plan does not include local law enforcement training and hardware/equipment costs.

Figure 3. Accident Reporting Summary Level Migration Plan

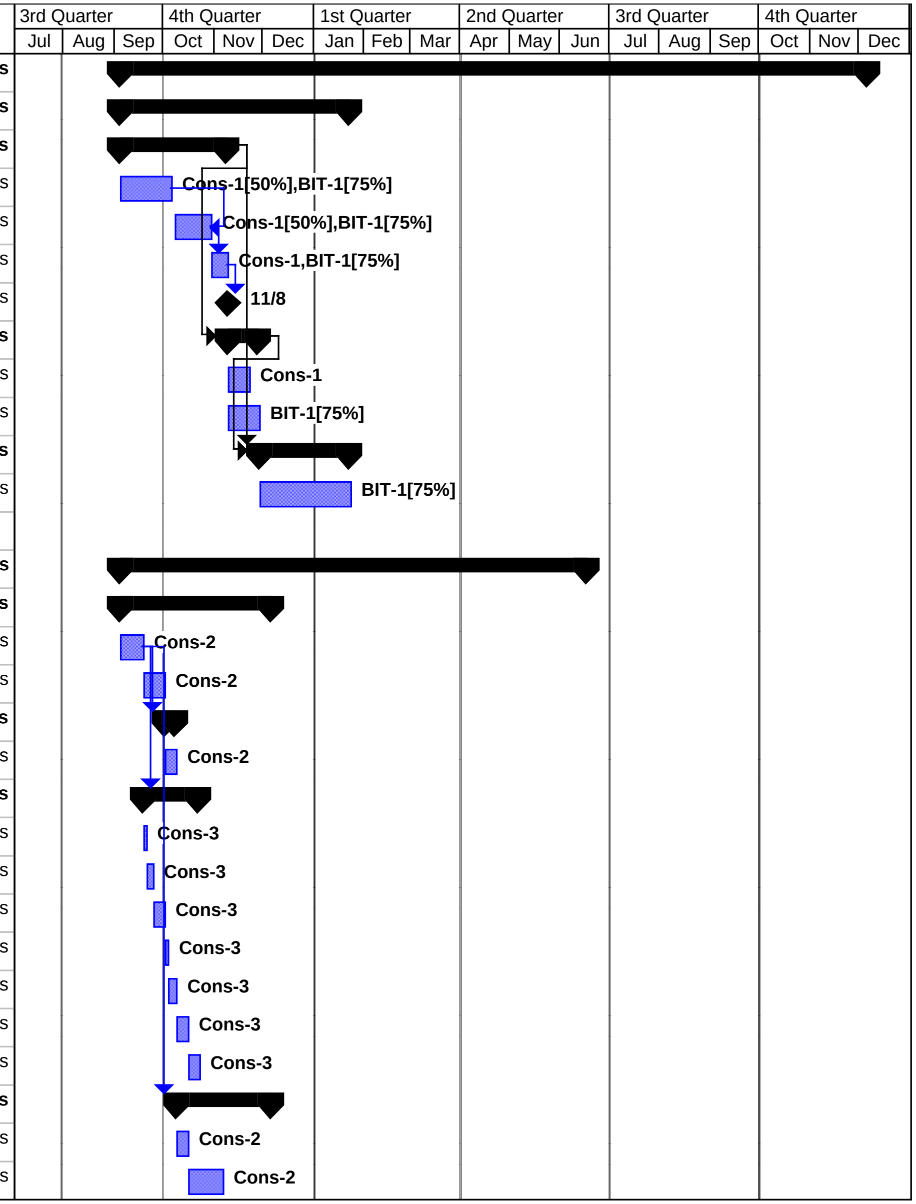
ID	Task Name	Cost	Duration
1	**A.R.S. DESIGN-CONSTRUCTION-IMPLEMENTATION**	**$550,970**	**329 days**
2	**ACCIDENT REPORT FORM**	**$70,458**	**102 days**
13			
14	**ACCIDENT RECORDS DATABASE**	**$208,434**	**205.43 days**
54			
55	**ELECTRONIC ACCIDENT REPORT FORM (TRACS)**	**$102,576**	**167.43 days**
65			
66	**IMPLEMENTATION**	**$90,542**	**108 days**
90	**FIELD BEGINS USE OF NEW FORM AND TraCS**	$0	0 days
91			
92	**Project Management**	$78,960	329 days



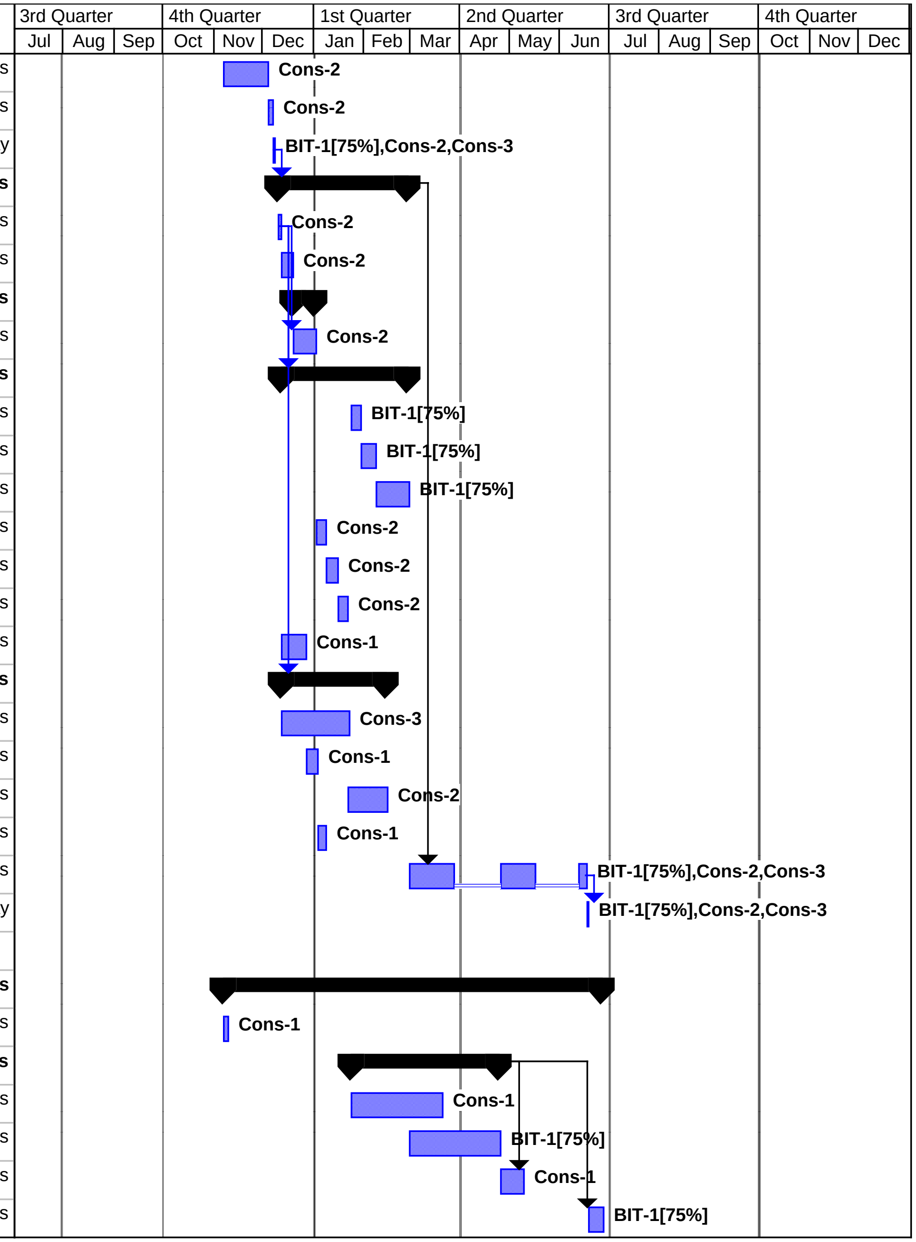
The following figure illustrates phasing, resource requirements, and time frame for the migration plan at a detailed level.

Figure 4. Accident Reporting Detail Level Migration Plan

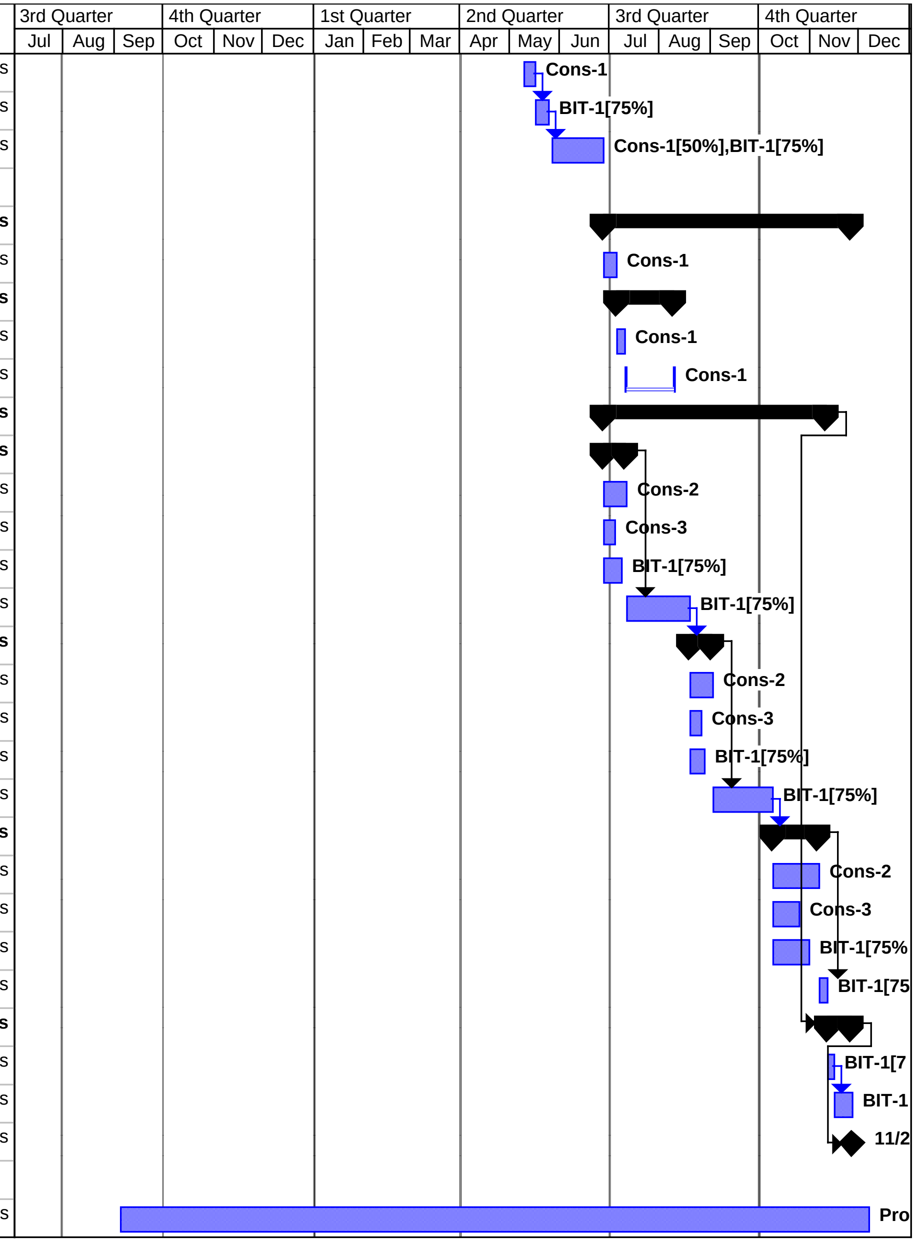
ID	Task Name	Cost	Duration
1	**A.R.S. DESIGN-CONSTRUCTION-IMPLEMENTATION**	**$550,970**	**329 days**
2	**ACCIDENT REPORT FORM**	**$70,458**	**102 days**
3	**Manual Form**	**$43,392**	**48 days**
4	Design Form	$21,096	24 days
5	Finalize Code Values	$14,064	16 days
6	Design Overlay	$8,232	8 days
7	Deliver to Printer	$0	0 days
8	**Training Materials**	**$15,906**	**14 days**
9	Develop Accident Report Form Coding Instructions	$12,000	10 days
10	Develop Office Coding Instructions	$3,906	14 days
11	**Test & Review Form Design**	**$11,160**	**40 days**
12	Field Test	$11,160	40 days
13			
14	**ACCIDENT RECORDS DATABASE**	**$208,434**	**205.43 days**
15	**Detail Design**	**$74,400**	**68 days**
16	Physical Database	$8,000	10 days
17	Online Analytical Processing Database	$8,000	10 days
18	**Program Modules**	**$4,000**	**5 days**
19	Database Maintenance	$4,000	5 days
20	**Interface Modules**	**$20,000**	**25 days**
21	SafetyNet Interface	$1,600	2 days
22	FARS Interface	$2,400	3 days
23	Remote Office TRACS Interface	$4,000	5 days
24	Driver History Interface	$1,600	2 days
25	Intersection Magic Interface	$2,400	3 days
26	GIS Interface	$4,000	5 days
27	Mainframe Interface	$4,000	5 days
28	**Report Modules**	**$34,400**	**43 days**
29	WEB Access (Trucking Assoc)	$4,000	5 days
30	Customized Queries (70)	$12,000	15 days



ID	Task Name	Cost	Duration
31	Standard Report Templates (20)	$16,000	20 days
32	Plot Diagram Report	$2,400	3 days
33	**Design Review**	$1,600	1 day
34	**Construction**	**$92,975**	**58 days**
35	Physical Database	$1,600	2 days
36	Online Analytical Procesing Database	$4,000	5 days
37	**Program Modules**	**$8,000**	**10 days**
38	Database Maintenance	$8,000	10 days
39	**Interface Modules**	**$31,375**	**56 days**
40	SafetyNet Interface	$1,116	4 days
41	FARS Interface	$1,953	7 days
42	Remote Office TRACS Interface	$3,906	14 days
43	Driver History Interface	$3,200	4 days
44	Intersection Magic Interface	$4,000	5 days
45	GIS Interface	$4,000	5 days
46	Mainframe Interface (4 programs)	$13,200	11 days
47	**Report Modules**	**$48,000**	**47 days**
48	Customized Queries (70)	$24,000	30 days
49	WEB Access (Trucking Assoc)	$6,000	5 days
50	Standard Report Templates (20)	$14,400	18 days
51	Plot Diagram Report	$3,600	3 days
52	**System Testing**	$37,580	40 days
53	**Review and Signoff**	$1,879	1 day
54			
55	**ELECTRONIC ACCIDENT REPORT FORM (TRACS)**	**$102,576**	**167.43 days**
56	System Development Training (SDK)	$3,600	3 days
57	**Develop Customized Electronic Forms**	**$59,160**	**65 days**
58	Electronic Only Input	$48,000	40 days
59	Entered from manual form	$11,160	40 days
60	Develop Customized Database	$12,000	10 days
61	Customize Training Manual	$1,953	7 days



ID	Task Name	Cost	Duration
62	Develop Automated Field Unit to Office Communication Link	$7,200	6 days
63	Functionality Testing	$1,674	6 days
64	Review/Signoff	$16,989	23 days
65			
66	**IMPLEMENTATION**	**$90,542**	**108 days**
67	**Installation of new Accident Reporting Database**	$7,200	6 days
68	**Install TraCs at DOT Central Office**	**$6,000**	**25 days**
69	Training	$3,600	3 days
70	Software installation	$2,400	2 days
71	**Pilot**	**$74,273**	**97 days**
72	**Alpha Pilot Office 1**	**$14,153**	**10 days**
73	Training	$8,000	10 days
74	Hardware Installation	$4,200	5.25 days
75	Software Installation	$1,953	7 days
76	**Pilot Office 1 Review/Refinement**	$7,533	27 days
77	**Alpha Pilot Office 2**	**$14,153**	**10 days**
78	Training	$8,000	10 days
79	Hardware Installation	$4,200	5.25 days
80	Software Installation	$1,953	7 days
81	**Pilot Office 2 Review/Refinement**	$7,533	27 days
82	**Beta Pilot Offices 3, 4**	**$30,064**	**20 days**
83	Training	$16,000	20 days
84	Hardware Installation	$9,600	12 days
85	Software Installation	$4,464	16 days
86	**Overall Pilot Review/Approval**	$837	3 days
87	**Implementation (variable function of TraCS installations @**	**$3,069**	**11 days**
88	Train the Trainer	$1,116	4 days
89	Trainer Support	$1,953	7 days
90	**FIELD BEGINS USE OF NEW FORM AND TraCS**	$0	0 days
91			
92	**Project Management**	$78,960	329 days



The following table summarizes the total number of estimated hours by month, by resource to complete the design and development

Table 1. Accident Reporting Migration Plan Resource Usage Hours

	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
BIT-1	114	138	132	126	138	120	126	132	138	120	120	117	123	135	84		1863
Cons-1	76	100	128	112	88	160	112	32	116	84	67	8					1083
Cons-2	152	184	176	168	184	88	152			21	67	76	3	132	27		1430
Cons-3	72	128		120	128	8	152			21	30	42		96			797
Proj Mgr	30	37	35	34	37	32	34	35	37	32	37	35	34	37	34	8	528
Total	444	587	471	560	575	408	576	199	291	278	321	278	160	400	145	8	5701

Legend:
BIT-1: BIT resource
Cons1-3: Consultants
Proj Mgr: Project Manager

Variable Additional Cost

There are some additional costs that are difficult at this time to illustrate in a project plan due to the level of detail required. The cost estimates below are approximations and may vary widely depending upon different circumstances.

1. Law Enforcement Personnel Training
   - The plan above provides for the training of a trainer ("train-the-trainer" approach). This cost can be reasonably estimated. What is difficult to predict at this point is how many sessions are necessary to train the law enforcement community in the use of the "new" paper accident report form and the use of TraCS. We estimate that it will take 2 – 3 days to train an officer in the use of the TraCS software. Scott Burke from the Sioux Falls police department said that it takes 15 days to rotate the entire police force through 1 day of training. Given this as a guideline, it may take anywhere from 30 – 45 days to train all the Sioux Falls police force in a 2 – 3 day class. The assumption on the training of the law enforcement officers is that this will be done by each agency's trainer (the individual that attended the "train-the trainer" session) and will not be a cost to this project. This training cost will be incurred by the agency as a cost of doing business for them.
2. Computer Hardware to run TraCS
   - By Mary Jensen's (TraCS Program Manager Iowa DOT) estimate, it costs $7,000 - $7,500 to equip a squad car with the hardware and software necessary to run TraCS. This value represents all the hardware required,

including: heavy-duty laptop, monitor (touch screen), scanner device, printer, mounting bracket, docking station, etc…

- Installation of the hardware in the squad car ranges in cost from $250 - $300 per car.
- The total cost to install the hardware has a wide range due to the fact that some cars already have a computer and others do not. The cars with computers may only need a memory upgrade or no upgrade at all. They may only need some additional software installed. Because of the variables, it is impossible to arrive at a firm cost to purchase and install the hardware necessary to run TraCS without completing a full inventory of all existing equipment (hardware and software). Adding the values for hardware and installation from the first two bullet points above, the cost is between $7,250 and $7,800 to equip a squad car that has no computer hardware. The number of cars that fit this situation is unknown until an inventory is completed. However, we can say that
    - There are 156 highway patrol cars. Total hardware and software installation would cost $1.2 million ($7,800 * 156) to equip all cars.
    - To equip each police department will vary depending upon how many cars they have and want to equip with TraCS. The same is true of the county sheriff's agencies.

Accident Report Form

This group of recommendations includes all items related to the final design and use of the new accident report form.

2. Drug and Alcohol Test Data

Due to the fact that each law enforcement agency can and does handle their drug and alcohol tests differently, we recommend that the process of gathering new (MMUCC and FARS-compliant) drug and alcohol test data be done by each agency (not the Office of Accident Records).

The results of drug and alcohol tests are not available immediately to the officer to place on the paper form or the electronic form. This is information that is currently collected later (by sending out additional forms) for the FARS system. However, to be MMUCC compliant, this information is now also required not only for fatality injured persons, but also for drivers and non-motorists involved in accidents whether there is a fatality or not. A new process is needed to capture this information.

The process for collecting drug and alcohol test results for the "paper" form should be to not send in the accident form until after the results are available to the officer. The officer then places the results on the paper form and sends it to the State. If the agency is using the "electronic" form, when the results become available, the officer merely adds the additional information to the system.

If the responsibility for obtaining the drug and alcohol test results were placed in the Office of Accident Records, this office would have to adapt the process to each agency's different sources for the data. Some agencies have in-house laboratories and others outsource this work to any number of different public laboratory service companies. Some results come back to the officer; some are placed on a bulletin board, etc. Ultimately, and even in the current system, it is the officer that knows where to find the test results. Therefore, it should be the officer that provides this information because the officer will always be the person receiving the results to give to the Office of Accident records. The officer should therefore be responsible for capturing the data.

3. Accident Form Re-design Pilot

We recommend that the re-designed accident form should be pilot-tested in a real-world environment.

As a step in the finalization of the new accident form, we recommend a pilot test (or parallel test) in the field. A project team member should accompany an officer and go to an actual accident scene. Either the officer or the team member (in parallel with the officer) would fill out the new form so we can observe how the process and form really work in the field and how well the new design will work.

4. Completion of Form Re-design

We recommend that there be a "phase 2" form re-design activity

This activity is the detailed design of the new accident form. The process should include looking at options such as:

a. Normalizing the form – for example, break out the summary section into road information, location information, and crash information; break out the unit section into vehicle information and driver information
b. Using a 4-sided form and getting rid of the overlay – this means all codified boxes would have the choices right on the form, but that means any change in choices produces a new form; this would also provide additional room for non-state data such as witness information and all parties' phone numbers. During the Technical Panel review meeting (July 25, 2001) of this Final Report ("DRAFT" version), the law enforcement

officials present did express flexibility on this point to allow more than a one-page accident report form. The flexibility arose out of a deeper understanding and discussion of the impact a one-page form had on the form design

c. Using color for enhancing form readability and usage, and highlighting the data fields needed for wild animal hits

This activity should also include additional rounds of review and input from all stakeholders as well as the development of the overlay design, assuming an overlay will be used.

5. Collect All Parties' Names for Social Services Recovery

We recommend that the names of all persons involved in an accident be collected.

Currently, passenger names and related information are not collected. Also note that passenger names are not required in order to be MMUCC compliant. The need to capture passenger name information comes from Social Services Recovery. This information would be helpful to them in validating Medicare and Title 19 claims. This process ensures that the auto insurance company(s) liable for the accident pays for the medical bills, rather than Medicare and Title 19. This is a policy issue that must be decided by the Research Review Board and the Technical Panel. (See Functional Requirement reference # 35 for more information presented in Appendix F of the appendix document).

6. Collect Information on All Parties

We recommend that the MMUCC-compliant data elements for all persons involved in an accident be collected. (Note: This is similar to #5).

To be MMUCC compliant, additional data elements should be collected on the following individuals involved in the accident:

- All Person Involved:
  - Date of birth, Sex, Injury Status, and Type of Person
- All Occupants Involved:
  - Seating Position, Protection System Used, Air Bag Deployed, Ejection, and Trapped

There was some concern among the project team about collecting this information for non-injured people. The Technical Panel does recommend collecting this information, however this is a policy issue that must be decided by the Research

Review Board and the Technical Panel before it can be finalized. (See Issue #1 in the Form Design Strategy in Appendix H of the appendix document).

7. Link Accidents and Citations

We recommend that if a citation is issued as a result of an accident, the citation number (ticket number) should be recorded on the accident report and in the accident database. This will provide linkage between accidents and the citation databases that exist.

This will be coordinated with CVISN (Commercial Vehicle Information Systems and Networks) projects. The reverse of this recommendation is to put the accident number on the citation. There was a concern raised that this may need legislation to put the accident number on the citation. (See Functional Requirement reference # 110 for more information presented in Appendix F of the appendix document).

8. Collect MMUCC Data

We recommend that the State of South Dakota collect the data elements as directed by the MMUCC guideline (Model Minimum Uniform Crash Criteria).

MMUCC is the common guideline that all states are encouraged to use to ensure a baseline set of common accident data, allowing for better cross-state analysis of traffic accidents. Some MMUCC data collection requirements may put an undue burden on the data collectors. Remember, MMUCC is a guideline and not a mandate. Therefore, certain data collection requirements could be dismissed. But careful consideration during the next phase of the project should be taken before doing this. Some possible data elements that may not be collected are:

- V09 – Carrier Identification Source
- Information of non-injured passengers. (This needs to be resolved in the next phase of the project)
- See Appendix F of the appendix document and the datamapping.xls for more information.

9. Automatic Data Collection using GPS

We recommend that the new accident data collection system implement the use of GPS coordinates and devices to collect the accident location coordinates. Using this technology will help ensure more accurate accident location data and reduce time spent obtaining and recording the information.

With the accident location being a GPS coordinate, the actual literal location of the accident will always be known. Even if the alignment of the highway changes, the GPS location does not. This will eliminate human error and decrease the amount of time to complete an accident report. The new data collection system should have the capability for both GPS and bar code enablement. The TraCS system currently handles GPS-enablement via an accident locator tool or reading the GPS location from a GPS device.

10. Automatic Data Collection using Bar Codes

We recommend that the new accident data collection system implement the use of bar code scanning technology to automate the collection of driver license and registration information. Using this technology will help ensure more accurate accident data and reduce time spent obtaining and recording the information.

Bar coding will allow the driver's information and vehicle registration information to be automatically populated into the electronic system. This will eliminate human error and decrease the amount of time to complete an accident report. The new data collection system should have the capability to collect information via bar code enablement. The TraCS system currently uses bar code scanning technology.

Accident Records Database

This group of recommendations includes all items related to the potential uses for the TraCS system beyond that of accident reporting.

11. Resolve Issues with Intersection Magic

We recommend that South Dakota schedule a meeting with Intersection Magic representatives and get the issues with the use of this software resolved.

The owner and original developer of Intersection Magic indicated to us that the Intersection Magic software could do virtually anything South Dakota needs it to do with respect to collision diagramming and analysis. If the software does not currently have the functionality required, his company is willing to develop it, assuming it is not unique to the State. For example, South Dakota's grid system is unique and may preclude building the desired functionality. Regardless, this activity should be pursued in depth so that a detailed action plan for the continued use of this product can be developed.

12. Develop Accident Data Privacy Policy

Accident data is collected on private citizens, private companies, and public companies. This accident data is distributed to and used by many organizations, both public and private. We recommend that South Dakota develop a privacy policy concerning the use and distribution of accident data.

There is a concern that if accident data and reports become accessible via the Internet or other electronic means, that the State needs to take the appropriate steps to ensure compliance with federal, state, and other applicable regulations governing privacy. Data elements of concern are social security number, date of birth, names of minors, etc. The privacy policy developed would be a guide to the development of security mechanisms to ensure that privacy needs are met. This accident data privacy policy should be published on any accident data web sites. (See Functional Requirement reference numbers: 13, 90, and 111 for more information presented in Appendix F of the appendix document).

13. Store Accident Narrative

We recommend that the officer's narrative of the accident should be stored in the electronic accident records database.

This is key information for the back-end traffic analysis users. Having the narrative in the database would provide the desired functional requirement to have the officer's narrative on the Accident Summary Report. With this data in the database there would be no need to search for the hard copy form or the imaged copy to do analysis. Without including the narrative in the database, there cannot be a paperless accident reporting system. The only consideration is that there may be a workload issue for entering the narrative verbiage when the accident reports come in on a "paper" form. But if the narrative is not entered into the electronic accident records database, then the same workload issue on the front-end data entry side of the system becomes a workload issue on the back-end data retrieval side of the system in the form of not having the data needed to make the correct decisions and lost time getting hardcopy accident forms for analysis. And more importantly, there will be no means for creating a copy of an accident report form from the database. We strongly encourage the Research Review Board and the Technical Panel to store this valuable data in the database. (See Functional Requirement reference # 109 for more information presented in Appendix F of the appendix document).

14. Store Accident Diagram

We recommend that the diagram of the accident should be stored in the electronic accident records database.

Although the diagram is not textual data, it can still be stored as part of the database record for the accident. Storing the diagram in the database provides a single integrated location for accident data to reside. The diagram is key information for the back-end traffic analysis users. With the diagram in the database, there would be no need to search for the hardcopy form or the imaged copy to perform analysis. The image could be displayed electronically with the click of a button. Without including the diagram in the database, there cannot be a paperless accident reporting system. And more importantly, there will be no means for creating a copy of an accident report form from the database. We strongly encourage the Research Review Board and the Technical Panel to store this valuable data in the database. (See Functional Requirement reference # 9 and 59 for more information presented in Appendix F of the appendix document).

Electronic Accident Report Form

This group of recommendations includes all items related to the "creation" of the new electronic version of the accident report form.

15. TraCS SDK (Software Development Kit) Training

We recommended that South Dakota should send two programmers (one BIT and one consultant resource that will be working on the next project phase of the accident reporting system) to a TraCS SDK training session sponsored by Iowa. This recommendation has already been acted upon. Robin Schumacher (BIT) and Mark Kirk (Consultant) attended SDK training in Tennessee on July 17-19.

The TraCS SDK (Software Development Kit) is the component of TraCS that allows for the customization of TraCS to fit each state's particular needs. Understanding the capabilities and functionality of the SDK is key to the implementation of TraCS.

16. TraCS as the Accident Data Collection System

We recommend that the TraCS system that has already been developed, tested, and implemented in Iowa be used in South Dakota for the front-end data collection piece of the new accident reporting system.

The TraCS software is offered free of charge to any State that desires to use it. Although TraCS licensing is free of charge, there are still significant costs associated with configuring and implementing it. The TraCS system is a generic program that can be modified through the use of a Software Development Kit (SDK) to meet the needs of each different State's requirements for accident data collection. Rough estimates gathered from TraCS experts indicate that it could take anywhere from 2 to 4 months to "develop customized electronic forms" for any particular State form. Once the configuration process is completed, all of the normal system implementation steps must still be accomplished, for example, interface development, security development, testing, procedures development, training, installation and rollout.

Deployment of New Accident Reporting System

This group of recommendations includes all items related to the potential uses for the TraCS system beyond that of accident reporting.

17. SAFETYNET Data Responsibility

We recommend that the responsibility for entering the SAFETYNET data should be moved from the South Dakota Highway Patrol Motor Carrier Division to the Office of Accident Records.

This recommendation comes from a functional requirement that there should be a single state agency that provides accident data to both NHTSA and FMCSA (Federal Motor Carrier Safety Administration). (See Functional Requirement reference # 108 for more information presented in Appendix F of the appendix document).

18. Collecting Non-state-reportable Accident Data

We recommend that local agencies be allowed to use the new accident reporting system to store non-state-reportable accidents if desired.

There is no requirement for non-state-reportable accidents to be reported to the State. This would merely give local agencies a place to store their additional accident data (non-state-reportable crashes). This data would be filtered out of the state-reportable accidents for state-level analysis and reporting, but may still be physically stored in the state's database where local agencies could access the data. TraCS marks accidents as state or non-state-reportable. The latter are not transmitted to the DOT and remain in the local database. There is a possibility that this will increase the Office of Accident Record's workload due to more reviews for accuracy, assignment of location, direction of travel, vehicle maneuver, manner of collision, etc. Also the extra accident will only be accepted in electronic format. Office of Accident Records will not be responsible for the data entry of non-reportable accidents. This is a policy issue that must be decided by the Research Review Board and the Technical Panel. (See Functional Requirement reference # 100 for more information presented in Appendix F of the appendix document).

19. Training Strategy

We recommend that the State of South Dakota develop a thorough training strategy that includes the front end accident data collection, statewide policies, the reasons and uses behind collecting each data element (help gain buy-in), proper data collection practices, etc.

Expanded Use of Electronic Accident Report System (TraCS)

This group of recommendations includes all items related to the potential uses for the TraCS system beyond that of accident reporting.

20. Traffic Citations in TraCS

We recommend that South Dakota not only use the accident data collection functionality of TraCS, but should also use the citation functionality. Therefore State should perform a research study to determine the functional requirements of Traffic Citations and develop a "unified common citation form" that can be used by all law enforcement agencies across the State.

Iowa's TraCS system, developed primarily with state funds and some federal funds as a national model for accident data capture, has much more functionality than just traffic accidents. If TraCS is chosen for accident data capture, South Dakota could benefit from the use of TraCS' additional built-in functionality to help make South Dakota's law enforcement officials more productive. Within the TraCS user program, the accident data and the citation data are integrated, which allows for faster data entry for the officer. For the officer using TraCS, it takes basically the same amount of time to write one citation as it does to write two or more citations for the same person. Writing paper citations takes an additional amount of time for each citation, where the electronic citation does not. The biggest benefit comes from capturing and transporting the citation data electronically. This reduces error rates, cycle times in processing citations, and allows for electronic integration of citation processing systems.

21. Other Law Enforcement Uses for TraCS

If TraCS is used for accident reporting, we recommend that the State perform a research study to determine what other areas of law enforcement can benefit from the use of TraCS "form automation functionality".

It would be beneficial for the State to use more of TraCS functionality to help make South Dakota's law enforcement officials more productive, for example, by providing witness data collection and storage. This information is not required at the State level, but is required at the local level. TraCS could be used to capture and manage this information at the local level, thus making law enforcement more productive. In general terms, TraCS is a "form automation tool". This means that just about any form used to collect data by law enforcement is a candidate for an electronic TraCS form. Another example might be crime scene information gathering. TraCS is not at all limited to the current five forms (including ECCO – Electronic Citation, MARS – Mobile Accident Report, MOWI – Mobile Operating While Intoxicated, VSIS – Vehicle Inspection, and CIRF – Incident/Arrest Report) that Iowa has implemented. This project would uncover new areas to automate.

22 TraCS and ROW Automation

We recommend that South Dakota perform a research study to determine if the TraCS system or a derivation of TraCS could be used to automate the Department of Transportation Right of Way Program Area's forms.

Note: this is a tangent/off subject recommendation. Mark Kirk, just prior to working on the SD2000-14 project, worked on a Business Area Analysis for the Right of Way Program Area. A vast amount of the actual work performed in this program area deals with filling out and completing forms. There are more than 150 forms that are used during the process of acquiring right of way for highway construction. Much of the data on the forms is duplicative, but as the acquisition progresses through various stages, different forms are required. There are some specific traffic/law enforcement aspects of TraCS, but the basic function of TraCS is to automate the creation and population of forms. Therefore, we suggest that TraCS could possibly be used to automate Right of Way forms, as well.

GIS Implementation

23. GIS Implementation

We recommend that the DOT initiate a GIS implementation project, which includes an analysis of the existing documentation/inventory of roads and a re-evaluation of the city/county "grid" system used for locating/analyzing accidents.

The SD2000-14 project did not study the current methods in use by South Dakota for documenting and inventorying their roads. This study also did not evaluate in detail the current GIS pilot project performed for Sioux Falls. We do, however, recognize the value of and recommend the use of GIS for accident analysis. Therefore, we recommend that a state-level (DOT) GIS implementation using the ESRI (Environmental Systems Research Incorporated) GIS software be undertaken. In order to begin such a project, an in-depth analysis and plan needs to be developed, as GIS implementations are quite difficult and risky. A separate project to support converting existing coordinate data to GPS coordinates is necessary. Without a GIS system the use of GPS coordinates cannot be fully utilized. Without GIS system there will still need to be analysis of accident data via state coordinate system. The GIS/GPS information will be necessary to develop plot maps that document accident information currently utilized by LGA (Local Government Assistance) and the Office of Road Design. The GIS implementation project should address the issue of converting existing State X/Y coordinate data (this includes, but is not limited to, the current accident data) to GPS coordinates.

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Problem Description

The South Dakota Department of Transportation's Accident Reporting System does not meet the data collection requirements of new initiatives (CVISN, SAFETYNET, FARS – Fatal Analysis Reporting System, and MMUCC – Model Minimum Uniform Crash Criteria). The process to obtain data from the system is slow and inflexible by today's technology standards and system expectations, which results in lost productivity, longer process cycle times to analyze accident information, and ultimately the inability to use to accident data to make the appropriate decisions about how and where traffic problems should be addressed by the DOT (Department of Transportation). Generally, the data that is put into the system cannot be easily retrieved from the system. This is because not all data collected is stored electronically in the State's database, but rather some data is stored on paper and microfilm. This data, though accessible, is not very easy to access by the average user. The users of the accident data must go through a manual process to request static reports from the central office, rather than obtaining the data they need, when they need it, on their own time schedules. Other systems (SAFETYNET and FARS) that rely on accident data must elicit additional information from the officers, post-accident, in the field because the current accident reporting system does not collect all the required data. This causes longer process cycle times and an increase in the workload for processing accidents and getting the data into these national systems. The purpose of this project is to recommend an appropriate course of action – whether to enhance the current Accident Reporting System, develop a replacement system, or purchase and customize a packaged system. Actually, the recommended course of action is a hybrid combination of all three options. Legacy systems do exist that must be supported. Totally new functionality will be added and new parts will be developed. And, whenever possible, existing packaged software will be leveraged.

The following issues and concerns regarding the current Accident Reporting System were documented:

- Multiple databases, including SAFETYNET, FARS, and PS-ACCIDENT, exist that document motor vehicle crash data. Keeping these databases in synchronization is a manual effort, which consumes human resources. The new system will eliminate or reduce this tax on human resources by automating this manual process.
- Two manually prepared forms are used to record and enter accident data into the databases. There are also four FARS forms that are manually sent to the accident-reporting officer and then mailed back to the state. Once the FARS forms have been received, the data is transferred onto four different forms, called FARS coding sheets, for entry into the FARS system. This process is prone to human error and is time consuming. The new system will automate this process as much as possible to reduce these effects.
- The Model Minimum Uniform Crash Criteria (MMUCC) data capture guidelines are not met. Meeting the MMUCC guideline will put South

Dakota in line with other states by collecting the same accident data. This will allow for better cross-state analysis of traffic accidents.

- Additional data elements have been defined that should be captured, which relate to vehicle speed, vehicle weight, time of day, driver's license classification, and the latitude/longitude coordinates of the crash. The technical panel suggested that only the three ranges (0 – 10,000 lbs; 10,001 – 26,000 lbs; over 26,000 lbs) of values be collected, rather than collecting an approximate weight as suggested in the RFP (Request For Proposal).
- SAFETYNET data elements should be included in the South Dakota Traffic Accident database. This will provide a single source for accident data and allow for electronic interfacing with the SAFETYNET system. This will eliminate the manual effort of entering commercial vehicle accidents into the SAFETYNET system.
- South Dakota accident reporting system project has been included in the Commercial Vehicle Information Systems and Networks Plan (CVISN).
- All data collected (including diagram and narrative) should be included in the Accident database. This functionality eliminates the requirement to retain paper forms for analysis and documentation purposes. This will result in more effective analysis due to the availability of the information required to do the analysis.
- There are many different sources through which alcohol and drug test results are gathered and reported. There needs to be a standard way of gathering this information for the accident reporting system.

In addition, the need for both paper and electronic reporting and the need for various methods of entering data into the system have been identified as "new" system requirements. Specifically, the entry of data could be achieved through the current entry screen process, the use of electronic means such as a handheld tablet, or direct entry via a Web browser application. Any change in the current forms and/or entry process will require considerable training and follow-up of the various law enforcement jurisdictions throughout the state.

Finally, the "new" system should meet the following design concepts:

- Meet the Bureau of Information and Telecommunications technical criteria for software and database design
- Provide an easy-to-use online interface that allows an authorized stakeholder to access data regardless of their geographic location
- Transparently incorporate State and National SAFETYNET data elements
- Meet State and National CVISN plan objectives
- Adhere to the reporting requirements of the National Center for Statistics Fatal Analysis Reporting System (FARS)

Both internal and external stakeholders considered this project to be a high priority in order to meet both current and future (within six months) initiatives. The original timeframe for delivering a new form was June 1, 2001 and a new system in time for SAFETYNET 2001. These initiatives include, but are not limited to, the reporting requirements of the Motor Carrier Safety Assistance Program (MCSAP), SAFETYNET 2001, and the implementation of bar coding vehicle registrations and drivers licenses.

In general, the process that was followed to accomplish the project's goals was to:

- Perform a literature search including, but not limited to, SDDOT research projects, USDOT (United States Department of Transportation) research projects, and AASHTO (American Association of State Highway Transportation Officials) papers
- Contact and evaluate other states' Accident Reporting systems
- Conduct an Information Engineering Business Area Analysis to create general design process and data models
- Conduct workshops to develop a preliminary design for a new accident reporting form
- Prepare final report with recommendation and migration plan

This project has a high priority in order to meet the following critical requirements:

- To meet the data reporting requirements of the Motor Carrier Safety Assistance Program
- To interface with "SAFETYNET 2001" scheduled for implementation in 2001
- To interface with FARS
- To create a preliminary accident report form
- To interface with state and federal CVISN initiatives currently underway (see the Final Report for the "CVISN Top-Level Design" SD1999-16 for more detail)
- To collect additional data elements as defined in the Model Minimum Uniform Crash Criteria guidelines and previous research projects
- To include additional crash data elements such as vehicle speed, time of day, driver's license classification, and the latitude/longitude coordinates of the crash

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Objectives

The objectives stated in the request for proposal are listed below. Included with each objective is a high-level view of the approach to be used to accomplish the objective. Detailed approach discussions can be found in the next section, “Research Plan”.

1. To document the current business processes, forms, and data used for accident reporting in South Dakota's and applicable National Databases.

The project requires the documentation of the current business processes, forms, and data used for accident reporting in South Dakota and applicable national databases. Shupe Consulting will perform an Information Engineering Business Area Analysis (BAA) to accomplish this objective. A BAA is a series of interactive sessions / workshops and resulting work products conducted and developed by a team of consultants. The facilitator uses the BAA sessions to elicit information from the workshop attendees in a concise, quick manner that result in the project work products. Representatives from all internal and external stakeholder groups, including Highway Patrol and FMCSA, will be invited and encouraged to attend the workshops. All areas of accident reporting will be investigated and documented including forms, databases, data fields, reports, business processes (activities performed by all users of the information), data relationships, and data exchange between this and other systems.

This objective’s importance was lowered at the start of the project in the review of the scope and work plan meeting. The Technical Panel decided that more emphasis should be placed on documenting the future “To-Be” functional system requirements and design of a new accident report form, rather than spending a lot of project time on documenting the current “As-Is” system. This objective was accomplished to some extent, though not entirely as indicated by the Technical Panel, and did help identify processing interfaces between different systems, including FARS, SAFETYNET, and local agencies. Most of these interfaces are manual and cumbersome, which relates back to the problem that accident data is not very accessible or flexible.

2. To determine functional requirements for a single system that can record, manage, and track accident information.

A single system/database is desired by the SDDOT at this time. The system will record, manage, and track accident data, and make information available to the various internal and external stakeholders regardless of geographic location. These requirements will be discussed in and gleaned from the BAA workshops. The requirements for the new system will be specifically documented and prioritized and approved by the Technical Panel for this project.

This objective was completely accomplished. During the project, eleven days of workshops were used to gather the ideas and functional requirements for the new system. These requirements lay out what is needed in a new system to remedy the problems described in the problem description above. Specifically the requirements determined address problem areas such as, the accuracy and completeness of the data gathered and the ability to access the data regardless of geographic local. A preliminary accident report form was developed to address the problem of missing commercial vehicle accident data.

3. To define a logical data architecture to address the single system to record, manage, and track accident information.

A logical data architecture must be defined that will address the requirements identified in objective #2 for the single system. Shupe will develop a logical data model, process model, CRUD (Create, Read, Update, Delete) matrix, and workflow diagram using the diagramming and documentation tools (BPwin and ERwin) currently in use by Shupe on other SDDOT projects. The logical data model is a direct result of conducting the BAA sessions.

This objective was completely accomplished by using the information and knowledge gained from the workshops to build a relational database model. The data model was created using the State's standard data modeling tool, ERwin 4.0. The data model produced lays out the logical design for a database that has the following characteristics:

- Facilitates easy access to the data
- Allows for flexible/customized access to the types of data desired by the user
- Structured in third normal form (see "Third Normal Form" in the glossary for definition) so that the system can be modified with relative ease.
- Provides storage elements for all collected accident data

A logical process model was created using the State's standard process modeling tool (BPwin 4.0). This model illustrates the logical processes for the Accident Reporting business area. A process/entity interaction matrix was created using Excel. This diagram shows, at a high level, the interaction between logical processes and the data entities that they manipulate:

4. To develop a migration plan for designing and building an updated accident reporting system including costs, resource requirements, phasing, training needs, and time frames.

A migration plan for modifying the existing accident reporting system, designing and building a new accident reporting system, or purchasing and customizing an accident reporting system will be developed. The plan should include costs, resource requirements, phasing, training needs, and time frames. Shupe will develop this plan as a direct result of completing objectives 1, 2 and 3 during the BAA part of this project.

This objective was completely accomplished. Using all of the information gathered throughout the project, a recommended migration plan was developed and presented to the Technical Panel. The Technical Panel approved the migration plan. The migration plan produced has the following characteristics:

- Supports the CVISN initiatives by tying USDOT numbers to the accident data
- Supports the CVISN initiatives by giving the ability for officers in the field to enter accident data electronically on mobile computers in their cars. This is accomplished by using Iowa’s TraCS system, which also has built in functionality for creating citations electronically
- Includes a centralized database containing all State-reportable traffic accidents
- Allows for flexible, customizable access to the accident data by the users, regardless of their geographic location
- Supports the CVISN initiatives by allowing password admitted access to the accident data via a Web interface
- Creates electronic interfaces into the SAFETYNET system and eliminates the manual coding sheets for the FARS system
- Allows bar code scanning to reduce data entry workload
- Supports the CVISN initiatives by allowing for electronic access to accident data and sharing of accident data with other States and Federal agencies
- Supports the CVISN initiatives by reducing manual movement of data to improve efficiencies in the workforce and to ensure the accuracy of the accident data
- Allows for the collection of all MMUCC data elements, but does not necessarily require that all data elements are collected
- Supports the CVISN initiatives by combining the accident report form and the supplement form into one accident report form, thus ensuring reliable collection of commercial motor vehicle accident data

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Task Description

The following comments represent the work results of the project tasks. This section does not represent findings or conclusions – just how the work steps were performed and the resulting documentation.

<u>1. Review project scope and work plan.</u>

Meet with project's Technical Panel to review the project's scope and work plan.

This task doubled as the "kick-off" meeting for the project and a working meeting to review, discuss, and approve the proposed work plan. This meeting allowed Shupe, the DOT and the other project stakeholders, the opportunity to get to know each other and ensure that we all had the same understanding of the objectives of the project. One significant change to the project approach did result from this meeting. Members of the Technical Panel stressed that more time should be spent on analyzing the "To-Be" system requirements than on the "As-Is" system definition. With this change, the "As-Is" data model, process model, and process/entity interaction matrix (CRUD) were dropped from the project deliverables. However, an "As-Is" work flow diagram was still produced. The extra time gained from this change in approach was shifted to focusing more effort on gathering the "To-Be" requirements desired by the Accident Reporting stakeholders and re-designing the accident report form. All of the "To-Be" deliverables, including the detailed process model, detailed data model, process/entity interaction matrix (CRUD), and detailed migration plan, were produced. At the conclusion of this meeting, the modified project scope and work plan were approved.

<u>2. Review and summarize literature</u>

Review and summarize literature including other States' experiences, pertinent to accident reporting procedures, American National Standards (ANSI) D16.1-1996 "Manual on Classification of Motor Vehicle Traffic Accidents", SAFETYNET, Fatal Analysis Reporting System (FARS), and the Model Minimum Uniform Crash Criteria (MMUCC) guidelines.

The research task consisted of a mixture of several types of research techniques and resulting documentation. The types of research included:

1. Research papers reviewed and summarized – the papers are not reproduced here. Our summary is presented in the Appendix document.
2. Web sites visited – we re-printed relevant material in the Appendix document with no summary or additional notes presented.

3. Products and national and State initiatives researched - we used a combination of web site re-prints, our review notes, and/or interviews with relevant parties. Our notes are presented in the Appendix document.

The technique of research used varied by individual topic, but, in general, followed this delineation:

- South Dakota research reports – we reviewed and summarized these using technique 1.
- FMCSA research reports – we reviewed and summarized these using technique 1.
- Review of national initiatives – includes a combination of all three techniques.
- Software and hardware products – includes a mixture of techniques 2 and 3.
- State and other agency interviews – we applied technique 3.

3. Document current processes and define the functional requirements

Conduct workshops with the Technical Panel, affected agencies, local governments and other stakeholders: a) to understand current processes, forms, and data; b) to define the high-level functional requirements; and c) to identify candidate improvement opportunities for the current and proposed accident reporting forms and system.

There was a heavy emphasis placed on conducting workshops to gather the functional requirements for a new accident reporting system. The workshop participants came from the different agencies (public and private) and interested parties involved in accident reporting. During the project, a total of eleven days were spent conducting workshops.

During the week of April 2, 2001, three days were spent on diagramming the current workflow for the current ("As-Is") business processes. During these sessions, the three functional areas, Accident Recording, Accident Reporting, and Accident Analysis were defined and documented. The stakeholders in attendance provided excellent participation and input.

During the week of April 9, 2001, three days were spent in Pierre to determine the future ("To-Be") candidate improvement ideas. Four different workshop strategies were employed to elicit ideas and discussion:

- "Customer Based" perfect process outcome
- "Information Technology based" Ideas
- "Rule Breaking"
- "Redesign Principles"

During the week of April 16, 2001, two days were spent in Sioux Falls, and one day in Rapid City to determine the "To-Be" candidate improvement ideas. These workshops utilized the same strategies as the workshops conducted in Pierre. As in Pierre, participation and input were excellent. By the end of the six days of workshops, more than 180 candidate improvement ideas had been produced. These ideas are presented in Appendix F of the appendix document.

On May 14-15th, a sub-group of the Technical Panel reviewed the data element list to determine which data elements were needed and how the data would be obtained. If it was determined that indeed the data element was needed, then the data is either **collected** on the accident form, **derived** based upon other data, or **linked** from existing databases. The approved data elements are presented in Appendix G of the appendix document.

On June 5, 2001, a workshop was held to gather accident report form design ideas. Prior to the workshop, a "straw-man" re-designed form was developed. The workshop participants were primarily the front-end accident data collection stakeholders (i.e. Highway Patrol, Police, and Sheriff's department). The ideas are documented and presented in Appendix H of the appendix document.

4. Review and approve workshop findings

Provide a technical memorandum and meet with the Technical Panel to review and approve the workshop findings.

Due to a number of factors listed below, the format of this task was modified.

a) High volume of 180 candidate improvement ideas to review and approve
b) Candidate improvement idea workshops were still in progress in Sioux Falls and Rapid City
c) Compressed timeline of this research project
d) "Tentative" list of candidate improvement ideas delivered with only 2 days to review (due to items a, b, and c above)

For these reasons an alternate method for approval was taken. A sub-panel of key members from the Technical Panel held meetings to approve the candidate improvement ideas, and then distribute the "tentatively approved" ideas to the entire Technical Panel for review, comment, and final approval. As a result, out of 180 total candidate improvements, 90 improvement ideas were approved, and these ideas guided the development of the detailed functional requirements, data model, and system migration plan.

5. Data elements for approved candidate improvements

Develop detailed business requirements, data elements, processes, definitions and relationships for the approved candidate improvements.

This task was an ongoing task to create several outputs. During the analysis of MMUCC, FARS, SAFETYNET, PS-ACCIDENT, and CVARS data requirements, data mappings were created. The data mapping documents the data similarities and differences between the different systems. This became the basis for determining the data elements required by these systems and standards. The required data elements are present in Appendix G of the appendix document.

The definitions of the data elements followed the ANSI D16.1-1996 standard where possible. All definitions list the source of the data element, whether from MMUCC, FARS, etc.

At the same time as the data elements for the approved candidate improvements were being developed, the initial data model, including the relationships that exist between the different data entities, was being created.

6. Approve the data structures

Provide a technical memorandum and meet with the Technical Panel to approve the information developed in Task 5.

Due to project workload and time constraints to produce the deliverables for this task, the review of the detailed data model, detailed business area process model and process/entity interaction diagram was moved to and fully completed in task #8.

7. Define logical data architecture

Define logical data architecture for the proposed accident reporting system.

Using all of the information gathered to this point in the project, two diagrams were produced for task #7. Using the State's standard tools for data modeling and process modeling, ERwin and BPwin, we created a logical data model and a logical process model.

The logical data model is an Entity Relationship Diagram. Developing the data model was a continuation and further development of the data model that was started in task #5. The data model used the approved candidate improvements and approved data elements as direct input into designing a logical data model that would support these new approved functional requirements. The data model is listed in Appendix I of the appendix document. The logical process model is a Data Flow Diagram and is listed in Appendix J of the appendix document. The process/entity interaction matrix was created using Excel and is presented in Appendix L of the appendix document.

8. Approve the proposed data architecture

Meet with the Technical Panel to review and approve the proposed data architecture.

The following items were reviewed and approved: proposed data architecture, detailed business area process model, and the detailed process/entity interaction matrix (CRUD). A preliminary traffic accident report form was presented and, lastly, the preliminary migration plan was presented, reviewed, and discussed. However, since there was a need for additional information on the migration plan cost and resource requirements, no decision was reached regarding the migration plan. Subsequent meetings were held with key Technical Panel members to obtain the required additional information. Questions were answered regarding the Information Review Board's project prioritization, the Bureau of Information and Telecommunications hardware and software strategy, and the appropriateness of using a middleware software system to provide communication between mainframe and SQL Server databases. The updated migration plan was sent to the Technical Panel by email for review and comment. The panel responded and gave tentative approval of the plan. It is estimated that final approval will be made at the final Technical Panel review meeting.

9. Develop and recommend a migration plan

Develop and recommend a migration plan for designing and building the approved accident reporting form and system including costs, resource requirements, phasing, training needs, and timeframes.

There are three different migration strategies that were considered: 1) Modify Existing System, 2) Construct New System, or 3) Purchase System & Customize. All three migration options were considered separately, but it became clear that any effective migration plan would include elements from all three. Therefore, the recommended migration plan presented to the Technical Panel was a hybrid strategy combining elements from all three strategies. The recommended migration plan, along with the three separate strategies, is documented in the Recommendations section of this report. The migration of the accident records system relies on the implementation of a GIS/GPS system. The accident records system as proposed cannot be fully implemented without a GIS/GPS system. Additional migration plan documentation is presented in Appendix D & E of the appendix document.

10. Submit Final Report and Executive Summary

Submit a Final Report and Executive Summary including findings, methods, conclusions, functional requirements, and recommendations. Deliverables will

include an entity relationship diagram (as-is), process model (as-is), and detailed Entity Interaction CRUD matrix (Created, Retrieved, Updated, Deleted)(as-is). Deliverables will also include a detailed process model (to-be), detailed data model (to-be) (using ERwin data modeling tool with every field defined), and a migration plan, with the final copies packaged together.

Because of the shift in importance to the future system, less time was spent on the current system (as previously described in Task #1 above). Therefore, all of the "As-Is" deliverables, as indicated immediately above, were not produced. However, the "As-Is" work flow diagram was developed at the beginning of the project. The Technical Panel agreed with and approved the approach change that resulted in these deliverables not being produced. All the other "To-Be" deliverables were produced and are included in the Appendix document.

11. Make an executive presentation

Make an executive presentation to the Technical Panel and the Research Review Board at the conclusion of the project.

This task was accomplished on August 16, 2001.

Findings and Conclusions

1. Re-designing the crash report form has many inherent challenges

Finding: There are conflicting constraints and outstanding issues to be decided concerning the accident report form design.

- There is a very strong desire by the law enforcement officials that use the traffic accident report form to limit the size of the main form as well as any supplements (i.e. the truck/bus form) to one double-sided piece of standard sized paper. (During the Technical Panel Final Report Draft review meeting on July 25, 2001, the law enforcement officials present expressed flexibility on this point. The impact of the one-page form constraint on the form design was discussed.).
- We did not find a State that accomplished 100% MMUCC compliance on a one-page form that was designed to allow the use of an overlay. There were one page forms, but none that matched the desires of law enforcement in South Dakota and the “approved” functional requirements of the new accident reporting system determined by this research project.
- The officials are also concerned about not spending any additional time coding more information than what they already do today.
- There are also conflicting requests among the various law enforcement agencies concerning witness information and design layout.
- The manner in which certain law enforcement and project team members requested to see data physically displayed on the form conflicts with our recommended layout of the form, which is a “normalized” approach. In general, normalization refers to the concept of grouping related data elements together and not inter-mixing non-related elements (such as data on vehicles mixed with data about people).
- Some MMUCC-compliant data is subjective and may not be reasonable to collect.
- It needs to be decided whether color will be used in the printing process of the new form. This has a large impact on the usability of a single form for both wild animal hits and all other accidents.
- The accident report must be designed to allow the use of an overlay for codified boxes due to the limited size of the form and as a direct request of all parties involved to use this technique.
- There are conflicts between MMUCC and FARS regarding the same or similar data elements with respect to their definitions and number of occurrences. MMUCC has priority when a conflict arises between MMUCC and FARS. There are still some data element coding definitions to be approved prior to the completion of final design.

These constraints taken together produce a very difficult task to undertake.

Conclusion: Although we have a preliminary form design, more time needs to be devoted to form design.

2. Development costs for the front-end accident data collection need not be expended

Finding: In this project several existing accident collection software packages have been evaluated. Of the packages evaluated, there was only one package, Iowa's TraCS, which seems to have the majority of the desired functionality built into the current product. To date, the TraCS project team has expended $5 million on analysis, design, and development of the system software. This $5 million does not include hardware implementation costs (cost to equip cars and agency offices). It does include costs for evaluation of hardware platforms. The front-end accident data collection development represents a significant investment that other states need not repeat.

Conclusion: Developing a new front-end data collection portion of the accident reporting system is cost prohibitive and is not necessary given the availability of other systems. Note: TraCS is not an effortless implementation. The software has been developed and is free, but there will still need to be a considerable effort to configure the software using the SDK (Software Development Kit) that comes with TraCS. However, this effort's cost is much lower than developing the software from ground zero.

3. The current accident data repository is incapable of providing end-user customized data access

Finding: The current PS-Accident system relies on technology that does not support the requirements for crash reporting as defined by this project. Due to the non-relational structure of the ADABAS database, it is not easily adaptable to end-user data input or retrieval. Also, specialized technical expertise is required to access this database.

Conclusion: A new architecture needs to be developed to support the crash reporting business area (data collection, reporting, and analysis). The new architecture will meet the data access needs of the end-users. With the increased ease and flexibility of access to the data, back-end analysis users will be better enabled to do their jobs. The electronic nature of the new architecture will allow more online analysis and less need for paging through thick paper reports trying to answer basic questions about accident-related problems.

4. TraCS offers a head start on electronic citations and other forms-based processes

Finding: Iowa's TraCS system has electronic citation creation functionality already built into it. The only paper involved in the system is the hardcopy of the citation that the officer prints out for the offender. All the citation information is electronically fed into Iowa's state systems. The system also comes delivered with a toolkit capable of supporting the development of virtually any type of form-based process. This could be used in a number of other business areas such as crime scene data capture.

Conclusion: If the TraCS system were implemented, it would give South Dakota a head start on implementing an "electronic" citation system. There would still need to be analysis done to do accomplish this, but the overall effort to get this CVISN goal accomplished would be reduced. Additionally, the TraCS system can be used for any number of other paper-based forms in South Dakota.

5. Existing software can be used for collision diagramming

Finding: South Dakota DOT's current collision diagramming software is Intersection Magic. This software is currently the market leader and is one of only three commercially available packages that we could identify. The vendor is quite willing to work with South Dakota to modify/enhance the software to meet any of South Dakota's business requirements that are not currently being met by their package.

Conclusion: South Dakota DOT should be able to successfully continue their use Intersection Magic for collision diagramming.

6. CVISN (Commercial Vehicle Information Systems and Networks) is only partially supportable at this time

Finding: CVISN (including CVARS) is still in a fairly early stage of design. While the vision is fairly well defined, the exact architecture and design are not yet finalized. Some parts of CVISN are supportable.

Conclusion: The crash reporting project should continue forward without trying to second-guess what the final CVISN architecture would look like. However, this is not to say that CVISN should be ignored – on the contrary, the vision should be kept in mind at all times while a new crash system is developed/implemented. The new system design does support CVISN in the following ways:

- Gives the ability for officers in the field to enter accident data electronically on mobile computers in their cars. This is accomplished by using Iowa's TraCS system, which also has built in functionality for creating citations electronically
- Allows password admitted access to the accident data via a Web interface
- Allows for electronic access to accident data and sharing of accident data with other States and Federal agencies

- Reduces manual movement of data to improve efficiencies in the workforce and to ensure the accuracy of the accident data
- Combines the accident report form and the supplement form into one accident report form, thus ensuring reliable collection of commercial motor vehicle accident data
- Provides a platform for a future electronic citations system

7. GIS (Geographical Information System) will provide benefits to the DOT

Finding: GIS systems are being widely used by governmental agencies throughout the US for many applications, including crash and safety analysis. GIS offers proven benefits such as the ability to incorporate non-traditional databases (population characteristics, zoning ordinances, land use) into problem identification and analysis; and evaluation using spatial relationships is better and faster than using traditional plots and tabular data. South Dakota completed a pilot project of GIS crash analysis for one city. The software chosen for this pilot is the market leader for this segment of the software market, ESRI's (Environmental Systems Research Incorporated) ArcView and ArcInfo. The SDARS (South Dakota Accident Reporting System) project team defined several requirements that can only be met by a GIS application. Our experience and research suggests that GIS projects are rather difficult and require a high degree of planning and expertise to be successful.

Conclusion: The products chosen by South Dakota for the pilot are the best on the market and should be part of the total crash reporting system architecture and strategy. However, additional analysis and planning work will need to be completed to properly support such an implementation. A separate project to support converting existing coordinate data to GPS coordinates is necessary. Without a GIS system the use of GPS coordinates cannot be fully utilized. Without a GIS system there will still need to be analysis of accident data via state coordinate system. The GIS/GPS information will be necessary to develop plot maps, which document accident information currently utilized by LGA (Local Government Assistance) and the Office of Road Design.

8. An updated statewide radio/communications system is needed

Finding: During this project, there were numerous discussions and issues raised regarding the stability and usability of the current statewide radio system. The SDARS project scope does not include any research or work effort related to this topic, but we are documenting the issue since it is apparently something that needs to be addressed. A radio (or other communications system) is an integral part of the entire law enforcement process and as such, can have implications for effective accident location identification and capture of response/arrival information. The Governor has approved the implementation of a new state radio system.

Conclusion: The current radio system is not adequate. An effective solution will provide added benefits for the accident reporting system and related business processes. Further investigation of the "new" statewide radio system needs to be performed.

9. GPS (Global Positioning System) devices will provide benefits to South Dakota

Finding: During this project, there was much discussion regarding issues in properly designating the location of accidents. The use of GPS devices can help resolve some of these issues. GPS also has broader uses, such as being the locator device used in AVL (Automatic Vehicle Location) systems. Prices and capabilities of GPS devices and systems vary widely from basic handheld units providing only coordinate data on a display (approximately $200 per unit) to fully integrated systems with engineering measurement devices, location coordinates, data capture software, etc. (approximately $7,000 per unit).

Conclusion: The local agencies should be encouraged and permitted to determine what GPS device(s) they want to procure. At the state-level, GPS-enablement of crash location identification should be provided for in the new crash data collection front-end software.

10. Inefficient use of resources exists in the current business processes

Finding: There are several manual, paper-based and/or inefficient processes in the current accident reporting business area. Examples include:

- FARS forms and data handling
- SAFETYNET forms and data handling
- Truck/bus supplemental forms handling
- Crash report forms handling
- Report imaging
- Report generation and distribution
- Data inquiry/access

Conclusion: These processes can be relatively easily addressed and made much more efficient through the implementation of a new data and systems architecture. Taken together, the automating of these manual processes will result in reduced workload requirements, freeing up state, county, local, and private personnel to spend more time on value-added processes (traffic accidents, analysis of traffic problems, analysis of unsafe drivers, etc). The new system will capture the accident data electronically once, effectively eliminating the time consuming manual movement of data via paper and keyboard entry.

11. State-level processes and policies are not being adhered to across all jurisdictions

Finding: Not all of the law enforcement agencies apply the crash reporting policies and procedures in a uniform manner. For example, the BIA (Bureau of Indian Affairs) does not currently report accidents unless they are "very serious or fatal". Many accidents that meet the state-reportable criteria go unreported as a result. The BIA Technical Panel representative expressed interest in implementing the state standards. Another example of inconsistent application of procedures is that the truck/bus supplemental form is not always filled out. Some of these issues are simply a matter of training, while others result from a conflict in policy between agencies.

Conclusion: The training effort for the rollout of the redesigned crash report form and data collection system needs to include a review of certain state policies and procedures. The training effort should include training on ANSI D16.1-1996 – Manual on Classification of Motor Vehicle Traffic Accidents. Through better education, adherence to policies will be more likely.

12. Squad car mobile data systems and handheld devices are rapidly becoming the norm in other states

Finding: Many local law enforcement agencies across the country are outfitting their squad cars with mobile data systems (MDS) and/or handheld devices (such as palm pilots). These devices have a number of potential and actual uses including crash reporting, traffic citations, crime scene data collection, email/chat, dispatch notification, AVL, etc. There are currently different radio systems in use across different jurisdictions. These need to be standardized so that all jurisdictions can communicate with each other better.

Conclusion: Any new systems or architectures implemented at a state level should include enablement for such devices. There also needs to be a BIT standard for hardware acquisition.

13. MMUCC has developed a good standard but it is not followed 100%

Finding: The MMUCC guidelines have greatly benefited this project by providing a well-defined standard for terminology and data element collection rules and code values. However, there are a few data elements that other MMUCC-compliant states do not collect or may derive and some that South Dakota will likely not be collecting. Example: Non-injured passenger information needs to be looked at closely.

Conclusion: MMUCC is a guideline. As such, it is reasonable for any state to deviate from the guideline as long as sound logic is applied to the decision, and given that the decision does not have an adverse effect on the ability of national initiatives to compile data from the states.

14. Many commercial vehicle supplemental forms are not completed

Finding: According to the SD1999-05 (Identification of Methods for Truck Crash Reduction) final report, one-third of commercial vehicle accidents in South Dakota go unreported to the national MCMIS (Motor Carrier Management Information System) database largely because the truck/bus supplemental forms are often overlooked by local law enforcement agencies. This conclusion was supported in the SD2000-14 (Unified Reporting of Commercial And Non-Commercial Traffic Accidents) study. The result is that both state and national initiatives involved in trying to address and improve commercial vehicle safety do not have complete information.

Conclusion: Combining the truck/bus supplemental form with the main crash report form will reduce if not eliminate this problem of under-reporting.

15. The new crash system should support abnormal accidents at intersections analysis

Finding: According to the SD1998-12 (Identification of Abnormal Accident Patterns at Intersections) research report, expected value analysis tables were produced for identification of abnormal accident patterns at intersections. In the future, updating the expected value analysis tables will be necessary. The tables will be updated with new accident records so that the values remain up to date. The updated tables will then be compared with the old tables in determining if the necessary actions are being taken to make the roads safer.

Conclusion: A new crash reporting system needs to be able to provide data to the process defined by the SD1998-12 (Identification of Abnormal Accident Patterns at Intersections) research project to update this data.

16. The new crash system should support ARF (Accident Reduction Factors) and SRR (Severity Reduction Ratio) analysis

Finding: According to the SD1998-13 (Development of South Dakota Accident Reduction Factors) research report, Accident Reduction Factors (ARFs) and Severity Reduction Ratios (SRRs) were developed for the South Dakota DOT. Future Hazard Elimination and Safety projects were recommended to be analyzed and added to the existing data as the projects are completed. The goal is to have at least ten accident locations per improvement type. The study also recommended that the Microsoft Access™ database used by that researcher should be redesigned to streamline the data-entry and calculation process. The design should include a form to enter and display all relevant data and calculations.

Conclusion: The new crash reporting system needs to provide the data to be able to calculate the ARF for each of the improvement types identified in the report.

17. FARS Issues

Finding: The FARS system does not have an electronic interface through which a new accident reporting system could automatically transfer data into the FARS system. The only interface into the FARS system is via manual data entry into the FARS system. As the FARS data collection process is performed today, there is ample room for human error. First, additional accident data is corrected weeks after the accident has occurred. There are a total of six forms that the FARS analyst transfers data from to four other forms. After this manual movement of data to the four forms, the data is manually entered into the FARS system. Additionally, the FARS system and forms are updated annually. The updates to the FARS system are not in place until February or March each year.

Conclusion: Automating data movement from the accident reporting system into the FARS system will be less than what was desired, because there will still be one manual data entry step in the process. What the new system can do is to automatically create the FARS coding sheets. These are the sheets from which the data is manually keyed into the FARS user interface. Doing this will reduce one leg of the manual movement of data, and thus decrease the risk of human data entry errors. Due to the annual system updates of the FARS system, there will be difficulty in entering the data for the first 3 months of each year.

18. SAFETYNET Issues

Finding: The SAFETYNET system does have an electronic interface through which a new accident reporting system could automatically transfer data into the SAFEYNET system. Currently, the two accident forms are duplicated and sent to the SDHP Motor Carrier Division. Then the SAFETYNET administrator manually enters the data. This manual movement of data provides room for human error and takes additional time to complete the data entry.

Conclusion: Automating data movement from the accident reporting system into the SAFETYNET system is possible and will reduce human error and cycle time to get accident data into this national system. This will result in a considerable reduction in time required to enter commercial vehicle accident information into SAFETYNET.

19. Bar code and magnetic strip codes and scanners should be incorporated in the final system design

Finding: The general consensus of the SDARS project team was that bar codes should be utilized to the fullest extent in enabling more accuracy and faster data collection. For example, state driver licenses are now issued with a scanable magnetic strip. Commercial vehicle registrations are bar coded, and the newly designed crash report form has a bar coded, pre-printed accident number on it. Other agencies are making use of portable scanners and coded information to enhance the data collection process.

Conclusion: Bar code and magnetic strip coding and scanning should be incorporated in the design of the new crash system.

20. There is confusion and inability to properly collect correct commercial vehicle information

Finding: The commercial vehicle information (carrier name, carrier identification, etc.) is not completely standardized across the commercial industry and is not always obtainable from the drivers. Therefore, the law enforcement officers cannot always obtain the information. Additionally, not all officers are completely aware of how to obtain the correct information. This results in a lack of or incorrect information at the state and national levels and results in manual effort to try and resolve the problems. While the solutions to some of these issues are out of our control (such as lack of consistent carrier identification numbers), some are resolvable. Additionally, a national initiative is underway to use a common US DOT number for all commercial vehicles, which will eliminate the identification problem. Also the use of PRISM (Performance and Registration Information Systems Management) will help resolve the problem of correctly identifying the “responsible” carrier.

Conclusion: By clarifying the data fields on the new crash report form and through proper training, the implementation project team can successfully address some of these issues.

21. National initiatives will be better supported via South Dakota having better/new systems and procedures

Finding: South Dakota does not consistently collect all of the data needed to support national initiatives such as FARS and SAFETYNET. Additionally, these initiatives are updated from time to time, thus resulting in additional data to be collected. The current systems architecture and business processes result in incomplete information and difficulty in updating the systems to allow for new data to be collected.

Conclusion: A new system that is built on relational and component-based/object-oriented technology will provide greater system flexibility allowing for an increased ability to stay current with national initiatives. New processes and technology will also facilitate better data collection via automated system uploads.

22. Law enforcement training needs are much broader than just how to use a new form

Finding: There are multiple problems regarding accident data collection caused by human error, confusion, or lack of knowledge. For example, accident locations can be miscoded, not all state-reportable accidents are reported, codes are entered as “other” with no explanation, and commercial vehicle identification is confusing and often wrong/missing Research participants identified law enforcement training as a means to address these issues.

Conclusion: The training for law enforcement officers that results from the eventual accident data collection system implementation project should include more than just “how to use the new form/system”. Policies should be reinforced and methods for properly capturing correct and useful data should be taught.

23. The safety of commercial carriers is a national problem that all states need to address and support national efforts dealing with the problem

Finding: Commercial vehicle safety has become an issue that the general public is more and more aware of and concerned about. Several research studies have looked into factors affecting safety and made recommendations on how to deal with them.

Conclusion: It is incumbent on South Dakota, as a good government citizen, to fully support national initiatives designed to track and improve commercial vehicle safety. Therefore, a new crash reporting system/process should be careful to encourage proper data collection and system integration with state and national databases dealing with commercial vehicle safety. Real-time safety information, including crash statistics for carriers and drivers, should be available to all law enforcement and trucking industry personnel so that they can take proactive and reactive measures to improve the safety on our nation's highways. In addition, law enforcement training should reinforce correct data collection regarding commercial vehicles involved in accidents.

24. Use TraCS diagramming tool and other software for accident diagramming

Finding: The term "accident diagramming" can include two types of diagrams – 1) sketches done on all state-reportable accidents (not to scale), and 2) accident reconstruction, scale drawings. There are many accident-diagramming tools on the market – some serving one function, some serving the other function, and some serving both functions. Iowa's TraCS system has a good, easy-to-use accident-sketching tool. However, the TraCS diagramming tool is not designed for reconstruction diagrams.

Conclusion: Assuming TraCS is the chosen front-end data collection system, its built-in sketching tools will meet the basic needs of South Dakota. Since reconstruction diagrams are not part of the state-level crash report, the local law enforcement agencies should continue to determine their own needs in this area and procure solutions that meet their needs. Reconstruction software is not part of the crash reporting system or process as currently defined for the implementation project.

25. OLAP (Online Analytical Processing)

Finding: Online Analytical Processing (OLAP) – also known as business intelligence – is a fast-growing segment of the software industry. OLAP provides the ability to perform graphical analysis of data using multiple simultaneous criteria (or dimensions) such as time, scenario, category, geography, etc. For example, OLAP will enable crash analysis using a combination of user-defined variables such as time (by hour of day, day of week, month of year, holidays, etc.), type of intersection, type of crash, people involved, factors involved, weather conditions, etc. All or any of these factors can be merged in an endless variety of combinations. This information can be summarized or displayed in detail using drill-down to obtain further granularity of various analyses. OLAP results can be displayed as tabular or graphically. The implementation of OLAP would satisfy several analytical requirements documented by the SDARS project team. Without OLAP, some of these requirements will likely remain unmet.

Conclusion: OLAP functionality should be part of the new system's architecture.

26. States have had mixed results implementing new crash report technologies

Finding 1: Louisiana and Kentucky developed OCR (optical character recognition) based crash forms. Other states and local agencies have also tried OCR. While there may be success stories, we did not uncover any. All the project teams we talked to abandoned their OCR efforts.

Conclusion 1: We do not recommend incorporating OCR into the re-design of the crash report form or in the systems architecture

Finding 2: Louisiana Web-enabled their crash form with mixed results.

Conclusion 2: South Dakota should take a wait and see approach on Web input of accident data for two reasons - 1) the TraCS development team is looking into Web-enablement; and 2), we may find that the TraCS interface in its current state, without Web access, is actually sufficient to meet the needs of data input. This is not to say there is no access to the accident data via the Internet, just no input of accident data via the Internet.

Finding 3: Iowa has successfully developed a PC-based crash report data collection system, as discussed elsewhere in this document.

Conclusion 3: A PC-based data collection system is a viable alternative to paper-only forms.

27. Kentucky's eCRASH does not support the functional requirements of the new system

Finding: There is no SDK provided with eCRASH to allow South Dakota to make modifications to the type of data collected or the values of the data to be collected. Any modifications/customizations must be done natively (hard-coded) rather than done externally through a SDK. Unlike Iowa's TraCS, there is no common information manager in eCRASH. Information such as carrier name/address must be re-entered for each new accident. Location coordinates can be manually input as displayed from a GPS device.

Conclusion: eCRASH does not support the functional requirements of the new accident reporting system and, therefore, is not a viable alternative to consider.

Implementation Recommendations

The twenty-three recommendations developed by the project team are organized into groups of related items.

Migration Plan

The following recommendation describes the recommended approach for accomplishing a migration to a new accident reporting system.

1. Migration Plan

We recommend that the research project's documented migration plan be approved in order to proceed to the next phase in the accident-reporting project.

The Migration Plan to design, construct, test, and implement a new Accident Reporting System that supports the functional requirements as determined by this research project is described in the following pages.

There are three migration alternatives:

- **(Modify Existing System)** Modify or Use the existing South Dakota Accident Reporting System.
- **(Construct New System)** Build a new Accident Reporting System.
- **(Purchase System & Customize)** Buy a packaged Accident Reporting System and customize it. Note: The software package may be free; i.e. TraCS. This option may also refer to the use of software that has already been purchased by the SD DOT, but is not currently being used for the stated function. An example of this is the use of Seagate Crystal Reports. The software is owned by the DOT, but is not used for accident reporting.

As we considered each of the alternatives, the distinction between the three choices became less defined. The recommended plan is actually a hybrid combination of all three and is as follows:

- For the front-end "Accident Data Collection" use TraCS (the Iowa system). **(Purchase System & Customize)**
- For the "Accident Data Repository", build a new database structure to centrally store the data collected using TraCS. This Accident Reporting database should use a RDBMS (Relational Database Management System). The State standard RDBMS is Microsoft SQL Server, which would serve as the "master" database for the Accident Reporting data. All other systems would get data from this database. Note: The old accident reporting database

(not the old accident reporting programs, just the data) on ADABAS will still need to be populated with data from the new system to support other existing non-accident reporting legacy systems that expect to find data in this file, such as RES, Drivers License, dROAD, etc. But from the new accident reporting system's perspective this database no longer exists, and is not required for the accident reporting system to function. Keeping the "old" accident reporting database populated with data is an interim solution to keep old legacy systems running until such time that BIT puts in place the "new" middleware solution that is currently under development. When this "new" middleware solution is put in place, then each legacy systems should be prioritized and scheduled for migration to the middleware solution. Once all legacy systems have migrated to the middleware solution, the "old" accident database will be entirely removed from the production system and not accessible. **(Construct New System)**

- For "Accident Reporting" buy/use existing reporting software packages. There are many commercial reporting tools readily available, including: Seagate Crystal Reports (State Standard) and Microsoft Access, among others. **(Purchase System & Customize)**
- For "Collision Diagramming" continue to use Intersection Magic. **(Modify Existing System)**
- For "Geographic Information System" GIS use the existing State standard. ArcInfo/ArcView is already in place and is the market leader in this area. **(Modify Existing System)**
- For "Statistical Analysis and Online Analytical Processing" use both the existing State standard "SAS" and supplement it with either Microsoft OLAP Services or Hyperion Essbase. **(Modify Existing System** & **Purchase System & Customize)**

Discussion of the three migration alternatives

At this point we must take a moment to address an issue. The issue/question is "Where is the side-by-side comparison of the three separate migration alternatives?" The answer to this question is that the side-by-side comparison resulted in plans that looked almost identical. (For your reference, the comparison we did create is in Appendix E of the appendix document). We started by developing a migration plan to "modify the existing State system" (the "modify" plan) and then proceeded to develop a migration plan to "construct an entirely new system" (the "new" plan). What we found while developing the "new" plan was that both plans had basically the same components required to support the functional requirements of the new system. In essence, the same components would have to be built for both the modify plan and the new plan.

The components that were common between both plans are:

- Front-end accident data collection
- Web access

- Ability for end-users to create customized queries
- Automating the SAFETYNET and FARS interfaces
- New end-user initiated and customized reports
- Use of OLAP (online analytical processing) for analysis

The major difference between the two plans is where the database resides, whether on a mainframe platform using ADABAS or on a client/server platform using Microsoft SQL Server. Below is a comparison of this difference.

The "Modify" Plan (ADABAS database on a mainframe platform)

1. The current implementation of the Accident Reporting database is not relational and does not support the functional requirements of the new system (i.e. Web access, user customized query access, easily enhanceable, etc). To meet these functional requirements, the existing database must be completely redesigned and re-implemented. The database would no longer exist in its current form.
2. Currently, third party middleware is used to provide Web access to existing ADABAS databases. This access only provides static HTML pages without query capabilities. Web browser access to ADABAS is not a skill set readily found in the programming marketplace.
3. The ADABAS database environment has been used exclusively in mainframe environments for approximately 20 years. It does not have the functions or features normally required to support a Web based application.

The "New" Plan (SQL Server database on a client/server platform)

1. This database will be designed and implemented to meet the functional requirements of the new system. This is essentially the same process that would occur in the modify plan (see bullet #1 above).
2. The expertise to utilize SQL Server for Web access is possessed by the State, and SQL Server Web expertise is a common skill set found in the programming marketplace.
3. SQL Server is designed for Web-enablement, is fully integrated with the Microsoft WEB Server environment, and is a market leader in Web system deployment in the United States and the world.
4. Microsoft SQL Server is a component within the Bureau of Information and Telecommunication's strategic technical architecture.

Given this single difference between the modify plan and the new plan, clearly the implementation of SQL Server on a client/server platform is the best choice. The cost of building a new ADABAS database is approximately the same as the cost to develop a new SQL Server database. We have estimated the detailed design and construction of the "physical database" to be approximately $14,400. However, there is a significant difference between the costs to develop a Web interface to the ADABAS database versus the Microsoft SQL Server database. The ADABAS interface would rely on using middleware, which would require additional development effort versus Microsoft's integrated development environment, which requires minimal development effort.

Finally, we evaluated the third alternative - "purchase and customize" a system. This is easy to answer. There is no package in the marketplace that includes all three functional areas of accident reporting (Accident Recording, Accident Reporting, and Accident Analysis). Therefore, this alternative was not a viable solution. However, what does exist is TraCS for the Accident Recording function. Our recommendation, already stated elsewhere in this report, is that TraCS be obtained from Iowa. There is no purchase cost for the software, it has been implemented in Iowa it is being pilot tested in several other states, and it meets the vast majority of the functional requirements for the front-end data collection process.

Discussion of the Migration Plan Project Plan

The objective of the migration plan is to provide a roadmap and vision for the implementation of a new Accident Reporting Form (manual and electronic), a central database, electronic interfaces, and enhanced reporting capabilities, all within a reasonable timeframe. As such, the approach used to accomplish this objective is to have project team members working on as many tasks concurrently as possible. The project plan reflects this approach in that the Accident Report Form design is completed, printed, and tested while the design and construction of the Accident Records Database is underway, and the customization of the TraCS system is in progress.

When these three phases are complete, the project enters a "pilot" phase where one office will receive the new form, TraCS system, training, and mentoring to "test" the new system. When the initial "pilot" phase is complete, the results are evaluated, the system modified as needed, and the system re-installed at the first site and also a second site for the second "pilot" phase. Again, at the end of the second pilot, the results are evaluated, modifications are made and the system is re-installed in both "pilot" sites. However, the system would then be installed in two additional sites to perform final testing over a one-month period. Upon completion of this "beta test", the system may again be modified and is now ready for general distribution.

When developing the migration plan, the following assumptions were made:

1. Scheduled availability of Accident Reporting Department staff and other stakeholders involved (i.e. Highway Patrol, Sheriff Departments, City Police, Trucking Association, etc)

2. Availability of three consultants with the requisite development skills to work on the project as scheduled
3. Scheduled availability of hardware and technical support staff to perform the TraCS hardware and software installations as planned during the system development project
4. Timely approval of the paper and electronic accident reporting form layout and codes
5. Availability of adequate hardware resources for development and testing
6. Availability and "buy-in" of the initial pilot agencies to use the system in a "test" mode
7. Availability of a Technical Panel or DOT sponsor who can resolve issues and facilitate the decision making process
8. An additional project would be required to develop a GIS/GPS system.

General distribution of the system will be accomplished in two phases. The first phase will be the training and general implementation of the new paper form to those agencies that do not opt to install the hardware and software required to use TraCS. The training and installation of the Accident Reporting Database system will also occur in this phase. The second phase will be the installation and training for the TraCS implementations. Both phases can occur simultaneously. The issue with any implementation plan resulting from this project is the unknown number of TraCS installations, which directly affects the cost and installation timetable. May need to have a contractor handle the installation of hardware and software for local agencies, because BIT typically does not do work for non-state entities.

Benefits to be realized from the implementation of this Migration Plan

The proposed migration plan is designed to provide for the implementation of a system and architecture that will provide benefits such as:

1. Eliminate manual re-keying of data, resulting in saved work time, and elimination of human data entry errors in the following areas:
    a. FARS
    b. SAFETYNET
    c. Paper form and notes to final form sent to the State
    d. Sending paper forms from the State to local agencies to collect additional data
2. Provide more complete, accurate, and timely accident data that can be easily accessed and used
    a. Eliminates the reliance on the Office of Accident Records to handle and process all reporting and data requests

   b. Allows users to produce their own customized reports and queries that answer the questions they need answered - (no longer dependent on existing pre-defined reports that must be manually analyzed)
3. Store all accident data electronically, which:
   a. Eliminates time needed to find all current documents that are either paper or electronic
   b. Eliminates lost information
   c. Provides timely availability of information
   d. Ultimately allows for the new system to be entirely paperless
   e. Allows for the easy transport of data regardless of geographic location
4. Verify data/codes at time of electronic entry at the accident scene rather than after the fact in the office
5. Provide a high level of compliance with MMUCC
6. Automate the follow-up of outstanding reports and incomplete reports
7. Eliminate relying on a single source (Office of Accident Records) for data querying and reporting
8. Provide a system that is consistent with BIT's strategic technical direction and standards
9. Tighter integration to existing and proposed systems, i.e. GIS
10. A separate project to support converting existing accident location coordinate data to GPS coordinates is necessary. Without a GIS system the use of GPS coordinates cannot be fully utilized. Without GIS system there will still need to be analysis of accident data via state coordinate system. The GIS/GPS information will be necessary to develop plot maps that document accident information currently utilized by LGA (Local Government Assistance) and the Office of Road Design.

The diagrams on the following pages illustrate the current and envisioned systems architecture.

Figure 1. Accident Reporting System Diagram – Current

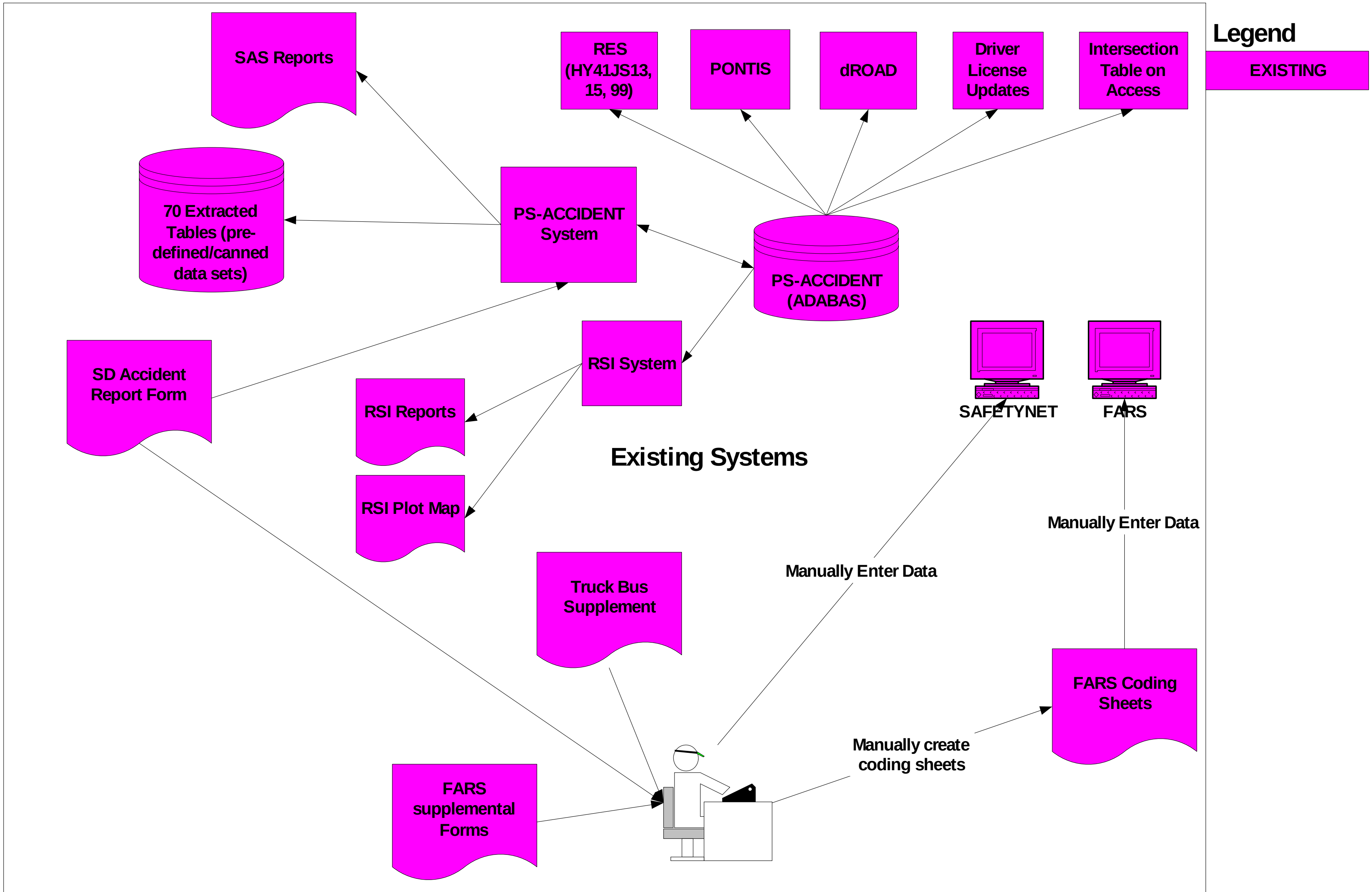
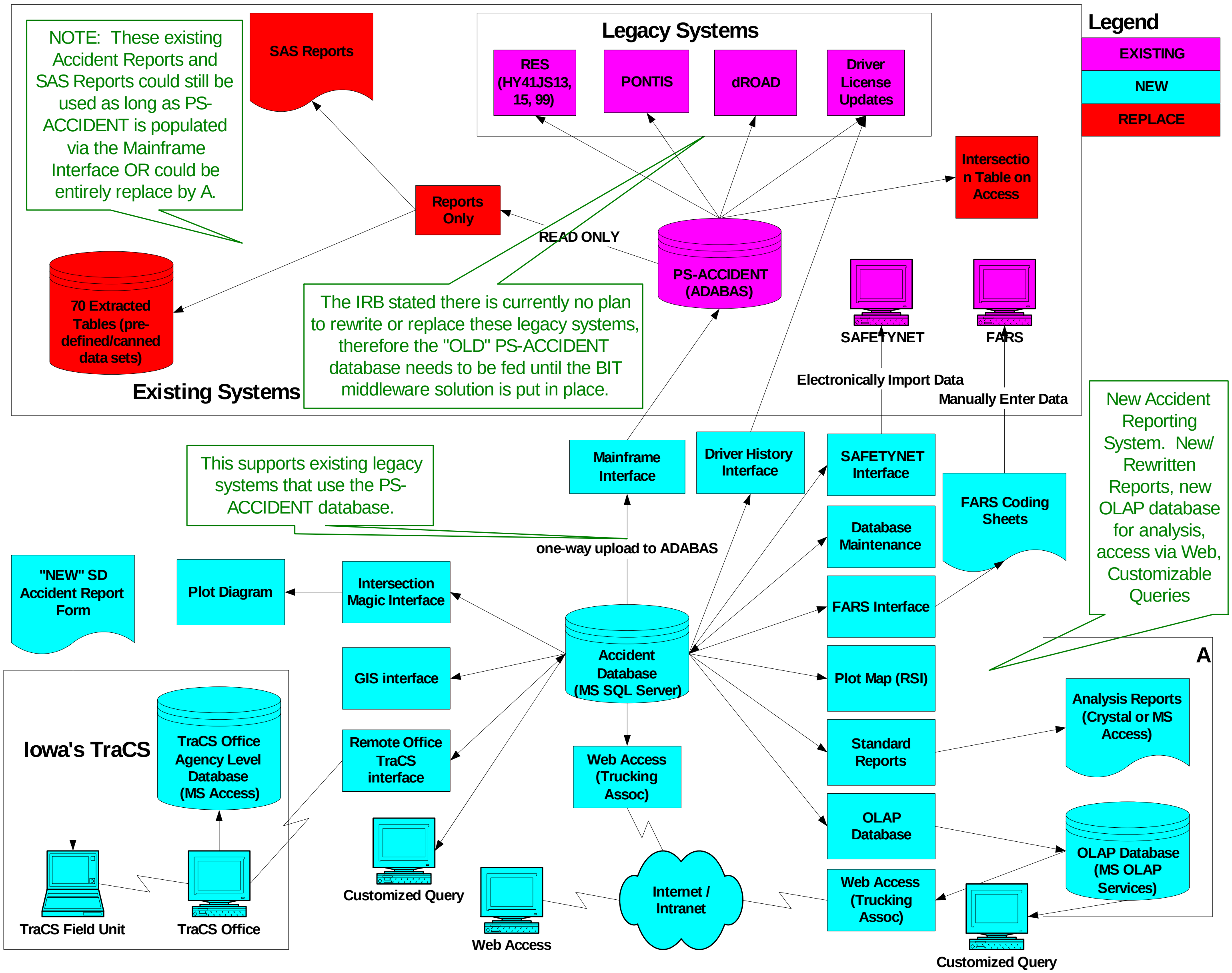


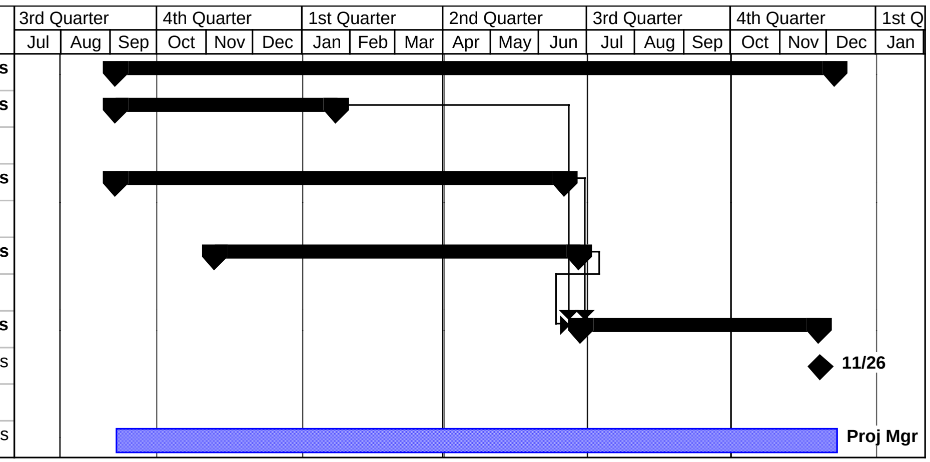
Figure 2. Accident Reporting System – New



The following figure illustrates phasing, cost, resource requirements, and time frame for the migration plan at a summary level. This is the project plan for the estimated amount of effort to design, construct, test, and implement an Accident Reporting System as defined by the functional requirements that were determined during the course of this research project. This project plan does not include local law enforcement training and hardware/equipment costs.

Figure 3. Accident Reporting Summary Level Migration Plan

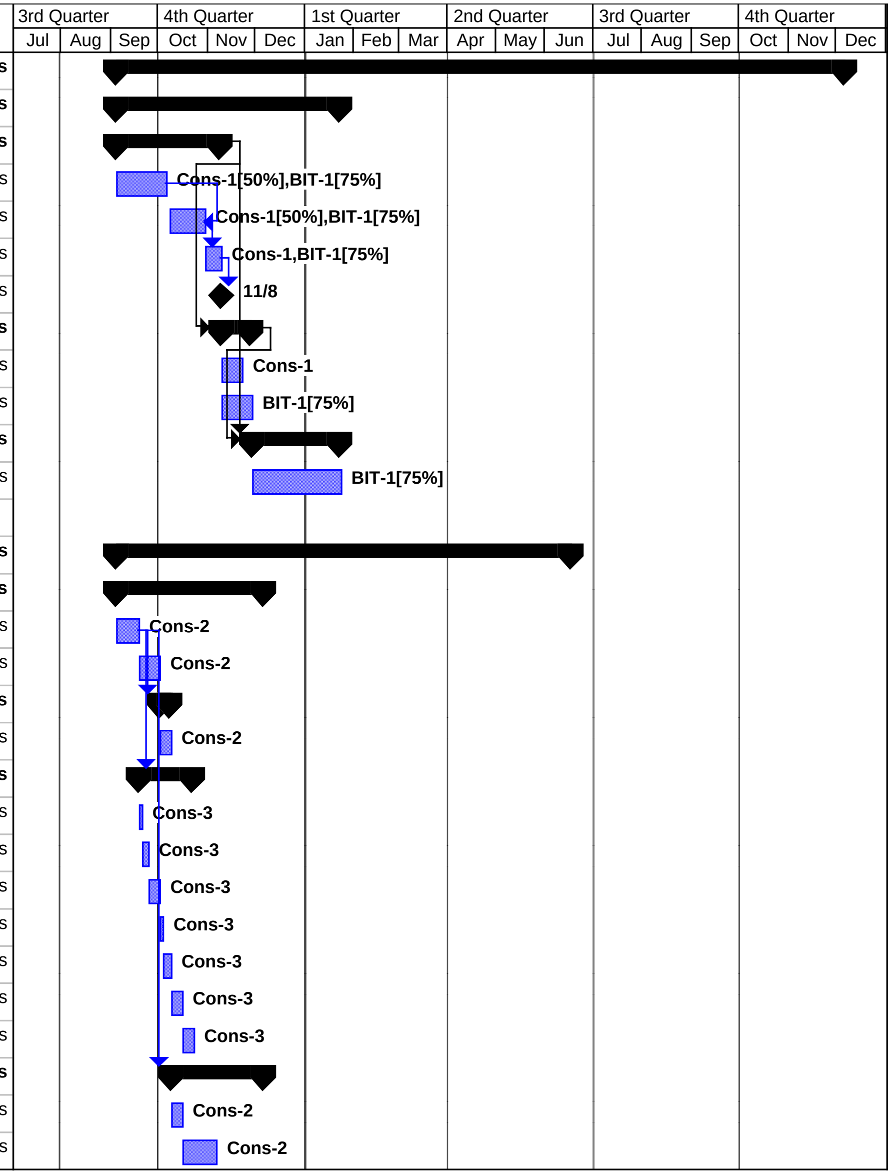
ID	Task Name	Cost	Duration
1	**A.R.S. DESIGN-CONSTRUCTION-IMPLEMENTATION**	**$550,970**	**329 days**
2	**ACCIDENT REPORT FORM**	**$70,458**	**102 days**
13			
14	**ACCIDENT RECORDS DATABASE**	**$208,434**	**205.43 days**
54			
55	**ELECTRONIC ACCIDENT REPORT FORM (TRACS)**	**$102,576**	**167.43 days**
65			
66	**IMPLEMENTATION**	**$90,542**	**108 days**
90	**FIELD BEGINS USE OF NEW FORM AND TraCS**	$0	0 days
91			
92	**Project Management**	$78,960	329 days



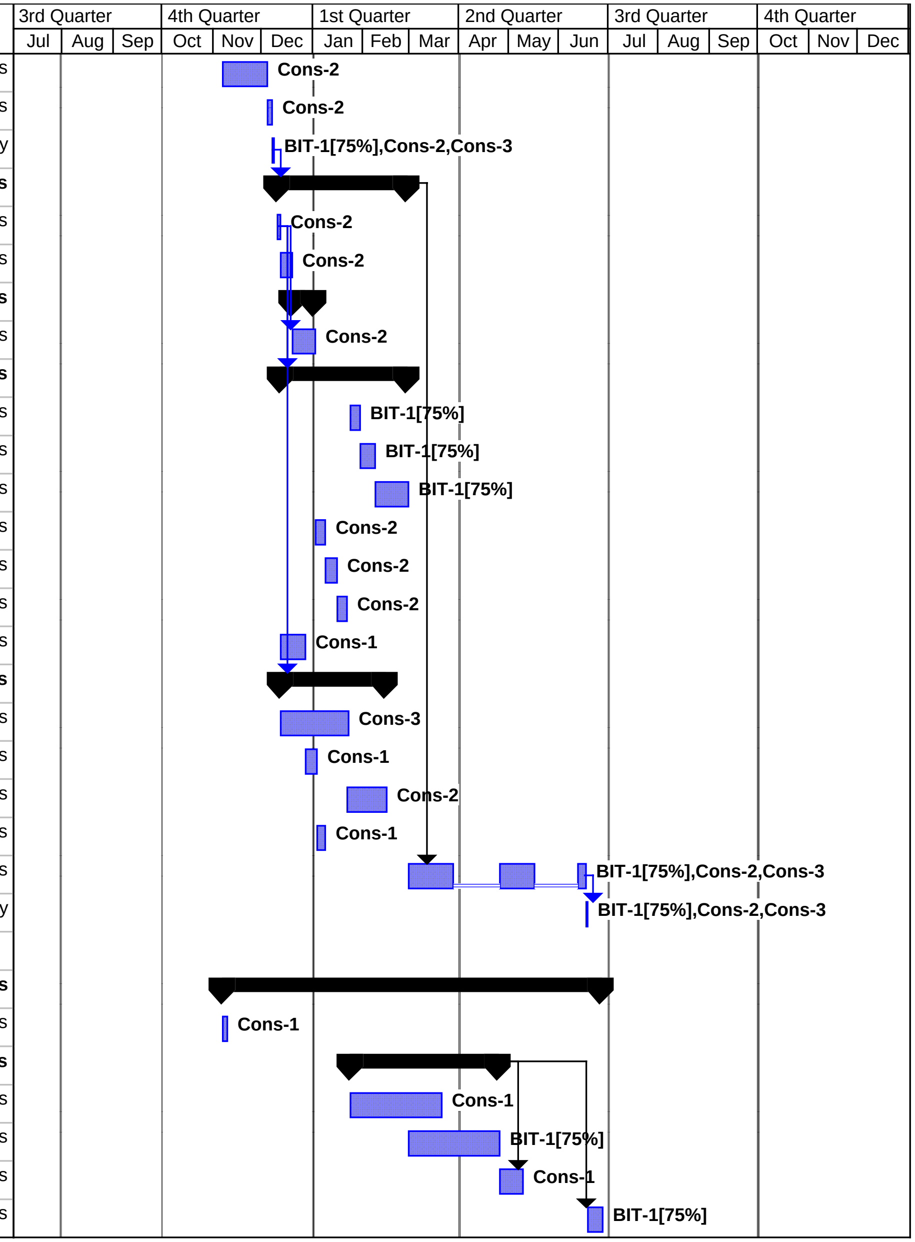
The following figure illustrates phasing, resource requirements, and time frame for the migration plan at a detailed level.

Figure 4. Accident Reporting Detail Level Migration Plan

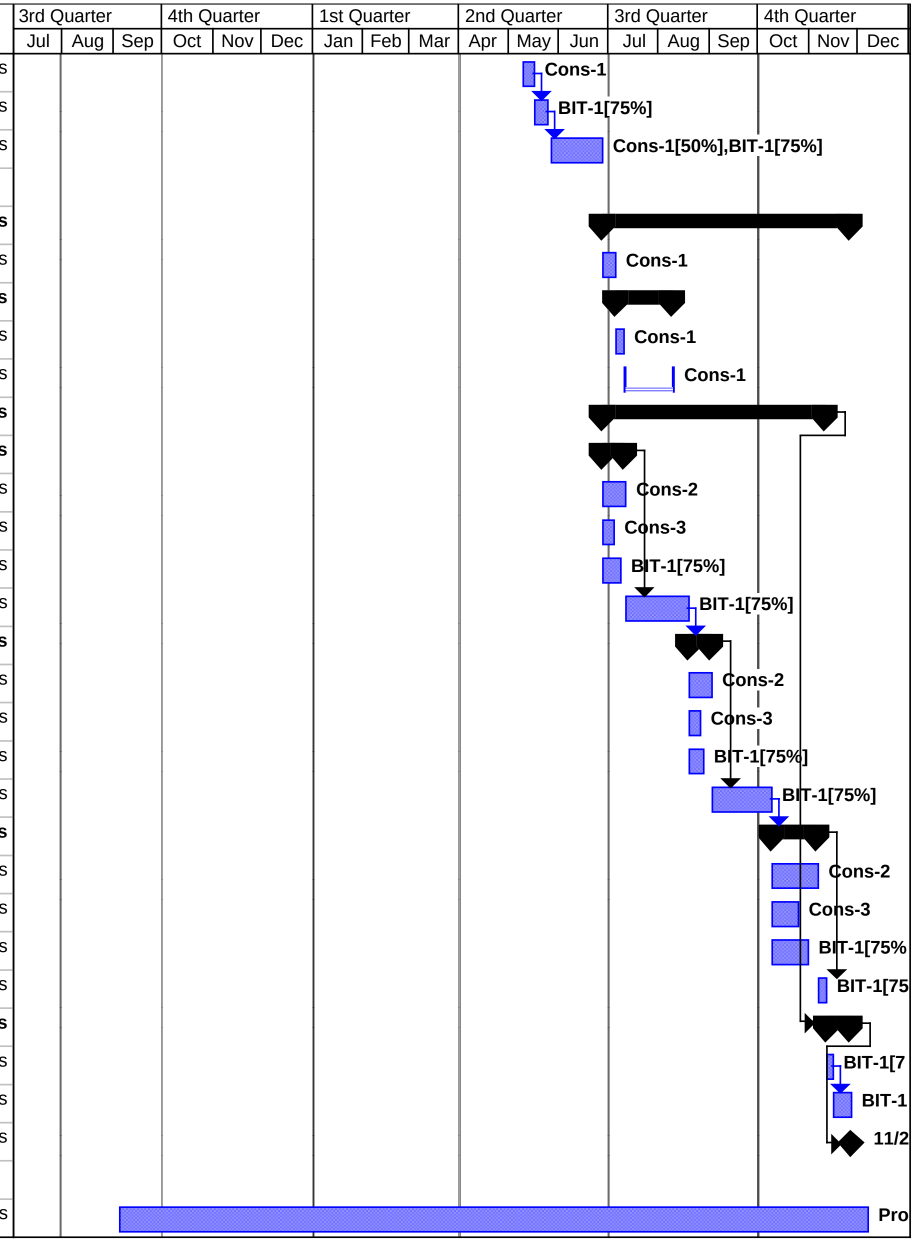
ID	Task Name	Cost	Duration
1	**A.R.S. DESIGN-CONSTRUCTION-IMPLEMENTATION**	**$550,970**	**329 days**
2	**ACCIDENT REPORT FORM**	**$70,458**	**102 days**
3	**Manual Form**	**$43,392**	**48 days**
4	Design Form	$21,096	24 days
5	Finalize Code Values	$14,064	16 days
6	Design Overlay	$8,232	8 days
7	Deliver to Printer	$0	0 days
8	**Training Materials**	**$15,906**	**14 days**
9	Develop Accident Report Form Coding Instructions	$12,000	10 days
10	Develop Office Coding Instructions	$3,906	14 days
11	**Test & Review Form Design**	**$11,160**	**40 days**
12	Field Test	$11,160	40 days
13			
14	**ACCIDENT RECORDS DATABASE**	**$208,434**	**205.43 days**
15	**Detail Design**	**$74,400**	**68 days**
16	Physical Database	$8,000	10 days
17	Online Analytical Processing Database	$8,000	10 days
18	**Program Modules**	**$4,000**	**5 days**
19	Database Maintenance	$4,000	5 days
20	**Interface Modules**	**$20,000**	**25 days**
21	SafetyNet Interface	$1,600	2 days
22	FARS Interface	$2,400	3 days
23	Remote Office TRACS Interface	$4,000	5 days
24	Driver History Interface	$1,600	2 days
25	Intersection Magic Interface	$2,400	3 days
26	GIS Interface	$4,000	5 days
27	Mainframe Interface	$4,000	5 days
28	**Report Modules**	**$34,400**	**43 days**
29	WEB Access (Trucking Assoc)	$4,000	5 days
30	Customized Queries (70)	$12,000	15 days



ID	Task Name	Cost	Duration
31	Standard Report Templates (20)	$16,000	20 days
32	Plot Diagram Report	$2,400	3 days
33	**Design Review**	$1,600	1 day
34	**Construction**	**$92,975**	**58 days**
35	Physical Database	$1,600	2 days
36	Online Analytical Procesing Database	$4,000	5 days
37	**Program Modules**	**$8,000**	**10 days**
38	Database Maintenance	$8,000	10 days
39	**Interface Modules**	**$31,375**	**56 days**
40	SafetyNet Interface	$1,116	4 days
41	FARS Interface	$1,953	7 days
42	Remote Office TRACS Interface	$3,906	14 days
43	Driver History Interface	$3,200	4 days
44	Intersection Magic Interface	$4,000	5 days
45	GIS Interface	$4,000	5 days
46	Mainframe Interface (4 programs)	$13,200	11 days
47	**Report Modules**	**$48,000**	**47 days**
48	Customized Queries (70)	$24,000	30 days
49	WEB Access (Trucking Assoc)	$6,000	5 days
50	Standard Report Templates (20)	$14,400	18 days
51	Plot Diagram Report	$3,600	3 days
52	**System Testing**	$37,580	40 days
53	**Review and Signoff**	$1,879	1 day
54			
55	**ELECTRONIC ACCIDENT REPORT FORM (TRACS)**	**$102,576**	**167.43 days**
56	System Development Training (SDK)	$3,600	3 days
57	**Develop Customized Electronic Forms**	**$59,160**	**65 days**
58	Electronic Only Input	$48,000	40 days
59	Entered from manual form	$11,160	40 days
60	Develop Customized Database	$12,000	10 days
61	Customize Training Manual	$1,953	7 days



ID	Task Name	Cost	Duration
62	Develop Automated Field Unit to Office Communication Link	$7,200	6 days
63	Functionality Testing	$1,674	6 days
64	Review/Signoff	$16,989	23 days
65			
66	**IMPLEMENTATION**	**$90,542**	**108 days**
67	**Installation of new Accident Reporting Database**	$7,200	6 days
68	**Install TraCs at DOT Central Office**	**$6,000**	**25 days**
69	Training	$3,600	3 days
70	Software installation	$2,400	2 days
71	**Pilot**	**$74,273**	**97 days**
72	**Alpha Pilot Office 1**	**$14,153**	**10 days**
73	Training	$8,000	10 days
74	Hardware Installation	$4,200	5.25 days
75	Software Installation	$1,953	7 days
76	**Pilot Office 1 Review/Refinement**	$7,533	27 days
77	**Alpha Pilot Office 2**	**$14,153**	**10 days**
78	Training	$8,000	10 days
79	Hardware Installation	$4,200	5.25 days
80	Software Installation	$1,953	7 days
81	**Pilot Office 2 Review/Refinement**	$7,533	27 days
82	**Beta Pilot Offices 3, 4**	**$30,064**	**20 days**
83	Training	$16,000	20 days
84	Hardware Installation	$9,600	12 days
85	Software Installation	$4,464	16 days
86	**Overall Pilot Review/Approval**	$837	3 days
87	**Implementation (variable function of TraCS installations @**	**$3,069**	**11 days**
88	Train the Trainer	$1,116	4 days
89	Trainer Support	$1,953	7 days
90	**FIELD BEGINS USE OF NEW FORM AND TraCS**	$0	0 days
91			
92	**Project Management**	$78,960	329 days



The following table summarizes the total number of estimated hours by month, by resource to complete the design and development

Table 1. Accident Reporting Migration Plan Resource Usage Hours

	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
BIT-1	114	138	132	126	138	120	126	132	138	120	120	117	123	135	84		1863
Cons-1	76	100	128	112	88	160	112	32	116	84	67	8					1083
Cons-2	152	184	176	168	184	88	152			21	67	76	3	132	27		1430
Cons-3	72	128		120	128	8	152			21	30	42		96			797
Proj Mgr	30	37	35	34	37	32	34	35	37	32	37	35	34	37	34	8	528
Total	444	587	471	560	575	408	576	199	291	278	321	278	160	400	145	8	5701

Legend:
BIT-1: BIT resource
Cons1-3: Consultants
Proj Mgr: Project Manager

Variable Additional Cost

There are some additional costs that are difficult at this time to illustrate in a project plan due to the level of detail required. The cost estimates below are approximations and may vary widely depending upon different circumstances.

1. Law Enforcement Personnel Training
   - The plan above provides for the training of a trainer ("train-the-trainer" approach). This cost can be reasonably estimated. What is difficult to predict at this point is how many sessions are necessary to train the law enforcement community in the use of the "new" paper accident report form and the use of TraCS. We estimate that it will take 2 – 3 days to train an officer in the use of the TraCS software. Scott Burke from the Sioux Falls police department said that it takes 15 days to rotate the entire police force through 1 day of training. Given this as a guideline, it may take anywhere from 30 – 45 days to train all the Sioux Falls police force in a 2 – 3 day class. The assumption on the training of the law enforcement officers is that this will be done by each agency's trainer (the individual that attended the "train-the trainer" session) and will not be a cost to this project. This training cost will be incurred by the agency as a cost of doing business for them.
2. Computer Hardware to run TraCS
   - By Mary Jensen's (TraCS Program Manager Iowa DOT) estimate, it costs $7,000 - $7,500 to equip a squad car with the hardware and software necessary to run TraCS. This value represents all the hardware required,

including: heavy-duty laptop, monitor (touch screen), scanner device, printer, mounting bracket, docking station, etc…

- Installation of the hardware in the squad car ranges in cost from $250 - $300 per car.
- The total cost to install the hardware has a wide range due to the fact that some cars already have a computer and others do not. The cars with computers may only need a memory upgrade or no upgrade at all. They may only need some additional software installed. Because of the variables, it is impossible to arrive at a firm cost to purchase and install the hardware necessary to run TraCS without completing a full inventory of all existing equipment (hardware and software). Adding the values for hardware and installation from the first two bullet points above, the cost is between $7,250 and $7,800 to equip a squad car that has no computer hardware. The number of cars that fit this situation is unknown until an inventory is completed. However, we can say that
  - There are 156 highway patrol cars. Total hardware and software installation would cost $1.2 million ($7,800 * 156) to equip all cars.
  - To equip each police department will vary depending upon how many cars they have and want to equip with TraCS. The same is true of the county sheriff's agencies.

Accident Report Form

This group of recommendations includes all items related to the final design and use of the new accident report form.

2. Drug and Alcohol Test Data

Due to the fact that each law enforcement agency can and does handle their drug and alcohol tests differently, we recommend that the process of gathering new (MMUCC and FARS-compliant) drug and alcohol test data be done by each agency (not the Office of Accident Records).

The results of drug and alcohol tests are not available immediately to the officer to place on the paper form or the electronic form. This is information that is currently collected later (by sending out additional forms) for the FARS system. However, to be MMUCC compliant, this information is now also required not only for fatality injured persons, but also for drivers and non-motorists involved in accidents whether there is a fatality or not. A new process is needed to capture this information.

The process for collecting drug and alcohol test results for the "paper" form should be to not send in the accident form until after the results are available to the officer. The officer then places the results on the paper form and sends it to the State. If the agency is using the "electronic" form, when the results become available, the officer merely adds the additional information to the system.

If the responsibility for obtaining the drug and alcohol test results were placed in the Office of Accident Records, this office would have to adapt the process to each agency's different sources for the data. Some agencies have in-house laboratories and others outsource this work to any number of different public laboratory service companies. Some results come back to the officer; some are placed on a bulletin board, etc. Ultimately, and even in the current system, it is the officer that knows where to find the test results. Therefore, it should be the officer that provides this information because the officer will always be the person receiving the results to give to the Office of Accident records. The officer should therefore be responsible for capturing the data.

3. Accident Form Re-design Pilot

We recommend that the re-designed accident form should be pilot-tested in a real-world environment.

As a step in the finalization of the new accident form, we recommend a pilot test (or parallel test) in the field. A project team member should accompany an officer and go to an actual accident scene. Either the officer or the team member (in parallel with the officer) would fill out the new form so we can observe how the process and form really work in the field and how well the new design will work.

4. Completion of Form Re-design

We recommend that there be a "phase 2" form re-design activity

This activity is the detailed design of the new accident form. The process should include looking at options such as:

a. Normalizing the form – for example, break out the summary section into road information, location information, and crash information; break out the unit section into vehicle information and driver information
b. Using a 4-sided form and getting rid of the overlay – this means all codified boxes would have the choices right on the form, but that means any change in choices produces a new form; this would also

provide additional room for non-state data such as witness information and all parties' phone numbers. During the Technical Panel review meeting (July 25, 2001) of this Final Report ("DRAFT" version), the law enforcement officials present did express flexibility on this point to allow more than a one-page accident report form. The flexibility arose out of a deeper understanding and discussion of the impact a one-page form had on the form design

c. Using color for enhancing form readability and usage, and highlighting the data fields needed for wild animal hits

This activity should also include additional rounds of review and input from all stakeholders as well as the development of the overlay design, assuming an overlay will be used.

5. Collect All Parties' Names for Social Services Recovery

We recommend that the names of all persons involved in an accident be collected.

Currently, passenger names and related information are not collected. Also note that passenger names are not required in order to be MMUCC compliant. The need to capture passenger name information comes from Social Services Recovery. This information would be helpful to them in validating Medicare and Title 19 claims. This process ensures that the auto insurance company(s) liable for the accident pays for the medical bills, rather than Medicare and Title 19. This is a policy issue that must be decided by the Research Review Board and the Technical Panel. (See Functional Requirement reference # 35 for more information presented in Appendix F of the appendix document).

6. Collect Information on All Parties

We recommend that the MMUCC-compliant data elements for all persons involved in an accident be collected. (Note: This is similar to #5).

To be MMUCC compliant, additional data elements should be collected on the following individuals involved in the accident:

All Person Involved:

Date of birth, Sex, Injury Status, and Type of Person

All Occupants Involved:

Seating Position, Protection System Used, Air Bag Deployed, Ejection, and Trapped

There was some concern among the project team about collecting this information for non-injured people. The Technical Panel does recommend collecting this information, however this is a policy issue that must be decided by the Research Review Board and the Technical Panel before it can be finalized. (See Issue #1 in the Form Design Strategy in Appendix H of the appendix document).

7. Link Accidents and Citations

We recommend that if a citation is issued as a result of an accident, the citation number (ticket number) should be recorded on the accident report and in the accident database. This will provide linkage between accidents and the citation databases that exist.

This will be coordinated with CVISN projects. The reverse of this recommendation is to put the accident number on the citation. There was a concern raised that this may need legislation to put the accident number on the citation. (See Functional Requirement reference # 110 for more information presented in Appendix F of the appendix document).

8. Collect MMUCC Data

We recommend that the State of South Dakota collect the data elements as directed by the MMUCC guideline (Model Minimum Uniform Crash Criteria).

MMUCC is the common guideline that all states are encouraged to use to ensure a baseline set of common accident data, allowing for better cross-state analysis of traffic accidents. Some MMUCC data collection requirements may put an undue burden on the data collectors. Remember, MMUCC is a guideline and not a mandate. Therefore, certain data collection requirements could be dismissed. But careful consideration during the next phase of the project should be taken before doing this. Some possible data elements that may not be collected are:

- V09 – Carrier Identification Source
- Information of non-injured passengers. (This needs to be resolved in the next phase of the project)
- See Appendix F of the appendix document and the datamapping.xls for more information.

9. Automatic Data Collection using GPS

We recommend that the new accident data collection system implement the use of GPS coordinates and devices to collect the accident location coordinates. Using this technology will help ensure more accurate accident location data and reduce time spent obtaining and recording the information.

> With the accident location being a GPS coordinate, the actual literal location of the accident will always be known. Even if the alignment of the highway changes, the GPS location does not. This will eliminate human error and decrease the amount of time to complete an accident report. The new data collection system should have the capability for both GPS and bar code enablement. The TraCS system currently handles GPS-enablement via an accident locator tool or reading the GPS location from a GPS device.

10. Automatic Data Collection using Bar Codes

We recommend that the new accident data collection system implement the use of bar code scanning technology to automate the collection of driver license and registration information. Using this technology will help ensure more accurate accident data and reduce time spent obtaining and recording the information.

> Bar coding will allow the driver's information and vehicle registration information to be automatically populated into the electronic system. This will eliminate human error and decrease the amount of time to complete an accident report. The new data collection system should have the capability to collect information via bar code enablement. The TraCS system currently uses bar code scanning technology.

Accident Records Database

This group of recommendations includes all items related to the potential uses for the TraCS system beyond that of accident reporting.

11. Resolve Issues with Intersection Magic

We recommend that South Dakota schedule a meeting with Intersection Magic representatives and get the issues with the use of this software resolved.

> The owner and original developer of Intersection Magic indicated to us that the Intersection Magic software could do virtually anything South Dakota needs it to

do with respect to collision diagramming and analysis. If the software does not currently have the functionality required, his company is willing to develop it, assuming it is not unique to the State. For example, South Dakota's grid system is unique and may preclude building the desired functionality. Regardless, this activity should be pursued in depth so that a detailed action plan for the continued use of this product can be developed.

12. Develop Accident Data Privacy Policy

Accident data is collected on private citizens, private companies, and public companies. This accident data is distributed to and used by many organizations, both public and private. We recommend that South Dakota develop a privacy policy concerning the use and distribution of accident data.

There is a concern that if accident data and reports become accessible via the Internet or other electronic means, that the State needs to take the appropriate steps to ensure compliance with federal, state, and other applicable regulations governing privacy. Data elements of concern are social security number, date of birth, names of minors, etc. The privacy policy developed would be a guide to the development of security mechanisms to ensure that privacy needs are met. This accident data privacy policy should be published on any accident data web sites. (See Functional Requirement reference numbers: 13, 90, and 111 for more information presented in Appendix F of the appendix document).

13. Store Accident Narrative

We recommend that the officer's narrative of the accident should be stored in the electronic accident records database.

This is key information for the back-end traffic analysis users. Having the narrative in the database would provide the desired functional requirement to have the officer's narrative on the Accident Summary Report. With this data in the database there would be no need to search for the hard copy form or the imaged copy to do analysis. Without including the narrative in the database, there cannot be a paperless accident reporting system. The only consideration is that there may be a workload issue for entering the narrative verbiage when the accident reports come in on a "paper" form. But if the narrative is not entered into the electronic accident records database, then the same workload issue on the front-end data entry side of the system becomes a workload issue on the back-end data retrieval side of the system in the form of not having the data needed to make the correct decisions and lost time getting hardcopy accident forms for analysis. And more importantly, there will be no means for creating a copy of an accident report form from the database. We strongly encourage the Research Review Board and the Technical Panel to store this valuable data in the database. (See Functional Requirement reference # 109 for more information presented in Appendix F of the appendix document).

14. Store Accident Diagram

We recommend that the diagram of the accident should be stored in the electronic accident records database.

Although the diagram is not textual data, it can still be stored as part of the database record for the accident. Storing the diagram in the database provides a single integrated location for accident data to reside. The diagram is key information for the back-end traffic analysis users. With the diagram in the database, there would be no need to search for the hardcopy form or the imaged copy to perform analysis. The image could be displayed electronically with the click of a button. Without including the diagram in the database, there cannot be a paperless accident reporting system. And more importantly, there will be no means for creating a copy of an accident report form from the database. We strongly encourage the Research Review Board and the Technical Panel to store this valuable data in the database. (See Functional Requirement reference # 9 and 59 for more information presented in Appendix F of the appendix document).

Electronic Accident Report Form

This group of recommendations includes all items related to the “creation” of the new electronic version of the accident report form.

15. TraCS SDK (Software Development Kit) Training

We recommended that South Dakota should send two programmers (one BIT and one consultant resource that will be working on the next project phase of the accident reporting system) to a TraCS SDK training session sponsored by Iowa. This recommendation has already been acted upon. Robin Schumacher (BIT) and Mark Kirk (Consultant) attended SDK training in Tennessee on July 17-19.

The TraCS SDK (Software Development Kit) is the component of TraCS that allows for the customization of TraCS to fit each state’s particular needs. Understanding the capabilities and functionality of the SDK is key to the implementation of TraCS.

16. TraCS as the Accident Data Collection System

We recommend that the TraCS system that has already been developed, tested, and implemented in Iowa be used in South Dakota for the front-end data collection piece of the new accident reporting system.

> The TraCS software is offered free of charge to any State that desires to use it. Although TraCS licensing is free of charge, there are still significant costs associated with configuring and implementing it. The TraCS system is a generic program that can be modified through the use of a Software Development Kit (SDK) to meet the needs of each different State's requirements for accident data collection. Rough estimates gathered from TraCS experts indicate that it could take anywhere from 2 to 4 months to "develop customized electronic forms" for any particular State form. Once the configuration process is completed, all of the normal system implementation steps must still be accomplished, for example, interface development, security development, testing, procedures development, training, installation and rollout.

Deployment of New Accident Reporting System

This group of recommendations includes all items related to the potential uses for the TraCS system beyond that of accident reporting.

17. SAFETYNET Data Responsibility

We recommend that the responsibility for entering the SAFETYNET data should be moved from the South Dakota Highway Patrol Motor Carrier Division to the Office of Accident Records.

> This recommendation comes from a functional requirement that there should be a single state agency that provides accident data to both NHTSA and FMCSA. (See Functional Requirement reference # 108 for more information presented in Appendix F of the appendix document).

18. Collecting Non-state-reportable Accident Data

We recommend that local agencies be allowed to use the new accident reporting system to store non-state-reportable accidents if desired.

There is no requirement for non-state-reportable accidents to be reported to the State. This would merely give local agencies a place to store their additional accident data (non-state-reportable crashes). This data would be filtered out of the state-reportable accidents for state-level analysis and reporting, but may still be physically stored in the state's database where local agencies could access the data. TraCS marks accidents as state or non-state-reportable. The latter are not transmitted to the DOT and remain in the local database. There is a possibility that this will increase the Office of Accident Record's workload due to more reviews for accuracy, assignment of location, direction of travel, vehicle maneuver, manner of collision, etc. Also the extra accident will only be accepted in electronic format. Office of Accident Records will not be responsible for the data entry of non-reportable accidents. This is a policy issue that must be decided by the Research Review Board and the Technical Panel. (See Functional Requirement reference # 100 for more information presented in Appendix F of the appendix document).

19. Training Strategy

We recommend that the State of South Dakota develop a thorough training strategy that includes the front end accident data collection, statewide policies, the reasons and uses behind collecting each data element (help gain buy-in), proper data collection practices, etc.

Expanded Use of Electronic Accident Report System (TraCS)

This group of recommendations includes all items related to the potential uses for the TraCS system beyond that of accident reporting.

20. Traffic Citations in TraCS

We recommend that South Dakota not only use the accident data collection functionality of TraCS, but should also use the citation functionality. Therefore State should perform a research study to determine the functional requirements of Traffic Citations and develop a "unified common citation form" that can be used by all law enforcement agencies across the State.

Iowa's TraCS system, developed primarily with state funds and some federal funds as a national model for accident data capture, has much more functionality than just traffic accidents. If TraCS is chosen for accident data capture, South Dakota could benefit from the use of TraCS' additional built-in functionality to help make South Dakota's law enforcement officials more productive. Within the TraCS user program, the accident data and the citation data are integrated, which allows for faster data entry for the officer. For the officer using TraCS, it takes basically the same amount of time to write one citation as it does to write two or more citations for the same person. Writing paper citations takes an additional amount of time for each citation, where the electronic citation does not. The biggest benefit comes from capturing and transporting the citation data electronically. This reduces error rates, cycle times in processing citations, and allows for electronic integration of citation processing systems.

21. Other Law Enforcement Uses for TraCS

If TraCS is used for accident reporting, we recommend that the State perform a research study to determine what other areas of law enforcement can benefit from the use of TraCS "form automation functionality".

It would be beneficial for the State to use more of TraCS functionality to help make South Dakota's law enforcement officials more productive, for example, by providing witness data collection and storage. This information is not required at the State level, but is required at the local level. TraCS could be used to capture and manage this information at the local level, thus making law enforcement more productive. In general terms, TraCS is a "form automation tool". This means that just about any form used to collect data by law enforcement is a candidate for an electronic TraCS form. Another example might be crime scene information gathering. TraCS is not at all limited to the current five forms (including ECCO – Electronic Citation, MARS – Mobile Accident Report, MOWI – Mobile Operating While Intoxicated, VSIS – Vehicle Inspection, and CIRF – Incident/Arrest Report) that Iowa has implemented. This project would uncover new areas to automate.

22. TraCS and ROW Automation

We recommend that South Dakota perform a research study to determine if the TraCS system or a derivation of TraCS could be used to automate the Department of Transportation Right of Way Program Area's forms.

Note: this is a tangent/off subject recommendation. Mark Kirk, just prior to working on the SD2000-14 project, worked on a Business Area Analysis for the Right of Way Program Area. A vast amount of the actual work performed in this program area deals with filling out and completing forms. There are more than 150 forms that are used during the process of acquiring right of way for highway construction. Much of the data on the forms is duplicative, but as the acquisition progresses through various stages, different forms are required. There are some specific traffic/law enforcement aspects of TraCS, but the basic function of TraCS is to automate the creation and population of forms. Therefore, we suggest that TraCS could possibly be used to automate Right of Way forms, as well.

GIS Implementation

23. GIS Implementation

We recommend that the DOT initiate a GIS implementation project, which includes an analysis of the existing documentation/inventory of roads and a re-evaluation of the city/county "grid" system used for locating/analyzing accidents.

The SD2000-14 project did not study the current methods in use by South Dakota for documenting and inventorying their roads. This study also did not evaluate in detail the current GIS pilot project performed for Sioux Falls. We do, however, recognize the value of and recommend the use of GIS for accident analysis. Therefore, we recommend that a state-level (DOT) GIS implementation using the ESRI GIS software be undertaken. In order to begin such a project, an in-depth analysis and plan needs to be developed, as GIS implementations are quite difficult and risky. A separate project to support converting existing coordinate data to GPS coordinates is necessary. Without a GIS system the use of GPS coordinates cannot be fully utilized. Without GIS system there will still need to be analysis of accident data via state coordinate system. The GIS/GPS information will be necessary to develop plot maps that document accident information currently utilized by LGA (Local Government Assistance) and the Office of Road Design. The GIS implementation project should address the issue of converting existing State X/Y coordinate data (this includes, but is not limited to, the current accident data) to GPS coordinates.

References

The following table includes research sources of information used on this project.

Table 2. Research References

Research Topic	Web Address or South Dakota Research Report Number
A Review of 4 Inexpensive, Easy GIS Packages	www.gis.com
Aether Government Systems	http://www.aethersystems.com/industries/industries_template.asp?PAGE=indu_gov_main
AIMS - Accident Information Management System / GIS System.	http://www.jmwengineering.com/
AIMS Collision Diagramming Software	http://www.jmwengineering.com/
ASPEN	http://www.inspector.org/fhwafsg1.htm
AVL Tutorial	http://www.trimble.com/cgi/mpc.cgi/avl/networks.htm
Commercial Vehicle Safety - Strategic Issues and Potential Solutions	http://spp.fmcsa.dot.gov/fmcsa/motorcar.nsf/9ba8442069238e44852568fe00708985/275d497f4ba533ca852569850071407c?OpenDocument
Crossroads Accident Data Collection and Collision Diagramming Software	www.crossroadssoftware.com
Development of SD Accident Reduction Factors	SD 1998-13
Documentation of SD's ITS/CVO Data Architecture Study	SD1999-07
Driver Background Paper: Current and Future Trends	http://spp.fmcsa.dot.gov/fmcsa/motorcar.nsf/9ba8442069238e44852568fe00708985/acf51ba303021deb852569ad0070c6e4?OpenDocument
EDCAD Accident Diagramming Software	http://www.edccorp.com/about/press-edcad.html
FARS	http://www.nhtsa.dot.gov/people/ncsa/fars.html
Garmin GPS Systems	http://www.garmin.com/products/
GPS Tutorial	http://www.trimble.com/gps/index.htm
IACP Technology Clearinghouse High Tech Patrol Car	http://www.iacptechnology.org/LEIM/TechCar/TechnologyCar.htm and http://www.datalux.com/mobile.html
Identification for Truck Crash Reduction	SD1999-05
Identification of Abnormal Accident Patterns at Intersections	SD 1998-12
Insuring the Safety of Motor Carrier Operations	http://spp.fmcsa.dot.gov/fmcsa/motorcar.nsf/9ba8442069238e44852568fe00708985/92e8d0985cd762ff85256982006a174a?OpenDocument
Intersection Magic Collision Diagramming Software	http://www.pdmagic.com/im/

Research Topic	Web Address or South Dakota Research Report Number
Manual on Classification of Motor Vehicle Traffic Accidents - ANSI D16.1-1996 Standard	www.nsc.org/public/mem/ansid16_1.pdf
MapInfo vs. ArcView – a Comparison	www.gis.com
MapScenes Accident Diagramming Software	http://www.mapscenes.com/mapscenes_4.htm
MCMIS (Motor Carrier Management Information System)	http://www.inspector.org/fhwafsg1.htm
MMUCC	http://www.nhtsa.dot.gov/people/ncsa/codes/MinData/minstand.html
Montgomery County (Rockville, MD) Dept. of Police - GIS and GPS Emerging Technologies In Law Enforcement	http://www.co.mo.md.us/services/police/Tech/geoconf2.htm
NASS (National Automotive Sampling System)	http://www-nass.nhtsa.dot.gov/nass/
SAFER	http://www.inspector.org/fhwafsg1.htm
SAFESTAT	http://www.inspector.org/fhwafsg1.htm
SAFETYNET 2001	http://www.inspector.org/fhwafsg1.htm
Salinas, California Police Department: Law Enforcement Use Of Geographic Information Systems	http://www.salinaspd.com/gis_vb.html
SD's CVISN Top Level Design Study	SD1999-16
Sokkia GPS Systems	www.sokkia.com
State Crash Forms Web Site	http://www.nhtsa.dot.gov/people/perform/trafrecords/crash/Pages/us_contact_map.htm
The Crash Zone Accident Diagramming Software	www.cadzone.com
The Large Truck Crash Picture	http://spp.fmcsa.dot.gov/fmcsa/motorcar.nsf/9ba8442069238e44852568fe00708985/bfab658feebaec7585256982006a1001?OpenDocument
The National Model for the Statewide Application of Data Collection & Management Technology to Improve Highway Safety (State of Iowa Crash Reporting Data Collection System)	http://www.dot.state.ia.us/natmodel/index.htm
Traffic Engineering In A GIS Environment	http://www.esri.com/library/userconf/proc95/to050/p029.html
Trimble GPS Systems	http://www.trimble.com/trimble.htm?splash
Visual Statement Accident Diagramming Software	http://www.visualstatement.com/
What is GIS?	www.gis.com

Appendices

There are a substantial number of supporting documents for this project. Due to the length of these documents, they were all placed in a separate external Appendix Document. However, we are including the Glossary and Acronyms List in this Final Report document for the reader's convenience.

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Appendix A. Glossary

Accident Diagramming – The process of drawing an individual accident at the accident scene.

Accident Reduction Factors – A value used to determine the degree to which accidents decrease. The percentage decrease of an Accident Reduction Factor is calculated by subtracting the ARF from 1.00.

ADABAS – The database used for the current PS-Accident database. The data are stored conceptually in a tabular format (rows, columns) like a relational database. But unlike a relational database, ADABAS stores information about how the data are related in structures called inverted lists. A true relational database creates relationships among the data each time a request is made.

ANSI D16.1-1996, Manual on Classification of Motor Vehicle Traffic Accidents – The purpose of this American National Standard is to provide a common language for reporters, classifiers, analysts and users of traffic accident data.

ArcInfo – From ESRI, ArcInfo is the complete GIS data creation, update, query, mapping and analysis system.

ArcView – Desktop GIS and mapping software from ESRI. Provides data visualization, query, analysis and integration capabilities along with the ability to create and edit geographic data.

"As Is" State – Documents the current characteristics of an existing system

ASPEN – Driver/vehicle safety inspection software that provides roadside access to various safety performance information including the last recent inspection results, the driver's CDL status, and the safety performance and past safety problems of the carrier.

Attribute – A significant property of a real-world object. Carries a value that assists in identifying the entity of which it is a part and in distinguishing the entity from other members of the same entity class.

Automatic Vehicle Location – Technology used for tracking vehicles, vessels, and mobile assets such as trailers, containers, and equipment. Each mobile unit has a GPS receiver that reports its position to the base station over a communications network.

Bar Code – The small image of lines (bars) and spaces that is affixed to retail store items, identification cards, and other items to identify a particular product number, person, or location. The code uses a sequence of vertical bars and spaces to represent numbers and other symbols. A bar code reader uses a laser beam that is sensitive to the reflections from the line and space thickness and variation to read the code. The reader translates the reflected light into digital data that is transferred to a computer for immediate action or storage.

BPwin – A business modeling software tool from Computer Associates used to visualize, analyze and improve business processes. Provides a framework to help gain a better understanding of business processes and determine how these processes interact with the data flowing through an organization.

Business Area Analysis – A structured, information engineering discipline for examination and description of a business or part of a business to establish a detailed understanding of the nature of the changes required to achieve improvement objectives.

Business System Design – A structured, information engineering discipline for defining computer system functional specifications from the knowledge-worker point of view. Purpose is to thoroughly understand, model, validate and document the knowledge-worker-visible features comprising the functional specifications of a computer system(s) required to support a business area.

Change Ideas – Ideas generated during interactive work group sessions while discussing changes that the participants would like to see in a system. Change ideas that are approved become functional requirements (see below).

Collision Diagramming – An analysis function performed at the state level usually involving multiple accidents. The collision diagram graphically represents multiple accidents that meet the user-specified analysis criteria on one diagram.

CRUD matrix – A CRUD matrix examines the interaction of data and process by specifying which processes create, read, update and/or delete which data elements.

Commercial Vehicle Information Systems and Networks – A safety and information exchange initiative sponsored by the United States Department of Transportation (USDOT) Federal Motor Carrier Safety Administration (FMCSA). Key operational concepts are to share data among safety, credentials, and screening processes; focus safety enforcement on high risks; use open communication standards, especially between carriers and government agencies; provide accessible but secure data; conform to national architecture; and allow flexible deployment options.

Data Dictionary – A collection of descriptions of the data objects or items in a data model.

Data Model – The analysis of data objects that are used in a business or other context and the identification of the relationships among these data objects.

Dead Reckoning – A way to make GPS more accurate and reliable when tracking vehicles by using extra sensors installed in the vehicle to measure speed and direction. By combining this information with GPS, it can figure out current position based on last known position, even when GPS signals are blocked.

Data Flow Diagram – Shows the flow of the data through a system and the work or processing performed on the data as it moves through the system.

Data Modeling –The analysis of data objects that are used in a business or other context and the identification of the relationships among these data objects.

Differential Global Positioning System – A way to make GPS more accurate by comparing the GPS measurements in the mobile units with GPS measurements taken at a reference station. Since the reference station is at a fixed location, it can find the difference between its known position and the information received from the satellites.

Entity – A unique representation of a single real-world object that is created by using the values of its attributes in computer-readable form. An entity is a single person, place, or thing about which data can be stored. An entity is some unit of data that can be classified and have stated relationships to other entities.

Entity Relationship Diagram – A concept or picture of what a database will eventually look like, what data it can store, and what information you can retrieve from it. Shows what a system can do, not how it does it.

Environmental Systems Research Incorporated – The leading software vendor for GIS software. About 70% of all GIS users use ESRI products. The three main GIS software packages available from ESRI are ArcInfo, ArcView and MapObjects.

ERwin – A database design tool from Computer Associates that creates and maintains graphical models that represent databases, data warehouses, and enterprise data models. Provides a modeling platform where corporate data requirements and related database designs can be defined, managed, and implemented across a wide variety of database platforms.

Expected Value Analysis – A researcher located intersections throughout South Dakota and categorized them by geometric type, stop control type, and traffic volume. A sample of each intersection category was taken, and coordinates for each intersection were found. Accident reports were obtained for the sampled intersections, and the data were entered into a spreadsheet for analysis. The mean, 90^{th} and 95^{th} percentile were calculated, and the expected value analysis tables were created for each category of intersections.

Fatal Analysis Reporting System – Includes information about motor vehicle traffic crashes that result in a fatality to a vehicle occupant or non-motorist, from injuries resulting from a traffic crash, that occur within 30 days of the crash.

FIPS Codes – Federal Information Processing Standards for coding states, counties, and cities.

Functional Requirements – Statements that describe the system functionality, features, and abilities that are required by the system users. Functional requirements do not specifically address technological aspects of the system.

Geographical Information System – A technological field that incorporates graphical features (typically geographical-related) with tabular data in order to assess real-world problems. A collection of hardware and software that is used to edit, analyze and display geographical information stored in a spatial database.

Global Positioning System – A worldwide radio-navigation system formed from a constellation of 24 satellites and their ground stations.

Handheld Computer – A small computer that can be held while being used can be divided into those that accept handwriting as input, and those with small keyboards. Also called palmtops and personal digital assistants.

Hybrid Vector-Raster Maps – Appear like raster map images, but they also include vector data to support geo-coding features.

Information Engineering – A framework of interconnected methods aimed at achieving optimum shareability and use of information in an enterprise.

Intersection Magic – An MS Windows-based PC application used for collision diagramming and 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.

ITS/CVO (Intelligent Transportation Systems/Commercial Vehicle Operations) – An initiative with a proposed technical infrastructure to link projects and information systems to enable the interchange of information electronically among agencies, motor carriers, and third-party service providers through the use of common standards and commercially available communications systems.

Mobile Data System/Terminal – Gives users access to data through a terminal away from an office, thus eliminating the need to radio or call for information. Similar to a personal computer.

Model Minimum Uniform Crash Criteria – This guideline is available to assist states in the process of revising their crash reporting forms and crash data processing systems. Except for the data elements required by the Office of Motor Carriers, implementation of the data elements included in the guideline are voluntary and according to state-specific specifications without any mandates by either NHTSA or FHWA. As a minimum, the guideline suggests that states should collect data for motorists, injured and uninjured, and for non-motorists involved in crashes in which at least one vehicle is disabled by damage severe enough to prevent driving it.

National Automotive Sampling System – Under the auspices of NHTSA's National Center for Statistics and Analysis, it is the mechanism through which NHTSA collects nationally representative data on motor vehicle traffic crashes to aid in the development, implementation, and evaluation of motor vehicle and highway safety countermeasures.

National Model – The National Model for the Statewide Application of Data Collection & Management Technology to Improve Highway Safety is a program for sharing information, resources, and technologies to improve highway safety. The focus of the National Model is improving data acquisition for roadway incidents, leveraging proven technology for law enforcement, streamlining the communication of safety information to key stakeholders, and extending the use of this information for short and long-range safety and law enforcement programs. The Iowa DOT and FHWA are the lead organizations in this consortium effort. This effort has resulted in the development of the TraCS crash data collection system.

Normalization – The process of organizing a database into tables in such a way that the results of using the database are always unambiguous and as intended.

Online Analytical Processing – Enables a user to easily and selectively extract and graphically view and analyze data from different points-of-view.

Optical Character Recognition – Recognition of printed or written text characters by a computer. Involves photo scanning of the text character-by-character, analysis of the scanned-in image, and then translation of the character image into character codes, such as ASCII, commonly used in data processing.

Process Model – A way to organize and document the flow of data through a business system's processes. Shows the structure of a company's activities and how the data flows through the company's processes.

Process/Entity Interaction Matrix – Examines the interaction of data and process. Also called a CRUD matrix.

PS-Accident/PS01 – A system consisting of an ADABAS database of accident information and programs that analyze and report the information. This is the system currently in use.

Raster Maps – Digital images of maps, usually created by scanning a printed map. Also known as Image Maps or Scanned Maps.

Relational Database – A collection of data items organized as a set of formally described tables from which data can be accessed or reassembled in many different ways without having to reorganize the database tables. The standard user and application program interface to a relational database is the structured query language (SQL).

Relational Database Management System - A relational database management system (RDBMS) is a program that lets you create, update, and administer a relational database. An RDBMS takes Structured Query Language (SQL) statements entered by a user or contained in an application program and creates, updates, or provides access to the database.

Roadway Safety Improvement Program – Formerly known as Hazard Elimination and Safety program. The purpose is to identify hazardous or high crash locations on all public roads in South Dakota and determine an effective countermeasure to reduce the crash numbers at the identified locations. The functions of the RSI (Roadway Safety Improvement) program are carried out annually by the SDDOT for all public roads in South Dakota. Projects to enact the countermeasures are funded by Federal Hazard Elimination and Safety (HES) funds and included in the State Transportation Improvement Program (STIP).

SAFER – A safety data access system now in development, SAFER will facilitate electronic collection and distribution of data between front-end systems like ASPEN and management information systems like SAFETYNET and MCMIS. SAFER will also serve as the interface between authoritative data sources and outside customers like motor carriers, insurers, shippers, and the public.

SAFESTAT – A national system of selecting motor carriers for on-site safety inspections that concentrates on a carrier’s safety performance to identify and prioritize carriers that are “at risk”.

SAFETYNET – The state level information management system for motor carrier safety. Captures inter and intra state driver/vehicle inspection data, accident data, carrier compliance reviews, enforcement data, and carrier identification data.

Severity Reduction Ratio – A ratio of overall accident severity prior to a road improvement project, to the overall accident severity after that project is completed.

Software Development Kit – A set of programs used by a computer programmer to write application programs.

SQL - Structured Query Language is a standard interactive and programming language for getting information from and updating a database.

SQL Server – Microsoft Corporation's relational database management system product.

State-Reportable Accidents – Those accidents which involve at least one motor vehicle within a trafficway (includes the entire area within the right of way) or outside the trafficway if control was lost within the trafficway, and which cause a fatality, injury, or property damage to an apparent extent of $1000 or more to any one person's property or $2000 or more per accident.

Telematics – The blending of computers and wireless telecommunications technologies, ostensibly with the goal of efficiently conveying information over vast networks to improve a host of business functions or government-related public services. General Motors has implemented this technology in the form of their "On*STAR" service.

Third Normal Form – For relational database tables, all column values are atomic (can't be broken down any farther), every non-key column is fully dependent on the entire primary key, and all non-key columns are mutually independent. This is a desirable state in relational database design.

"To Be" State – Documents the desired or future characteristics of a system.

TraCS – The traffic accident data collection system developed by the state of Iowa as the national model for crash reporting systems.

Truck/Bus Supplemental Form – A form that is currently used in SD to supplement the State of SD Investigator's Motor Vehicle Traffic Accident Report if the accident involved a truck having 6 or more tires, or a vehicle displaying a hazardous material placard, or a bus designed to carry 16 or more, including driver; and the accident resulted in a fatality, or an injury requiring transportation for immediate medical attention, or one or more involved vehicles had to be towed from the scene as a result of disabling damage or had to receive assistance to leave.

Vector Maps – Databases of map information, such as street names and the latitude and longitude of street intersections, fire hydrants, etc.

WAAS – A real-time differential correction source for GPS that accepts corrections on the ground, transmits them to a non-GPS satellite, which broadcasts corrections that can be received by the GPS device. WAAS is an FAA experimental service available at no charge to the public.

Web-enabled – System functionality allowing system users to enter, edit, and/or access system information using an Internet browser (such as Internet Explorer). In this context, the term is used interchangeably with “Internet-enabled”.

Wild Animal Hit Accident Form – A form that may be filled out instead of the motor vehicle traffic accident report when the accident resulted in property damage only from a wild animal hit.

Appendix B. Acronyms

AASHTO – American Association of State Highway Transportation Officials

ARFs – Accident Reduction Factors

AVL – Automatic Vehicle Location

BAA – Business Area Analysis

BIA – Bureau of Indian Affairs

BIT – Bureau of Information and Telecommunications

BSD – Business System Design

CRUD – Create, Read, Update, Delete

CVISN – Commercial Vehicle Information Systems and Networks

DFD – Data Flow Diagram

DGPS – Differential Global Positioning System

DOT – Department of Transportation

ERD – Entity Relationship Diagram

ESRI – Environmental Systems Research Incorporated

EVA – Expected Value Analysis

FARS – Fatal Analysis Reporting System

FMCSA – Federal Motor Carrier Safety Administration

GIS – Geographical Information System

GPS – Global Positioning System

HES – Hazard Elimination and Safety programs

ITS/CVO – Intelligent Transportation Systems /Commercial Vehicle Operations

MCMIS – Motor Carrier Management Information System

MDS – Mobile Data Systems

MDT – Mobile Data Terminal

MMUCC – Model Minimum Uniform Crash Criteria

NASS – National Automotive Sampling System

OAR – Office of Accident Reporting

OCR – Optical Character Recognition

OLAP – Online Analytical Processing

PRISM – Performance and Registration Information Systems Management

RDBMS – Relational Database Management System

RSI – Roadway Safety Improvement

SDARS – South Dakota Accident Reporting System

SDK – Software Development Kit

SQL - Structured Query Language

SRR – Severity Reduction Ratio

USDOT – United States Department of Transportation

Appendix C. Other Individuals Involved

There also were contributions from over 60 other individuals from agencies across state, federal, city, county, public, and private organizations. The contribution of these additional people is gratefully acknowledged. Listed below are individuals with significant contributions:

Janet McKenzie .... South Dakota Highway Patrol
Mike Thorson... South Dakota Highway Patrol
Sgt. Scott Sheldon... South Dakota Highway Patrol
Dan Staton .... SDDOT – Rapid City Region
Doug Kinnibaugh.. SDDOT – Rapid City Region
Ron Jarvis .... SDDOT – Rapid City Region
Scott Hammond ....SDDOT – Mitchell Region
Scott Jansen ....SDDOT – Mitchell Region
Chris Seaboy.. Bureau of Indian Affairs - Lower Brule
Coral Assam...DCR/Office of Highway Safety - Director
Pat Winters...SDDOT - Data Inventory
Mary Jensen ....State of Iowa TraCS Program Manager
Tom McHugh.. Iowa Highway Patrol
Bill Armstrong ....Pennington County Sheriff Office
Ken Hauser ....Pennington County Highway Department
Jeff Zanfes ....Minnehaha County Sheriff Office
Scot Pfeifer ....Minnehaha County Sheriff Office
Sandy Sawvell .... Sioux Falls Police Department
Scott Burke .... Sioux Falls Police Department
Tom C. Olson.. Sioux Falls Police Department
Dallas Hofer... Sioux Falls - City Traffic Engineer
Shannon Ausen .... Sioux Falls
James Ronfeldt.. Rapid City Police Department
Mel Preble.. Rapid City Police Department
Jack White .... Rapid City - Engineering
Dave Stratton .... Rapid City
Doug Adelman.. Rapid City
Kip Harrington.. Rapid City
Patsy Horton .... Rapid City
Jeff Gies... Rapid City MPO Coordinator
Mark Jandt ....Pierre Police Department
Sgt. Dave Miles ....Mitchell Police Department

SD2000-14-F2

South Dakota
Department of Transportation
Office of Research

U.S. Department of Transportation
Federal Highway Administration

Unified Reporting of Commercial And Non-Commercial Traffic Accidents

Study SD2000-14
Final Report Appendices

Prepared by
SHUPE CONSULTING
10065 E. Harvard Avenue, Suite 202
Denver, CO 80231

August, 2001

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Appendix A. Research Summary/Recommendation Grid

The following table summarizes the hardware and software products reviewed in this research document. The products are grouped into categories with a summarized recommendation given for each category.

Topic	Product / Vendor	Pricing, if available	Recommendations and Comments
Collision Diagramming (analysis of multiple accidents)			Recommendation – There are apparently only 3 products in the marketplace for collision diagramming. We recommend that SD DOT continue to use Intersection Magic, which is currently the market leader. We suggest SD DOT meet with them to resolve any problematic requirements. The vendor should be able to resolve them. Consider Cross Roads as a total solution if Intersection Magic and TraCS do not meet SD's needs.
	Intersection Magic	N/A since the State of SD already owns a statewide license.	Used by 13 state DOTs. Integration with ArcView. SD currently uses this. The version in use by the DOT does not currently have ability to display accidents within a radius - only has specific point capability. It also cannot sort, filter and combine multiple types of accidents. New release 6.6 was just released in May, 2001 that has more functionality.
	AIMS	$1500 per user to store up to 100,000 records.	I really could not determine whether this product offers any advantages over Intersection Magic.
	Cross Roads Software	Not available	Offers much more than just collision diagramming. Also offers reporting, GIS, accident report data entry system and back-end accident records database. Also includes an accident data entry "system" for the Palm Pilot. Would likely require heavy customization.
Accident Diagramming (diagram of single accident at the scene)			Recommendation – There are many accident diagramming tools on the market. We reviewed several. Assuming TraCS is the chosen front-end data collection system, then its built-in diagramming software will meet the basic needs of SD. It is not robust enough for reconstruction

Topic	Product / Vendor	Pricing, if available	Recommendations and Comments
			diagrams of serious accidents however, and the local agencies should continue to determine their own needs in this area and procure solutions that meet their needs.
	Crash Zone	$199/copy in quantities of 5 or more.	Claims that it is very easy to use, although I did not find it intuitively obvious. Brief training is probably required for this tool. It appears very robust and is probably very good for accident reconstruction diagramming for severe crashes or for use by personnel who are dedicated to accident investigation (such as is the case in Sioux Falls). It looked like overkill for accidents that do not require full reconstruction or for use by non-specialized law enforcement personnel. Contains many pre-defined symbols (Chevron sign), street signs (Stop), land features (bridges, trees), etc. Delivered support for import of measurements from Laser Technology's measuring device and all standard CAD data files. Outputs several file types including proprietary (CZD), BMP, WMP, and JPG. Note - TraCS will import diagrams in JPG format (among others). This package should be evaluated as a potential tool for the reconstruction process and/or for all accidents.
	Visual Statement	$595 - $795 per license	This package is a very robust accident diagramming tool that is easy to use. It has an extensive library of car makes and models to choose from. It also has the ability to drag various points on the car body to show accident damage. My only complaint is that I did not see any street-type templates/objects. You had to manually draw each line and arc of your diagram. Other products allow you to select the type of street or intersection you need (such as 4-line intersection) and then apply that to your drawing.
	Iowa's TraCS system Built-in Diagramming Tool	Freeware	Very easy to use. Contains pre-defined symbols for objects, signs, vehicles, intersections and roadways. Did not have high-end features like indicating vehicle/property damage areas. Probably not robust enough for severe accident reconstruction.

Topic	Product / Vendor	Pricing, if available	Recommendations and Comments
	MapScenes	$1695 1st user, 20% less for 2-5 and 30% less for 6 and up.	This is a fairly heavy-duty accident and crime scene analysis and reconstruction diagramming tool. It accepts measurement data input from several measuring devices on the market including Sokkia's TotalStation (see Sokkia review in this document). It can generate the basic diagram based solely on measurement/coordinate data entered into the product or captured via one of the measuring device products. It is a fairly complex tool that does not appear to be well suited to the day-to-day accident diagramming function.
GIS			Recommendation - ArcView is the market leader and SD has a license and a pilot project in place. There is no need to look at other tools.
	ESRI (ArcView and ArcInfo Products)	Already licensed by SD.	ArcInfo is a "light" user GIS and ArcView is the "heavy" user product. These products are the industry standard for public safety/traffic engineering analysis. Many government agencies are using these tools for the purposes SD DOT has an interest in. SD has already developed a pilot project using these tools.
	MapInfo		This is the second most-often mentioned GIS product applicable to our needs. There is much research available on this and the ESRI product. See our research review for more info.
GPS and Laser Measuring Devices			Recommendation - Permit the local agencies to determine what GPS device(s) they want to procure. At the state-level, we should provide GPS-enabled capability in the crash data collection front-end software.
	Garmin	$219	This GPS device includes WAAS correction (unlike consumer GPS models). It gives longitude/latitude read-out, accurate to within 10 feet. WAAS service is experimental but free. This is but one example from one vendor.
	Trimble	approx. $1500	Trimble offers competitive WAAS correctible GPS devices and is one of the market leaders. Several law enforcement agencies are using this brand.

Topic	Product / Vendor	Pricing, if available	Recommendations and Comments
	Sokkia	$7300 per Total Station system	GPS/ Measuring Device/ Accident Diagramming All-in-one includes distance measuring device, GPS differentially corrected receiver (accuracy to 3 feet), tripod, diagramming software and palmtop to record accident data. Exports to ArcView GIS. Law enforcement is not an industry focus for them.
	Laser Technologies	$2,800 - $3,400 per unit depending on model	Laser Measuring Device - standalone (single function, not integrated with other hardware/software) handheld laser measuring devices are available for use in taking measurements at the scene of accidents. Accuracy is within 1/10 foot at 175 feet away (or 17/100 at 500). Max. range is 1,886 feet from target. Some devices allow you to add-on other features that tell you the N/S/E/W direction as well as the distance. Other devices are available that incorporate laser measuring into a speed enforcement laser gun.
Accident Report Data Collection System			Recommendation - The Iowa TraCS system appears to meet our needs (assuming some customization).
	Iowa's TraCS	Freeware	Great looking front-end, data capture product. Also has forms for traffic citations, DUIs, and criminal offenses These are all integrated together. Comes with an SDK for customizing the system to meet our needs. Does not contain back-end functionality (consolidation of reports, interfaces to other systems, summary reporting, etc).
	Kentucky's CRASH	Freeware	We will be receiving an evaluation copy of this software shortly and will update this document at that time.
	California's STARS	Freeware	We will evaluate this system if needed. Iowa's system seems to be a good fit for SD.
OLAP (Online Analytical Processing) Server			Recommendation - Reserve OLAP evaluation for a later phase.
	Hyperion Essbase	$25,000 per server plus $1,500 per workstation	This is the market leader in the OLAP market. Essbase comes with extensive built-in calculations and statistics, such as standard deviation. It can be loaded directly from relational files, flat files or Excel. The analytical capabilities are extensive. For GUI analysis, however, an additional tool must be purchased from one of several vendors

Topic	Product / Vendor	Pricing, if available	Recommendations and Comments
	MS OLAP Services	Bundled with MS SQL Server 7.0 and above	

Appendix B. State Research Review

As part of the research phase of the accident reporting project, we interviewed several state and local agencies regarding their use of electronic accident reporting, GPS, GIS, and diagramming tools. The information from those interviews is presented below.

Note – all states' crash report forms can be found at http://www.nhtsa.dot.gov/people/perform/trafrecords/crash/Pages/us_contact_map.htm

Iowa

Iowa developed a front-end crash data collection system called TraCS. This is a freeware system available to any government entity. See separate appendix "Iowa TraCS System Review" for more information.

Louisiana

Louisiana has created a Web version of their accident report. Here are the notes from two interviews with Louisiana representatives.

Dan Magri
225-379-1871
DanMagri@dotd.state.la.us

- Implemented a system provided by state. Enter crash report data fields on Internet. Issues for larger agencies – slow response time
- For smaller agencies – have faster response time
- 411 funds – money administered thru NHTSA for implementation of traffic records systems – one of the requirements is a statewide traffic records committee that looks at proposals and projects. LA is using these funds for hardware and initial setup of system for police agencies.
- Marketing the system is an important issue since the burden of data entry is being shifted to local level.
- Went live in 1999.
- Creighton has a book that is the instruction manual for Internet input and we can get one from Dan.

- Originally looked at OCR technology but due to problems in Washington state, we backed off. Vendor was IBM and there were too many problems with accuracy.
- Went from 1-page, 2-sided form to 2-page, 4-sided form plus supplements for things like train crossing accidents, CV form. Got some resistance from officers for longer form but it's easier to use. Incorporated about 75-80% of the MMUCC elements. The longer form is partly due to the prior plan to go to OCR.
- Internet entry is not fully rolled out so state still gets lots of paper forms. Only 22 of 350 agencies are using the Internet. They started with the larger agencies first - i.e. Jefferson Parish.
- Other agencies transmit electronically. University of LA does the data entry for them. Data goes into an Access database and then transmits the data to the state.
- Benefits to local agencies – agency receives back their data (not via Internet yet).
- Local agencies have to do their own "spotting" (accident location designation) using route markers if they use the Internet for data entry.

Jim Dickerson
Highway Safety Commission – agency that is responsible for crash records
225-925-3927

- Have 7major metro areas all about 300K people average about 15K reports a year except New Orleans, which does 30K. New Orleans's equipment did not meet minimum specifications (1 mhz computers).
- Designed form using Lotus Notes and tried to make it look like a nice report with graphics but this slowed down the response time. Takes about 45 seconds to load with a dial-up line. Revised data entry online form to make it more heads down data entry style, which improved the response time.
- Have about 25% of the data coming in over the Internet.
- Some cities have investments in their own local systems so they got some resistance from a statewide form. Baton Rouge modified the form, uses SQL/Access and FTP's the data to the state.
- Shreveport FTP's a file and state FTP's back a file in Shreveport's custom format.
- Lake Charles has a laptop system but not a crash report system but hopes to use the state system soon.
- Therefore, we need multiple ways to accept the data – laptop, Internet, FTP, manual.
- Internet works best for agencies that did not already have an investment in systems.
- Have an online bulletin board where they post notices when system changes are made. Users can pose Q&A among themselves. Help manual is also online.
- The system produces statistics for things like number of records in each status (pending, errors, etc.) and to show which agencies/officers are having the most issues so training issues can be identified and addressed.

- They originally had online verification of VIN, DL # and registration information but this resulted in problems when the databases were not current (such as I sell my car and the new owner gets in an accident but the registration system has not been updated yet so the info was faulty). They added an override capability to get around this problem.
- Ned to contact Dr. Helmut Schneider at LSU at 225-388-2516 to get access to the Access database.
- Web site is www.dps.state.la.us, id = highway test

South Carolina

SC has licensed Iowa's TraCS system.

Ron Bass, Interim Director of the Information Technology Office, Dept. of Public Safety.
803-896-7887
bass_ronaldr@scdps.state.sc.us

- Ron is heading up project to consolidate accident and ticket tracking systems.
- TraCS representative is Corporal Jim Cleckley – in SCHP – 803-896-7848 803-513-5698 cell.
- Ron's project – build a new system to consolidate state's tracking systems (tracking of accidents and traffic citations). Will have workflows for reviews, etc. TraCS is the data collection system. Just finished needs analysis phase (12 month project). Next phase is to develop system. Want it to be Web-enabled as much as possible. Want to push data collection responsibility out to the field. Will have multiple means of data collection – TraCS, paper, Internet form.
- Iowa's impetus was the front-end. They have back-end mainframe systems that were already integrated. SC's was more back-end oriented but that also led to new front-ends.
- Kept accident report the same as it was and modified TraCS to work with it. SCCATS (SC collision and ticket tracking system).
- Working closely with Courts system to get the consolidated system project done.
- Have not made technology decisions yet. Currently use SQL Server for other applications. Challenge is that they don't have a totally wireless infrastructure in the field and how to keep laptops current as software is upgraded. They are not waiting for the wireless infrastructure to do the AR (accident reporting) project.
- Anticipating 14 months for development of the new system.
- Ron was not aware of any collision diagramming software they are using or plan to use but thought they might be using SPSS or SAS. SC Highway Safety Staff is responsible for accident analysis.
- GIS will be part of the new system. Analysis is manual today. SC does not have a completed geobase of centerline data – in progress. Illinois has a site where the

public can look at GIS online at http://samnet.isp.state.il.us/ispso2/samintro.htm . ArcView is the product SC already owns and will continue to use.

- Forms builder utility in TraCS is very powerful. Will have to add workflow capabilities.

County of Riverside, CA

The County has developed an extensive GIS system for accident (and other) analysis.

Ron Filian - GIS Based Accident Records System (BARS)
909-955-6807

- Using ArcView for GIS application. Collision diagrams by segments don't always scale properly – objects in drawing like signs don't scale properly.
- Their GIS includes traffic volumes to produce accident rates. Currently converting traffic control device inventory into GIS and pavement lane/width data. This has been a 5-year project, but it would have been 2-years if had been able to find the people to hire.
- Looked at Intersection Magic and Cross Roads (more robust than IM). IM reference points aren't as good as CR's. Not using either system. Using GIS for total analysis, including cluster diagrams of accidents. Use Standard Traffic Engineering Diagram industry standard notation for collision diagramming. Cross Roads is great for smaller localities to use for collision diagramming. CR does radius or area (polygon) analysis. IM does not. CR had you manually build a matrix of streets and cross-streets. This was very time consuming both up front and ongoing. For places like Riverside, they have 3,000 accidents per year and needed something more robust than IM or CR, so developed the GIS application. Currently hosting 165,000 collisions over 10 years on the GIS.
- State of CA is doing an automated accident reporting system – CSTARS – gets all reports on laptop and will force them to use laptop or desk top in order to file report (eventually)
- Experimented with GPS. Trimble's Direct GPS works with ArcInfo. Did 3 prototypes with GPS with mixed results. Decided to scrap the project for now.
- All accident reports go through state HP. Do reporting quarterly – takes 6-9 months to get access to reports – trying to catch up with data entry. Now have 6 weeks turnaround by adding a data input module. CSTARS files are exported to a flat file and then imported to GIS. ArcInfo cannot accept records more than 400 characters in length. Wrote a C program to parse AR into multiple files – collision, parties, victims. This data is pasted into an ArcInfo input template. The AR is currently an MS Word form.

- AR reports include summary rpt, location rpt, condition rpt (type/severity/day/night), collision diagram, accident rate, traffic volumes, traffic control devices rpt.
- Advice for GIS - need a reliable centerline layer in existence. CA primary base map is parcels, 2nd is centerline and the two don't always match.
- Have a matrix that assigns accident types based on various factors (left-hand turn, broad side). This is how accident types are displayed in the GIS. The matrix was fine-tuned and is able to assign they type (they have about 60 types) about 80% of the time. The other 20% have to be assigned manually.
- CSTARS is the front-end data collection software and is freeware – we should evaluate – Bev Christ or Doris Gibson 916-375-2850.
- The GIS system is also freeware because it was developed under a federal grant. We could probably have it up and running in 90 days if we have the centerline data already.
- SWITRS is the statewide traffic reporting system.
- He says that ArcView is fine for the casual use, but the heavy-duty users will need ArcInfo.

Colorado

CO has developed a GIS system and is implementing TraCS.

CDOT - Charles Ellison, Safety Department
303 757-9345

- CO uses both paper and electronic accident forms. The state highway patrol creates electronic accident report forms using a pen grid computer running Vision Tech software (Boulder, CO company).
- The accident report data elements were incorporated into CO's drivers license file. This is the back-end system for accident reporting and interfacing. It is a mainframe, home-grown system.
- They use a 1–page (front and back) paper from that was revamped in 1997 and should be included in the accident report forms book we have. It does contain a narrative block and a diagram block. It does not contain the truck/bus supplemental info. That is on a separate form. There is a FARS supplemental form also.
- They are MMUCC-compliant to the extent that they were very thorough in re-designing their form and it happens to match closely with MMUCC criteria.
- There are some GPS devices used and they can be integrated with the electronic form. Charles thinks GPS coordinates are pretty useless. You need a GPS correlated survey of all of the state's roads in order to be effective, but that is still only part of the issue. If you don't know what objects are associated with the accident/location (i.e. occurred in the middle of a bridge), then the GPS

coordinates don't do any good. Some officers relied too much on the GPS reading to completely identify the scene and didn't further review the scene and use verbal and object references, so they quit using GPS.

- Charles feels that the way they designed their form helps tremendously in getting accurate location info. If report form is not properly designed, officers will put data in wrong. CDOT has a location block with 3 data fields that forces the officer to gather the needed information. In order, they are –1) accident occurred on route/street and cardinal direction (N/S/E/W), 2) alternate location (i.e. another road) and cardinal direction, 3) miles/feet in reference to 2nd location. You shouldn't just provide a blank block that says "location" and let them figure out what to write in the block. Latitude/longitude is kept separately, but Charles says that data is not used at the state level.
- There is no state standard for accident diagramming. The Vision Tech software includes Visio for diagramming. Otherwise, the diagrams use hand-drawn diagrams.
- Accident analysis software was written in house. They run summary sheets against the database, which gives them numbers of accidents meeting the chosen criteria. Accident plotting is done with AutoCAD. They have Intersection Magic but don't like it. It's pretty but you can't extract what is going on. Need to be able to look at numbers and data points and compare them to statistics to see what's going on. You need pattern recognition (what direction of travel, what quadrant of the intersection and what type of accident, etc. all taken together). In other words, Charles feels that analysis must be done manually to determine the real cause of accidents.
- GIS is used in the Planning department. Not a good solution for safety assessment. Need to look at the locations. GIS is too broad.
- They are currently implementing TraCS for those cities that want to use it for the capture of accident report data. State patrol will still use Pen Grid system. Other agencies will continue to use paper forms. TraCS is not a back-end system so their mainframe system will remain in place.

CDOT GIS manager – Tammy Goorman
303 757-9811
email tamela.goorman@dot.state.co.us

- They link accident report data to highway centerline file and then select a segment to view and see the number of accidents. They have a point shape file with accident location and can query a point to see number of accidents. Hard to get most recent AR data. Just working on 1999 data now. Not very useful for analysis since it's old data.
- Using both ArcView and ArcInfo. Been using since 1980's. Accidents are located using a route reference point. That point is related to the highway file.
- They export accident reports from their drivers' license file to a DBF or ASCII file which is imported to Access or dBASE. Then they use dynamic segmentation

function in ArcInfo to locate the accident via the route reference or x,y coordinates.

- They also sometimes use the ArcView maps to assign accident locations prior to the accident being finalized in the accident database. (i.e. this is a front-end process rather than a back-end analysis process).
- The state patrol's PC-based accident diagrams are passed directly (electronically) to the Office of Revenue (they are the keepers of accident records/system).
-
- Other contacts in the safety department - Brian Allery 303-757-9967 and Jake Kononov 303- 757-9039, traffic engineer.

VisionTEK Accident Reporting Software Review

This system was developed by VisionTEK Incorporated of Superior, CO. The software is used in Colorado and several other states, although not statewide anywhere but Colorado.

Contact Info:

Company Headquarters
VisionTEK Inc.: Colorado
1000 McCaslin Blvd. Suite 310
Superior, CO 80027
V: 303-554-8835
F: 303-554-8834
T: 800-595-8835

www.visiontekinc.com

Art Ahaedike - Regional Account Manager
(303) 554-8835 ext 231

VisionTEK has a suite of mobile reporting systems, including: Accident Reporting, Citations, Towing, Bookings, and more. VisionTEK recommends using the Panasonic CF Series (currently CF28) for the hardware platform. The systems work in either a "CDPD network" (cellular/wireless) or a "standalone" mode. VisionTEK has installations in Colorado, Texas, Tulsa, OK and Lee County, FL, a couple agencies in Arizona.

Cathy Pakkebier (PCS - Portable Computer Systems, (303)346-2487), can give us pricing information on the Panasonic CF Series computers that the VisionTEK software runs on.

Our review of the software:

- We see no ability for us to customize this software. VisionTEK said on the phone and in their cover letter that they would work with us to customize the application.
- EMS data collected for fatalities only, not for injured.
- Restraint is Yes/No only except for fatalities.
- On first input screen (Accident Scene Data), we indicated in a check box that it was a fatal accident, but we were able to leave the number killed at zero without getting an error message.
- We indicated one vehicle was a tractor/trailer, but the system did not make me enter the data specific to truck accidents. We were able to choose that screen, but We left it blank without an error message.
- The screens were laid out nicely and easy to read. We were able to enter data in any order by choosing the screen we wanted from a list on the left of the screen. The list also indicated which screens had been completed.
- It doesn't look like we can customize this system ourselves, so we didn't spend much time on it. We can investigate it more thoroughly if needed.

Montgomery County, MD

The County has a progressive technology department and wrote a paper on GPS/GIS potential uses in law enforcement – see "Research Literature Review" section for web link and copy of the paper.

Police Dept. Technology Division – Sgt. Bruce Blair
240-773-5210

- County is implementing a new system called Public Safety 2000 – a fully integrated system.
- Telematics is the generic term for communicating between vehicles and a service provider (i.e. OnStar system) or for public safety responders with crash, and other info. Telematics industry has begun to standardize technology and approach. We should lookup the COM CARE alliance about this industry and how they are interacting with public safety departments. Another interesting area is intelligent transportation systems (ITS) – use resources of highway and people on highway to manage transportation resources.
- PS 2000 – Employing new radio system (multi-trunk) supplemented by mobile data systems. MDS – gives officer ability to do everything they could do at a desktop via a mobile/wireless PC. The DOT could not get timely info from the officers. To solve this, they need to capture high-quality info in an electronic format in the field. MDS provides access to information – voice radio system, command/control center. Their police, fire, and transportation management are all housed in one building with common technology infrastructure.

- Software for accident diagramming – they use the EasyStreet Drawer (Visio-like program) – wireless bandwidth is very limited, so need to manage file sizes. I could not locate this software after many search attempts. Bruce was unable to provide any additional info that would help me locate them.
- PS 2000 is a $130M project. UCS vendor is the MDS mobile client software vendor. UCS was bought by THE but UCS was dismantled so the county switched to Cerulean. Aether Government Systems (in Columbia, MD) bought Cerulean – front-end software to combine CAD (computer-aided dispatch) – combined with messaging and interface to do warrant checks, etc. Radio system cost $50M.
- County maintains a geo-base and GIS system. Not using GIS for accident analysis. State of MD is not progressive in the use of technology. State does not accept electronic crash reports. County must still fill out 1-page, 2-sided form with codes and hand-drawn diagram that goes to the state.
- MDS software for phase 1 does not include field report writing but does include chat/email, interface with NCIC, obtaining warrants info, etc. Requires complete modification of the police car equipment. Accident reporting module will be phase 2. Hoping that the state will have an electronic standard by the time they get to phase 2.
- Another aspect of telematics is the "black boxes" that are being built into cars containing sensors for measuring crash forces, air bag usage, etc.. This will lead to creating automated systems alerting emergency personnel that a crash has occurred. His advice –be aware of trends in the telecomm industry and national initiatives.

Sioux Falls, SD

Sioux Falls was the pilot location for a state-funded GIS project.

Steve Van Aartsen, GIS System Information Coordinator
vanaartsen@sioux-falls.org
605-367-8653

- They have had GIS for 11 years. Built their parcel database first. Then, built street centerline (geocoded with ranges of addresses) – gives ability to do routing (type in address and location is found). He says the DOT is trying to build a complete geo-coded state database now.
- Have their database tied to GIS mapping. Public utilities are digitized. Working on metro communications (handles dispatch for 911 calls) and they are buying computer aided dispatch software for location and additional data that is available from fire/police available to dispatcher to make it available to responding officer.
- Also looking at GPS receivers in the vehicles to obtain location. Don't know what kind of GPS units they'll use. GPS antenna can be hard-mounted on car –

this is an intermediate priced model). Best way to assign location is with an address – requires a good address database to do this. A huge portion of the GIS project is taking existing address data and running address match with parcels database and put points out to the GIS.

- Grid – Pierre looks at a county map grid system (A3), assigns the location based on measurements on the sheet.
- GIS – traffic engineering for city analyzes accident data to see if have a problem. Use ArcView application. Use Intersection Magic. Locate point on GIS map and select the location and accidents occurred at that intersection will come up and IM diagram will also pop up. The integration between ArcView 3.1 and 3.2 to IM was custom built. IM does not provide any additional data, but does give a good visual to see how the accidents are located in the intersection. The accident report from PS-01 is not accessible directly from ArcView or IM.
- The DOT OAR funded and managed the project (Valerie – outside consultant) to build this GIS application for Sioux Falls and Minnehaha county as a pilot.
- Have had some problems with ArcView and IM working correctly since Valerie left. The pilot project is on hold until the state DOT accident reporting project is completed.

Georgia

Georgia has licensed Iowa's TraCS software.

Brenda Raines – Dept. of Public Safety
(404) 624-7660.

- Office of Accident. Reports is splitting away from State Patrol and a new Dept of Motor Vehicle Safety is being created.
- Currently, all accident reports are on paper and are scanned and sent to a private company where they are key punched. Data is sent back to the state. Have had so many problems that they are still working on 1999 reports and, therefore, they do not do any kind of analysis. They are not using TraCS at the state level. They are thinking of reverting back to a pre-1998 system due to the problems they are having with the current system implemented in 1998.
- She thinks Cobb County or DeKalb County Police Dept. may be using TraCS – ask for records section when calling.

Kentucky

Sgt. John Carrico - State Police Records Branch.
502-227-8700

Sgt. Carrico is the project director for the CRASH (web version called eCRASH) system, Kentucky's accident system.

- MMUCC compliant except where state law is in conflict with MMUCC
- Feeds into FARS
- Paper report and laptop version
- Website
- Imaging
- Bubble report scanned, imaged, and maintained on optical jukeboxes
- Oracle database
- Captiva to extract handwritten info – OCR
- FileNet for imaging
- Bar coding
- System has > 1200 edits
- Wizard-based form
- System partially paid by federal funds so the system is available to any other state as long as they have the hardware/software needed to run it
- Runs on NT, Windows 98 or Windows 2000 and later versions of Windows 95.
- The CRASH system took 7 ½ years to complete (they plan to add GIS as soon as they get the funding), and they did the system in phases. The form design alone took 2 ½ years. The system has now been running for a year and a half, and the federal funding so far has been > $2.5 million. The users are very satisfied with the CRASH system.
- I asked how they get information into the FARS system – FARS extracts the data out of the KY system. KY wrote some reports and data extracts that are used only by FARS, and direct access from FARS into CRASH.
- OCR – Now they only use OCR to scan the bubbles on the written form. It's 99.9% accurate. Originally they used it on handwritten narrative, etc., but as much time to correct the errors as to just not use it that they disabled much of the OCR that they had in the system originally.
- Have other states implemented system? – No. Several states have expressed an interest.
- Key problems with form design – Their main problem was that the data elements kept changing. MMUCC kept changing at the time KY was designing their form, and they finally had to incorporate what they could and get on with it. He did say, though, that CRASH is MMUCC-compliant. Getting buy-in from all the people who use the form. KY state police administer the CRASH system. The form design was a joint cooperative effort between the DOT and law enforcement, which was a very important point for a successful design. Sgt. Carrico also recommended pilot areas to test the form. They used 6 different areas/agencies for field testing, and they ended up changing the form several times, and Sgt.

Carrico recommends retesting after the form changes. Some of the form problems they had were bubbles being too small, ink color was unreadable at night or certain times of day (real bright light, etc.), too little space for an address, paper too thin (tore easily and fell apart in rain). The final form works very well. All of the issues that were uncovered during the test were resolved. It has color inks, is readable at night, uses thicker paper, etc, except that the bubbles are still spaced a little close together.

- Similarities & differences between CRASH and TraCS – Sgt. Carrico said TraCS is paperless, but they basically collect the same info.
- On the back end after they collect data on the front end, data is loaded to a back-end Oracle database (state standard at the time) – Extract data through Oracle and do queries and reports. They are getting ready to hire a person for GIS and statistical reports. He said the front end would work with any kind of database on the back end.

Please see Appendix O. for a review of Kentucky's system.

Salinas, CA

Salinas is using GIS for crime analysis. See "Research Literature Review" for web link and copy of documentation from web site.

Police Dept. – Captain Larry Myers
larrym@ci.salinas.ca.us

- Did not return my email request for more info.

Maine

Creighton Miller of the SD DOT referred us to Maine to be interviewed.

Department of Transportation - Gerald (Gerry) Audibert,
(207) 287-8244
gerry.audibert@state.me.us

- Did not return my phone call.

North Carolina

Creighton Miller of the SD DOT referred us to interview NC.

- Did not return my phone call.

Michigan's FACT

Michigan Fatal Accident Complaint Team

- Michigan State Police began collecting crash data in a program called FACT. The FACT program collects data on vehicle and driver contribution to crashes. The data are collected by state police officers using a special crash reporting form. Indicates that accident causation is mostly human factors and those factors can be recorded and analyzed.

FMCSA's ASPEN

South Dakota currently uses the ASPEN system for commercial vehicle inspections. A suggestion arose during one of our workshops, that the project team should investigate the potential use and/or modification of ASPEN as the accident data collection system. An interview was conducted by Robin Schumacher, as documented below.

- According to Mike Blevins at FMCSA in Lakewood, CO, ASPEN is not an accident data-collection system, nor can it be modified for this purpose. It is only vehicle inspection software. An inspector could mark an inspection as post-accident, and they are considering adding the ability in ASPEN to mark individual values as pre-accident or post-accident, but that's as far as it will go.
- Mike mentioned Vision Tech software as something we might want to investigate. He said it covers accidents and citations.

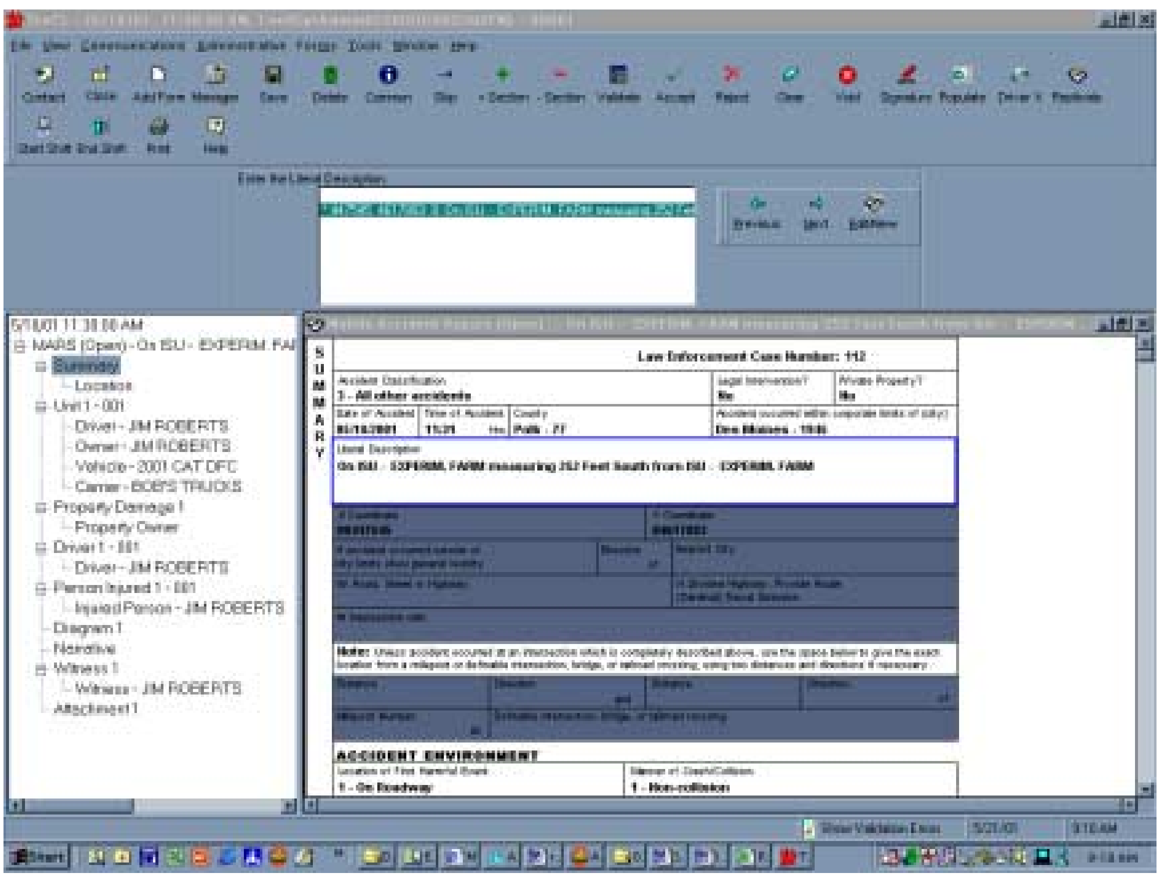
  Vision Tech
  401 Discovery Dr
  Boulder CO
  (303) 415-1010
  www.visiontechinc.com
  Alan Bishop – President
- He also mentioned that all states except Texas, California and Iowa use ASPEN, and Iowa is thinking about it. (According to Iowa's TraCS Program Manager, Iowa will continue to use the VSIS componenet of TraCS, which collects essentially the same information as ASPEN. Iowa is planning to add some ASPEN functionality to TraCS, such as direct upload to SAFER and the interfaces with ISS, PIQ and CDLIS by the end of the year.) I assured him we weren't going to replace South Dakota's inspection software, but that we just wondered if ASPEN could meet our accident recording needs.

Appendix C. Iowa TraCS System Review

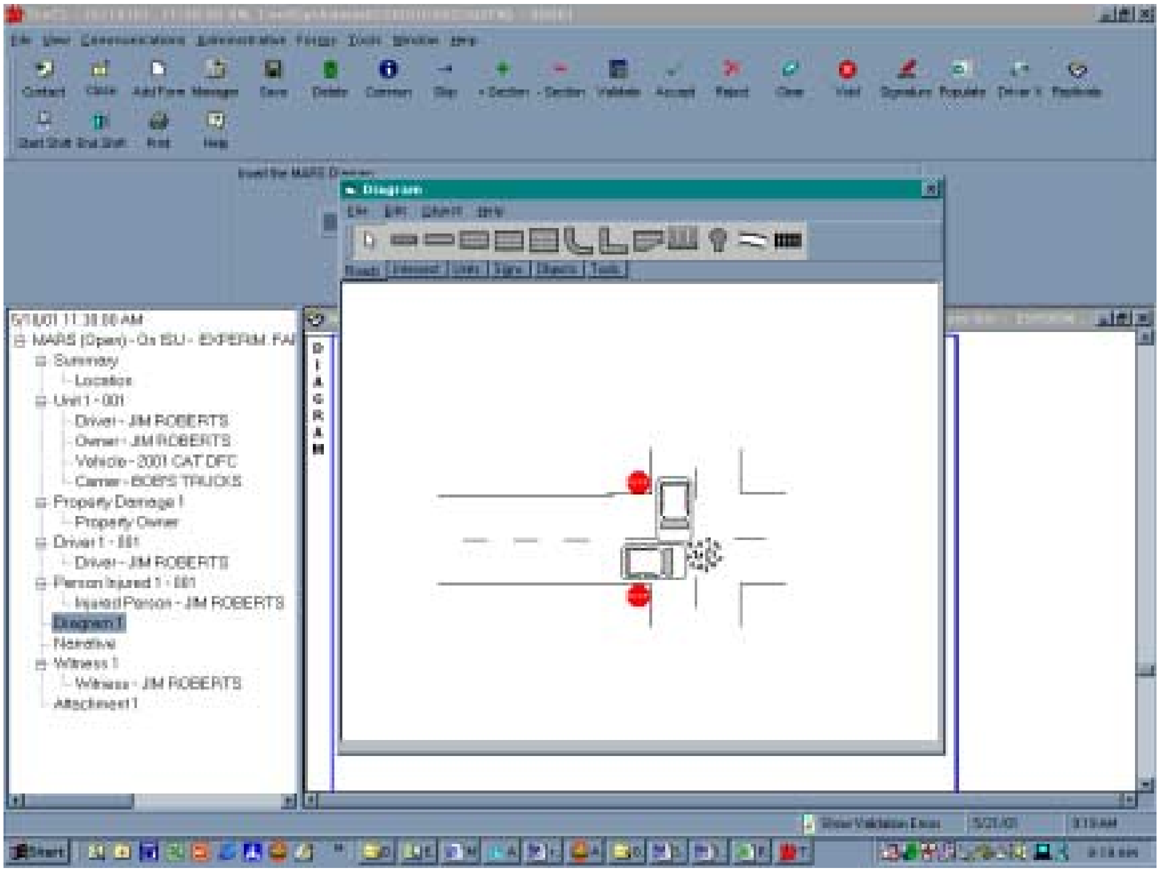
Overview

This system was developed primarily with state funds and some federal funds with the premise that it would be made available to all other states as a "national model" for uniform crash reporting. See research topic earlier in this document "The National Model". The TraCS system is a front-end data collection system for entering traffic accident reports (as well as citations, inspections, DUIs, and criminal offenses.

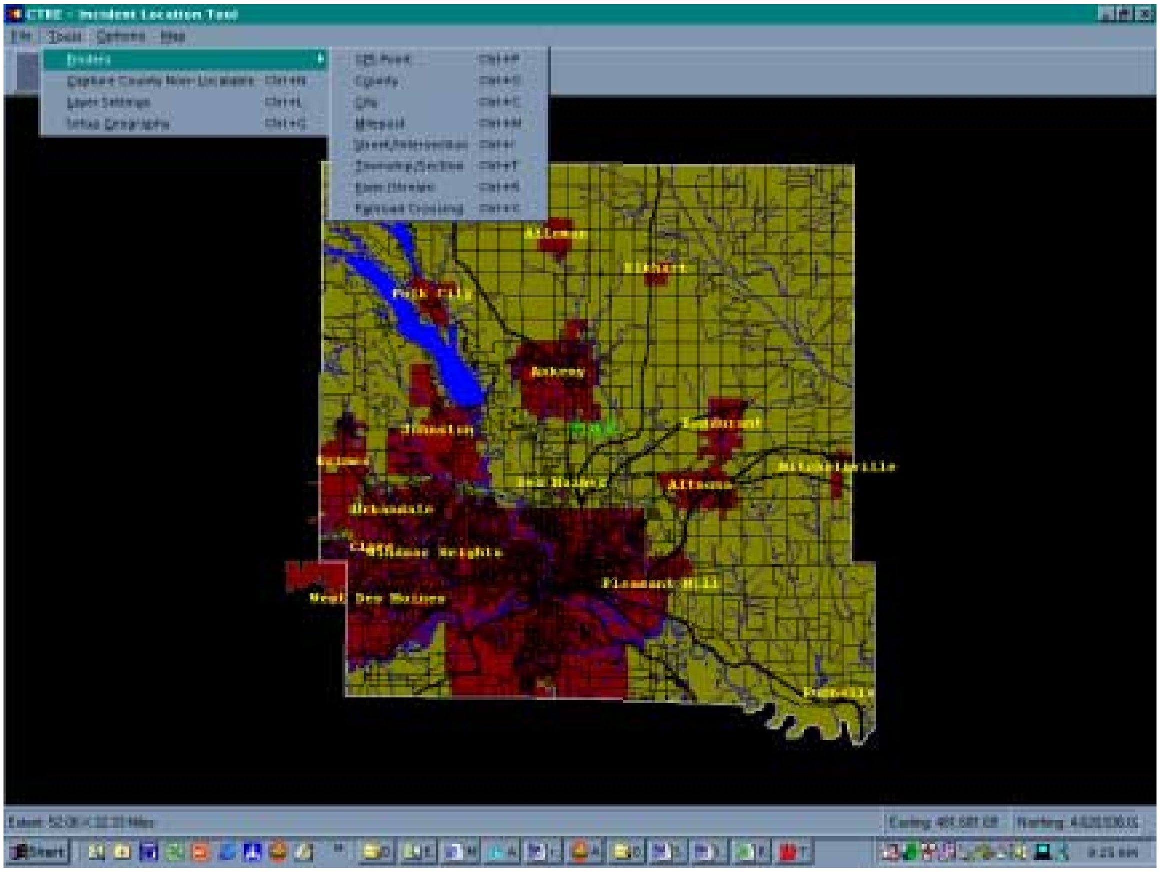
Below is a screen print showing the accident report data entry and review window. Below the icons, is the data entry panel. Below that, is the accident form, which the system fills in as you enter data in the data entry panel. Notice that data fields that do not apply are grayed out as you enter data. The panel on the left is a tree structure showing the various sections of data applicable to this accident report based on the data that was entered. You can scroll to any section by clicking on it in the left pane, causing the form panel to go to the selected section. Clicking anywhere on the form, also changes the data entry window to the selected field where it can then be edited, if desired.

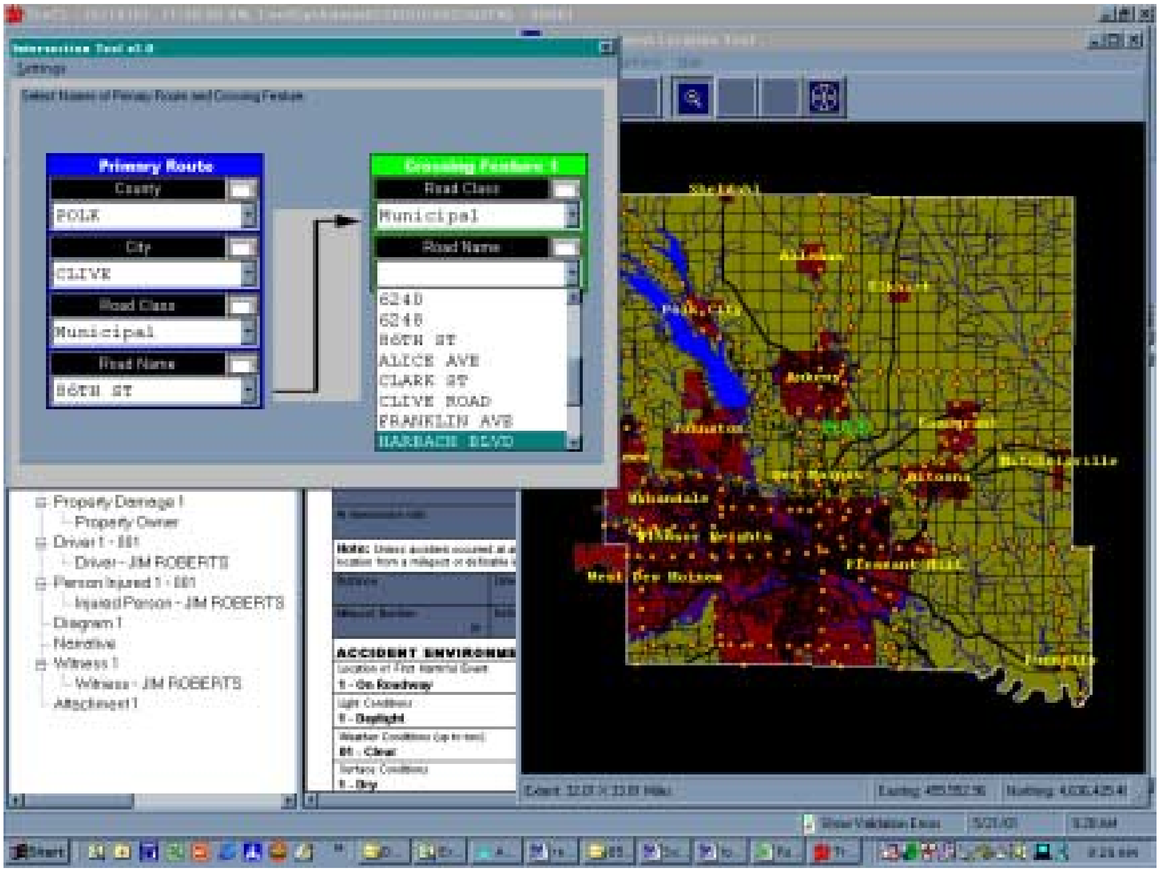


The built-in, custom developed accident diagramming tool is easy to use, while not being overly feature-rich. For example, I could not change the color of the cars, indicate any physical damage, or designate a point of contact.



The LOCATE tool, also a custom-developed tool, is also quite easy to use. There are multiple ways to locate the accident site as you can see in the menu below.


CTRE - Incident Location Tool
Alleman
Elkhart
Polk City
Ankeny
Johnston
Bondurant
Mitchellville
Urbandale
Des Moines
Altoona
Windsor Heights
Pleasant Hill
West Des Moines
Runnells



Functionality Review Matrix

An overview of the features and functions that were reviewed is found in the table below.

System Compo-nent	**Function-ality Area**	**Comments**
N/A	Iowa Contact Info	Mary Jensen is the primary TraCS contact for state's evaluating the system 515-237-3235 Mary.Jensen@DOT.STATE.IA.US Paula Page works with Mary Jensen Paula.Page@DOT.STATE.IA.US

System Compo-nent	Function-ality Area	Comments
N/A	General Info	State currently evaluating TraCS include: Alaska Arizona Arkansas Colorado (DPS) Connecticut FHWA FMCSA Georgia (Dekalb Co. Police Dept.) Illinois Indiana Maine Mississippi Nebraska Nevada New Hampshire New Jersey New York (NYPD) NHTSA Oklahoma Rhode Island South Dakota Tennessee Virginia Wisconsin States with licensing agreements: Alabama Colorado (Dept. of Revenue) Georgia (Georgia Tech Research Inst) New York (State Police) South Carolina Wisconsin

System Component	Functionality Area	Comments
N/A	System Hierarchical Structure	The system is currently written in VB 6.0. There are about 180 Iowa agencies using the system. Mobile version – used at local level – no database – flat files. Office Version – local agency level – includes run-time Access database or can export flat file data to a local records system. Some agencies use Sleuth. State Version – batch process of flat files into DB2 database. The highest level of data is the contact. Contact = an incident such as "6-car pile up". Contacts are also referred to as "cases". Each contact may have one or more of any of the 5 types of forms in the system – traffic citations, accident (only one per contact allowed), inspections, DUIs, criminal offenses. Each of these 5 types of forms may occur one or more times per contact (i.e. multiple traffic citations issued for one contact). Some sections within each form may also occur multiple times if needed (i.e. multiple vehicles in an accident). There is an effective "file manager" type window always visible to the left of the active form window, showing you all relevant forms and form sections for the active contact. A separate Contact Manager window shows all contacts and all forms associated with each contact.
N/A	Response Time	Overall, I did find the system response time to be a bit slow on my IBM ThinkPad 266 mhz, Pentium II, 192 mb RAM laptop. The LOCATE tool and the diagramming tool were slow to load, as were contacts and forms (the time varied from a few seconds up to a minute).

System Compo-nent	Function-ality Area	Comments
All	Common Information Manager	This function, which is integrated into all of the forms, allows you to enter, edit, duplicate, delete and view info about individuals, vehicles and carriers so as to use this info across forms. The info is unique to each contact and is not shared across contacts.
All	Data Flow/Data Entry	The split screen (one for entering data and one for viewing the filled-in form) was quite nice and enhances the effectiveness of the data entry process. Fields that are not applicable based on a previously entered data value are grayed out and skipped over during the data entry flow. This works very well. Drop down lists allow you to "type-ahead" more than one character. Ex: I type MER and I get Mercury and Mercedes choices. This makes data entry easier. With other programs, when you type the second character, it resets the search to values that begin with that character, ignoring the first character. Provides ability to tab to next field using the ENTER key rather than having to use the mouse to click on the NEXT button. This enhances data entry efficiency, although a lot of data entry people prefer the TAB key over the ENTER key. To jump to any place on the document, just find the field you want in the form display window and click on it. You don't have to use the PREV/NEXT buttons to scroll through all the fields to go where you want to go. Nice! There were a few areas that may be candidates for improvement/modification: When clicking "PREV" to go back to a previous field, it took you back through some previously skipped fields (some fields are skipped based on the prior value entered). Some fields with default values (such as IA for state) and Yes/No options, still make you click on it and then hit NEXT, rather than just hitting NEXT.

System Compo-nent	Function-ality Area	Comments
All	Edits	Most fields are not edited real-time. The separate error validation process is very easy to use. The form window splits, adding an error message window. As you double-click any of the error messages, the form window highlights the field in error associated with the selected error message.
All	Help	The Help system was very good when I asked for help with the Iowa diagramming tool. I found the help to be somewhat limited in other areas such as individual field help. For example, using "CMV" as a lookup, I was still not able to determine why I could not un-gray the CMV fields (I was not able to duplicate this CMV problem later).
All	Auto-Populate	The Auto Populate button allows the user to automatically update open forms in a Contact with information from other forms within the same Contact. For example, if an officer issues a citation resulting from a Driver/Vehicle Inspection, selecting Auto Populate will open and update the ECCO (citation) form with the VSIS (inspection) violation information. Similarly, if citation and accident reports are completed for one Contact, this option will update the MARS form with the ECCO citation number(s) and description(s).
All	System Development Toolkit (SDK)	The SDK has the following options: Forms Builder Validation Builder Database Builder Prompt Password Product Settings Report Settings Export Forms Import Forms Synchronize Database I did not review/evaluate these functions.
All	TraCS Administrator Desktop	This is where the administrator sets up and performs system options, security, communications, imports/exports, backups, etc. This is also where the SDK is located.

System Compo-nent	Function-ality Area	Comments
All	Maintenance/ Enhancement Procedures	Iowa plans to continue meeting with states that are using the software to determine what enhancements are desired/needed and prioritize them (see matrix below). Iowa is also looking at a pooled funding concept, and looking to the Feds for money to benefit all the states. The procedures for reporting/fixing bugs: Unless you have a contract with Tadd at Technology Enterprise Group, the bugs should be reported directly to Iowa (Mary).
All	Training Availability	The Licensing Agreement states that each state needs to develop their own technical support program, which includes training; so this would be each state's responsibility. However, Iowa is planning on having SDK training in Tennessee on July 17-19..

System Compo-nent	Function-ality Area	Comments
Accident Report	Accident Location	Location fields (literal description and X/Y coordinates) are auto-populated if you choose to use the automated LOCATE function. The LOCATE tools is written in VB and is maintained by a different group than TraCS, called the CTRE group. Contact is Dan Geisman. The LOCATE function provides several ways of locating an accident: by manually entering the X/Y coordinates provided on the display of a GPS device. There is a "GPS-enabled" option, which may provide direct integration from a connected GPS device, but I could not test this. by locating a place on a map – this works like various Internet map/location finders – you can enter a county, city, milepost, intersection/street, township/section, river/stream, or railroad crossing. This will take you to a view of the map corresponding to the lowest level of information you entered. by zooming in/out on the state map to manually locate the incident location. Once you have the map positioned to your incident location, click on the location. If you need measurements from say an intersection, click on "enable measuring". As you move your mouse around on the map, you will see how many feet/miles/yards/meters/kilometers you are from the nearest definable object (such as an intersection). Clicking "locate incident" when you are at the right spot, provides the: county number state route signed route street name city number X/Y coordinates longitude/latitude literal description Clicking ACCEPT populates the literal description and X/Y coordinate fields on the accident report. This same LOCATE program is used by the other forms in the TraCS system as well.

System Compo-nent	Function-ality Area	Comments
Accident Report	Paper-based use	All 100 MVE officers are equipped with laptops. Ninety out of 350+ state patrol troopers have laptops, with another 40 coming soon. Local agencies have about 400+ laptops at various agencies throughout the state. Still, in Iowa, with about 5,000 law enforcement officers, the majority do not have laptops. Those officers/vehicles that do not have laptops carry paper forms that are filled out in the field and taken back to the office where a data entry operator uses TraCS to enter the data into the desktop system.
Accident Report	Case Number	Appears to be a manual data entry field only – did not see the capability to scan a "document number" bar code.
Accident Report	Consistency of data fields between Iowa's data model and SD's new data model	Unable to evaluate without having the SD data model.
Accident Report	Info about individuals (drivers, owners, injured persons, etc.)	Allows you to select a name from a drop-down list created upon 1st entry of any info about an individual on any form related to the current contact. All info about the individual is auto-populated such as address. This functionality is a result of the Common Information Manager mentioned earlier. As a side note, there is no place to include non-injured passenger info, such as may be desired by SD for Social Services Recovery's use.

System Compo-nent	Function-ality Area	Comments
Accident Report	CMV Data	USDOT # and MC# are mutually exclusive data fields. Carriers are part of the common info data structure, but do not cross contacts. I would think you would want to be able to store carriers at a level above contact so they can be shared and not re-entered for every new contact. There is no picture to select from when stating the CMV type (as there currently is on the SD Supplemental form). There is a drop-down list of 24 different vehicle configurations used for both CMV and non-CMV vehicles. There is also a cargo body type field containing 19 choices.
Accident Report	Accident Diagram	Offers 3 choices of tools – Visio, Iowa Diagram, and Image Capture and Import. The Iowa Diagram option (a custom-built tool), brought up an easy to use drawing tool with pre-defined images of roadway types, intersection types, signs and other objects such as bushes. The image capture option provides the capability to capture input from an existing file (bmp, ico, jpg, wmf and cur file types) or from a document placed on a scanner.
Accident Report	Misc. Features	Nighttime mode is an interesting feature that reverses the video on the screen so you can see better at night. The system has the ability to insert an additional instance of a section such as Property Damage, if more than one is needed. Apparently, the “Driver X” function is a subset view of the accident report intended to provide each driver with a printable view of the report containing only certain summary data and the information about each other – name, address, etc. I was a bit surprised that insurance agency info is not a drop-down list but rather is a direct input field only. Large agencies such as Allstate, State Farm etc. should be frequently used values.
Accident Report	Case Export	Via the “start/end shift” functions, you can export your cases via floppy disk, serial connection, local drive, network drive, FTP site, or dial-up.

System Compo-nent	Function-ality Area	Comments
Accident Report	Print	I was able to successfully and easily print one or more copies of the accident report I created. Some of the coded data fields only contained the entered code on the printed copy, while others printed the code and the associated descriptor. (Online views always contain both the code and descriptor). Unused sections of the form were automatically omitted in the printing process.
Accident Report	FARS	There were no additional FARS-specific data fields presented to me when I indicated a fatality had occurred in the accident.
Accident Report	Witness Info	This data was located in a separate block with separate fields for name, address and phone. There was not a separate witness statement block, although this could be added with the SDK.
Accident Report	Attachments	There is a separate section for attachments, which accepted a description/narrative of the attachment. Have to click on smaller block to import.
Accident Report	Review/ Approval	There are "reviewed by/date" fields on the report but they were grayed out indicating that these are used only by supervisors. A supervisor has the ability to reject a report and send it back to the officer. There is an electronic Accept/ Reject function. The access to these fields is controlled by security groups/levels.
Accident Report	EMS data	The only EMS-related data on the report is "transported by/to". No time or EMS ticket # fields were available.
Accident Report	GPS Support	Rich says that each agency purchases its own GPS devices (there is no state standard or mandate). Some are handheld and others are car-mounted. He mentioned Trimble (I assume this is a vendor). They use real-time differentially corrected devices, but he was not sure whether they are using the ones accurate to about 10 feet or those accurate to about 3 feet. It is probably a mix since there is no standard in place.

System Compo-nent	Function-ality Area	Comments
Accident Report	GIS Support	Iowa uses ArcView . Dan Geiseman at the Center for Transportation and Research is the contact. Iowa's ,aps are created with MapObjects using VB. Iowa's base records are accessed with Geo Media Pro which outputs the ArcView shaoe files which can be read by the Location tool.
MOWI (DUI form)		This form is used to record the results of an officer's observation of a potential/actual DUI. The MOWI form contains info not found on the MARS form, and there is some overlap between the two forms. Although with the auto-populate feature, defaulting common data between the two forms is an easy task, though it did not appear to be automatic (i.e. if any of the drug/alcohol-related fields contain positive data on MARS, the MOWI form did not automatically "pop up", nor was there an error/warning message issued that would remind the officer to go to the related form).
ECCO (citations form)	Signature	Allows either a bar coded signature or an "ink" signature. The ink option brought up a window that appeared to allow me to sign right there, if I had a writable computer display. I'm not positive as to how this works. There was no such signature capability on the accident report form as delivered, since Iowa does not require signatures on accident reports. This can be modified using the SDK.

In summary, the TraCS system appears to be capable of meeting South Dakota's accident report creation needs, assuming customization will be required to match the re-designed SD Accident Report Form, as well as to add/modify any other features that might be required to meet SD's specific needs. This system should be considered as the front-end of the accident reporting/analysis process. A back-end accident reporting system is needed that all of the accident reports will feed into at the state level (Office of Accident Records) as there are no reporting functions included in the TraCS system (beyond creating a hard-copy of a single accident report) and no central repository that interfaces with other systems such as FARS and SAFETYNET. Also, TraCS does not have the analytical capabilities needed to analyze accident causations.

Iowa Interview

On May 23, 2001, several representatives of the SDARS project team met by phone with several of the Iowa TraCS team members. The table below summarizes the Q&A from that call.

Ref #	Category	Question	Answer	Who gave answer
1	Accident Diagram	What accident sketch and/or reconstruction diagramming tools are typically being used in Iowa or other states? Delineate between basic sketches and full-scale reconstructions.	All 3 of the diagramming options are used in Iowa. Patrol mostly does hand-written that are scanned. Also looking into Easy Street as an option. Using another tool for more sophisticated for technical/reconstruction diagrams. They don't get the technical drawings at the state level.	Mary Jensen

Ref #	Category	Question	Answer	Who gave answer
2	Attachments	Can pictures, audio recordings, and other files be attached to the accident report/record?	bmp, jpg, ico, wmf, and cur file types are all supported. Officer might take picture of evidence using scanner or digital photo. Might take picture of drivers' license. Attachments do not get transmitted to DOT. Narrative and diagram do get transmitted to state. Import picture files from hard drive, can scan an image and attach, or use bar code imager to pull in a picture (like a digital camera). Can only store picture files, no audio or other types of files. Use OLE to store pictures. To transmit attachments to state - can use transmission process which is hard-coded for Iowa-based forms. Pulls data out of db, formats into flat file, zips it, ftps it to mainframe. Plan to develop a transmission builder for states to define their own flat file format or XML or other formats - this would include images. Iowa uses TIFF files for images. We cannot define what data we want to export. DB is Access 2000. We can grab the data ourselves if we want. In SDK, have export function - for local agencies to export local data to a records management system. This format is somewhat customizable. You can define the field formats and which fields to export.	Mary/Tad
3	Form	Is TraCS collecting all of the data elements required for FARS, SAFETYNET, MMUCC?	MMUCC - about 97% compliant - Iowa chose not to collect a few things such as occupant protection info on all occupants (including non-injured passengers). Working on developing a generic MMUCC accident form for other states to be 100% compliant by end of June. There are some differences in definitions between the 3 standards. They are looking at collecting CVARS data. They have some but not all of the FARS fields included in TraCS. NY has approached NHTSA about automating the collection of FARS. NY will be deploying TraCS so Iowa is in discussion stages about doing this.	Mary

Ref #	Category	Question	Answer	Who gave answer
4	Form	When was the paper accident report form re-designed?	Iowa's paper form originally pre-dated the TraCS form. They did just re-design their from as of 1/2001.	Mary
5	Future	TraCS currently has the 5 different types of Forms (traffic citation, accident, inspections, DUIs, and criminal offenses). Are there more types planned?	Have a desire to add more forms but have not planned any currently. Will make any new forms available to all state users. Can use the SDK ourselves to add any forms we'd like. Iowa would want our developed forms shared back. Tow slips, un-served suspensions, time/activity reports, complaints, affidavits are all potential new forms.	Mary
6	Future	Are there plans to create a "central" repository database for TraCS information at the "State" level? Is TraCS also being used as the back-end system do the reporting and analysis at the state level? If so, where is this functionality in TraCS? If not, what are they using? What do the TraCS people think about our plans to use TraCS as the front-end collection piece for a back-end analysis and repository we will be building.	Use APS (accident processing system) written in-house using DB2 database. Has GUI front-end in MicroFocus COBOL for any data entry. Integrates MARS reports and paper reports into the one db. Has business rules for financial responsibility compliance. Has functionality to use LOCATE tool centrally to locate accidents without proper locations. Store paper files on IBM ImagePlus document imaging system. Store MARS data on imaging db as well so can be displayed as a scanned doc. Have converted old records to 3 flat files - crash level, vehicle level, person level. Not using these any more. Connect with roadway files to locate accidents. Modified accident reports are not pushed back down to local level if changed. Don't make changes to what the officer reported. This is incentive for local agency to do their own locations. Local agencies can modify reports and re-send to state. These are marked as modified. State stores both versions of the image. Are currently revising APS to add MMUCC values.	Terry Dillinger

Ref #	Category	Question	Answer	Who gave answer
7	General	What are the differences between TraCS and Kentucky's CRASH/eCRASH system?	Have not heard much about it. Don't think it was designed to be transportable between jurisdictions.	Terry
8	General	What State(s) is/are furthest down the road of implementing/using TraCS?	NY is furthest along. They're developing forms and by Aug will have a pilot. Doing state police, a county, and a city police agency all in one geographic area. Making some mods to baseline source code. SC has developed their forms. About ready to do a pilot with 5 laptops. Are not doing elec. transmitting initially. CO/GA/AL/OK/TN making forms mods. NV is interested in a handheld platform which is not currently avail. No one is in production yet.	Mary
9	GIS	What GIS does Iowa use? Is it integrated with TraCS?	Using ESRI for sophisticated analysis. Purchase state license from MapObjects to distribute LOCATE tool. LOCATE uses ArcView. Currently building a GIS analysis tool for state-level analysis for less-sophisticated users/queries without ESRI built-in. Not integrated with TraCS but might be interested in sharing info. Casual product is Access based with predefined queries and reports. Same type of info as GIS without the mapping. Called Access ALAS. Use Map Objects from ESRI (map library that can be customized - ActiveX components). Used with VB 6.0. They mask things like table names, SQL code.	Mary/Dan Geisman

Ref #	Category	Question	Answer	Who gave answer
10	GPS	Does the GPS-enabled feature allow you to hook the GPS device into the mobile computer to automatically capture the GPS coordinates? What brand devices are they using? How much do they cost?	TraCS can integrate with a GPS device. Have only one agency doing so - Marion police dept. Using Trimble. Contact is Dan Geisman. Will be using in conjunction with AVL functionality. Think they are about $1,000.	Mary
11	LOCATE	How do the initial local maps get loaded into LOCATE? What does it take to implement the "Locate" functionality in TraCS? GIS, Map Coordinate system, etc…	NY provided some mapping that Dan was able to import into LOCATE. Per Hal, Data Inv has trunk state system and RoadTrack (all county roads) being converted to state system so will have one statewide map based on GPS long/lat. Planning & Programs uses GIS system set up to make map look better on paper. SD has about 13 different ways to define location. Iowa uses both coordinates and lat/long. Iowa would share their thoughts on their project to --- locations. FARS is working on a mapping standard based on a commercially available product. To implement - NY already had shape files. Iowa already had a statewide map system stored in Oracle. Communications between TraCS and LOCATE is Iowa-specific and needs to be genericized. Both must be modified in order to work for other states. LOCATE is Iowa-specific. GDT is a provider of GIS map data and has national data available.	Mary/Dan

Ref #	Category	Question	Answer	Who gave answer
12	SDK	Will we have access to the source code?	Iowa keeps one master baseline source code that they maintain. Each state develops their own forms. If modifications are needed in baseline source, then Iowa will work with us to contract for those changes which will be rolled into the baseline code. Ex: citation nbr is computer-generated, but NY needs to manually assign the numbers. NY contracted with Iowa and made the changes avail. back to Iowa. States do not have access to the source code.	Mary
13	SDK	Tell us about the SDK functionality. Form Builder, Validation Builder, Database Builder, Prompt Password, Product Settings, Report Settings, Export Forms, Import Forms, and Synchronize Database.	Sync DB function - Database builder allows you to define translation tables (TraCS form filed will be stored in a particular field in your db table). Once fields are built they are working tables. Sync DB takes those translation tables and updates the structure in Access. DB is blank upon delivery and gets built when forms get built.	Tad Geist
14	SDK	Any word on the SDK training? Late June/early July.	No definite plans yet.	Mary

Ref #	Category	Question	Answer	Who gave answer
15	Support	What are the support/bug fix procedures? Is each state on their own to upgrade/maintain the software once they receive it? If so, are they entitled to receive copies of upgrades Iowa does for themselves? What is the Service Level Agreement?	Enhancement priorities - were set in a meeting with the current customer states. Priorities will continue to be set by consensus. Bugs - If part of source code, reported to Mary. If we contract with Tad for modifications, then those bugs are part of the modification contract. Help Desk - Iowa has their own. Each state should have their own since their forms will differ. State should supply their own technical support and training. Release schedule - want to limit these to a reasonable schedule. Looking at 2-3 upgrades in a 12-month period. Would like to reduce this to an annual cycle. Each state's help desk can go back to Iowa's TEG for support. CTRE group that wrote LOCATE is willing to provide source code since they are not currently set up to support the tool for other states.	Mary
16	Support	Discuss USER FORM - is there or will there be a user group?	An ongoing user group communication vehicle is important. Met with 10 states recently. Anticipate continuing this on an as needed basis for now. Internally, Iowa has statewide user group meetings once or twice a year.	Mary
17	Technology	What is the DBMS (SQL Server, Oracle, Access, etc..)?	TraCS Office uses Access. Both versions uses Access 2000 for support and maintenance data - things like drop-down lists in forms. These are static tables. Storing incident data - field unit - stores them in structured binary files on field unit. Office unit - data is stored directly on Access db. There is a lot interest in the office unit being on a SQL Server db and being ODBC compliant. NY needs this functionality.	Dan

Ref #	Category	Question	Answer	Who gave answer
18	Technology	What is the operating (run-time) and development environment/tools? What versions are used?	Runs on Windows 95/98/ME or Windows 2000/NT 4.0. Haven't tested it on Win XP yet. Written in Visual Basic 6.0. Are looking into making it a web-based application.	Tad
19	Technology	Is anyone using TraCS on a laptop in the field that also transmits the data to the central office using wireless technology?	Yes. Cedar Rapids PD and several others are doing this. TraCS hands off a file to the wireless client which is responsible for transferring the file to the network in the office. TraCS Office then picks up the file from the network.	Tad
20	Training	What training is available and at what fee? Any word on the SDK training? Late June/early July.	Iowa may use federal funds to fund the SDK training/facility. Each state would pay travel costs. Have developed their own training manuals for end-user training. They will provide these to us. Have not developed generic training for other states. Iowa mostly trains administrators on admin. functions.	Mary
21	Training	How much effort/time did it take Iowa to train the TraCS users?	Deployed it originally in 93-94. But, completely re-built it based on feedback. Took 3 months to upgrade everyone on the newest version. Didn't do much training. Small agencies take 1 day to roll-out. Larger agencies take 2-3 days using train-the-trainer concept (3-day course). Have 188 agencies using it.	Mary

Appendix D. Reasonable Migration Alternatives Matrix

The following matrix was created by the consulting team to assist in deriving the migration strategy. It shows the range of reasonable alternatives to be considered when developing the recommended migration strategy. It is included for reference purposes only.

Functional Area	**Reasonable Alternatives**		
	Modify Existing System	**Construct New**	**Purchase System/ Customize**
Accident Data Collection	N – no system currently exists at SD for this function	Y	Y –for ex: use Iowa TraCS or KY eCRASH
Accident Data Repository providing interfaced data to other mainframe systems	Y – with substantial modifications	Y	N – no packages are commercially available to satisfy this function, that we are aware of
Accident Reporting	N – need report writer tool that users can easily use in order to meet our requirements	N – many commercial packages are available so there is no need to build	Y – many reporting packages are available such as Crystal Reports
Accident Analysis a) Collision Diagramming	Y/N – SD is currently using a software package (Intersection Magic) that does not satisfy all requirements but we could possible modify it or provide this functionality via another system (ex: via GIS)	N – many commercial packages are available so there is no need to build	Y
Accident Analysis b) Geo-spatial analysis (GIS)	Y – SD has a pilot GIS project in Sioux Falls that can be further rolled out	N – many commercial packages are available so there is no need to build	N – the ArcInfo/ArcView product already at SD is the market leader for this function – there is no reason to change vendors

Functional Area	**Reasonable Alternatives**		
	Modify Existing System	**Construct New**	**Purchase System/ Customize**
Accident Analysis c) OLAP/statistical analysis	Y/N – can continue to use SAS, but OLAP capability is not part of SAS so additional system is needed for OLAP	N – many commercial packages are available so there is no need to build	Y – many reporting packages are available such as MS OLAP and Hyperion Essbase - these can replace or supplement SAS

Appendix E. Migration Strategy Comparison

The following table is a comparison between the three choices described in the recommended migration strategy.

Functional Area	***Modify Existing System***	***Construct New System***	***Purchase System & Customize***
Develop New Manual Form	No difference	No difference	No difference
Develop Training Materials	No difference	No difference	No difference
Pilot Form & Training Materials	No difference	No difference	No difference
User Training	No difference	No difference	No difference
Rollout of New Manual Form	No difference	No difference	No difference

<table>
<tr><th>Functional Area</th><th>Modify Existing System</th><th>Construct New System</th><th>Purchase System & Customize</th></tr>
<tr><td>Accident Reporting Database</td><td>Current PS-Accident system uses ADABAS.
<u>Pros:</u>
Other systems currently use the PS-Accident database.
BIT has extensive ADABAS experience.
<u>Cons:</u>
Current design is not relational or is easily changed.
Is not as easily queried as a relational database. Queries must be pre-defined by BIT staff.
Must use middleware to communicate with Client/Server environment.</td><td>Use RDBMS (Relational Database Management System)
<u>Pros:</u>
Easy to make Ad Hoc queries using industry wide standard “Structured Query Language” (a.k.a. SQL).
State standard
Tight integration with Client/Server environment.
Easy to make transparent changes to database without affecting existing systems. (i.e. easy to add new indexes and data elements as needed).
Many vendors to choose from: Oracle, Microsoft, Sybase, SQL Anywhere, etc… Note: Microsoft SQL Server is the State standard.</td><td>TraCS uses Microsoft Access. Important to note that TraCS does not provide a “centralized” database.
<u>Pros:</u>
Access is a RDBMS
Access is a well-supported Microsoft product.
<u>Cons:</u>
Access is a “desktop” grade database. It is not meant as a “Server” grade database system. Therefore there could be throughput issues with larger numbers of users.
Access lacks fault tolerant capabilities (i.e. recoverability in the event of system failure) that “Server” grade database have.</td></tr>
<tr><td>Accident Reporting data collection</td><td>State does not have a data collection system. The current system is the paper form. This needs to be built new.</td><td>Develop a new data collection system to gather the accident data in the field at remote sites.</td><td>Use TraCS or eCrash.</td></tr>
</table>

Functional Area	***Modify Existing System***	***Construct New System***	***Purchase System & Customize***
Analysis Functionality • Web-based access	State does not have Web-based access. This needs to be built new. **Pros:** • ? **Cons:** • Web-based access to an ADABAS database will require middleware (i.e. EntireX). Communication through EntireX will be in both directions. • Web-based access is not optimized for existing PS system.	Develop Web-based access. **Pros:** • Web-based access is tightly integrated with Client/Server RDBMS's • No middleware layer required. • Better performance	• TraCS does not have Web-based access functionality. This needs to be added to TraCS. • Louisiana has a front-end accident data collection only web site. No analysis functionality.

Functional Area	***Modify Existing System***	***Construct New System***	***Purchase System & Customize***
Analysis Functionality • User Customizable Ad Hoc Query	With ADABAS, queries are "pre-defined reports". There is no "user" Ad Hoc query capability. **<u>Pros:</u>** • ? **<u>Cons:</u>** • ADABAS does not support the functional requirements of the new system. (i.e. the need for Ad Hoc user queries) • Every new query desired needs to have an expert "Natural" programmer create the query.	User can easily create their own Ad Hoc queries. **<u>Pros:</u>** • With a little instruction anyone can write a SQL statement to query the database. • Queries processed and optimized by the RDBMS. • Users can use GUI query tools, such as Microsoft Access, to create query by pointing and clicking (the SQL statements will be automatically generated).	TraCS does not have a centralized accident data repository. This would have to be added to the TraCS functionality. The accident data could either be stored in the ADABAS or in the RDBMS database systems. Depending upon which database was used the Pros and Cons as seen in the left two columns would apply.
Analysis Functionality • User-friendly Reporting	With ADABAS there is no User-friendly Reporting. **<u>Pros:</u>** • ? **<u>Cons:</u>** • Requires "Natural" language programmer to create new reports.	There are many report generating software packages available. Construct New System is not an option.	Use Microsoft Access and/or Seagate Crystal Reports to create reports. **<u>Pros:</u>** • GUI interface for creating reports. • Drag and drop. • Create professional reports fast and easy. **<u>Cons:</u>** • Some training required, but you don't have to have a degree in computer science.

Functional Area	***Modify Existing System***	***Construct New System***	***Purchase System & Customize***
Develop middleware to communicate between mainframe and client/server environments	With ADABAS there will be a need to develop two-way communication between the Client/ Server pieces of the system and the mainframe using the middleware EntireX.	With RDBMS there will be one-way communication. Upload the data to the existing ADABAS to support "legacy" systems that use PS-Accident.	Same as Construct New System.
Interfaces with other systems • FARS • SAFETY NET • Current mainframe systems • GIS	Build programs to create files and reports needed to support FARS, SAFETYNET, et al. These programs use the ADABAS database. **<u>Cons:</u>** • Need "Natural" programmers.	Build programs to create files and reports needed to support FARS, SAFETYNET, et al. These programs use the RDBMS database. **<u>Pros:</u>** • "Visual Basic" programs.	TraCS does not have these interfaces. This would have to be added to TraCS.
Ability to store other miscellaneous files associated with the accident	ADABAS cannot store binary large objects (i.e. *.tif files).	RDBMS can store binary large objects (files) as a data element on the actual database records. **<u>Pros:</u>** • Provides for centralizing all accident data in one place (i.e. no *.tif files on the U: drive, but the *.tif file will actually be integrated as part of the accident record in the database).	TraCS uses Microsoft Access. Access has the ability to store an OLE object, which is similar to a binary large object. This has the same Pros as the "Construct New System" option.

Functional Area	***Modify Existing System***	***Construct New System***	***Purchase System & Customize***
Maintain existing mainframe applications and reports	• Maintain and develop new applications and reports using "Natural" on the mainframe environment.	• Rewrite reports using Crystal Reports as time permits. • Modify existing reports for new data elements as required.	Not Applicable
Development Language	Natural **<u>Pros:</u>** • Current BIT staff experienced in environment. **<u>Cons:</u>** • Not BIT stated direction for new development.	Visual Basic **<u>Pros:</u>** • Availability of workforce • BIT stated direction for new development. **<u>Cons:</u>** • Existing BIT staff lacks experience compared to Natural.	Visual Basic **<u>Pros:</u>** • Availability of workforce • BIT stated direction for new development. **<u>Cons:</u>** • Existing BIT staff lacks experience compared to Natural.
System Platform	Mainframe	Client/Server	Client/Server

Appendix F. Approved Change Ideas/Functional Requirements

The following table represents the business process change ideas and functional requirements gathered in the initial analysis workshops. These were analyzed by the consulting team and recommendations added. These recommendations were then presented to the Technical Panel for review. The panel approved the recommended items, which are marked as "Y" in the "Recommend" column.

Seq	Ref	Change Idea/Functional Requirement	Core	Rcmd	Recommendation Note	Assumptions/ Comments	Category
1	5	Use OLAP (Online Analytical Processing) technology to provide analytical reporting capabilities (drill-down, slice and dice, multi-dimensional, graphical).	**X**	**Y**	This needs to do what the SAS system does now.		Accident Analysis
2	3	Be able to distinguish as to whether the accident (point of impact) occurred on the bridge or in the approach area to the bridge. Be able to query by this distinction.	**X**	**Y**		Satisfied by Location Special on the Crash Entity.	Accident Analysis
3	1	Need commercial vehicle supplemental info included with the accident data we get. For analysis of traffic problems.	**X**	**Y**			Accident Analysis
4	2	Report by causation factors - ex: identify safe/unsafe locations (i.e. steep grades, etc.) for motor carriers.	**X**	**Y**			Accident Analysis
5	4	Integration with/support for Intersection Magic collision diagram software.	**X**	**Y**	Integration via the ability to create ASCII data file.		Accident Analysis
6	6	Accident data collection is MMUCC-compliant.	**X**	**Y**			Characteristic
7	7	Store truck/bus supplemental information in the accident database (not just in SAFETYNET).	**X**	**Y**			Characteristic

Seq	Ref	Change Idea/Functional Requirement	Core	Rcmd	Recommendation Note	Assumptions/ Comments	Category
8	9	Remote (wireless) access to Accident Reports, collision diagrams, and summary reports.	**X**	**Y**			Data Access
9	10	Need ability to store/access Accident Report/historical data on our mobile data terminal or laptops for taking into the field. Provides the ability to bring past Accident Reports and information to help identify/analyze problem intersections.	**X**	**Y**			Data Access
10	12	City Traffic Engineers currently get a data cartridge that contains last 7 years of accident information for intersections & mid-block accidents. Eliminate the need for data cartridge and provide the ability to get the accident information when needed, rather than just once a year. Be able to download the data.	**X**	**Y**			Data Access
11	14	Electronic Accident Reports. These electronic reports Cliff would take with him on the road, rather than boxes of Accident Reports. They would include Accident Reports organization around a location. Be able bring the electronic report by location.	**X**	**Y**			Data Access

Seq	Ref	Change Idea/Functional Requirement	Core	Rcmd	Recommendation Note	Assumptions/ Comments	Category
12	8	Electronic Access to Accident Data/Reports by: Accident Type, Location, City, County, Intersection Type, non-seatbelt, DUIs, Intersection, highway segment, GPS, highway MRM, Jurisdiction (by Reservation), etc… List of Accident Numbers For date ranges covering days, weeks, months, years, etc… Fast response time Pick and Choose the data elements desired to be retrieved On screen reports of filtered data Have canned queries/reports for the most common information desired Access to data via Internet Customized query by user User-friendly query interface Accessible by State, County, City, BIA, Public, etc... Accessible without the intervention of Office of Accident Records.	X	Y		Use Relational Database Management System to enable complicated Ad Hoc query capability.	Data Access
13	11	People who contribute the data would like to retrieve back the same data. Any data that goes into the system must be retrievable. Also be able to get just their data by Location, Department, City, etc…	X	Y			Data Access

Seq	Ref	Change Idea/Functional Requirement	Core	Rcmd	Recommendation Note	Assumptions/ Comments	Category
14	13	The public can access Accident Reports via the Web. (Won't post reports until there is no more criminal investigation, etc. based on a status code. Also subject to issues around not posting data involving minors).	X	Y	Need to have a privacy policy defined for data privacy issues.	Assumes we can effectively control which reports are posted (based on certain criteria including statuary limitations like not posting SSN) and who has access to what data.	Data Access/Policy
15	16	Accident diagramming software tool which includes a measurement taking device (laser) and that generates the scene drawing (There is a company called Laser Technologies that does this - product is Crash Zone - Colorado uses this, Rapid City also has the laser tech product). (Impact) Eliminates manual drawing of accident diagrams, electronically integrates with Accident Report.	X	Y	There is no mandate for a specific diagramming tool, but can provide ability to attach electronic files to the accident report in the database.		Diagram
16	15	Intersection Magic. Want to able to generate collision diagrams that would span a segment of the highway, city street, service roads. Need to find a software package that can do this. Intersection Magic is Point data only.	X	Y			Diagram
17	17	Use software to generate collision diagrams. (Intersection Magic does this, but there are problems - lack of data)	X	Y	Need to look for software packages that can be used.		Diagram
18	21	Single state-reportable accident form that contains state required fields including NHTSA fields (FARS), commercial vehicle National Governor's Association (SAFETYNET) fields, with MMUCC compliance. One form fits all.	X	Y	This is an extension of the combination of the two State forms. This includes the FARS forms and the Wild Animal Hit form as well.		FormDesign

Seq	Ref	Change Idea/Functional Requirement	Core	Rcmd	Recommendation Note	Assumptions/ Comments	Category
19	93	(Old Rule) Truck/bus form is not always filled out unless the accident is National Governor's Association-reportable. (New Rule) Truck/bus info is filled out for all accidents involving commercial vehicles regardless of whether it meets the National Governor's Association criteria. (Impact) Removes the requirement for the officer to have to make the fill out/don't fill out decision, more complete commercial vehicle accident data.	**X**	**Y**	With the forms being combined this becomes a mute point.		FormDesign
20	20	New Accident Report form must be easily adaptable to bar coding.	**X**	**Y**			FormDesign
21	19	SAFETYNET 2000 has additional data fields such as collision/non-collision, was a ticket issued, etc, which we need to add to the Accident Report.	**X**	**Y**		All of SAFETYNET 2000 data elements are in the data model.	FormDesign
22	25	User-friendly form - similar size, one sheet of paper, not multiple pages like they have now.	**X**	**Y**	Some flexibility to the number/size of the form may be required, due to space limitations and data collection needs. It just might not be feasible to have just one sheet of paper. Good goal - need to review design proposals.		FormDesign
23	18	Streamline the truck/bus form by using more codes/boxes and put these on the main form to help eliminate the truck/bus form. State should develop a streamlined, combined form (Accident Report and truck/bus form together)	**X**	**Y**			FormDesign

Seq	Ref	Change Idea/Functional Requirement	Core	Rcmd	Recommendation Note	Assumptions/ Comments	Category
24	22	Use one form to cover all federal, state, BIA, city, county motor vehicle traffic accidents.	**X**	**Y**	With the exception that we may not be able to collect every data element that each of the different agencies across the State may want.		FormDesign
25	31	Display accident data on a map (I.e. GIS) and allow drill-down - pinpointing accident locations.	**X**	**Y**			GPS
26	33	ArcView is a GIS package. Map Link. Give the ability to from a map (visual representation) to generate summary reports, collision diagrams for the area selected on the map. There is currently only 12 counties that have the GIS information in the system. The GIS system should setup for all counties in the State and Class 1 Cities.	**X**	**Y**	Use this as a model example.		GPS
27	29	GIS map in the office that you use to locate the accident and store the GPS coordinates with the Accident Report.	**X**	**Y**			GPS
28	27	The current clear-paper overlay accident location plot needs to be replaced with a GIS system.	**X**	**Y**	Single State Accident Display Map using GPS coordinates.	Talk to Rocky Hook about this.	GPS
29	30	Use GIS for accident analysis - drill down into locations to see accidents.	**X**	**Y**			GPS
30	32	Use GIS to replace the current accident plot diagrams. Would like drill-down capabilities.	**X**	**Y**			GPS
31	28	GIS (graphical map overlays) with accident notations on them with ability to drill-down into the map and also attach the Accident Reports, summaries and collision diagrams.	**X**	**Y**			GPS

Seq	Ref	Change Idea/Functional Requirement	Core	Rcmd	Recommendation Note	Assumptions/ Comments	Category
32	26	Use GPS to determine accident location at the scene. (City, Rural, etc…) Regardless if we have GPS or not, the location of the accident is assigned at the scene. If GPS, then automatically populate the Accident Report. If not GPS, then need to convert location to GPS coordinates. GPS coordinates need to be "Real-Time Differential Corrected".	**X**	**Y**		GPS works consistently all the time, everywhere in the state. Assumes all law enforcement vehicles have GPS receivers. GPS or our accident location determination needs to be more accurate than the "30 feet" that is being advertised.	GPS
33	34	Need ability to access data from old PS-Accident system when we have a new system, at least 3 years' data.	**X**	**Y**	This will require a data conversion process to convert the old accident data into the new relational format.		Migration
34	35	Capture Passenger names. Need to identify factors relating to non-injured passengers (such as belted/not belted, air bags went off/didn't). Passenger names are not keyed into the PS-01 system so we don't currently have this information. Need to capture passenger name info so we can provide it to Social Services Recovery. Social Services Recovery does not currently receive passengers' names to use in this comparison process. This would be helpful to them. This would save the state money to have the additional information for the same reason they save money by having drivers' names.	**X**	**Y**	Caution: Form Design must be on one piece of paper. This is a policy issue that must be decided. MMUCC does not require names for non-injured passengers. We currently capture injured passenger data, but does it require info on seat belts and air bags?	But, you have to justify the need to key and store this info because there is no other need for passenger name. Assumes Officers won't resent additional data collection. We can fit this additional data on the new one-page form? Passenger names can be included in the narrative or on electronic form?	Policy

Seq	Ref	Change Idea/Functional Requirement	Core	Rcmd	Recommendation Note	Assumptions/ Comments	Category
35	36	Electronic capture of Address and Driver License information with editing/override capabilities of scanned information. Training issue that only the address should really be changed because the name information needs to match the driver history file.	X	Y	From Bar Coded driver licenses & registrations. What standards are we following, and what equipment is necessary?	Driver Licenses and MV registrations already have bar coding rolled out (which they do). The bar codes contain all of the data fields, not just the identifier/number. This will require officer training.	Process
36	38	Shorten the time it takes to receive the Accident Report data and have it available for the customers.	X	Y	Goal / Measure of the system that is implemented.		Process
37	37	Enter the accident data into the system via mobile data terminal or laptop in the squad car at the scene by the officer to eliminate duplicate keying of the data and to capture the information at the source. Eliminate typing of Accident Report by agency secretary who transfers officer hand-written Accident Report to a typed form to send into State. Once the form is at the State, the accident data is entered into the system by Office of Accident Records and then re-keyed through a verification process. Even if the accident data is not entered at the scene, when Office of Accident Records enters the data, eliminate the re-keying step by using electronic edits/program logic. (Impact) Improves accuracy of data by capturing it on the scene, eliminates re-keying of data later, increases officers' time out in the field and reduces time spent in the office, eliminates paper forms (for those using mobile data terminal or laptops).	X	Y		Motorcycles won't have mobile data terminal or laptops. There will be some lag time as to when squad cars will have mobile data terminal or laptops.	Process

Seq	Ref	Change Idea/Functional Requirement	Core	Rcmd	Recommendation Note	Assumptions/ Comments	Category
38	42	Automate the data entry/population of the FARS & SAFETYNET systems/databases. Right now data capture occurs on Accident Report forms and then later data entry occurs to key the data into various different systems (PS-01, FARS, SAFETYNET). For the FARS system the information is taken from the Accident Report, coded onto FARS code sheets, and then from the FARS code sheet keyed into FARS system.	**X**	**Y**	This may or may not be possible. It depends upon the FARS & SAFETYNET systems and whether or not they provide an interface other than a computer data entry screen.		Safety/Fars
39	43	Eliminate rekeying of SAFETYNET info by keying the data at the scene. IF not at the scene, data should be keyed at the point the data reaches Office of Accident Records which eliminates making the copies that go to the SAFETYNET department.	**X**	**Y**			Safety/Fars
40	44	Eliminate control process of manually auditing that FARS/PS-01 and SAFETYNET/PS-01 are in sync by having FARS/SAFETYNET fed from the single accident database.	**X**	**Y**			Safety/Fars
41	45	We would like to know when a commercially licensed driver is driving their personal vehicle or their commercial vehicle when an accident occurs.	**X**	**Y**		Suggestion from SD1999-05. This is satistified by the "Person Driver" attribute on the Crash Vehicle entity. If the Crash Vehicle is a commercial vehicle, then the Person was driving a commercial vehicle.	Safety/Fars

Seq	Ref	Change Idea/Functional Requirement	Core	Rcmd	Recommendation Note	Assumptions/ Comments	Category
42	39	If errors are encountered when entering data into SAFETYNET, they usually involve the carrier info or the tow-away info. These changes are not sent back to Office of Accident Records to be updated on the original accident form or in the PS-01 system. <u>Changes made by SAFETYNET administrator should be reflected back in the PS-01 database and the original accident form.</u>	**X**	**Y**		CVARS is working on Data Element requirements presently. CVARS will be replacing SAFETYNET. There is an issue here with the fact that this project (SD2000-14) is going forward with design as SAFETYNET is today. We want the new SAFETYNET data items included. See #19.	Safety/Fars
43	40	Office of Accident Records does not have the data for sequence-of-events, truck configuration, etc.	**X**	**Y**			Safety/Fars
44	41	(Old Rule) For fatalities, FARS forms are sent to the officer after the FARS personnel know there has been a fatality. (New Rule) Officer enters/creates FARS data at the time of the accident rather than waiting for the forms to come to him later. (Impact) Better chance of actually getting the FARS data, easier for officers to deal with all info at once, eliminates duplicate info on separate forms today..	**X**	**Y**		The FARS form is either captured electronically or we can manage the process of inventorying/updating the forms when changes are needed.	Safety/Fars
45	46	FARS does not collect data on private property accident fatalities. Per ANSI D16.1, some parts of a parking lot are considered public (i.e. driving lanes through the parking lot) but SD state law says these areas are not considered as public. <u>We need to better define how we will handle these gray areas.</u> Example gray area – when does a trail become a road (fire roads example); two people were killed in a private construction area.	**X**	**Y**	Need to develop a training course that includes D16.1.	May need legislation.	Training

Seq	Ref	Change Idea/Functional Requirement	Core	Rcmd	Recommendation Note	Assumptions/ Comments	Category
46	47	The carrier responsible for the load is correctly identified preferably at the scene, but at least before the commercial vehicle data goes to the national database.	X	Y	This ties into PRISM.		Training
47	48	There is sometimes more than one code entered into a box (such as snow and ice – but officers should use the one that most represents the problem) – training issue	X	Y			Training
48	49	(Old Rule) Carrier name is not always entered on the truck/bus form. (New Rule) Carrier name is required. (Impact) Eliminates additional work after the fact to track down this data.	X	Y	There is a big training issue here. Determine of the carrier is not straight forward. This also ties into the PRISM system.	There has to be a provision made when it really is unknown because the driver doesn't know and does not have documentation. Janet needs the carrier company name but it usually is not entered on the supplemental form.	Training
49	51	There is a lot of confusion as to how to fill out the Truck/Bus form. There is a need for more training. Officers don't always know how to determine the commercial vehicle carrier, owner. Data on form includes both interstate carrier number and DOT number – what's the difference – gets confusing. Counties aren't used to filling out these forms so it's even harder for them.	X	Y	Additional training needs to be provided to help officers complete the SAFETYNET information.		Training
50	50	Make sure the forms get filled out (I.e. truck/bus supplement gets missed occasionally).	X	Y	With the forms being combined this becomes a moot point.		Training
51	168	Continue to use paper maps to determine the accident location.	X	Y	Will not be able to eliminate paper maps.	Assumes that we don't already get the data from the GPS location.	z_oos

Seq	Ref	Change Idea/Functional Requirement	Core	Rcmd	Recommendation Note	Assumptions/ Comments	Category
52	142	Take a look at the software package available for collision diagrams (intersection magic) to see what data they require to function, to make sure that we are collecting all the appropriate data to fully use the software.	X	Y	Still need to perform a search to see what other software packages are available for collision diagramming. See comment numbers 15 - 17.		z_oos
53	52	The system should be able to look for patterns of accidents. Example: At a given intersection there are 10 accidents and 9 of them are the same type of accident. Electronically weed out the random accidents. Automated warnings sent when a threshold has been reached, rather than waiting for analysis to identify problem areas.		Y	May need additional data input from the RES system for traffic volumes.		Accident Analysis
54	70	Use voice recognition for entry of accident data.		Y	This could have a huge impact. Caution: Technology may not be feasible at this point in time.	The Lakewood systems group that builds ASPEN has incorporated voice recognition software.	Characteristic
55	71	Use voice dictation to record accident information at the scene.		Y		Would back up the voice recognition process.	Characteristic
56	61	Can print out a blank Accident Report or FARS or other forms from the mobile data terminal or laptop if the officer wants to capture the information on paper.		Y			Characteristic

Seq	Ref	Change Idea/Functional Requirement	Core	Rcmd	Recommendation Note	Assumptions/ Comments	Category
57	63	Transfer digitally recorded voice, image, and/or video file(s) to the Accident Report. Can be used for officer's statement and/or drivers' statements. (Impact) Captures information at the source, eliminates data entry of narrative info, enhances safety analysis to hear things in their own words without paraphrasing. Tie the photos to the Accident Report. A picture is worth a 1,000 words. We can eliminate driving to store for photo processing, we can obtain photos and Accident Reports together electronically, images are available sooner to interested parties (i.e. insurance companies).		**Y**		Sheriff's deputy thinks voice narrative might be valuable in very bad accidents - now they have a place to say what the obstruction was. Make digital images read-only or somehow protected so that they cannot be altered. There must be security safe guards against tampering with photo images.	Characteristic
58	73	Ability to amend Accident Reports after they have been sent to the State. (For adding additional info later, for example, "hit & run" update with the second driver.)		**Y**			Characteristic
59	55	Have a system that can incorporate new data fields as new requirements come along. Changes should also be reflected in the documentation, including hard copy manuals (I.e. Officer's Instruction Manual).		**Y**	A new code value to collect for an existing data field should be very easy to incorporate. A whole new type of data field to collect will still require system modification, paper form modification, etc…	We have a process that reviews requested changes/additional data fields to justify them. Generally changes to the logic will be needed. A self-modifying system is not a current technology. This would also require a change to the Accident Report form.	Characteristic
60	72	Need both paper and electronic Accident Report system. Not all agencies have the equipment and equipment can fail.		**Y**			Characteristic
61	66	Have a Web-based Accident Report form.		**Y**		Ability to keep general public from being able to	Characteristic

Seq	Ref	Change Idea/Functional Requirement	Core	Rcmd	Recommendation Note	Assumptions/ Comments	Category
						send in a fictitious form.	
62	58	If the form is electronic, and we make subsequent updates to the data, we need to be sure we can retrieve/recreate a version that matches the officer's original data report. Store "snapshot" in time of the Accident Report (ex. save as snapshot of report as of when the report was sent to the state). Need an audit trail of who changed what, when, and why (currently we keep the original data separately for insurance company, legal purposes). Track/audit changes made to Accident Reports. Any change to Accident Reports/data, needs to trigger a notification process back to the originating law enforcement agency and all other involved agencies (I.e. SDHP Motor Carrier). The change reason should be included in the notification.		**Y**		Small cities/counties may not have email, so need to look at notification alternatives.	Characteristic
63	65	Have wizard-driven form (like Turbo Tax). As questions are answered, the form dynamically tailors itself. The type of accident, for example, the form knows to only present the data fields that are needed for that type of accident. Use wizards to direct the officer to the groups of data fields that need to be entered based on the type of accident/situation we have (I.e. for fatality, present FARS data elements, National Governor's Association reportable attributes, etc...)		**Y**	On the surface this seems like a great idea. I only caution that the User Interface that is developed or required for the data collection needs a more detailed design to know if this concept is the best fit.		Characteristic
64	56	Need to date/time stamp all requested copies of the reports and print a disclaimer that says the report is current as of x date and time.		**Y**			Characteristic

Seq	Ref	Change Idea/Functional Requirement	Core	Rcmd	Recommendation Note	Assumptions/ Comments	Category
65	69	Scanned "paper" accident report is "electronically" linked into the electronic storage of the accident data/report. (I.e. If a paper form is used to initial capture the data and submit it to the State, then that paper form itself also becomes part of the electronically stored data for this accident.)		**Y**			Characteristic
66	53	A breakdown of Interstate interchanges so we can get information at different points in the interchange rather than the interchange as a whole. Need information on interstate interchanges. Need more detailed information about exactly where the accidents where. Intersection of service ramps with cross road, service ramp with interstate. Be able to determine whether the accident was on the ramp or the interstate between the ramps. Diamond, Clover Leaf, Single Point interchanges. Be able identify accidents in the intersections of the frontage road versus the accident in the intersection on the divided highway. Like the intersection in Brookings by the Wal-Mart.		**Y**	With GPS location of accident this should be possible.		Characteristic
67	54	Have one set of data used by Office of Accident Records, law enforcement, insurance companies, public, SDHP Motor Carrier Division, which is always accurate, changes are always approved by the officer. Or, we could keep the "statistical" data values identified separately from the actual report form.		**Y**	With a centralized database this would be possible.	The data does change over time, so there will always be different versions of the report depending on when the copy of the report was created. As a general rule all reports should be date and time stamped so that point in time the hard copy report was created is known.	Characteristic
68	59	Capture accident diagram electronically as well as		**Y**	Either scanned or		Characteristic

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		the Accident Report.			diagrammed electronically.		
69	67	Ensure the collision drawing capability stays on the form (stays with the process) if we go to electronic versions of the form.		**Y**			Characteristic
70	74	Identify locations for enforcement actions (I.e. sobriety checks) or roadway improvement projects.		**Y**	This can be done via a Customized Report which is very much a requirement of the new accident reporting system.		Data Access
71	85	Tie the city police department 'call number' to accident number of the Accident Report. Box for the local agencies' case number. Case Number = Call Number. Provide a "generic" reference control box on the form that each agency can use as they see fit. From the State's accident database perspective it is just something that it will store for the convenience of the other agencies needs.		**Y**			FormDesign
72	84	There are some intersections that have two types of control, but not at the same point. Example: intersection with Stop at intersection, but also has a Right turn ramp with a Yield sign. Need to ability to code both types of control at this intersection.		**Y**	Tie the control type to the vehicle. Show in the diagram.		FormDesign
73	76	There is a box on the form for vision obscurement but the type of obscurement is not a data field. Need the capability to define what "other" means when the officer chooses "other" on the form. Need to provide a data field on form for defining the "other" choice.		**Y**			FormDesign

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74	78	(Old Rule) Choosing "other" as the cause of the accident on the truck/bus form is OK because there are not enough choices on the form. (New Rule) When choosing "other" an explanation must be given. We also need to determine if more choices are needed. (Impact) More accurate accident causation information.		**Y**		Janet gets a lot of “other” as the cause of accidents, which is not useful information. Need to indicate what "other" is in comment field. Analysis would be improved if any field containing “other” (i.e. contributing factors) included a blank to fill out to explain the “other”. This space is available now but it is not coded into the accident system.	FormDesign
75	82	Need to split the restraint system box into two - 1 for air bags and 1 for seat belts. Need to capture Airbag deployment.		**Y**		This is satisfied by the "Crash Person Occupant Protection System Used" Entity.	FormDesign
76	80	The one form should be on one 8.5 x 11 piece of paper (two-sided) - officers like pictures to select from. They want to write as few words as possible. Would rather use codified boxes (explained by an overlay/cheat sheet) than boxes that have the choices labeled (which takes up more room).		**Y**			FormDesign
77	86	Form design needs to have different vehicle types (motorcycle, truck, etc.)		**Y**	This is currently done.		FormDesign
78	88	Code for lane change, vehicle maneuver.		**Y**	This is currently done.		FormDesign

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79	89	Need to capture cell phone factor among other possible contributing factors that may have played a role in the events that led up to the accident.		**Y**	Add new code for Cell Phone factor in Box E of the accident report form. This does not need its very own new data field.	Validity of the data is based upon the honesty of the driver.	FormDesign
80	91	Leave narrative and diagram boxes as is - don't make smaller.		**Y**			FormDesign
81	92	Make form more adaptable in cases of multi-car accident.		**Y**	This will be easy to do for the electronic method. Not as doable on the paper form.		FormDesign
82	94	Add Railroad crossing related code. Similar to Intersection related.		**Y**	Add new code value for Rail crossing related.		FormDesign
83	95	Eliminate need for duplicate forms. Federal (ex: BIA), local (city/county) and state forms have duplicate information.		**Y**	Revise the State accident form and distribute to agencies to use. It is then the agencies' decision whether or not to use the form for their non-reportable accidents and thus drop the use of their in-house forms they have developed over the years to support their needs.	Assumes that we have the authority to be able to do this. This is not very likely. The best the SD2000-14 project can hope for is to eliminate duplicate forms and processes within it scope.	FormDesign/Policy

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84	90	Date of birth for injured persons.		**Y**	Do not collect age. Collect just the date of birth. There could be a privacy issue with making date of birth public. Therefore reports and displays of information may need to convert the date of birth into the age at the time of the accident and not show the actual date of birth of the individual.		FormDesign/Policy
85	110	A way to tie citations to Accident Report. Put the ticket # on the Accident Report.		**Y**	This will be coordinated with CVISN projects. Put Accident # on all tickets Statewide for all agencies. And put ticket # on the accident report. May need legislation to get this done.		Policy
86	105	(Old Rule) National Governor's Association reportable/recordable is defined by number of tires. (New Rule) Should by gross vehicle weight and/or number of axles.		**Y**	This new rule is actually the new rule that is in place for SAFETYNET 2000.	**Actual New Rule (SafetyNet 2000): A truck having a gross vehicle weight rating (GVWR) of more than 10,000 pounds for the power unit, or any other vehicle displaying a hazardous materials placard.**	Policy

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87	108	Single state agency responsible for handling all aspects of accident data including providing data to both NHTSA and FMCSA.		Y	Policy issue that needs to be decided. Move SAFETYNET responsibility from SDHP Motor Carrier Division to Office of Accident Records.		Policy
88	100	Provide the new Accident Reporting system software to the local law enforcement offices for them to enter the Accident Report data into. Make the accident system software available to local law enforcement for them to use for non-state reportable accidents, if they choose.		Y	Non-Reportable Accidents: Agencies can either at their own discretion choose to submit non-reportable accidents to State's system or not. **There is NO requirement to submit non-reportable accidents what so ever.** There is a possibility that this will increase the Office of Accident Record's workload due to more reviews for accuracy, assignment of location, direction of travel, vehicle maneuver, manor of collision, etc... This is the policy issue that must be decided.		Policy
89	111	Need a privacy policy for accessing reports on the Web by various agencies, stakeholders.		Y	Technical Panel recommends that DOT management develop a Privacy Policy unless BIT has an existing policy.	Creation of the Privacy Policy is out of scope.	Policy

Seq	Ref	Change Idea/Functional Requirement	Core	Rcmd	Recommendation Note	Assumptions/ Comments	Category
90	109	Store the officer's narrative in the database. This would give the "desired" ability to have the officer's accident narrative on the Accident Summary report.		**Y**	This is key information for the back-end traffic analysis. Caution: There may be a workload issue here for entering this data.		Policy
91	127	May want the ability to produce a "report card" that audits the officers' or departments' track record on completeness of data (I.e. one officer works on 20 fatal crashes but has not reported any Blood Alcohol Content).		**Y**			Process
92	113	A reconstruction scale drawing may be drawn after the accident (if there is potential for litigation). But, this is not made a part of the official state report. We might want to change this to be part of the state report to benefit the state analysis process. Officers would not always want to be required to do a scale drawing, depending upon the circumstances.		**Y**	Could provide the ability to add "electronic" attachments to the Accident Report data.		Process
93	118	(Old Rule) Photos are only taken when there is a fatality or probability of litigation. (New Rule) Provide the ability to take pictures for wider range of accidents to aid the road engineers in their analysis (ex: need pictures of guard rail damage). (Impact) Ability to better analyze accidents and to improve safety.		**Y**	Taking pictures is not mandatory. The system will provide an easy means of storage and retrieval of digital images (either scanned in from film or taken digitally).		Process

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94	114	Need to get changes made during entry into the PS-01 database reflected on the accident form. There is a possibility that the accident form does not have the corrected data fields on it (from system edit reject corrections). Need to improve this process.		**Y**	With data ultimately residing in an "electronic" database changes should be automatically reflected in the data. The Accident Report form just becomes a temporary medium used to get the data into the system.		Process
95	123	Generate the Accident Report/case number at the scene - could be done by having the forms pre-numbered/bar coded with a number. We do not need a "smart" number like we have now.		**Y**		Use the X.14 standard? What is the X.14 standard?	Process
96	117	(New Rule) No report copies or accident information are distributed/released until the investigation is completed. (Impact) Protects the integrity of the investigation. Trucking industry does not want the accident to be submitted and finalized until the investigation is completed.		**Y**			Process
97	122	Data entry must be fast and not add additional time to the officer in the field.		**Y**			Process
98	112	When drugs/alcohol are involved – Results of blood test done at a later point in time should be added to accident report but the report is usually sent to state before the results are back. This process should be improved so that the results are added to the report.		**Y**			Process

Seq	Ref	Change Idea/Functional Requirement	Core	Rcmd	Recommendation Note	Assumptions/ Comments	Category
99	120	Use program logic to perform various validity checks on data to help eliminate some of validity checks done by the Office of Accident Records. (override fields, verify accuracy, etc.)		Y			Process
100	128	(Old Rule) Office of Accident Records requires original Accident Reports, includes when doing amendments. (New Rule) Make changes to copy or electronic transmission of data.		Y			Process
101	133	Hit and Run Accident Reports should be sent into the State when they are as Complete as they can be. Right now Hit and run accident forms are not forwarded to the state pending investigation (finding the other driver) and these may not get sent to the state. Hit and runs can take a while to investigate and could result in two accidents in the minds of the state - one when it first happens and another when the other party is identified.		Y		There may be a State Law that mandates a time period for accident reports to be submitted.	Training
102	131	Ability to tell when construction zones are causing accidents. Need a way to determine if construction zone caused the accident vs. another cause that just happened to occur in a construction zone.		Y	This is already done.		Training

Seq	Ref	Change Idea/Functional Requirement	Core	Rcmd	Recommendation Note	Assumptions/ Comments	Category
103	134	Name, DL #, address, DOB on the Accident Report should be the same as the information in the Driver History database.		Y	All this stuff must match to locate the driver in the Driver History database. For this reason the officer needs to collect the information off of the driver license exactly as it is on the drivers license. (i.e. don't put down Bob, if the driver's name is Robert on the license.) If a change is made to these data elements for the driver, then that change needs to be made in both systems.		Training
104	136	The instruction manual should explain the difference between the license number, DOT number, etc		Y			Training
105	137	More complete and accurate information to be able to understand what happened (in the accident). Complete, accurate filled out Accident Reports. Have enough time to make it so.		Y	This is a goal.		Training
106	140	Shorten the backlog window of Accident Reports at the state level. Typically there is about 2 months backlog.		Y	New system should address this issue.		Workload
107	139	Accident recording process must not be increased without a direct benefit. Need to streamline and speed the process of recording the accident information.		Y			Workload

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108	141	Put the EMS Trip Report # on the Accident Report to obtain additional info from EMS such as name of ambulance driver, injury specifics (better determination on whether seat belts were used, etc).		**Y**		Trip numbers are already on the paper Trip Report. There can be multiple trip reports per accident since there is one trip report per injured person. The officer may need to collect the trip number at the hospital later.	Workload/FormDesign
109		**ALL ITEMS BELOW ARE NOT FUNCTIONAL REQUIREMENTS OF THE NEW SYSTEM.**					
110	24	No loss of information on form due to 3-hole punching later.	**X**	**N**	Lack of space on paper form to implement this.		FormDesign
111	23	Need railroad crossing number (to be MMUCC compliant? **YES**)	**X**	**N**	This will be handled by GPS location. There is a conflict between this "non" approved change idea and what the technical did approve for collection on the form. (see data element ref #53) Therefore, rail road cross identifier will be collected on the form.		FormDesign
112	64	Use of palm pilots for entering Accident Reports.		**N**	Not sure that palm computers are that well adaptable to the function of data entry. This may be a future data entry method, but current technology is not where it needs to be.		Characteristic

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113	62	We can't match records across localities until they get to the state office - ex: a driver hits a car in Pierre, then goes home to Ft. Pierre and says somebody hit them - there is no way to link these and see that there is a problem. (I.e. there was one accident, but it was reported as two because it was a hit and run. This Artificial Intelligence functionality would help law enforcement identify the link between two supposed different accidents)		**N**	In my opinion this has very limited benefit for the implementational cost.	This starts down the road of Artificial Intelligence	Characteristic
114	60	Database of damage figures for cars damage, property damage (like signs, utility poles, etc.) that would automatically populate the damage estimate field.		**N**	In my opinion this has very limited benefit for the implementational cost.		Characteristic
115	68	Eliminate the process of scanning the paper report to create the *.tif file. All "copies" of the Accident Report will now be computer reports printed in an "Accident Report" format (I.e. looks similar to the actual paper form)		**N**			Characteristic
116	57	Let insurance company to submit the "non-reportable" accidents.		**N**	This will introduce too much risk into the system. There is a risk of duplicate reports. Reporting incorrect damage estimates as actual cost. This might push some non-reportable into the reportable category.		Characteristic
117	75	Accident investigation can proceed more efficiently if the officers will draw an 8.5 x 11 neat diagram of the accident.		**N**	Form Design must be on one piece of paper. This would totally not be possible if this statement is true. However, this is very possible in the electronic input method.		FormDesign

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118	81	Be able to identify jurisdiction - I.e. have a box on the Accident Report that indicates reservation/non-reservation, and if it is a reservation, state which one. Other data types are state park, federal park.		**N**	Should be able to derive this information via the Location information already gathered on the Accident Report form. The jurisdiction can be determined from the GPS coordinates and the GIS data. As long as the location is known, then the jurisdiction is derivable from that location.		FormDesign
119	79	Use intuitive coding to eliminate having to look at a legend to determine what the codes mean - I.e. translate the codes into real words.		**N**	Form Design must be on one piece of paper. This would totally not be possible if this statement is true. There just will not be room for intuitive real words to be on the form. However, on the electronic method this is exactly how this will be done.		FormDesign
120	77	Need a way to include closed-road construction zone accidents in with all of the other accident data (closed roads are treated as private property).		**N**	This is contrary to ANSI D16.1 classifications.		FormDesign
121	87	Phone number for drivers/owners.		**N**	This information is captured by the officers in their field notebooks. This information is not needed by anyone else other than the officer.		FormDesign
122	83	Need to add a data field for investigating officer who assisted in finalizing the report.		**N**	This is a department training issue.		FormDesign/Training

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123	96	On state Accident Report form – officers would like one block for witness contact information, separate from the witness statement narrative area. For serious accidents, there is not enough room to put all the causation info and still put the contact info. Reviewers may miss the contact info if it's buried in the narrative.		**N**	Caution: Form Design must be on one piece of paper. It is recommended that this information be put in the narrative.	Workload issue for collecting the additional information.	FormDesign/Workload
124	101	Include non-reportable accidents in our analysis. Would like every motor vehicle traffic accident to be reported (including non-state reportable) so that we have access to data for all accidents in order to enhance safety project analysis. Another benefit is that law enforcement could stop using their own local systems for accident data. Maybe just get the basic information for non-reportable (intersection, maneuver). Basic meaning the bear essentials needed by the back-end analysis area to be able to use the data in traffic analysis.		**N**	Non-Reportable Accidents: Agencies can either at their own discretion choose to submit non-reportable accidents to State's system or not. **There is NO requirement to submit non-reportable accidents what so ever.** If so, then the data is available for the back-end engineers and traffic analysis. If so, must enter into the State's system electronically, whether by agency or by accident participant.		Policy
125	104	(Old Rule) Alcohol testing is only required on fatal accidents. (New Rule) Require test on all reportable accidents. (Impact) More complete data on lower blood alcohol levels, could be a deterrent against drinking and driving if they know they will always be tested.		**N**	Legal issue here. May need to pass legislation to accomplish this.	This is a state law so may be hard to change.	Policy

Seq	Ref	Change Idea/Functional Requirement	Core	Rcmd	Recommendation Note	Assumptions/ Comments	Category
126	97	Standardize the way Accident Reports/data can be obtained by creating a centralize place that Accident Report copy request can go to. Eliminate duplicate sources of Accident Report copies (sometimes a person/insurance company comes to both the police and the DOT to obtain copies). This would eliminate the need for all agencies to provide reports and accident data to the requestor. All request could just be made to the central Accident Report repository. Anyone, including the general public can request copies of Accident Reports electronically, via Internet.		**N**	With a web interface to obtain reports and data this would be possible. At issue is charging for reports. This is a Policy decision.	Assumes we develop a process to hold the request until the $4 is paid (unless we do away with that rule as suggested) and that we can ensure privacy of information requested. We need to possibly keep an audit trail of who has requested what Accident Reports because there is a law that says the people involved have a right to know who is accessing the info.	Policy
127	98	(Old Rule) Only certain accidents (state reportable by law) are reported/recorded at the State level. <u>(New Rule) Record all motor vehicle traffic accidents on public roadways at the State level. Eliminate the $1,000 property damage limit for deciding if accidents are reportable or not.</u> (Impact) Larger base of data for analysis of problem sites, eliminates subjective determination of reportable or not, will get more supplemental commercial vehicle data, don't have to make the determination as to whether a vehicle is commercial or not, eliminate local law enforcement systems to capture the accident data. This will provide a deeper database of accident information for traffic analysis, thus enabling better determinations of problem areas.		**N**	This is huge workload and legal issue. There has already been State Laws passed to eliminate the workload of reporting "small" accidents. We can not effectively reverse those laws and put the workload back on the reporting agencies to submit all of these "small" accidents. The best the DOT can hope for is to provide support for agencies that want to voluntarily submit these reports.	Assumes Officers would not object to increased work load of recording more accidents or we can improve the process so much that there is no net increase in work load.	Policy

Seq	Ref	Change Idea/Functional Requirement	Core	Rcmd	Recommendation Note	Assumptions/ Comments	Category
128	102	(Old Rule) Accident Report copies cost $4. (New Rule) Copies of Accident Reports are free. (Impact) No accounting/billing process, no auditing, would enhance customer service by involved parties not having to pay $4 for their own Accident Report.		**N**	The benefit of charge the $4.00 for the report is out weighed by the cost of tracking accounts, invoices, and billings, but this is a Policy issue. State Law needs to be changed to avoid charging for accident reports.	Loss of revenue is made up for by not having the accounting/billing processes.	Policy
129	106	Electronic signatures on electronic Accident Reports.		**N**	The question of "Are electronic signatures needed?" revolves around one concept. Is the signatures a "legal-binding" part of the accident form or is it just a indication that the officer is done with the report and that the reviewing officer is done with the report. If it is the later, then electronic signatures are NOT needed. Because all the signature is doing is indicating the status of the report. Electronically the system will store the status of the report during the life cycle of the accident report. Some statuses could be: Initial Creation, Reporting Officer Complete, In Review (Local Agency), Local Agency Review Complete, In Review (State),		Policy

Seq	Ref	Change Idea/Functional Requirement	Core	Rcmd	Recommendation Note	Assumptions/ Comments	Category
					State Review Complete. Only when an accident report reaches the State Review Complete status will any of the information be released to the public. The other aspect that the signature provides is "who" did what. In the electronic system every field that is entered or changed would know exactly who made the change. This is possible because the system knows who is "logged" into the system.		
130	103	(Old Rule) All requests for Accident Report copies are honored with no regard to privacy issues. (New Rule) Reports are only distributed with approval of involved parties. Might make a blanket approval for all insurance company requests. (Impact) Individual's privacy is protected, adds more steps in the process.		**N**	It has been well noted that Accident Reports are "Public" information. We can not just change the "Freedom of Information" Act.	This is public information so we may not be able to keep this confidential.	Policy

Seq	Ref	Change Idea/Functional Requirement	Core	Rcmd	Recommendation Note	Assumptions/ Comments	Category
131	99	Let accident victims submit the "non-reportable" Accidents to the State. Accidents can be submitted via paper form that is mailed in or can be electronically entered at a web site. Include deer hit reports. This would save on the man-hours needed to collect the additional "non-reportable" accidents, while still giving the back-end analysis area the data that it needs to do traffic analysis. Have involved drivers fill out a written (or tape recorded) statement (narrative) of what they think happened. What they saw at the intersection/why they think the accident happened – were they able to see the stop lights, yield signs, stop signs, lane use signs, etc. or did they miss them. (Impact) Captures additional information, moves some of the data capturing from the officer to the driver, adds capability to prosecute driver if it is later determined that the driver lied.		**N**	Non-Reportable Accidents: Agencies can either at their own discretion choose to submit non-reportable accidents to State's system or not. **There is NO requirement to submit non-reportable accidents what so ever.** If so, then the data is available for the back-end engineers and traffic analysis. If so, must enter into the State's system electronically, whether by agency or by accident participant.	The driver's statement does not eliminate the officer's narrative.	Policy
132	107	(Old Rule) All RR crossing accidents must be investigated by DOT. Then a report is sent to the Secretary of DOT. (New Rule) Whatever agency has jurisdiction should investigate. (Impact) Lessen work load on DOT. Put responsibility on the shoulders of those who are responsible.		**N**	Must use old rule.	Based on ANSI D16.1 reporting requirements.	Policy

Seq	Ref	Change Idea/Functional Requirement	Core	Rcmd	Recommendation Note	Assumptions/ Comments	Category
133	116	(Old Rule) Some officers are required to have all paperwork turned in at the end of the shift. (New Rule) Allow more time to complete paperwork (I.e. next day) as long as it does not jeopardize the integrity of the investigation and the Accident Reporting process. (Impact) Officer quality of life, can result in more detailed information (do it when we're not as tired) and fewer errors.		**N**	Out of scope. This is a policy issue that each agency must handle as they see fit.	Not all officers agree with this rule change.	Process
134	115	Office of Accident Records might want to start requesting copies of the officer's supplemental narrative/notes.		**N**			Process
135	119	(Old Rule) Officer completes Accident Report either at the scene or at the office. (New Rule) Officer completes the Accident Report onsite, whenever possible. (Impact) Increases accuracy of information since it's gathered at the scene.		**N**	This is a policy issue that each agency must handle as they see fit.		Process
136	129	Use accident investigation specialist. This provides for better accuracy and completeness. Rapid City is currently doing this. Both the Office of Accident Records and the RC police department agree that the Accident Reports are of higher quality when done by these specialist.		**N**	I agree and think it is a great idea, but this is a agency organizational decision.		Process
137	130	Get environmental conditions from scan stations (surface temp, precipitation (snow/rain), wind speed, chemical presence on surface of road.		**N**	There are not but ~40 stations across the State. The chances of the accident being near one is very slight and the benefit is greatly out weighed by the implementational cost.		Process

Seq	Ref	Change Idea/Functional Requirement	Core	Rcmd	Recommendation Note	Assumptions/ Comments	Category
138	121	Set a standard for when Accident Reports must be sent in (daily, weekly, 10 days, etc...). Need to be somewhat flexible on this for the "non-reportable" Accident Reports.		**N**	This is a policy issue that each agency must handle as they see fit.		Process/Policy
139	125	The officer filing the Accident Report should never be the same person that reviews/approves the report.		**N**	I agree, but this is a policy issue that each agency must handle as they see fit.	Some jurisdictions have only one officer so there needs to be an exception for this.	Process/Policy
140	126	All errors in forms are identified in the review process or prior to the review (I.e. via the electronic input process). Make the procedural changes in the departments that a supervisor is not required to do this process.		**N**	I agree, but this is a policy issue that each agency must handle as they see fit.	Local law enforcement offices all know what errors to look for and assumes that there is always someone on duty who has the knowledge to do this.	Process/Policy
141	124	Make sure all Accident Reports do get reviewed (some don't due to various local law enforcement procedures or staffing situations).		**N**	I agree, but this is a policy issue that each agency must handle as they see fit.		Process/Policy
142	135	There should be one instruction manual for both forms.		**NA**	With the forms being combined this becomes a mute point.		Training

Seq	Ref	Change Idea/Functional Requirement	Core	Rcmd	Recommendation Note	Assumptions/ Comments	Category
143	132	Accident System should automatically send out notifications/alerts to people based upon the accident type, location, etc… (Example: Region DOT office wants to be notified when there is an accident in a construction zone.)		**N**	To me this sounds like a nice to have, but probably has limited benefit for the implementational cost to produce this functionality. This functionality can easily be substituted with a customized report that the user can run daily, weekly, etc… to get the accidents they're interested in. Training issue: Officer should notify Region DOT.		Training
144	138	Use OCR (Optical Character Recognition) technology to input the data from Accident Reports that still come in on paper.		**N**	In conversations with Louisiana State DOT personnel, it does not seem to be technologically feasible at this point in time. Louisiana dropped their OCR initiative after troubles getting it to work. Washington State is still trying to get it to work. Additionally with the focus on "electronic" entry of the accident data there would be no need for OCR. OCR is only important if the data capture and recording method is still via paper forms.	There will still be some data entry required to correct OCR errors. Continue to monitor the OCR technology for possible use in the future.	Workload

Seq	Ref	Change Idea/Functional Requirement	Core	Rcmd	Recommendation Note	Assumptions/ Comments	Category
145	159	Electronically disable fleeing vehicle via satellite, cellular or other technology.		**N**	Out of scope		z_oos
146	161	Electronically gather insurance information and populate Accident Report. Need to link to insurance companies or centralized insurance information database. Would also be nice to have proof of insurance card bar coded so we can scan in the info if we don't have the link to the insurance database. All Insurance cards must also have phone number and other contact information on it.		**N**		May require a statute to get insurance companies to provide access to the data.	z_oos
147	147	The Technical Panel recommended that accident reduction averages look at a 10-accident location history for intersection analysis.		**N**	BIT & LGA should look into this. This could be handled by use of customized queries into the Accident database.		z_oos
148	150	There is a research project going on now to electronically gather the vehicle volume data for non-state trunk roads. The new software will transmit about 80% of the needed volume data. If we can tie into this system, we could have volumes on more roads.		**N**	Out of scope		z_oos
149	165	Need to get the State's Accident Number onto the EMS trip report. (Out of scope)		**N**	This is up to the Health Department (EMS) to look into doing on their side. On the Accident Reporting side, we have included the EMS trip report number on the Accident report/data so that we can map to the EMS data.	EMS comes to the scene and leaves in a lot of cases before law enforcement arrives. So how do we get the accident case id on the EMS report?	z_oos

Seq	Ref	Change Idea/Functional Requirement	Core	Rcmd	Recommendation Note	Assumptions/ Comments	Category
150	148	State Radio also has a similar form as the Office of Accident Records fatality short form. **Should these forms be combined? NO**		**N**	Highway Patrol has short form just for press releases.		z_oos
151	152	Tie the Video Log to Accident information. This would give the ability to display associated accidents (reports, summaries and diagrams) when requested when using the Video Log for analysis. Would like road videos to indicate when there is an associated accident at the point in the video.		**N**	Good Idea. BIT & Data Inventory should look into this.	Interface the Video Log.	z_oos
152	156	Have a camera that produces both a film and a digital image. (Impact) Eliminates risk of photo tampering.		**N**	Technology issue.		z_oos
153	157	Integrate GPS receivers in private cars with squad car receivers and have software that determines who is the closest officer to respond to an accident. (Impact) Response time is reduced.		**N**	Out of scope		z_oos
154	158	Combine accident data, citation data and commercial vehicle inspections into one software system. (Impact) Reduces duplicate data entry, combines information in one report.		**N**	This will be coordinated with CVISN projects.	Citations & Commercial Vehicle inspections are not part of the scope of the SD2000-14 project.	z_oos
155	162	Use Accident Reconstruction software to speed crash investigation.		**N**	Reconstruction software is Out of Scope.	Crash reconstruction is not in scope.	z_oos
156	146	Sort, filter and combine multiple accident types on collision diagrams.		**N**	This is a change request for the manufacturer of Intersection Magic.		z_oos

Seq	Ref	Change Idea/Functional Requirement	Core	Rcmd	Recommendation Note	Assumptions/ Comments	Category
157	149	Automate the manual calculation of Accident Rates. Use RES traffic volume data in combination with the Accident Data to automatically calculate the Accident Rates. Use this data to determine the expected rates of accidents and plot a standard bell curve of accident numbers by type of intersection by vehicle volume.		**N**	This is a good idea. Keep this idea for another project. BIT & LGA should look into this.	Will need to interface with RES system to get ADT data for traffic volumes. Interfacing with RES is OOS for the SD2000-14 project	z_oos
158	154	Use high-band radio for data communication. (Impact) No holes in coverage.		**N**	This is a good possible mechanism for "data communications", but this is the responsibility of the "Network Communications Group" to decide. We would merely suggest to them that this may be a possible route the State may want to take for "data communication" to remote sites.		z_oos
159	167	AVL - Automatic Vehicle Location. GPS coordinates will be automatically provided. (Impact) Get both GPS/AVL and know location of closest squad car to accident.		**N**	Out of scope		z_oos
160	169	(Old Rule) DUIs on BIA/reservation land are not reported. (New Rule) All DUIs should be reported. (Impact) Accurate reflection of actual DUIs for individuals - get repeat offenders off the road.		**N**	Out of Scope of this project due to the fact that a DUI not an Accident.	This is out of scope if there is not accident involved, but merely a citation.	z_oos
161	151	More staffing in the computer support area.		**N**	Staffing Issue		z_oos

Seq	Ref	Change Idea/Functional Requirement	Core	Rcmd	Recommendation Note	Assumptions/ Comments	Category
162	160	Automatically populate Accident Report with date, time of day, location (etc.) information from dispatch (911). Actual location/GPS coordinates can be obtained when available from 911 system.		**N**	This may be something that could be done in the future. But the benefit of doing this seems slight and the feasibility and cost to implement seem to be prohibitive.	May not work for all law enforcement agencies. Data needs to be editable (such as correcting location information).	z_oos
163	144	ASPEN (commercial vehicle inspections software) should have access to Accident Report data.		**N**	We have no control/input into the ASPEN system.	Requires customization of ASPEN at the state level to bring in the SD-specific Accident Report. ASPEN software is free. HP District 4 (commercial enforcement) already has ASPEN and is the only group of officers with ASPEN today.	z_oos
164	145	ASPEN (roadway inspections software) should have the ability to record accidents.		**N**	We have no control/input into the ASPEN system.	Several states have already done this customization to their version of ASPEN. ASPEN downloads inspection reports data to SAFER, which updates SAFETYNET today. ASPEN is used today via laptops in the HP cars.	z_oos
165	153	Better cellular phone coverage. (Impact) Roadside access to databases to send or receive data.		**N**	Out of scope	Assumes we can get Cellular providers to improve SD system.	z_oos

Seq	Ref	Change Idea/Functional Requirement	Core	Rcmd	Recommendation Note	Assumptions/ Comments	Category
166	164	Generate the abnormal accidents at intersections rate and accident reduction factors rate data automatically (relates to SD98-12 and SD98-13 studies).		N	BIT & LGA should look into this. They could develop a program to do this. Accident Reporting database does not contain the RES data needed to make this happen. RES has the average daily traffic counts, etc…		z_oos
167	155	Put mobile data terminal or laptops in squad cars and combine as many technologies as possible into one combo device (I.e. bar code scanner, GPS receiver, cell phone, camera, radar, etc.) (Impact) Reduce number of pieces of equipment in cars while adding technology.		N	Agency issue & Technology issue.		z_oos
168	163	Generate the annual Facts Book/Accident Summary automatically including all of the narrative.		N	System will provide the data for the facts book via customizable queries and/or standard reports.	-	z_oos
169	143	Automated reminders to do follow-up analysis for intersections that had improvements.		N	BIT & LGA should look into this. They could develop a program that could do this.	Improvement information is not available. Where is the information for roadway improvements stored? RES?	z_oos
170	166	Tie existing traffic studies done by various agencies across the State into accident system.		N			z_oos
171	170	DMV take back plates if driver's insurance expires or is canceled. Gets the uninsured vehicles off the road.		N	Legislation needed to accomplish this.	Need insurance companies' cooperation.	z_oos/Legal

Seq	Ref	Change Idea/Functional Requirement	Core	Rcmd	Recommendation Note	Assumptions/ Comments	Category
172	171	(Old Rule) Accidents on private land are not reported. (New Rule) Accidents are reported on private property and/or if there is a DUI arrest. (Impact) More complete accident data, trucking industry would like the official report to keep the "he said, she said" from happening.		**N**	Need to make/change State Law to make this accidents reportable.	Out of scope for now since "traffic accidents" implies private property.	z_oos/Legal
173	172	(Old Rule) Issue red tags for all damaged vehicles. (New Rule) Don't issue red tags. (Impact) Eliminates work step and forms management.		**N**	Out of scope. Issuing Red Tags is required by State Law.		z_oos/Legal/Red Tag
174	173	Print-out red tags from squad car mobile data terminal or laptop or body shop accesses accident record via Internet. (Impact) Eliminates a manual process and form, eliminates manual effort to produce and distribute the forms, body shops can verify that this vehicle has damage from a reported accident.		**N**	Out of scope		z_oos/Legal/Red Tag
175	175	Red tags issued even to people who don't intend to repair their vehicles in case they get stopped by police.		**N**	Out of scope		z_oos/Legal/Red Tag
176	174	Replace red tag with a windshield sticker easily seen by officers passing by. (Impact) More easily identifies damage already reported.		**N**	Out of scope	Has disadvantages - may not want to do this. Training issue - officers don't rely on the sticker which could be from prior damage not current damage.	z_oos/Legal/Red Tag

Seq	Ref	Change Idea/Functional Requirement	Core	Rcmd	Recommendation Note	Assumptions/ Comments	Category
177	176	(Old Rule) BIA only reports fatalities and serious injuries. (New Rule) BIA reports accidents using same standards as other law enforcement agencies in the state. (Impact) Better accident data in the system, saves looking up BIA reports by hand, better accident stats to justify safety improvement $. There is not enough data to prove the number of accidents, so a project to fix the problem could not be funded. The BIA should make it a standard process to do state accident forms on ALL state-reportable accidents, not just serious injury/fatal. Reservation roads would benefit from qualifying for safety projects.		**N**	I agree. Seems that this is a good idea, but it is not in the State's authority to make this decision. This is a BIA decision.		z_oos/Legal/Training
178	178	Make public aware of reasons why Accident Reports are collected/analyzed/publicized. Educate the public. This will help stop fear of "Big Brother".		**N**	I agree, but this is Out of Scope.		z_oos/Training
179	177	(Old Rule) Officers are required to take accident investigation training only at the academy. (New Rule) Officers need periodic, refresher training and need to be trained on the D16.1 standards on how to classify/code accidents. (Impact) Better informed, more knowledgeable officers resulting in more accurate/complete accident data.		**N**	I agree, but this is Out of Scope for the SD2000-14 project.		z_oos/Training
180	179	More complete training to help sell the importance of complete & accurate data on Accident Report.		**N**	I agree, but this is Out of Scope.		z_oos/Training

Seq	Ref	Change Idea/Functional Requirement	Core	Rcmd	Recommendation Note	Assumptions/ Comments	Category
181	181	(Old Rule) Reports cost $6.00 by city ordinance. (New Rule) Reports online. (Impact) Saves time filling requests for Accident Reports.		**N**	Legal issue here. Cities handle their own local systems. Local systems and reporting issues are out of scope.		z_oos\Legal
182	180	(Old Rule) State records must be retained on microfilm by state (or federal?) law for 10 years. (New Rule) Image the reports/records instead of microfilm. (Impact) Better access to imaged reports & records.		**N**	Out of scope	By federal law, SF has to keep Accident Reports on microfilm, not on disk. This is public information, so web system would be helpful. They now charge $6.00 for copies.	z_oos\Legal

Appendix G. Approved Data Elements "To Be"

The table below lists all of the proposed data elements that are associated with a crash in the new system. This table was derived based on the functional requirements analysis, the MMUCC criteria, the current PS-Accident system data elements, FARS requirements and SAFETYNET requirements.

Note: Reference number is the original number assigned to an item. Sequence number is used to logically order the items.

Seq #	Ref #	Entity	Attribute/Data Element	On New Form? (Y, N or Field Acronym)	New Form Section	Need Data (Y/N)	Collect Derive Link Generate Other	Notes
1	1	Carrier	Address City	Y	Unit	Y	C	Possible link given ICC or DOT #
2	2	Carrier	Address State	Y	Unit	Y	C	Possible link given ICC or DOT #
3	3	Carrier	Address Street A	Y	Unit	Y	C	Possible link given ICC or DOT #
4	4	Carrier	Address Street B	Y	Unit	Y	C	Possible link given ICC or DOT #
5	5	Carrier	Address Zip	Y	Unit	Y	C	Possible link given ICC or DOT #
6	9	Carrier	Carrier Identification Issuing Authority	Y	Unit	Y	C	Possible link given ICC or DOT #
7	8	Carrier	City	Y	Unit	Y	C	Possible link given ICC or DOT #. Referred to as FIPS City on form
8	7	Carrier	Colonia	Y	Unit	Y	C	Possible link given ICC or DOT #
9	15	Carrier	Interstate Carrier	Y	Unit	Y	C	Possible link given ICC or DOT #
10	10	Carrier	Name First	Y	Unit	Y	C	Possible link given ICC or DOT #
11	11	Carrier	Name Last	Y	Unit	Y	C	Possible link given ICC or DOT #
12	12	Carrier	Name Middle	Y	Unit	Y	C	Possible link given ICC or DOT #
13	14	Carrier	Name Suffix	Y	Unit	Y	C	Possible link given ICC or DOT #

Seq #	Ref #	Entity	Attribute/Data Element	On New Form? (Y, N or Field Acronym)	New Form Section	Need Data (Y/N)	Collect Derive Link Generate Other	Notes
14	16	Carrier	State Census Issue State	Y	Unit	Y	C	Possible link given ICC or DOT #
15	6	Carrier	State Census Number	Y	Unit	Y	C	Possible link given ICC or DOT #
16	19	Contributing Circumstance Crash	Circumstance	CCC1 and CCC2	Summary	Y	C	3 occurrences provided on form
17	20	Contributing Circumstance Crash Person	Circumstance	CCP1 and CCP2	Unit	Y	C	4 occurrences provided on form
18	207	Contributing Circumstance Crash Vehicle	Circumstance	CCV1 and CCV2	Unit	Y	C	2 occurrences provided on form
19	264	Crash	Agency Approval Date	Y	Approval	Y	C	

Seq #	Ref #	Entity	Attribute/Data Element	On New Form? (Y, N or Field Acronym)	New Form Section	Need Data (Y/N)	Collect Derive Link Generate Other	Notes
20	296	Crash	Agency Use Only			Y	C	from change idea nbr 85 Should this be on the form? Yes. This is a Generic box that each agency can use as they see fit. Most will probably use this to put their agency specific "Call Number"/"Dispatch Number". Up to 20 characters long.
21	24	Crash	Ambient Light	LITE	Summary	Y	C	
22	269	Crash	Approval Officer Badge Number	Y	Approval	Y	C	
23	28	Crash	Crash City Name	Y	Summary	Y	C	
24	29	Crash	Crash County	Y	Summary	Y	C	
25	30	Crash	Crash Date Time	Y	Summary	Y	C	
26	262	Crash	Diagram	Y	Diagram	Y	C	
27	50	Crash	Filing Officer Badge Number	Y	Approval	Y	C	

Seq #	Ref #	Entity	Attribute/Data Element	On New Form? (Y, N or Field Acronym)	New Form Section	Need Data (Y/N)	Collect Derive Link Generate Other	Notes
28	41	Crash	First Harmful Event Location	FHEL	Summary	Y	C	How can FHE Location be determined in the field if FHE is not determined in the field? The of old name of this data element is "Relation To Roadway". Officers collect this data element and OAR overrides it as necessary to make it the "correct" value for which the FHE happened. Note: OAR may override this data element.
29	42	Crash	Hit-And-Run	RUN	Summary	Y	C	
30	43	Crash	Information Source	Y	Approval	Y	C	Not the same as #263 - see data dictionary
31	263	Crash	Information Source Name	Y	Approval	Y	C	Not the same as #263 - see data dictionary
32	74	Crash	Location Coordinate	Y	Summary	Y	C	GPS, City/County Map X and Y coordinates.
33	45	Crash	Location Mile Reference Marker (MRM)	MRM	Summary	Y	CD	could be derived from # 74. This is now an optional field on the form - officer could supply #feet from street, #miles from street or MRM
34	33	Crash	Location Roadway	Y	Summary	Y	C	I-90, US-66, etc… This coded by OAR
35	60	Crash	Location Special	SPE	Summary	Y	C	
36	261	Crash	Narrative	Y	Summary	Y	C	
37	270	Crash	Photos Taken	PIC	Summary	Y	C	

Seq #	Ref #	Entity	Attribute/Data Element	On New Form? (Y, N or Field Acronym)	New Form Section	Need Data (Y/N)	**C**ollect **D**erive **L**ink **G**enerate **O**ther	Notes
38	271	Crash	Police Date & Time Arrival	Y	Summary	Y	C	
39	272	Crash	Police Date & Time Notified	Y	Summary	Y	C	
40	53	Crash	Rail Grade Crossing	RR	Summary	Y	C	
41	55	Crash	Road Surface Condition	RSC	Summary	Y	C	
42	56	Crash	Roadway Junction Type	JUN	Summary	Y	C	
43	57	Crash	Scene Investigation Location	INVL	Summary	Y	C	
44	58	Crash	School Bus Related	SBR	Summary	Y	C	
45	65	Crash	Work Zone Location	WZL	Summary	Y	C	
46	66	Crash	Work Zone Related	WZR?	Summary	Y	C	
47	67	Crash	Work Zone Type	WZT	Summary	Y	C	
48	68	Crash	Worker Present In Work Zone	WOR?	Summary	Y	C	
49	276	Crash Person	Address (including Street, City, State, Zip)	Y	Unit & Other Parties	Y	C	I left this in both the motorist (unit) and non-motorist (other persons) area so it can be used as a property owner, injured person, witness, etc.

Seq #	Ref #	Entity	Attribute/Data Element	On New Form? (Y, N or Field Acronym)	New Form Section	Need Data (Y/N)	Collect Derive Link Generate Other	Notes
50	76	Crash Person	Alcohol Determination Method Police	ADET	Unit & Other Parties	Y	C	This data element comes from FARS and is associated with "all" persons. The other alcohol/drug data elements come from MMUCC and are associated with non-motorist and drivers.
51	86	Crash Person	Alcohol Drug Suspected	ALC?	Unit & Other Parties	Y	C	This value is coded for all persons involved for the FARS system.
52	87	Crash Person	Alcohol Test Result	BAC	Unit & Other Parties	Y	C	may be collected later. This value is coded for all persons involved for the FARS system.
53	88	Crash Person	Alcohol Test Status	ALCS	Unit & Other Parties	Y	C	may be collected later.
54	89	Crash Person	Alcohol Test Type	ALTT	Unit & Other Parties	Y	C	may be collected later. This value is coded for all persons involved for the FARS system.
55	77	Crash Person	Birth Date	Y	Unit & Other Parties	Y	C	

Seq #	Ref #	Entity	Attribute/Data Element	On New Form? (Y, N or Field Acronym)	New Form Section	Need Data (Y/N)	Collect Derive Link Generate Other	Notes
56	90	Crash Person	Cited	Y	Unit	Y	C	We should be collecting violation information for drivers and pedestrian involved in the crash. We do not need to collect citation information the other people involved (passengers).
57	268	Crash Person	Damaged Object Owner & Address	Y	Unit & Other Parties	Y	C	3 occurrences provided on form
58	78	Crash Person	Injury Status	INJS	Unit & Other Parties	Y	C	
59	106	Crash Person	Name First	Y	Unit & Other Parties	Y	C	
60	107	Crash Person	Name Last	Y	Unit & Other Parties	Y	C	
61	108	Crash Person	Name Middle	Y	Unit & Other Parties	Y	C	
62	109	Crash Person	Name Suffix	Y	Unit & Other Parties	Y	C	
63	79	Crash Person	Other Drug Determination Method Police	ODET	Unit & Other Parties	Y	C	Refers to all persons, so this is in the Summary section of the form

Seq #	Ref #	Entity	Attribute/Data Element	On New Form? (Y, N or Field Acronym)	New Form Section	Need Data (Y/N)	Collect Derive Link Generate Other	Notes
64	80	Crash Person	Other Drug Involvement Police	OTHR?	Unit & Other Parties	Y	C	
65	81	Crash Person	Person	Y	Unit & Other Parties	Y	C	
66	83	Crash Person	Person Type	TYPE	Unit & Other Parties	Y	C	assumed value when person is the motorist.
67	84	Crash Person	Sex	SEX	Unit & Other Parties	Y	C	
68	85	Crash Person	Vehicle Number	Y	Unit & Other Parties	Y	C	2 occurrences provided on form
69	143	Crash Person Condition	Person Condition	COND1/2	Unit & Other Parties	Y	C	2 occurrences provided in non-fatality area, no more in fatality area. FARS needs 4 elements but we are not collecting additional info that is fatality-only data since the info comes from coroner, not officers. Should law enforcement really be collecting subjective values such as depressed or emotional? Technical Panel says YES.

Seq #	Ref #	Entity	Attribute/Data Element	On New Form? (Y, N or Field Acronym)	New Form Section	Need Data (Y/N)	Collect Derive Link Generate Other	Notes
70	123	Crash Person Driver	Driver License Restrictions Compliance	Y	Unit	Y	C	
71	122	Crash Person Driver	Driver License Endorsements Compliance	Y	Unit	Y	C	
72	100	Crash Person Driver	Driver License Number	Y	Unit	Y	C	
73	102	Crash Person Driver	Driver License State Province	Y	Unit	Y	C	
74	104	Crash Person Driver	Driver License Type Compliance	Y	Unit	Y	C	
75	98	Crash Person Driver	Height	Y	Unit	Y	C	
76	116	Crash Person Driver	Weight	Y	Unit	Y	C	
77	139	Crash Person Drug Involvement	Drug Test Result	DTRE	Unit & Other Parties	Y	C	may be collected later. This value is coded for all persons involved for the FARS system. **Need room for 3 Drug Test Results.**

Seq #	Ref #	Entity	Attribute/Data Element	On New Form? (Y, N or Field Acronym)	New Form Section	Need Data (Y/N)	Collect Derive Link Generate Other	Notes
78	140	Crash Person Drug Involvement	Drug Test Status	DTST	Unit & Other Parties	Y	C	may be collected later.
79	141	Crash Person Drug Involvement	Drug Test Type	DRTT	Unit & Other Parties	Y	C	may be collected later. This value is coded for all persons involved for the FARS system. **Need room for 3 Drug Test Results.**
80	127	Crash Person Injured	EMS Run Number	Y	Injury Info	Y	C	The officer should either put the EMS run # or the Name of the EMS Service in this box on the form. EMS run # is best, but if not available then the Name must be used. And then later the EMS run # must be derived from the Name.
81	129	Crash Person Injured	Injured Transport Method	Y	Injury Info	Y	C	This probably should be collected, because there may be nothing to link to to get this information.
82	132	Crash Person Injured	Medical Facility	Y	Injury Info	Y	C	This probably should be collected, because there may be nothing to link to to get this information.
83	142	Crash Person Non-Motorist	Non-Motorist Action	ACT	Other Parties	Y	C	

Seq #	Ref #	Entity	Attribute/Data Element	On New Form? (Y, N or Field Acronym)	New Form Section	Need Data (Y/N)	Collect Derive Link Generate Other	Notes
84	144	Crash Person Non-Motorist	Non-Motorist Location Before Impact	LOC	Other Parties	Y	C	
85	145	Crash Person Non-Motorist	Non-Motorist Struck By Vehicle Number	STRU	Other Parties	Y	C	
86	148	Crash Person Occupant	Air Bag Deployment	ABAG	Unit & Other Parties	Y	C	
87	149	Crash Person Occupant	Air Bag Switch Status	ASWI	Unit & Other Parties	Y	C	
88	150	Crash Person Occupant	Ejection	EJECT	Unit & Other Parties	Y	C	
89	151	Crash Person Occupant	Ejection Path	EPATH	Unit & Other Parties	Y	C	
90	155	Crash Person Occupant	Extrication	EXTRI	Unit & Other Parties	Y	C	
91	152	Crash Person Occupant	Occupant Vehicle Number	Y	Other Parties	Y	C	
92	154	Crash Person Occupant	Seating Position	SEAT	Unit & Other Parties	Y	C	a motorist's position cannot be assumed/derived (mail carriers sit in position 2 to drive)

Seq #	Ref #	Entity	Attribute/Data Element	On New Form? (Y, N or Field Acronym)	New Form Section	Need Data (Y/N)	<u>C</u>ollect <u>D</u>erive <u>L</u>ink <u>G</u>enerate <u>O</u>ther	Notes
93	153	Crash Person Occupant Protection System Used	Protection System	PROT	Unit & Other Parties	Y	C	From change idea # 82 - Should this be on the form? YES. Need to allow for a second occurrence of Protection System Used.
94	75	Crash Person Violation	Violation Code	Y	Unit	Y	C	We should be collecting violation information for drivers and pedestrian involved in the crash. We do not need to collect citation information the other people involved (passengers). Up to 3 codes provided for on form. Note: <u>Also we need to not only collect the violation code (I.e. 26 - Speeding), but also collect the citation number (I.e. ticket number 01928340) on the form (see Change Idea #110).</u>
95	191	Crash Vehicle	Axle Count	Y	Unit	Y	C	
96	159	Crash Vehicle	Body Type Cargo	CTYP	Unit	Y	C	
97	193	Crash Vehicle	Bus Use	BUS	Unit	Y	C	
98	279	Crash Vehicle	Damage Amount	Y	Unit	Y	C	for the Vehicle and Contents.
99	280	Crash Vehicle	Damage Area	Y	Unit	Y	C	
100	165	Crash Vehicle	Damage Extent	DAMG	Unit	Y	C	
101	166	Crash Vehicle	Direction of Force to Vehicle	Y	Unit	Y	C	
102	167	Crash Vehicle	Emergency Use	EMER	Unit	Y	C	

Seq #	Ref #	Entity	Attribute/Data Element	On New Form? (Y, N or Field Acronym)	New Form Section	Need Data (Y/N)	Collect Derive Link Generate Other	Notes
103	177	Crash Vehicle	Event Sequence Most Harmful	Y	Unit	Y	C	
104	170	Crash Vehicle	Gross Vehicle Weight Rating of Power Unit	Y	Unit	Y	C	
105	171	Crash Vehicle	Hazardous Material Name	Y	Unit	Y	C	
106	173	Crash Vehicle	Hazardous Material Placard Number	Y	Unit	Y	C	
107	174	Crash Vehicle	Hazardous Material Released	HAZR	Unit	Y	C	
108	181	Crash Vehicle	Impact Point Initial	Y	Unit	Y	C	
109	176	Crash Vehicle	Impact Point Most Damaged	Y	Unit	Y	C	
110	275	Crash Vehicle	Insurance Company Name	Y	Unit	Y	C	
111	282	Crash Vehicle	Insurance Effective Date	Y	Unit	Y	C	
112	283	Crash Vehicle	Insurance Expiration Date	Y	Unit	Y	C	
113	281	Crash Vehicle	Insurance Policy Number	Y	Unit	Y	C	
114	200	Crash Vehicle	Leave Scene Method	LEAV	Unit	Y	C	
115	175	Crash Vehicle	License Plate Number	Y	Unit	Y	C	

Seq #	Ref #	Entity	Attribute/Data Element	On New Form? (Y, N or Field Acronym)	New Form Section	Need Data (Y/N)	Collect Derive Link Generate Other	Notes
116	178	Crash Vehicle	No Carrier Identification Available	N	Unit	Y	C	Can this be written in as "none" in the Carrier id field rather than having a separate box on the form? I think we should just put a small checkbox inside the Carrier Identification Box for "No Id Avail". Either way will work, but with out the checkbox there becomes a training issue that the officers know to put "no id available' in the box, instead of just checking a box.
117	206	Crash Vehicle	Registered Owner Type	OWNT	Unit	Y	C	
118	184	Crash Vehicle	Registration State	Y	Unit	Y	C	
119	185	Crash Vehicle	Registration Year	Y	Unit	Y	C	
120	210	Crash Vehicle	Special Use	VUSE	Unit	Y	C	
121	157	Crash Vehicle	Speed Authorized Limit	Y	Unit	Y	C	
122	212	Crash Vehicle	Speed Estimated Travel Speed	Y	Unit	Y	C	
123	168	Crash Vehicle	Speed Estimated Travel Speed Determination Method	SDET	Unit	Y	C	
124	189	Crash Vehicle	Travel Direction Before Crash	Y	Unit	Y	C	
125	190	Crash Vehicle	Underride Override	U/O	Unit	Y	C	

Seq #	Ref #	Entity	Attribute/Data Element	On New Form? (Y, N or Field Acronym)	New Form Section	Need Data (Y/N)	**C**ollect **D**erive **L**ink **G**enerate **O**ther	Notes
126	195	Crash Vehicle	Vehicle Configuration	Y	Unit	Y	C	super-type of Body Type Vehicle (MMUCC-VD03)
127	198	Crash Vehicle	Vehicle Identification Number	Y	Unit	Y	C	
128	201	Crash Vehicle	Vehicle Make	Y	Unit	Y	C	
129	202	Crash Vehicle	Vehicle Maneuver	MANU	Unit	Y	C	
130	196	Crash Vehicle	Vehicle Maneuver Avoidance (swerved left)	AVOID	Unit	Y	C	maneuver made. Ex. Swerved left, braking,
131	203	Crash Vehicle	Vehicle Model	Y	Unit	Y	C	
132	204	Crash Vehicle	Vehicle Model Year	Y	Unit	Y	C	
133	205	Crash Vehicle	Vehicle Number	Y	Unit	Y	C	
134	278	Crash Vehicle	Vehicle Owner Name and Address	Y	Unit	Y	C	
135	208	Crash Vehicle	Vehicle Role	ROLE	Unit	Y	C	
136	211	Crash Vehicle	Vehicle Trailing	NBRT	Unit	Y	C	
137	160	Crash Vehicle	Carrier Identification Number (I.e. USDOT # or ICC #)	Y	Unit	Y	C	This is either an USDOT # or an ICC #.
138	213	Crash Vehicle Event	Crash Event	Y	Unit	Y	C	Up to 4 events may be coded per vehicle on the new form.

Seq #	Ref #	Entity	Attribute/Data Element	On New Form? (Y, N or Field Acronym)	New Form Section	Need Data (Y/N)	<u>C</u>ollect <u>D</u>erive <u>L</u>ink <u>G</u>enerate <u>O</u>ther	Notes
139	63	Crash Vehicle Traffic Control	Traffic Control Device Functioning	TCD?	Unit	Y	C	Is this not a Contributing Circumstance? NO. I think this should be associated with the Crash Vehicle. FARS associates this data element at the Accident/Crash level. Because we are collecting 2 Traffic Control Device Types, we should also collect 2 occurrences of this data element as well. One for each Control Device collected. (see ref #188)
140	188	Crash Vehicle Traffic Control	Traffic Control Device Type	TCDT	Unit	Y	C	Need to provide space for 2 occurrences of Traffic Control Device Types (see Change Idea #84)
141	162	Crash Vehicle Trailer	License Plate Number	Y	Unit	Y	C	Only allow room for one trailer on the form. If there are two or more trailer, then the additional trailer information will be placed in the narrative.
142	163	Crash Vehicle Trailer	Registration State	Y	Unit	Y	C	Only allow room for one trailer on the form. If there are two or more trailer, then the additional trailer information will be placed in the narrative.

Seq #	Ref #	Entity	Attribute/Data Element	On New Form? (Y, N or Field Acronym)	New Form Section	Need Data (Y/N)	Collect Derive Link Generate Other	Notes
143	164	Crash Vehicle Trailer	Registration Year	Y	Unit	Y	C	Only allow room for one trailer on the form. If there are two or more trailer, then the additional trailer information will be placed in the narrative.
144	277	Crash Vehicle Trailer	Trailer Owner Name and Address	Y	Unit	Y	C	Trailer owner name and address can be collected in the "generic" people involved area of the form. This way no extra space is taken up for this specific type of person involved in the crash.
145	214	Crash Weather Condition	Weather Condition	WEA1 and WEA2	Summary	Y	C	2 occurrences provided on form
146	266	Damaged Object	Damage Amount	Y	Unit & Other Parties	Y	C	3 occurrences provided on form
147	267	Damaged Object	Object Description	Y	Summary	Y	C	3 occurrences provided on form
148	292	N/A	"Other" explanations	N		Y	C	As per guidance from the participants in the form re-design workshop, "other" explanations will be done in the Narrative. There will be no separate place taken up for these explanations.
149	215	Non-Motorist Safety Equipment Used	Non-Motorist Safety Equipment	SAF1 and SAF2	Other Parties	Y	C	2 occurrences provided on form

Seq #	Ref #	Entity	Attribute/Data Element	On New Form? (Y, N or Field Acronym)	New Form Section	Need Data (Y/N)	Collect Derive Link Generate Other	Notes
150	219	Roadway	Bikeway	BIKE	Summary	Y	C	not in RES system (Roadway Environment System)
151	221	Roadway	Delineator Presence	DELI	Summary	Y	C	not in RES system (Roadway Environment System)
152	222	Roadway	Grade/Profile	GRAD	Summary	Y	C	not in RES. Not collected if not strictly linkable. This is the profile/side view of the road. Includes: hillcrest, sag, level, etc…
153	225	Roadway	Horizontal Alignment	Y	Summary	Y	C	only is it a Curve or Straight, not the much more technical data described in MMUCC-RL02. Use the A08 definition.
154	227	Roadway	Intersection Mainline Lane Count	Y	Summary	Y	C	
155	228	Roadway	Intersection Side-Road Lane Count	Y	Summary	Y	C	
156	229	Roadway	Intersection Traffic Control Type	CNTR	Summary	Y	C	
157	231	Roadway	Lane Count	Y	Summary	Y	C	
158	237	Roadway	Route Signing	SIGN	Summary	Y	C	
159	236	Roadway	Surface Type	SURF	Summary	Y	C	
160	239	Roadway	Trafficway Description	ROAD	Summary	Y	C	

Seq #	Ref #	Entity	Attribute/Data Element	On New Form? (Y, N or Field Acronym)	New Form Section	Need Data (Y/N)	Collect Derive Link Generate Other	Notes
161	241	Roadway	Width Lane	Y	Summary	Y	CL	This data element can be LINKED if possible, but must be COLLECTED if it can not be linked (as per Technical Panel).
162	242	Roadway	Width Median	Y	Summary	Y	CL	This data element can be LINKED if possible, but must be COLLECTED if it can not be linked (as per Technical Panel).
163	243	Roadway	Width Shoulder	Y	Summary	Y	CL	This data element can be LINKED if possible, but must be COLLECTED if it can not be linked (as per Technical Panel).
164		**Data Elements below here are required but not collected.**						
165	26	Crash	Crash	Y	Summary		CG	Pre-printed on accident form
166	23	Crash	Alcohol/Drug Involvement	N		Y	D	
167	27	Crash	Crash City	N		Y	D	derived from Crash City Name. Coded in OAR
168	31	Crash	Crash Impact Manner	N		Y	D	This is coded by OAR. Therefore does not need to be on the Form.
169	34	Crash	Crash Severity	N		Y	D	derived from the most severe injury or greatest property damage.

Seq #	Ref #	Entity	Attribute/Data Element	On New Form? (Y, N or Field Acronym)	New Form Section	Need Data (Y/N)	Collect Derive Link Generate Other	Notes
170	273	Crash	Damage Property Total	N		Y	D	The total dollar value estimate of losses incurred including objects struck, vehicles, and contents. Is this derived by added (PS-A19 + PS-V34)? This is not currently on the form.
171	36	Crash	Day of Week**	N		Y	D	derivable
172	37	Crash	Driver Count** (derived from number of Crash Person Driver records)	N		Y	D	PS-A46 is not on the form currently
173	40	Crash	Event First Harmful	N		Y	D	This is coded by OAR. Therefore does not need to be on the Form.
174	38	Crash	Fatality Count** (this should be derivable Crash Person)	N		Y	D	
175	39	Crash	Federal Reportable	N		Y	D	
176	44	Crash	Injury Count** (this should be derivable Crash Person)	N		Y	D	

Seq #	Ref #	Entity	Attribute/Data Element	On New Form? (Y, N or Field Acronym)	New Form Section	Need Data (Y/N)	Collect Derive Link Generate Other	Notes
177	298	Crash	Interchange Location	N		Y	D	Officers do not code this data element. This is derived from the crash diagram in the Office of Accident Records at the state. This is a totally new data element. Cliff Reuer in LGA brought up the need for this data element.
178	46	Crash	Motorist Count**	N		Y	D	
179	47	Crash	National Highway System (Y/N)	N		Y	L	linked via RES
180	48	Crash	Non-Motorist Count** (derived from number of Non-Motorist records)	N		Y	D	
181	51	Crash	Person Count** (derived from number of Person records)	N		Y	D	
182	52	Crash	Population Group	N		Y	D	derived from City
183	274	Crash	RES Key	N		Y	D	A 17 character key which identifies the accident location according to the state RES system. This key is created in the OAR.

Seq #	Ref #	Entity	Attribute/Data Element	On New Form? (Y, N or Field Acronym)	New Form Section	Need Data (Y/N)	Collect Derive Link Generate Other	Notes
184	59	Crash	Special Jurisdiction** (derivable based upon GPS location and GIS system translation)	N		Y	D	
185	61	Crash	State Reportable	N		Y	D	
186	62	Crash	Time Zone	N		Y	D	The is key information because South Dakota has two time zones. This is derivable.
187	64	Crash	Vehicle Count** (derived from number of vehicle records)	N		Y	D	
188	69	Crash	Crash State	N		Y	D	this will always be South Dakota
189	71	Crash	Crash Vehicle Count** (this should be derivable from the number of records in Crash Vehicle)	N		Y	D	

Seq #	Ref #	Entity	Attribute/Data Element	On New Form? (Y, N or Field Acronym)	New Form Section	Need Data (Y/N)	Collect Derive Link Generate Other	Notes
190	72	Crash	Total Occupant Count** (derivable)	N		Y	D	derived from sum of PS-V32 - How can this be derived if all occupants are not documented on form (form only has drivers and room for 2 more non-driver persons). Right now unless the tech panel changes previous direction we will be collecting information on all occupants, and therefore this will still be derivable. The Technical Panel says YES, we will collect information on all occupants. Therefore this is derivable.
191	91	Crash Person Driver	Convictions Related to This Crash	N		Y	L	
192	94	Crash Person Driver	Driver Date Of First Accident, Suspension, Convictions	N		Y	L	
193	95	Crash Person Driver	Driver Date Of Last Accident, Suspension, Convictions	N		Y	L	
194	97	Crash Person Driver	Driver Height(Feet)	N		Y	D	derived from inches
195	99	Crash Person Driver	Driver License Class	N		Y	L	

Seq #	Ref #	Entity	Attribute/Data Element	On New Form? (Y, N or Field Acronym)	New Form Section	Need Data (Y/N)	Collect Derive Link Generate Other	Notes
196	101	Crash Person Driver	Driver License Restriction	N		Y	L	
197	103	Crash Person Driver	Driver License Status	N		Y	L	
198	110	Crash Person Driver	Driver Presence** (derivable)	N		Y	D	
199	111	Crash Person Driver	Driver Previous DWI Convictions	N		Y	L	
200	112	Crash Person Driver	Driver Previous Other Harmful MV Convictions	N		Y	L	
201	113	Crash Person Driver	Driver Previous Recorded Accidents	N		Y	L	
202	114	Crash Person Driver	Driver Previous Recorded Speeding Convictions	N		Y	L	
203	115	Crash Person Driver	Driver Previous Recorded Suspensions And Revocations	N		Y	L	
204	49	Crash Person Driver	EMS Notification Time	N		Y	L	linked via EMS trip report #
205	25	Crash Person Driver	EMS Time Arrival	N		Y	L	Linked via the EMS run #
206	128	Crash Person Driver	EMS Time At Hospital	N		Y	L	linked via EMS trip report #

Seq #	Ref #	Entity	Attribute/Data Element	On New Form? (Y, N or Field Acronym)	New Form Section	Need Data (Y/N)	Collect Derive Link Generate Other	Notes
207	124	Crash Person Injured	Death Date Time	N		Y	L	Not on form since info is gathered from coroner's office - not from officer.
208	125	Crash Person Injured	Death Location	N		Y	L	Not on form since info is gathered from coroner's office - not from officer.
209	126	Crash Person Injured	EMS Agency Identifier	N		Y	L	Linked via the EMS run #
210	284	Crash Person Injured	EMS Service Name	N		Y	L	Linked via the EMS run #
211	130	Crash Person Injured	Injury Area	N		Y	L	
212	131	Crash Person Injured	Injury Description	N		Y	L	
213	133	Crash Person Injured	Taken To Hospital Or Treatment Facility	N		Y	D	
214	192	Crash Vehicle	Body Type Vehicle	N		Y	D	derived from VIN number. Sub-type of Vehicle Configuration (MMUCC-V10)
215	172	Crash Vehicle	Hazardous Material Placard**	N		Y	D	
216	180	Crash Vehicle	Passenger Vehicle Type / Body Style** (this is derivable from the Vehicle the passenger was occupying)	N		Y	D	

Seq #	Ref #	Entity	Attribute/Data Element	On New Form? (Y, N or Field Acronym)	New Form Section	Need Data (Y/N)	**C**ollect **D**erive **L**ink **G**enerate **O**ther	Notes
217	158	Crash Vehicle	Speed Authorized Limit Unit of Measure	N	N/A	Y	D	Derived - assume that all roads in SD use MPH as the UOM
218	169	Crash Vehicle	Speed Exceeding Limit**	N		Y	D	derivable from authorized Speed Limit and the Vehicle Travel Speed
219	187	Crash Vehicle	Total Occupant In Vehicle Count** (derivable)	N		Y	D	Derivable assuming all occupants are documented on form.
220	197	Crash Vehicle Event	Event Vehicle Fire Occurrence	N - derived from events	N/A	Y	D	Fire Occurrence, Jackknife, Rollover are all events.
221	199	Crash Vehicle Event	Event Vehicle Jackknife	N - derived from events	N/A	Y	D	Fire Occurrence, Jackknife, Rollover are all events.
222	209	Crash Vehicle Event	Event Vehicle Rollover	N - derived from events	N/A	Y	D	Fire Occurrence, Jackknife, Rollover are all events.
223	217	Roadway	Access Control	N		Y	L	
224	218	Roadway	Annual Average Daily Traffic	N		Y	L	
225	220	Roadway	Bridge/Structure Identification	N		Y	L	
226	223	Roadway	Highway Class	N		Y	D	coded by OAR
227	224	Roadway	Highway Functional Class	N		Y	D	coded by OAR
228	226	Roadway	Intersection Mainline Approach Volume	N		Y	L	link if possible, otherwise not collected

Seq #	Ref #	Entity	Attribute/Data Element	On New Form? (Y, N or Field Acronym)	New Form Section	Need Data (Y/N)	Collect Derive Link Generate Other	Notes
229	232	Roadway	Longitudinal Pavement Marking Function Color	N		Y	L	link if possible, otherwise not collected
230	233	Roadway	Longitudinal Pavement Marking Material	N		Y	L	link if possible, otherwise not collected
231	238	Roadway	South Dakota Highway System	N		Y	D	done in Office of Accident Records
232		**Data Elements below here are NOT required.**						
233	138	Contributing Circumstance Crash Person	Critical Event Initiated By Pedestrian, Pedalcyclist, Other Non-Motorist, Animal or Object	N		N		like contributing circumstance
234	22	Crash	Additional State Information	N		N		
235	265	Crash	Counter (check sum value)	N		N		Used as an internal check to determine if the proper number of records have been encoded for the accident.
236	285	Crash	Extrication Equipment Used	N		N		
237	286	Crash Person	No BAC Reason (Fatal)	N		N		

Seq #	Ref #	Entity	Attribute/Data Element	On New Form? (Y, N or Field Acronym)	New Form Section	Need Data (Y/N)	Collect Derive Link Generate Other	Notes
238	299	Crash Vehicle	Approximate Weight	N		N		Though mentioned in the RFP, this data element never came up in any of the workshops. The Technical Panel could not think of a good reason to have this data. MMUCC, FARS, SAFETYNET, CVARS, PS-ACCIDENT all do NOT need this data element.
239	161	Crash Vehicle	Carrier Identification Source	N		N		We do not need to collect this element as per Mark Gilmore. (6/4/01) Mark confirmed this fact on 6/6/01.
240	182	Crash Vehicle	Pre-Crash Location	N		N		is this where the unstabilized event started? Creighton thinks this is what Pre-Crash Location is.
241	183	Crash Vehicle	Pre-Crash Vehicle Control	N		N		need more info
242	105	Crash Vehicle	Vehicle Maneuver to Avoid Object (to avoid deer)	N		N		If we need space, we will drop this data element. This issue has been submitted to the tech panel to decide. (6/6/01). The Technical Panel has decided to drop this data element (6/11/01) object trying to avoid. Ex. Deer, car, dog

Seq #	Ref #	Entity	Attribute/Data Element	On New Form? (Y, N or Field Acronym)	New Form Section	Need Data (Y/N)	Collect Derive Link Generate Other	Notes
243	230	Roadway	Intersection Type	N		N		very similar to MMUCC-C16
244	297		Phone numbers for drivers and owners	N		N		Was not on approved list, but officers need this. Technical Panel says NO to collecting this on the form, put it in the Narrative.
245	287						G	FARS system generated number.
246	290	N/A	Approving Officer Signature	Y	Approval			
247	289	N/A	Filing Officer Signature	Y	Approval			
248	291	N/A	Non-motorist Alcohol Determination Method, Other Drug Determination Method, Other Drug Involvement	Y	Unit			These are "shared" fields in the data model between in the crash person table (not separated by driver and non-motorist).
249	293	N/A	Source of Location Coordinates - GPS or X/Y	Y	Summary			When the "coordinates" box is filled in, do we need to know where they got these from?

Appendix H. Preliminary Accident Report Form Design

Using the proposed logical data model, an initial "straw-man" re-designed accident report form was developed for this project. It was used as a starting point for discussions in the form re-design meeting documented below. The assumptions used for the first draft of the new form were:

- The accident form and the supplemental truck/bus form MUST be combined and MUST fit on one 2-sided 8.5 x 11" piece of paper
- The form/data fields will include all FARS-related data fields
- The form/data fields will include additional fields from the MMUCC standard
- The form/data fields will be compliant with all requirements for SAFETYNET 2001
- Fields with a pre-defined list of acceptable values should be put into "code boxes"
- There will be an overlay for the form that will provide the acceptable values for each of the code boxes
- The form will not be optically scanned

On June 5, 2001, a workshop was held to discuss the re-design of the accident report forms. The results of that meeting are documented below.

Accident Report Form Design Workshop

Attendees:

Hal Rumpca
Jon Becker
Robin Schumacher
Creighton Miller
Mark Kirk
Ginger Morgan (Tele-conference)

Sgt. Dave Miles - Mitchell Police Dept.
James Ronfeldt - Rapid City Police Dept.
Scott Burke - Sioux Falls Police Dept.
Chris Seaboy - BIA Lower Brule
Mike Thorson - SDHP Pierre

Gary Gruman - SDHP Pierre
Kendall Light - Hughes Co. Sheriff's Office
Scot Pfeifer - Minnehaha Co Sheriff's Office
Pierre Police Dept. did not attend.

<u>Notes & Form Design Strategy Ideas:</u>

1. Crash diagram and Narrative should be together. The Narrative should be above the diagram (as it is on the current form). There should be the same amount of space as there is now for the diagram and the narrative (Approved Change Idea #91). Diagram and narrative should be on back at the bottom just above the agency information.
2. Headings should be placed inside the boxes, not above the boxes (see Iowa's form for example).
3. We need more room in the **<u>Location area</u>** of the form to place all the different ways in which to describe the location (see Iowa's form and current South Dakota form).
4. We still need to indicate the "seating position" for the Driver. The driver of the vehicle is not always behind the wheel. Example: Mail delivery vehicle where the person was slid over to the other side to put mail in the box. And there are vehicles (usually foreign) that have the driver side on the "wrong" side.
5. Make the Driver, Occupant, Pedestrian, Owner, and possibly Witness (see Change Idea #96) information boxes identical. This will allow us to place one "generic" block of Involved People and the Officer will indicate whether the person is an Occupant, Pedestrian, Owner, or Witness. There will be different rules as to what data elements must be collected for each different type of person. For example, on an owner just the name and address is required, unless they were also an occupant or driver in the crash as well as the owner.
6. Put Form ____ of _____ Forms at the top of the main form and supplement form on the front of the form only. This is not page # of pages, but form # of forms. (I.e. where there may be 4 pages front and back, there is only 2 forms)
7. Due to lack of space on the form, allow a box on the form to take on different meanings depending upon the context. Example: In the Unit block there is space to indicate the Driver's information (including driver license, class, restrictions, etc…). Well none of these items apply when collecting data for a Pedestrian. For the Pedestrian we need to collect other information that is not collected for a Driver (including location prior to impact, safety equipment used, non-motorist action, vehicle striking non-motorist). Rather than create a whole new set of boxes for this Pedestrian specific information, we will just redefine what a box contains. Example: Box A contains the driver's license number in the "driver" context, but Box A contains the non-motorist location prior to impact in the "pedestrian" context. By doing this we conserve the scarce form space.

8. Follow Iowa's lead on the "Supplement" Form. The supplemental form is to be used when there are more vehicles and/or people involved than will fit on the main form.
9. Continue to use an "Overlay" for coding boxes. Do not do what the Iowa form did. Iowa form does not have coding boxes along the sides of the form. Therefore they do not use an "overlay" to code their boxes. With the Iowa form there is a lot of back and forth between the coding cheat sheet and the form. This is not desired. We can use both front and backside of the overlay for codes. This will probably be necessary due to the increased number of codified data elements and the increased number of code values per codified data element. If there are 2 boxes for a data element, put them side-by-side, instead of over/under.
10. Need to not only collect the violation code (i.e. 26 - Speeding), but also collect the citation number (i.e. ticket number 01928340) on the form (see Approved Change Idea #110).
11. If a vehicle has more than one Trailer, then the second, third, etc trailers have their information placed in the narrative. Note for data model: Need to break the Trailer information out of the Crash Vehicle entity because it is a repeating group.
12. For the "No Carrier Identification Available" data element, just write in the Carrier Identification box "no identification available", rather than putting another box on the form.
13. We will provide a box at the top of the form for the Reporting Agency to use as they see fit (see Approved Change Idea #85). We will also store the contents of that box in the database. Some examples uses of this data element are:
    a. Some agencies will broadly categorize (wild animal hit, non-injury, injury, fatality, etc) their reports by placing a code at the top of the form.
    b. Agency could put their agency specific CC#, Dispatch Call Number, etc in this data element.
    c. Maybe the agency would do both by placing <category>-<Call Number>
    d. An agency can basically use it as they see fit. We will store this data element on the database a character data so that they could put anything in this field.
14. We should try to keep the "terminology" on the new form the same as on the old form. This will help by reducing the need to learn new terminology on top on a new form layout.
15. NGA requirements do not require the source of the carrier identification information-- it was eliminated and is not needed on South Dakota's new accident form. (as per Mark Gilmore 6/6/01)
16. The CDL people recommended that all electronic forms have a field containing 20 alpha/numeric characters to ensure that all versions of CDLs (including CDL from Canada and Mexico) can be accommodated. (as per Mark Gilmore 6/6/01)

General Layout of Main Form:

1. Location and Crash Level information.
2. Unit 1 (note the block for Unit 1 & 2 are totally identical)
    a. Driver/Pedestrian
    b. Vehicle Information
    c. Commercial Vehicle Information
3. Unit 2 (note the block for Unit 1 & 2 are totally identical)
    a. Driver/Pedestrian
    b. Vehicle Information
    c. Commercial Vehicle Information
4. Other People Involved (will need to indicate what Unit the person goes to)
    a. Injured
    b. Non-Injured
    c. Witness
5. Narrative (include in the narrative descriptions of what "other" meant if coded anywhere on the form)
6. Crash Diagram
7. Agency Information

Layout of the Supplement Form:

(Although the meeting discussion is documented here for reference, this idea of having a supplemental form was subsequently decided against by the Technical panel. See issue #10 below)

Note: All information is contained on the Main Form. The supplement form here does nothing more than provide additional space for collecting more of the same information that is collected on the main form. To say it another way, there is no data element on the supplemental form that is not found on the main form. Example: If there were more than two Units involved in the accident, then the supplement would be used. Generally speaking the supplement form is the same as the main form.

The supplemental form will not have the following items on it:

- Crash Diagram (only needed once on main form)
- Location and Crash Level Information (only needed once on main form)
- Narrative (only needed once on main form)

- Agency Information (only needed once on main form)

The supplemental form will have the following items on it:
- Unit(s) blocks (similar to the ones on the main form)
- Other People Involved block (similar to the ones on the main form)
- A blank box at the top of the form in which the Officer must transfer the "pre-printed" accident number from the main form. This is the tie between the supplement form and the main form.

Issues raised:

1. Do we really want to collect information on "non-injured" occupants? What did Iowa do with this issue? This information is required by MMUCC, but it appears from Iowa's form that they decided not to collect this information. The comment was made that even if this information is collected that it might not be of any value, due to the honesty of the occupants (i.e. most occupants will say, "Why, Yes, I did have my seat belt on", when they actually did not). The Technical Panel did want to collect information on all occupants. Approved Change Idea #35:

    > "Capture Passenger names. Need to identify factors relating to non-injured passengers (such as belted/not belted, air bags went off/didn't). Passenger names are not keyed into the PS-01 system so we don't currently have this information. Need to capture passenger name info so we can provide it to Social Services Recovery. Social Services Recovery does not currently receive passengers' names to use in this comparison process. This would be helpful to them. This would save the state money to have the additional information for the same reason they save money by having drivers' names."

    > The majority of responding technical panel members indicated we should collect the information whenever possible. This should be covered as a training issue, and we do recognize the fact that it takes up more space on the form and there is a premium on law enforcement's time when at the accident scene. Follow-up comments from Hal Rumpca after the design meeting:
    > "On this issue, the technical panel recommended that the information be collected whenever possible. After further checking into this, I (Hal) would like to put the answer to this question on hold. The issue was earlier described as a policy issue (change idea 35) and therefore needs to be brought to the Research Review Board's attention. This should be handled under the recommendations section of the final report. The panel and Board will both decide on how this issue should be handled, with the Boards decision being the final answer. Phase two of this project will address final design and construction, so we should have the decision by that time (August 2001)."

2. Rapid City and Sioux Falls both indicated that they would like to have phone numbers on the form for units, witnesses, and/or occupants. They currently will place this information in the narrative or have their own separate supplemental forms to get the phone number information. (See Change Idea #87). This is a good idea, but due to lack of space on the form, we (technical panel) recommend that the phone numbers be included in the narrative section.
3. There may be an issue with collecting the Person Condition information (see Data Element #143). The question is "should law enforcement really be collecting subjective values such as depressed or emotional? (Liability/court case issue)". The law enforcement officials at the form design workshop expressed a concern about collecting this information because of its "subjective" nature. For example, how does the police officer know that the person was angry before the accident? How do they know that the person was tried? The police are worried that when they get in court that the defense will argue this condition information by saying, "How do you know the person was depressed? When did you get your Psychiatry degree?" The condition information is for MMUCC and FARS. Below are two definitions from MMUCC for the Driver Condition and the Non-Motorist Condition:
    a. **Non-Motorist Condition Definition:** The condition of the ***non-motorist*** immediately prior to a crash. **Code:** Apparently normal, Physical impairment, Emotional (e.g., depression, angry, disturbed) Illness Fell asleep, fainted, fatigue, etc., Under the influence of medications/drugs/alcohol, Other, Not reported, Unknown. **Rationale:** Information about the condition of the non-motorist is needed to develop engineering, educational, and enforcement countermeasures to reduce crashes involving non-motorists. Needed to determine "fault" of crash. Needed to evaluate effect of existing, if any, countermeasures that have been applied. **Definition Source:** US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998)
    b. **Driver Condition Definition:** The condition of the ***driver***, which may have contributed to the crash. **Code:** Apparently normal Physical impairment Emotional (e.g., depressed, angry, disturbed) Illness Fell asleep, fainted, fatigued, etc. Under the influence of medications/drugs/alcohol Other Not reported Unknown **Rationale:** Important for evaluating the effect that driver fatigue, medications/alcohol/drugs, or other conditions have on the crash. **Definition Source:** US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998)

    We (technical panel) would like more information on what other states are doing with this item. We recognize the fact that law enforcement officers are not trained to answer some of these questions. It could possibly be handled as a training issue where the information is collected if known or volunteered by the person. Otherwise the information should be left as unknown or not reported.

4. For “Violation Codes” (i.e. “Citations”), data element #75, we should also allow for collecting "WARNING" citations here. Some insurance agencies will not pay a claim unless there is a “citation” issued to their client. Therefore even if the Officer is not going to issue a citation to the person involved in the accident, they will still issue them a “warning” citation. What this does is gives the insurance companies something to indicate to them that “yes” their client was at fault and “yes” they should pay a claim. Without this information the police officer spends much time on the phone trying to convince an insurance company that they should pay the claim because their client was at fault, even though they did not receive a citation. Also we need to not only collect the violation code (i.e. 26 - Speeding), but also collect the citation number (i.e. ticket number 01928340) on the form (see Change Idea #110). The majority of responding technical panel members said we should not collect warning information. The feeling was that if the guy violated a rule of the road, which contributed to the accident, he should be issued a citation rather than a warning.

5. There was one *“beta”* CVARS data element (#105-Vehicle Maneuvered to avoid object, i.e. maneuvered to avoid hitting deer, child, etc…) that was approved and not required for MMUCC, SAFETYNET, FARS, or PS-ACCIDENT. This data element is only required by the “beta” CVARS data elements list. Because of space limitations on the physical form and because we really don’t know for sure if this data element is going to be in the *“Final”* approved data elements for CVARS, it was proposed that we drop this data element if we need the space. Technical panel recommends dropping the beta element.

6. The Roadway Lane Width, Median Width, and Shoulder Width (data elements #241, 242, 243) were suggested to be changed from “Collect” to “Link if possible, otherwise do not Collect”. The technical panel had previously approved these data elements as needing to be “Collected” on the form. The reason for the change is the manpower involved in collecting this information. On a busy road the officer investigating the accident would have to call in additional help to collect these data elements. How do you measure 41st Street during rush hour? Technical panel recommends to link the information if possible, and if not possible then this needs to be collected on site. Comments from Hal Rumpca following the meeting:

   > “On this issue, based on Cliff's comment, we need to collect the information if it cannot be linked. There may currently be a problem linking the information on local city or county roadways. However, with the implementation of the Roadtrac County based data in our GIS/GPS system, we may be able to link all of this information. This is expected to be available by October 2001.”

7. The law enforcement officials in the design workshop also wanted a place to put “Witness” information on the form (see Iowa’s form) (see Change Idea #96). The majority of responding technical panel members said to put the information in the narrative.

8. For fatalities, the Officer is not the official person who should be stating date/time of death and other death information, even if the person died at the scene. Also, some deaths occur later and the Officer doesn't have this info. The official values for these data elements should come from the Coroner's office. It was decided that the separate fatalities code block should be removed from the form, thus freeing up more space. This means that the FARS data is not completely available from the form even though that was one of the project goals.

   Technical Panel Response: The majority of responding technical panel members indicated that the information should be kept on the form for record keeping purposes and future analysis. A process should be set up for accident records staff to obtain this information from the Coroner and add the information onto the form and database. This way both FARS and the law enforcement officer can be easily notified of the results.

   Research Team's Response (This is agreed to by Technical Panel): We still do not recommend keeping the "fatality" information on the "PAPER" form. This recommendation directly conflicts with the above Technical Panel Response. Here is why we don't need this on the form:

   1. First of all the "fatality" information will be in the "electronic" database.
   2. The "PAPER" form is merely a data collection device, NOT the database. Analysis should been done from the "electronic" database, not a stack of "paper" forms. And with the "new" system this will be entirely possible. This is one of the main reasons for developing a "new" system, "to have the ability to do online analysis without having to go back and get copies of the paper forms for additional information." Specifically speaking, 100% of every piece of data that is on the "paper" form will be stored in the "electronic" database (including the crash diagram, the narrative, every code, etc). Actually there will be more information available in the "electronic" database than is available on the "paper" form. Therefore, there really is no need to have the "paper" forms for analysis.
   3. We recommend that a new/modified process be put in place to gather this additional information that "can not be collected at the scene of the crash". Once the additional information has been gathered, it will be placed in the "electronic" database and accessible by everyone. Example: Maybe the central office will be responsible for gathering this information. Actually I believe this is how it is done now, for collecting Death date and time, Death location, Died at Scene, etc.

9. Wild Animal Form – If we can make it very obvious on the "Main Form" as to which data elements/boxes need to be filled out in the case of a wild animal hit, then we can drop the use of the separate "Wild Animal Hit Form". But if this cannot be accomplished, then the law enforcement officials at this workshop said that they must still have the "Wild Animal Hit Form". The responding technical panel members agreed.

10. Using a Supplemental Form to gather information on additional units and/or people vs. using an extra copy of the Main Form – Should we have a supplemental as described above or should we just use the same form for collecting additional information that will not fit on one form? The responding technical panel members recommend using the same form, but make sure there is a box to indicate the "Form __ of # of Forms ___". This should also be included as a training issue. Here are some of the pros/cons related to this topic:

Use Supplemental Form	**Use Additional Main Form**
<u>Pros:</u> • This was the suggestion that came from the form re-design workshop attendees. • No wasted space for Crash Diagram, Narrative, Location/Crash Level information, and Agency information. This information is only needed once. Because there is no wasted space, fewer forms may be used to capture the same information as compared to "Use Same Form" **<u>Cons:</u>** • May run out of supplement, and then be forced to use same form anyway	**<u>Pros:</u>** • No possibility of running out of supplemental forms. • Only need to stock one form • No additional cost for extra design publication. Better volume discount on just one form. **<u>Cons:</u>** • There is wasted space that will not be used. (i.e. Crash Diagram, Narrative, Location/Crash Level information, Agency information will be repeated but not used)

Preliminary New Crash Report

CRASH SUMMARY, LOCATION, ROADWAY

State of South Dakota Crash Report - Mail to: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx 00000001
Form _____ of _____ Total Forms for this crash

WZR? WZT WZL WOR? SPE RR LITE

WEA1 WEA2 INVL PIC ODET DELI FHEL

Agency Special Use | Crash Date / Time / / : | Officer Arrived Date / Time / / : | Officer Notified Date /Time / / :

City County Coordinates Source On Roadway At Intersection With

At ___ MRM or ___ feet or ___ miles N S E W NE SE NW SW from:

And ___ MRM or ___ feet or ___ miles N S E W NE SE NW SW from:

Width - Lane Shoulder Median I # Lanes I Lanes -Inter. Siderd. Inter . Main I Horiz. Alignment

ROAD SURF RSC SIGN CNTR GRAD

SBR RUN JUN BIKE CCC1 CCC2 CCC3

UNIT # _ PERSON TYPE _

ALC? ADET OTHR? ODET PROT NBRT CCV1 CCV2 MANU AVOID CTYP U/O BUS HAZR

SDET TCD? TCDT ACT STRU BAC ALCS ALTT DRTT DTRE DTST

Name (First, Middle, Last, Suffix) Address/City/St/Zip

DL# State DOB / / Sex Weight Height Transport Method Facility ID EMS ID or name EMS Ticket #

Cited? ___ Violation #1____________ #2 ____________ #3 ________________ #4 ________________

Ticket Nbr #1____________ #2 ____________ #3 ________________ #4 ________________

Damage $ DL Restrctions DL Endoresements DL Type Compliance Force Dir.

Lic Plate State Year Configuration # Axles VIN Make Model Year

Vehicle Owner Name / Address Trailer Owner Name / Address

Shade all damaged areas
Initial Impact Point ___
Most Damaged Impact Point ___

06 07 08 05 01 04 03 02

Insur. Company Policy Nbr Exp. Date Eff. Date

Travel Direction Est. Speed Speed Limit Trailer Reg. State Year Plate # Event #1 Event #2 Event #3 Event #4 MHE for Unit

Carrier Name: First, Middle, Last, Suffix Address (address, city, state, zip, colonia)

Carrier ID # Issuer Interstate Carrier? State Census # Census State Haz Mat Placard # Haz Mat Name

EJECT EPATH COND 1 COND 2 LOC LEAV ROLE

ABAG ASWI SEAT EXTRI INJS VUSE OWNT DAMG CCP1 CCP2 CCP3 CCP4 EMER GVWR

UNIT # _ PERSON TYPE _

ALC? ADET OTHR? ODET PROT NBRT CCV1 CCV2 MANU AVOID CTYP U/O BUS HAZR

SDET TCD? TCDT ACT STRU BAC ALCS ALTT DRTT DTRE DTST

Name (First, Middle, Last, Suffix) Address/City/St/Zip

DL# State DOB / / Sex Weight Height Transport Method Facility ID EMS ID or name EMS Ticket #

Cited? ___ Violation #1____________ #2 ____________ #3 ________________ #4 ________________

Ticket Nbr #1____________ #2 ____________ #3 ________________ #4 ________________

Damage $ DL Restrctions DL Endoresements DL Type Compliance Force Dir.

Lic Plate State Year Configuration # Axles VIN Make Model Year

Vehicle Owner Name / Address Trailer Owner Name / Address

Shade all damaged areas
Initial Impact Point ___
Most Damaged Impact Point ___

06 07 08 05 01 04 03 02

Insur. Company Policy Nbr Exp. Date Eff. Date

Travel Direction Est. Speed Speed Limit Trailer Reg. State Year Plate # Event #1 Event #2 Event #3 Event #4 MHE for Unit

Carrier Name: First, Middle, Last, Suffix Address (address, city, state, zip, colonia)

Carrier ID # Issuer Interstate Carrier? State Census # Census State Haz Mat Placard # Haz Mat Name

EJECT EPATH COND 1 COND 2 LOC LEAV ROLE

ABAG ASWI SEAT EXTRI INJS VUSE OWNT DAMG CCP1 CCP2 CCP3 CCP4 EMER GVWR

OTHER PERSON # _ PERSON TYPE _ UNIT # _

ALC? ADET OTHR? ODET PROT

SAF1 SAF2 ACT STRU

Name (First, Middle, Last, Suffix) Address/City/St/Zip

DOB / / Sex Weight Height Transport Method Facility ID EMS ID or name EMS Ticket #

Damaged Object Description Damage $

BAC ALCS ALTT DRTT DTRE DTST

EJECT EPATH COND 1 COND 2 LOC

ABAG ASWI SEAT EXTRI INJS

OTHER PERSON # _ _
PERSON TYPE _ _
UNIT # _ _

ALC? | ADET | OTHR? | ODET | PROT

SAF1 | SAF2 | ACT | STRU

Name (First, Middle, Last, Suffix) Address/City/St/Zip

DOB / / Sex Weight Height Transport Method Facility ID EMS ID or name EMS Ticket #

Damaged Object Description Damage $

BAC | ALCS | ALTT | DRTT | DTRE | DTST

EJECT | EPATH | COND 1 | COND 2 | LOC

ABAG | ASWI | SEAT | EXTRI | INJS

OTHER PERSON # _ _
PERSON TYPE _ _
UNIT # _ _

ALC? | ADET | OTHR? | ODET | PROT

SAF1 | SAF2 | ACT | STRU

Name (First, Middle, Last, Suffix) Address/City/St/Zip

DOB / / Sex Weight Height Transport Method Facility ID EMS ID or name EMS Ticket #

Damaged Object Description Damage $

BAC | ALCS | ALTT | DRTT | DTRE | DTST

EJECT | EPATH | COND 1 | COND 2 | LOC

ABAG | ASWI | SEAT | EXTRI | INJS

OTHER PERSON # _ _
PERSON TYPE _ _
UNIT # _ _

ALC? | ADET | OTHR? | ODET | PROT

SAF1 | SAF2 | ACT | STRU

Name (First, Middle, Last, Suffix) Address/City/St/Zip

DOB / / Sex Weight Height Transport Method Facility ID EMS ID or name EMS Ticket #

Damaged Object Description Damage $

BAC | ALCS | ALTT | DRTT | DTRE | DTST

EJECT | EPATH | COND 1 | COND 2 | LOC

ABAG | ASWI | SEAT | EXTRI | INJS

Narrative

Diagram

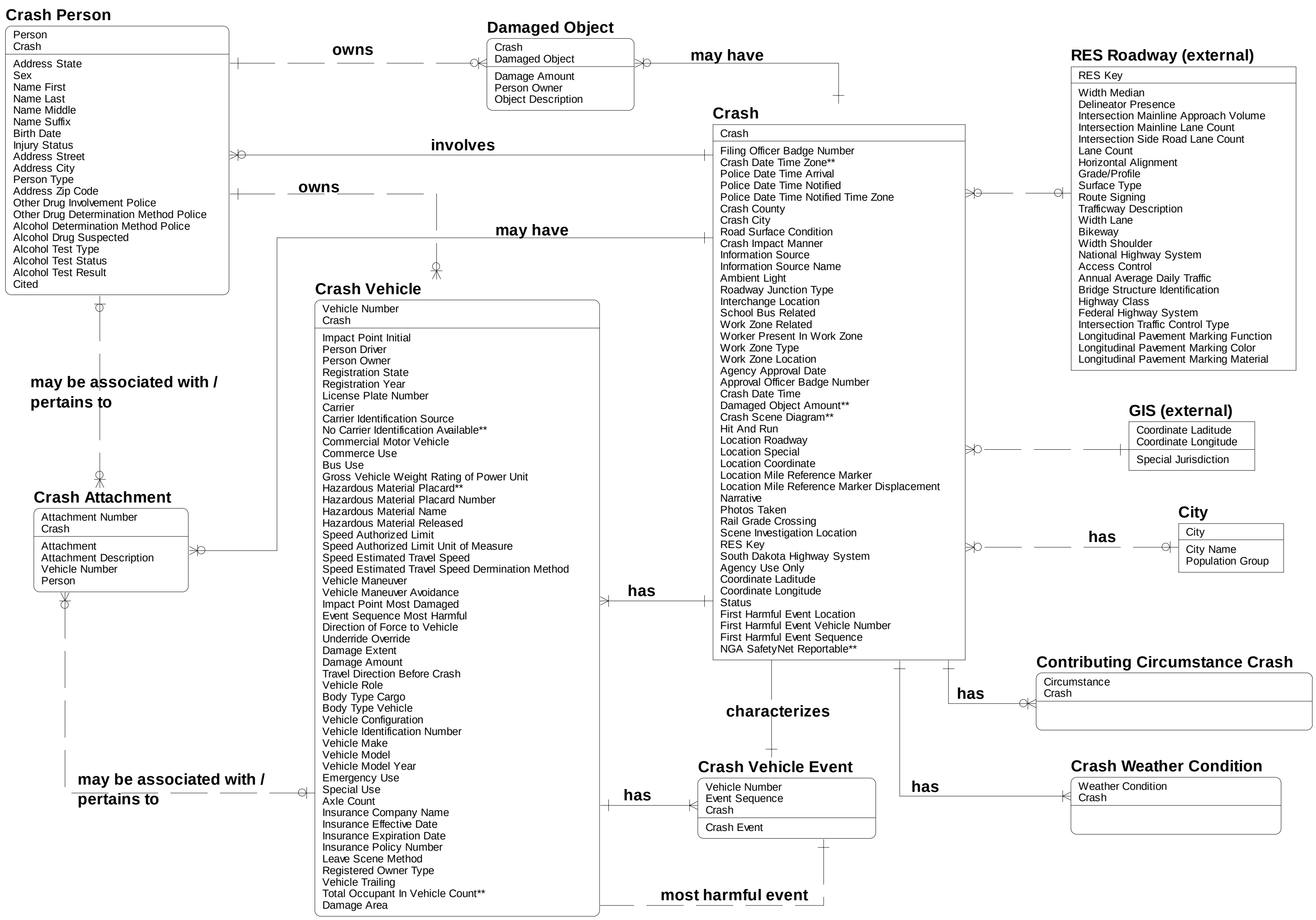
Indicate North

Report Source	Officer Agency Id	Agency Type	Officer Badge #	Officer Signature	Agency Approval Date /Signature	Approval Badge #

Appendix I. Logical Entity Relationship Diagram

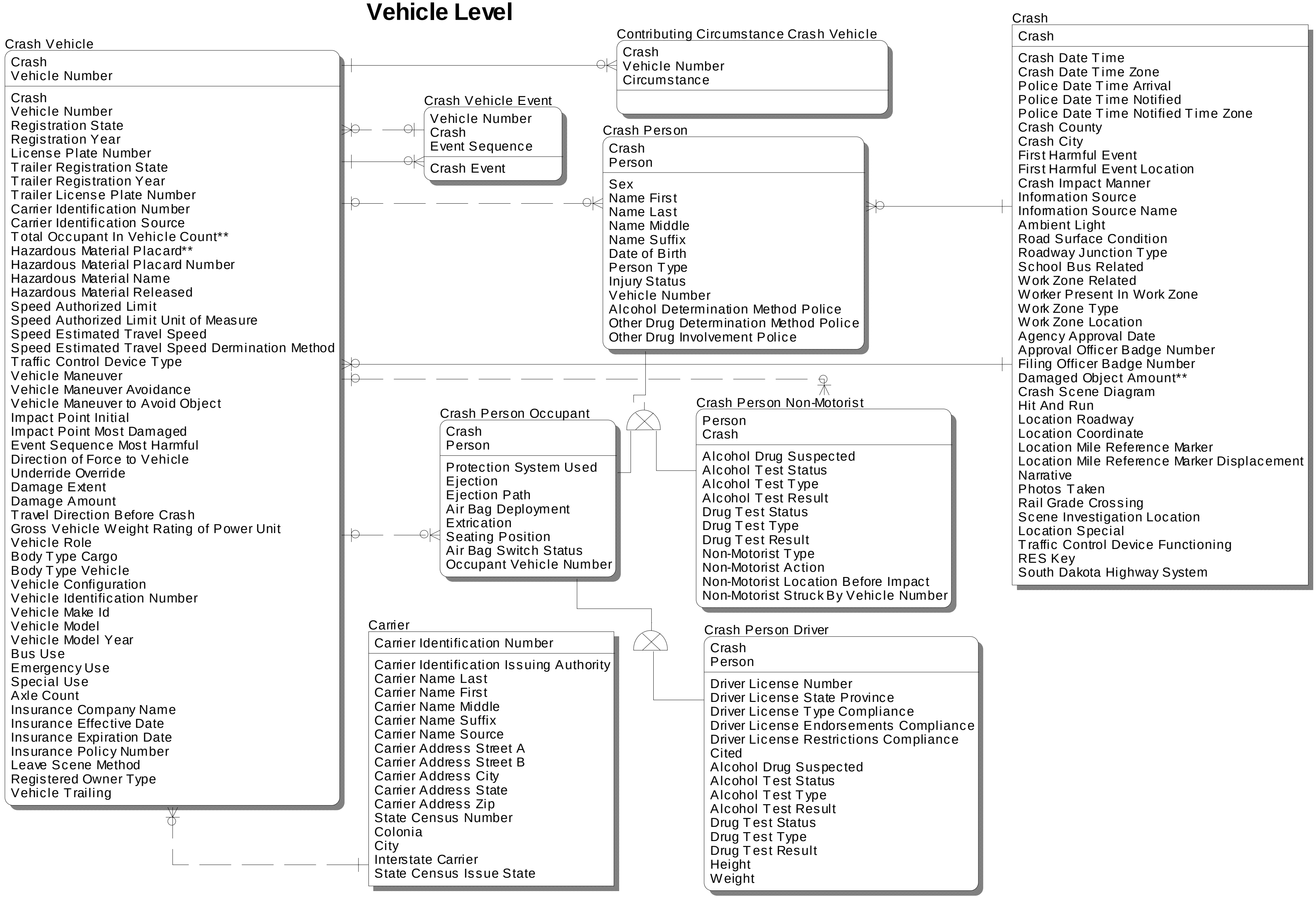
The Logical Entity Relationship Diagram (ERD) provides a visual representation of the data fields that are within the accident reporting business area. The data elements are grouped into logical groups (entities) and rules are applied to determine the cardinality of the relationships (one-to-one, one-to-many, etc.) Certain generally accepted rules are applied in developing the ERD so that it may be implemented in a correct physical form during the next phase of the project. The ERD is displayed on the following pages.

Crash Level

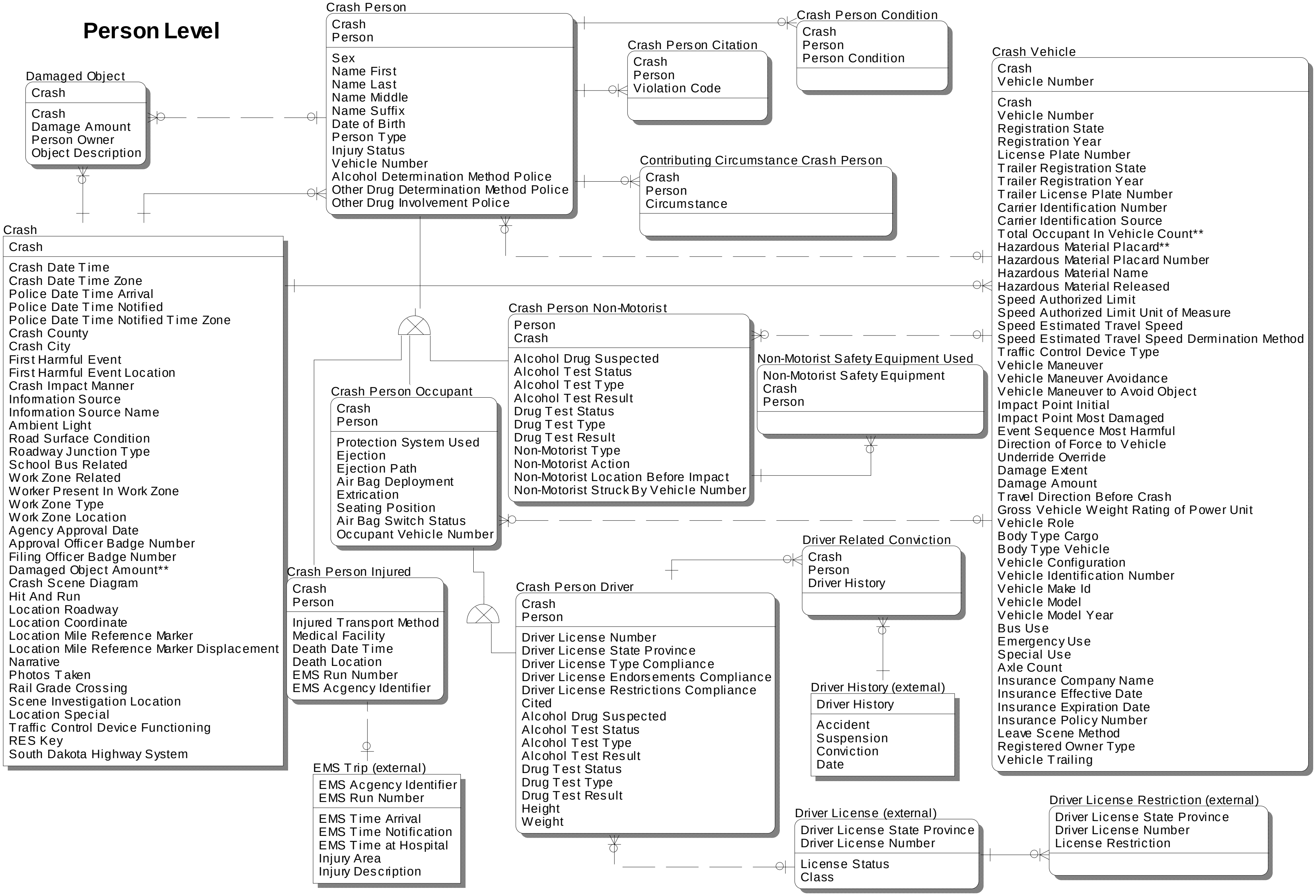


Crash Person
Person
Crash
Address State
Sex
Name First
Name Last
Name Middle
Name Suffix
Birth Date
Injury Status
Address Street
Address City
Person Type
Address Zip Code
Other Drug Involvement Police
Other Drug Determination Method Police
Alcohol Determination Method Police
Alcohol Drug Suspected
Alcohol Test Type
Alcohol Test Status
Alcohol Test Result
Cited
owns
Damaged Object
Crash
Damaged Object
Damage Amount
Person Owner
Object Description
may have
involves
owns
may have
RES Roadway (external)
RES Key
Width Median
Delineator Presence
Intersection Mainline Approach Volume
Intersection Mainline Lane Count
Intersection Side Road Lane Count
Lane Count
Horizontal Alignment
Grade/Profile
Surface Type
Route Signing
Trafficway Description
Width Lane
Bikeway
Width Shoulder
National Highway System
Access Control
Annual Average Daily Traffic
Bridge Structure Identification
Highway Class
Federal Highway System
Intersection Traffic Control Type
Longitudinal Pavement Marking Function
Longitudinal Pavement Marking Color
Longitudinal Pavement Marking Material
Crash
Crash
Filing Officer Badge Number
Crash Date Time Zone**
Police Date Time Arrival
Police Date Time Notified
Police Date Time Notified Time Zone
Crash County
Crash City
Road Surface Condition
Crash Impact Manner
Information Source
Information Source Name
Ambient Light
Roadway Junction Type
Interchange Location
School Bus Related
Work Zone Related
Worker Present In Work Zone
Work Zone Type
Work Zone Location
Agency Approval Date
Approval Officer Badge Number
Crash Date Time
Damaged Object Amount**
Crash Scene Diagram**
Hit And Run
Location Roadway
Location Special
Location Coordinate
Location Mile Reference Marker
Location Mile Reference Marker Displacement
Narrative
Photos Taken
Rail Grade Crossing
Scene Investigation Location
RES Key
South Dakota Highway System
Agency Use Only
Coordinate Laditude
Coordinate Longitude
Status
First Harmful Event Location
First Harmful Event Vehicle Number
First Harmful Event Sequence
NGA SafetyNet Reportable**
may be associated with / pertains to
Crash Vehicle
Vehicle Number
Crash
Impact Point Initial
Person Driver
Person Owner
Registration State
Registration Year
License Plate Number
Carrier
Carrier Identification Source
No Carrier Identification Available**
Commercial Motor Vehicle
Commerce Use
Bus Use
Gross Vehicle Weight Rating of Power Unit
Hazardous Material Placard**
Hazardous Material Placard Number
Hazardous Material Name
Hazardous Material Released
Speed Authorized Limit
Speed Authorized Limit Unit of Measure
Speed Estimated Travel Speed
Speed Estimated Travel Speed Dermination Method
Vehicle Maneuver
Vehicle Maneuver Avoidance
Impact Point Most Damaged
Event Sequence Most Harmful
Direction of Force to Vehicle
Underride Override
Damage Extent
Damage Amount
Travel Direction Before Crash
Vehicle Role
Body Type Cargo
Body Type Vehicle
Vehicle Configuration
Vehicle Identification Number
Vehicle Make
Vehicle Model
Vehicle Model Year
Emergency Use
Special Use
Axle Count
Insurance Company Name
Insurance Effective Date
Insurance Expiration Date
Insurance Policy Number
Leave Scene Method
Registered Owner Type
Vehicle Trailing
Total Occupant In Vehicle Count**
Damage Area
GIS (external)
Coordinate Laditude
Coordinate Longitude
Special Jurisdiction
City
City
City Name
Population Group
has
Crash Attachment
Attachment Number
Crash
Attachment
Attachment Description
Vehicle Number
Person
has
Contributing Circumstance Crash
Circumstance
Crash
has
characterizes
Crash Vehicle Event
Vehicle Number
Event Sequence
Crash
Crash Event
has
Crash Weather Condition
Weather Condition
Crash
has
may be associated with / pertains to
most harmful event

Vehicle Level



Person Level



Roadway Level

Crash

Crash

- Filing Officer Badge Number
- Crash Date Time Zone**
- Police Date Time Arrival
- Police Date Time Notified
- Police Date Time Notified Time Zone
- Crash County
- Crash City
- Road Surface Condition
- Crash Impact Manner
- Information Source
- Information Source Name
- Ambient Light
- Roadway Junction Type
- Interchange Location
- School Bus Related
- Work Zone Related
- Worker Present In Work Zone
- Work Zone Type
- Work Zone Location
- Agency Approval Date
- Approval Officer Badge Number
- Crash Date Time
- Damaged Object Amount**
- Crash Scene Diagram**
- Hit And Run
- Location Roadway
- Location Special
- Location Coordinate
- Location Mile Reference Marker
- Location Mile Reference Marker Displacement
- Narrative
- Photos Taken
- Rail Grade Crossing
- Scene Investigation Location
- RES Key
- South Dakota Highway System
- Agency Use Only
- Coordinate Laditude
- Coordinate Longitude
- Status
- First Harmful Event Location
- First Harmful Event Vehicle Number
- First Harmful Event Sequence
- NGA SafetyNet Reportable**

RES Roadway (external)

RES Key

- Width Median
- Delineator Presence
- Intersection Mainline Approach Volume
- Intersection Mainline Lane Count
- Intersection Side Road Lane Count
- Lane Count
- Horizontal Alignment
- Grade/Profile
- Surface Type
- Route Signing
- Trafficway Description
- Width Lane
- Bikeway
- Width Shoulder
- National Highway System
- Access Control
- Annual Average Daily Traffic
- Bridge Structure Identification
- Highway Class
- Federal Highway System
- Intersection Traffic Control Type
- Longitudinal Pavement Marking Function
- Longitudinal Pavement Marking Color
- Longitudinal Pavement Marking Material

Appendix J. Logical Process Model

The Logical Process Model is displayed on the following pages. This model depicts the logical (not necessarily physical) flow of information within the Accident Reporting business area.

USED AT:	AUTHOR: Mark Kirk / PROJECT: SD2000-14	DATE: 5/23/2001 / REV: 5/23/2001	■ WORKING	READER DATE	CONTEXT:
			DRAFT		TOP
			RECOMMENDED		
	NOTES: 1 2 3 4 5 6 7 8 9 10		PUBLICATION		

A0

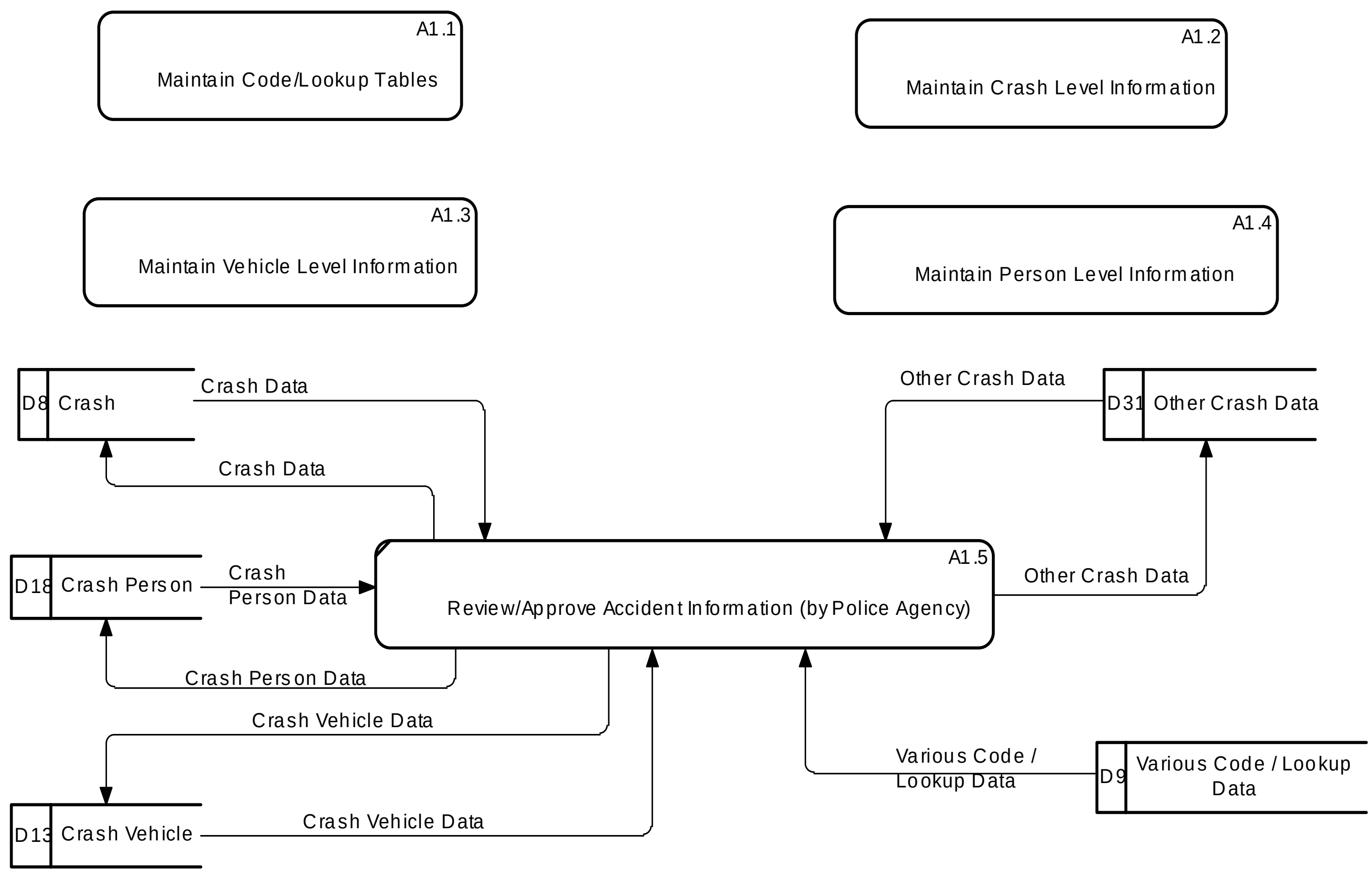
Accident Reporting Business Area

NODE: A-0	TITLE: Accident Reporting Business Area	NUMBER:

USED AT:	AUTHOR: Mark Kirk	DATE: 5/23/2001	WORKING	READER	DATE	CONTEXT:
	PROJECT: SD2000-14	REV: 5/23/2001	DRAFT			
			RECOMMENDED			
	NOTES: 1 2 3 4 5 6 7 8 9 10		PUBLICATION			A-0

NODE:	TITLE:	NUMBER:
A0	Accident Reporting Business Area	

USED AT:	AUTHOR: Mark Kirk PROJECT: SD2000-14	DATE: 5/23/2001 REV: 5/28/2001	■ WORKING	READER DATE	CONTEXT:
			DRAFT		
			RECOMMENDED		
	NOTES: 1 2 3 4 5 6 7 8 9 10		PUBLICATION		A0

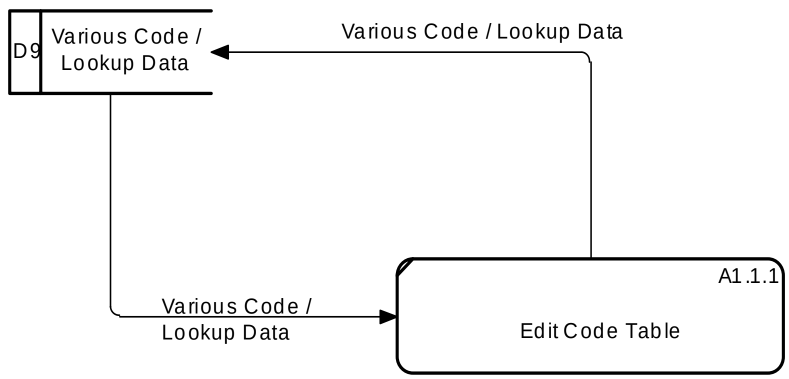


NODE: A1

TITLE: Accident Recording

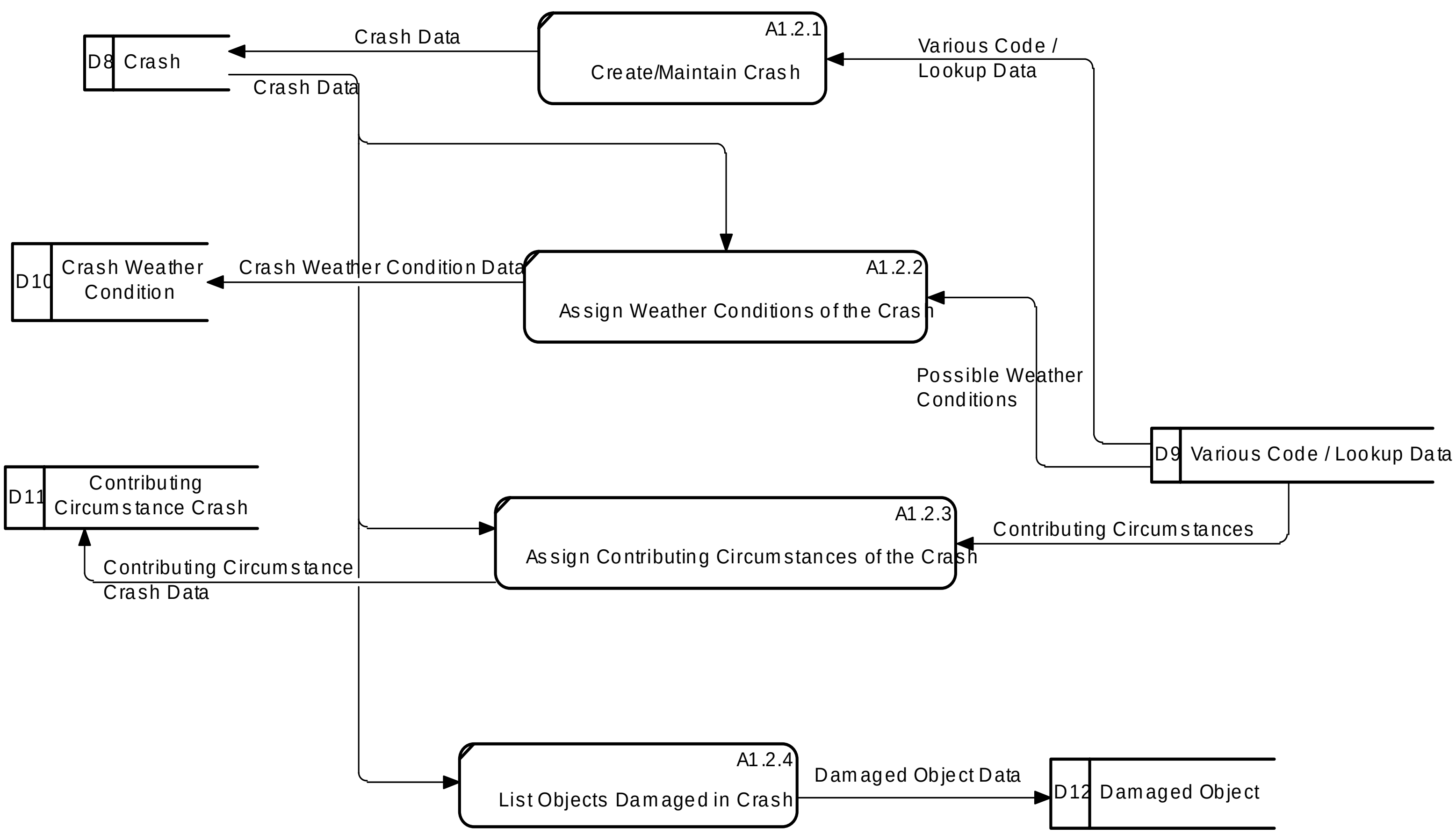
NUMBER:

USED AT:	AUTHOR: Mark Kirk	DATE: 5/23/2001	■	WORKING	READER	DATE	CONTEXT:
	PROJECT: SD2000-14	REV: 5/28/2001		DRAFT			
				RECOMMENDED			
	NOTES: 1 2 3 4 5 6 7 8 9 10			PUBLICATION			A1



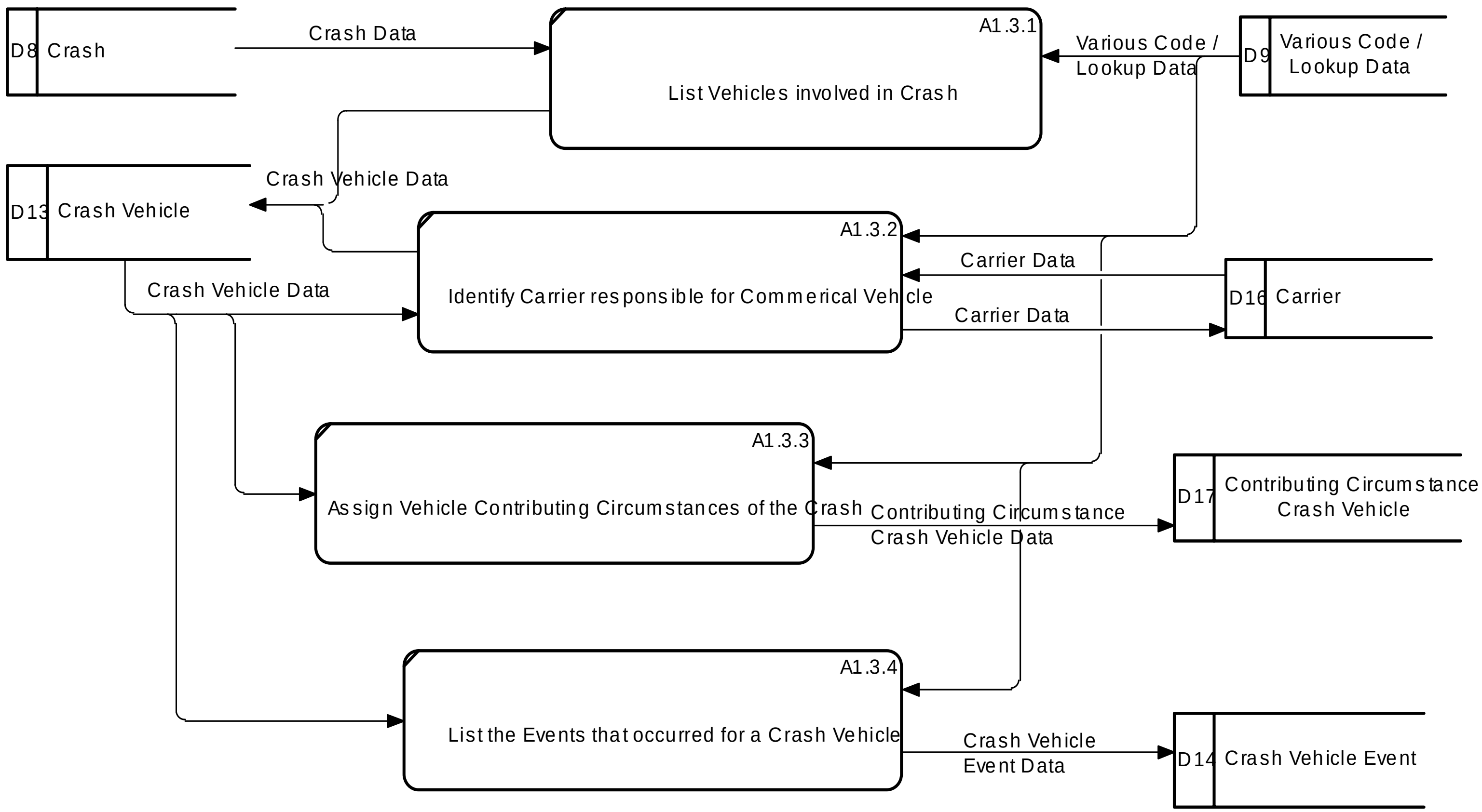
NODE:	TITLE:	NUMBER:
A1.1	Maintain Code/Lookup Tables	

USED AT:	AUTHOR: Mark Kirk PROJECT: SD2000-14 NOTES: 1 2 3 4 5 6 7 8 9 10	DATE: 5/23/2001 REV: 5/24/2001	■ WORKING DRAFT RECOMMENDED PUBLICATION	READER DATE	CONTEXT: A1



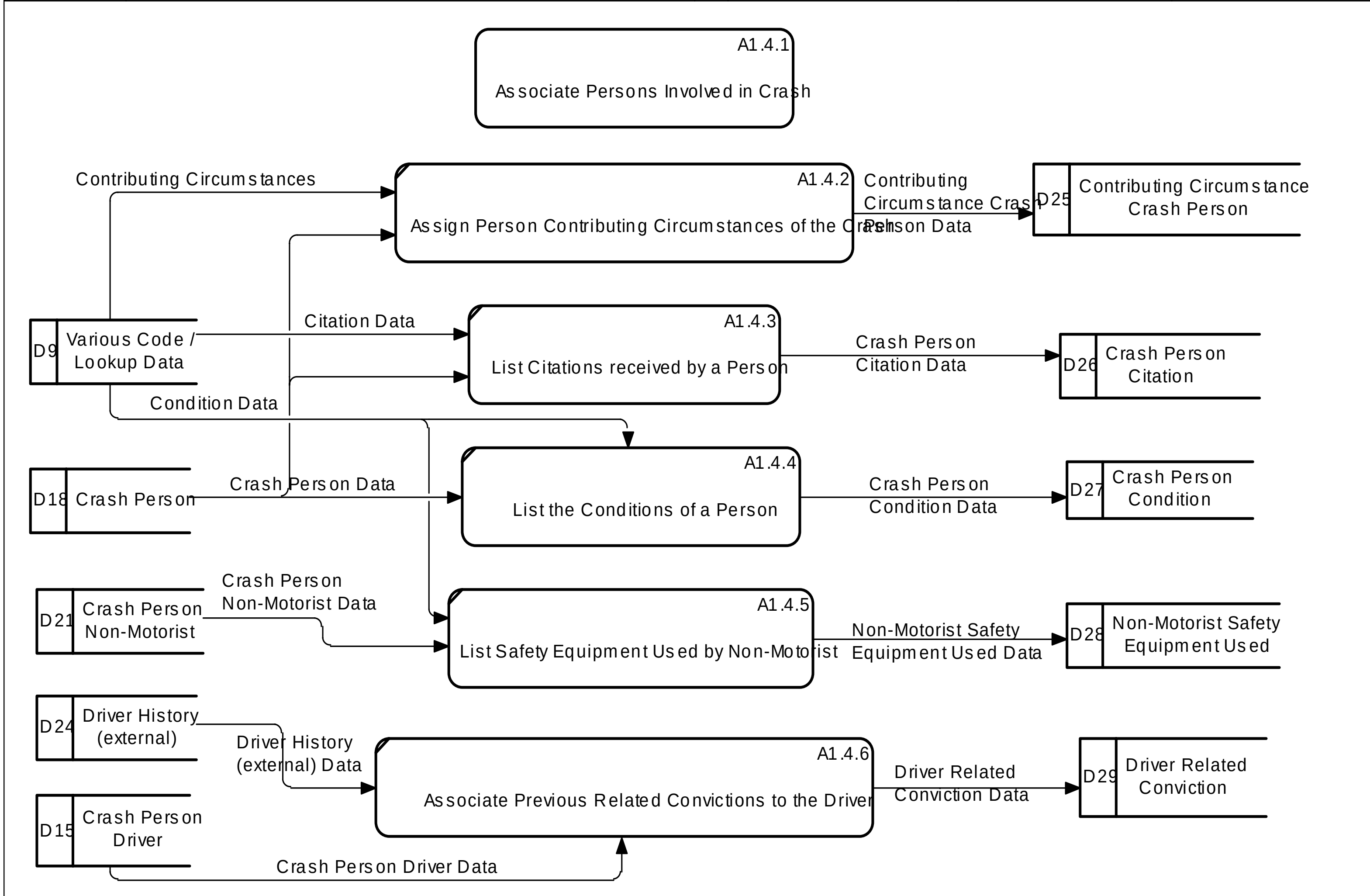
NODE:	TITLE:	NUMBER:
A1.2	Maintain Crash Level Information	

USED AT:	AUTHOR: Mark Kirk	DATE: 5/23/2001	■	WORKING	READER	DATE	CONTEXT:
	PROJECT: SD2000-14	REV: 5/24/2001		DRAFT			
				RECOMMENDED			
	NOTES: 1 2 3 4 5 6 7 8 9 10			PUBLICATION			A1



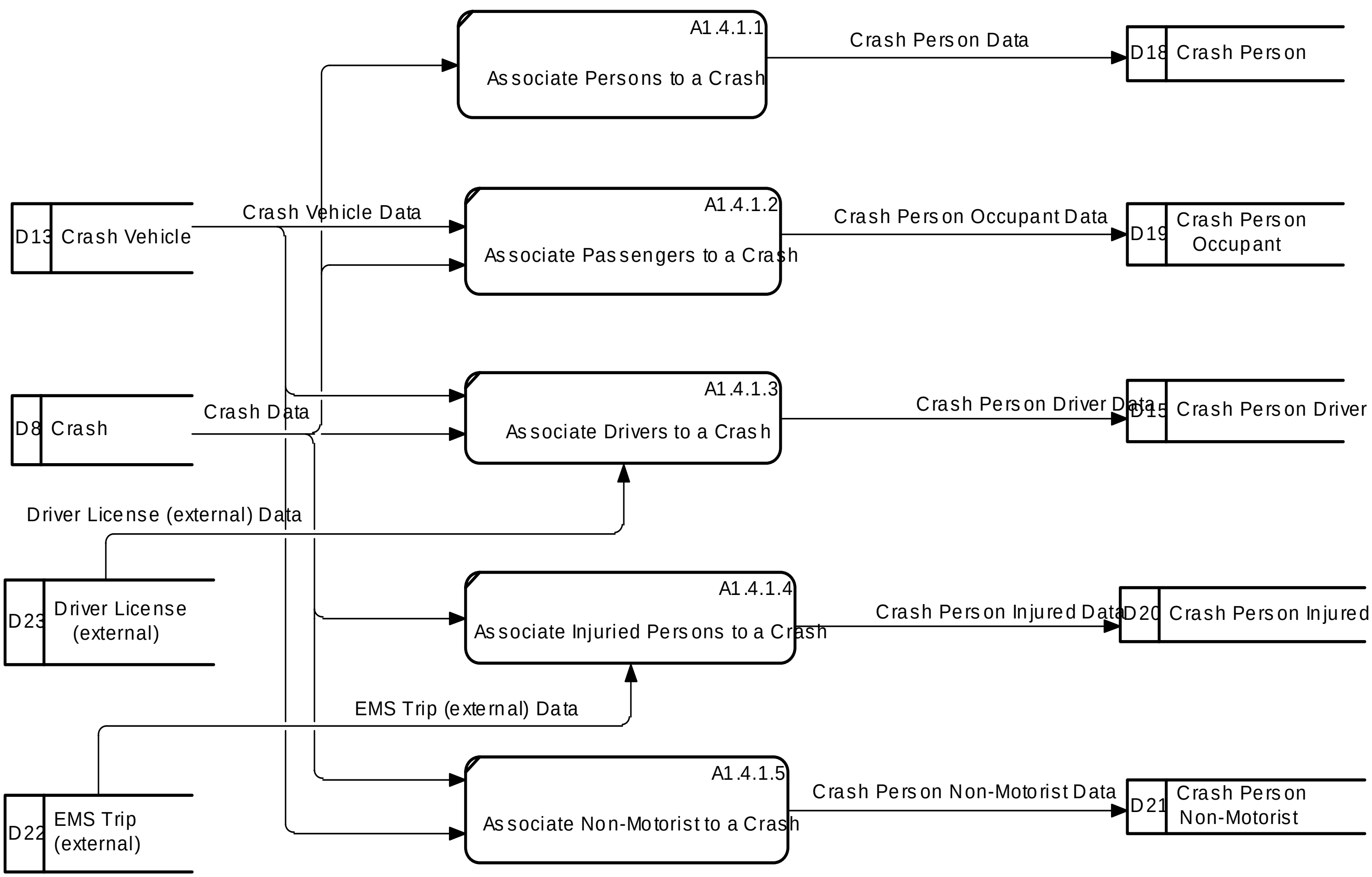
NODE:	TITLE:	NUMBER:
A1.3	Maintain Vehicle Level Information	

USED AT: | AUTHOR: Mark Kirk | DATE: 5/24/2001 | WORKING | READER | DATE | CONTEXT:
PROJECT: SD2000-14 | REV: 5/28/2001 | DRAFT
RECOMMENDED
NOTES: 1 2 3 4 5 6 7 8 9 10 | PUBLICATION | A1



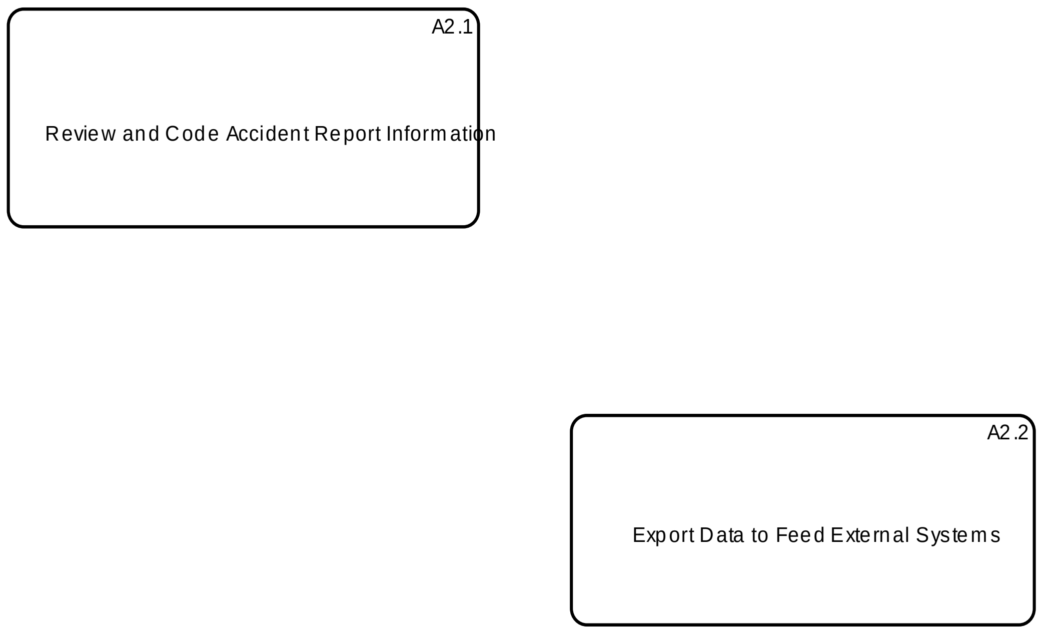
NODE: A1.4 | TITLE: Maintain Person Level Information | NUMBER:

USED AT:	AUTHOR: Mark Kirk PROJECT: SD2000-14 NOTES: 1 2 3 4 5 6 7 8 9 10	DATE: 5/24/2001 REV: 5/28/2001	WORKING DRAFT RECOMMENDED PUBLICATION	READER DATE	CONTEXT: A1.4



NODE:	TITLE:	NUMBER:
A1.4.1	Associate Persons Involved in Crash	

USED AT:	AUTHOR: Mark Kirk	DATE: 5/28/2001		WORKING	READER	DATE	CONTEXT:
	PROJECT: SD2000-14	REV: 5/29/2001		DRAFT			
				RECOMMENDED			
	NOTES: 1 2 3 4 5 6 7 8 9 10			PUBLICATION			A0



NODE:	TITLE:	NUMBER:
A2	Accident Reporting	

USED AT:	AUTHOR: Mark Kirk	DATE: 5/28/2001		WORKING	READER	DATE	CONTEXT:
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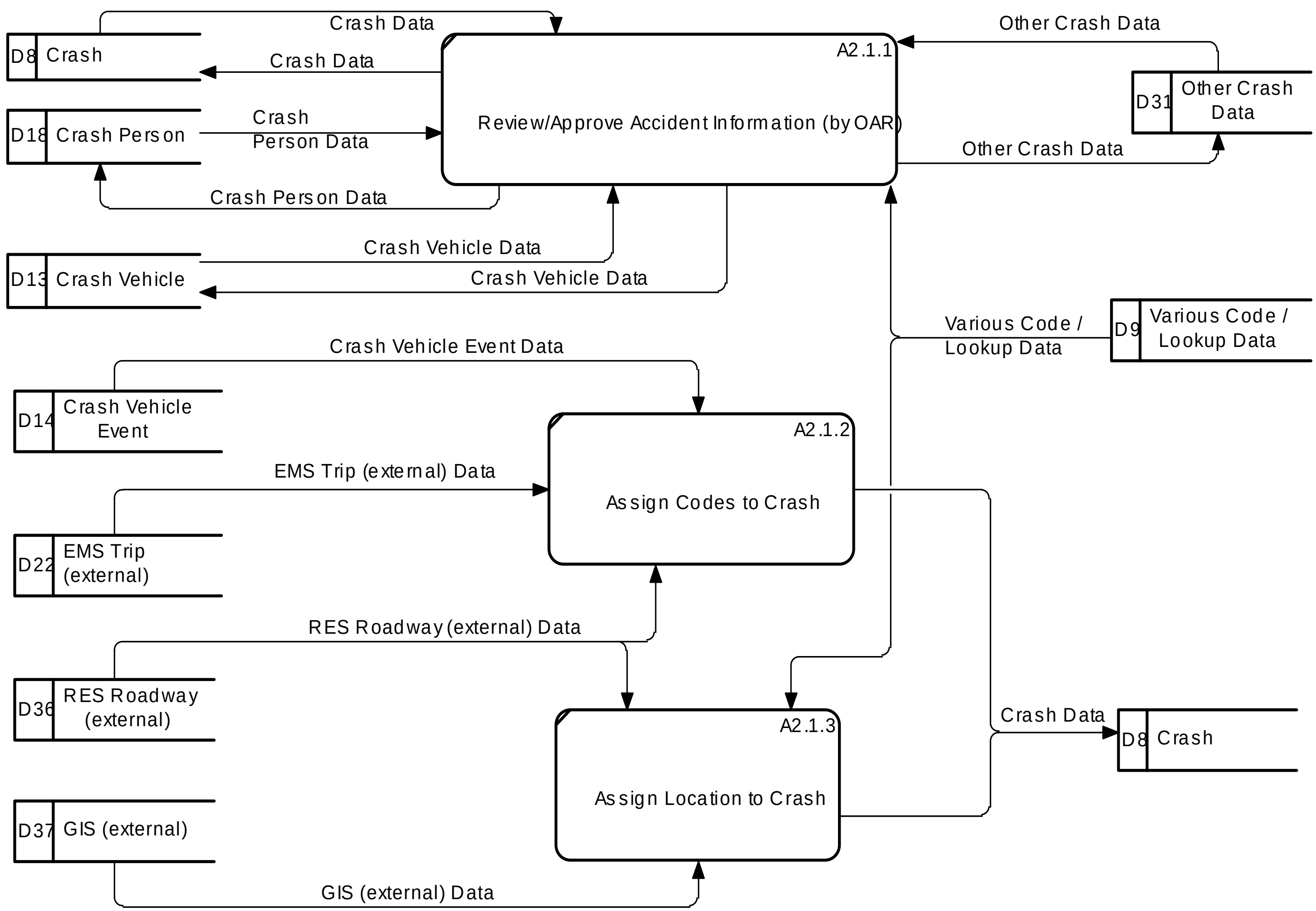
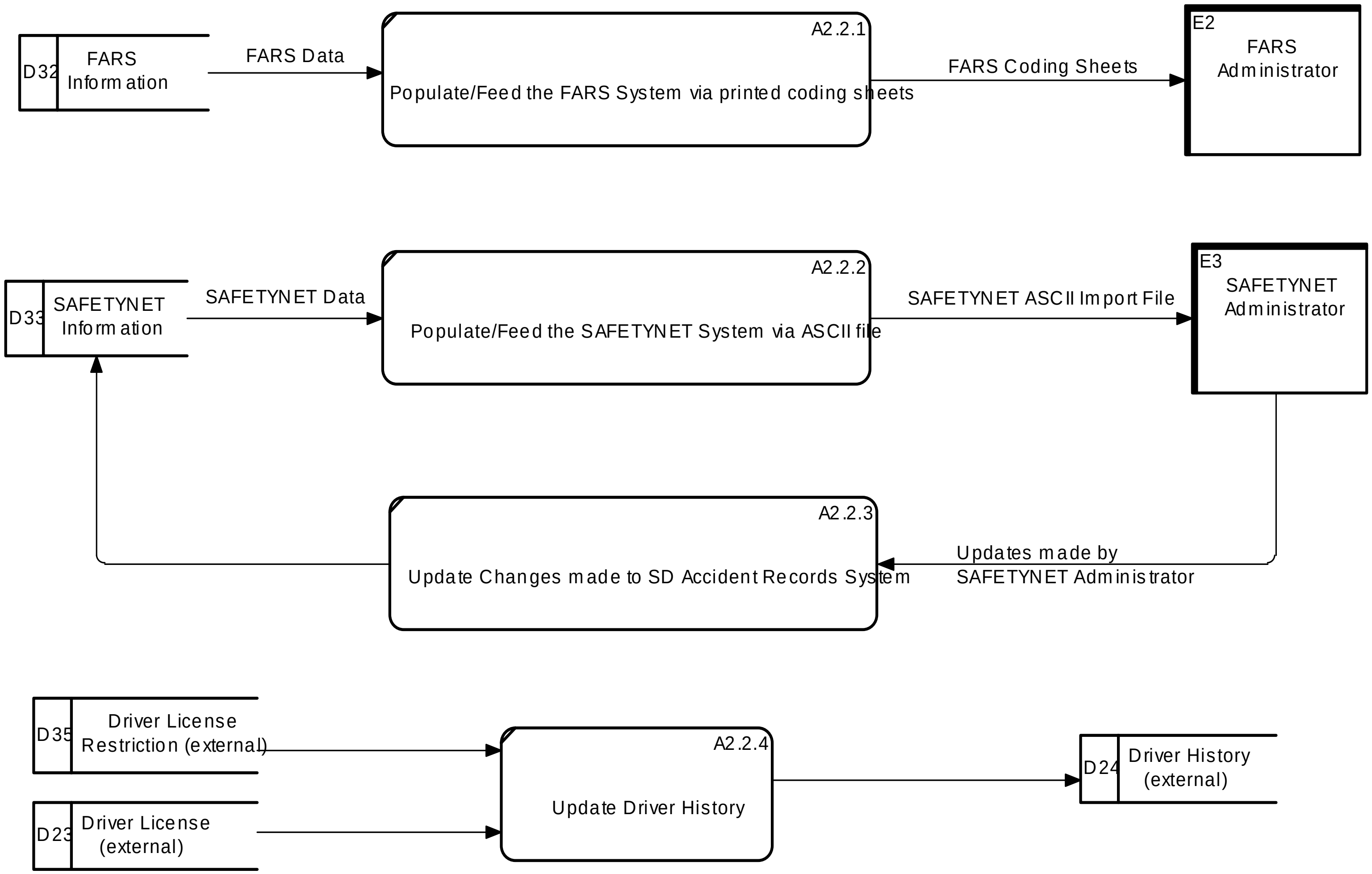
				RECOMMENDED			
	NOTES: 1 2 3 4 5 6 7 8 9 10			PUBLICATION			A2



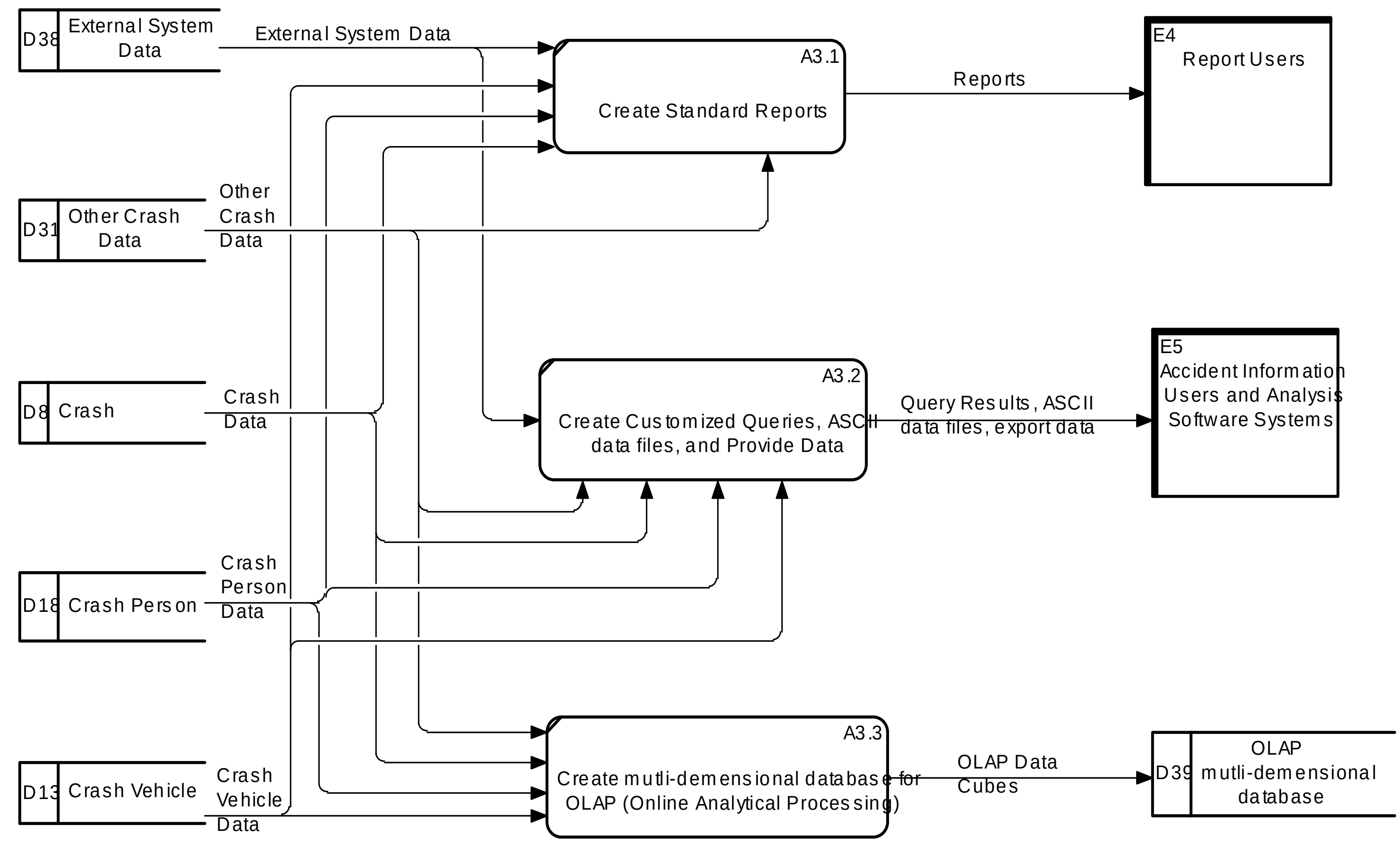
NODE:	TITLE:	NUMBER:
A2.1	Review and Code Accident Report Information	

USED AT:	AUTHOR: Mark Kirk PROJECT: SD2000-14 NOTES: 1 2 3 4 5 6 7 8 9 10	DATE: 5/28/2001 REV: 5/28/2001	WORKING DRAFT RECOMMENDED PUBLICATION	READER DATE	CONTEXT: A2



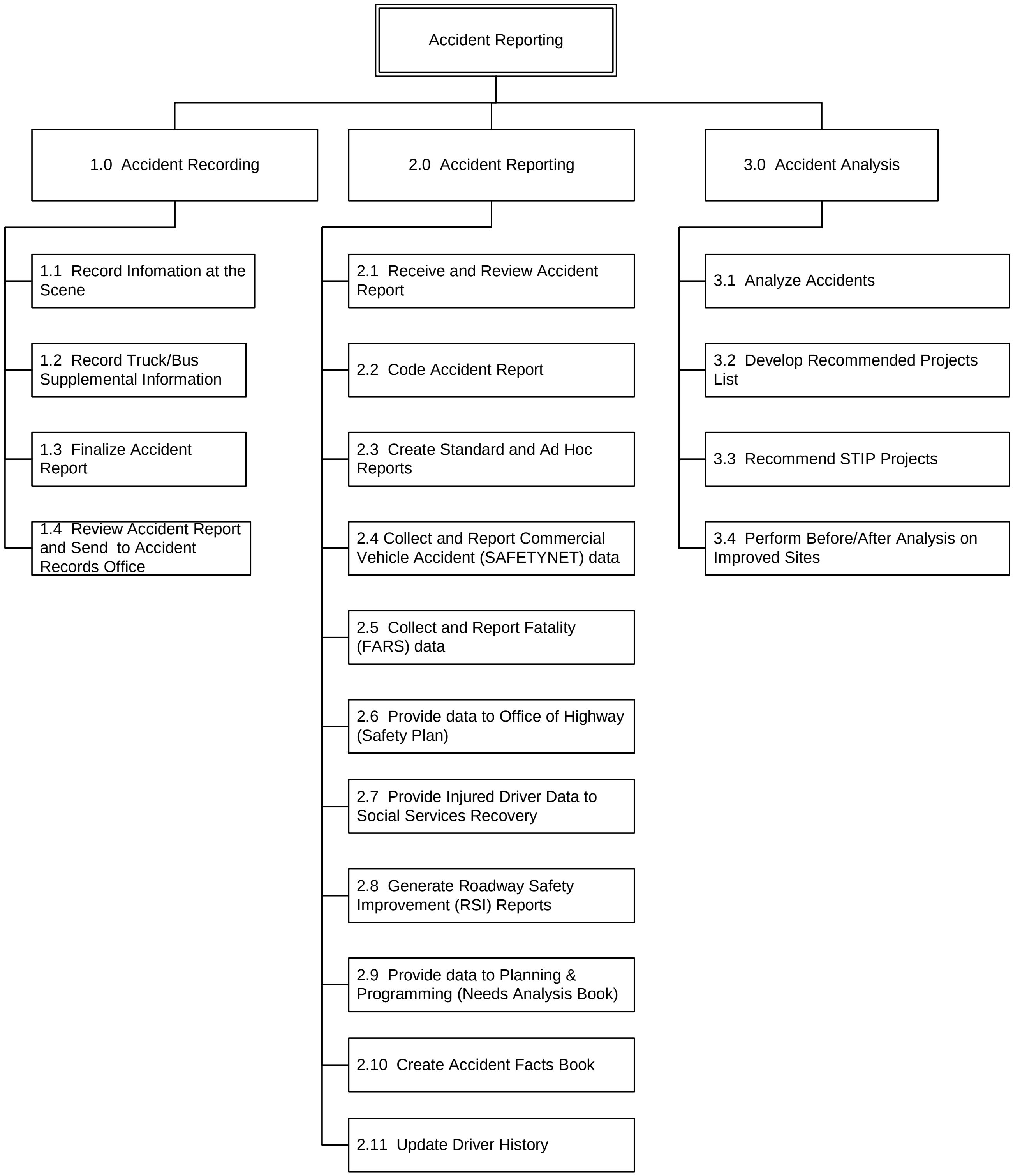
NODE:	TITLE:	NUMBER:
A2.2	Export Data to Feed External Systems	

USED AT:	AUTHOR: Mark Kirk PROJECT: SD2000-14 NOTES: 1 2 3 4 5 6 7 8 9 10	DATE: 5/29/2001 REV: 5/29/2001		WORKING	READER DATE	CONTEXT:
				DRAFT		
				RECOMMENDED		
				PUBLICATION		A0



NODE:	TITLE:	NUMBER:
A3	Accident Analysis	

Appendix K. Accident Reporting High-Level Functional Decomposition



Appendix L. Logical Process/Logical Data Entity Matrix (CRUD)

The following matrix provides a map of the intersections between logical processes and the entities (from the ERD). At each valid intersection, we note whether the entity is being **C**reated, **R**ead, **U**pdated, or **D**eleted by the associated process, thus the term CRUD matrix.

Legend:
X = Create, Read, Update, & Delete
R = Read
U = Update (implied Read)

Logical Process/Entity Matrix	Driver History (external)	Driver License (external)	(external)	EMS Trip (external)	GIS (external)	RES Roadway (external)		Various Code/Lookup Entities	Crash	Crash Weather Condition	Crash	Crash Person	Crash Person Driver	Crash Person Injured	Crash Person Non-Motorist	Crash Person Occupant	Damaged Object	Crash Person	Crash Person Citation	Crash Person Condition	Driver Related Conviction	Used	Carrier	Crash Vehicle	Crash Vehicle	Crash Vehicle Event			
Driver History (external)	X																												
Driver License (external)		X																											
Driver License Restriction (external)			X																										
EMS Trip (external)				X																									
GIS (external)	External				X																								
RES Roadway (external)	To System					X																							
Accident Recording																													

Legend:
X = Create, Read, Update, & Delete
R = Read
U = Update (implied Read)

Logical Process/Entity Matrix

Logical Process/Entity Matrix	Driver History (external)	Driver License (external)	(external)	EMS Trip (external)	GIS (external)	RES Roadway (external)		Various Code/Lookup Entities	Crash	Crash Weather Condition	Crash	Crash Person	Crash Person Driver	Crash Person Injured	Crash Person Non-Motorist	Crash Person Occupant	Damaged Object	Crash Person	Crash Person Citation	Crash Person Condition	Driver Related Conviction	Used	Carrier	Crash Vehicle	Crash Vehicle	Crash Vehicle Event			
Maintain Code/Lookup Tables								X																					
Create/Maintain Crash					R	R		R	X																				
Assign Weather Conditions of the Crash								R	R	X																			
Assign Contributing Circumstances of the Crash								R	R		X																		
Associate Persons to a Crash								R	R			X																	
Associate Drivers to a Crash		R	R					R	R				X																
Associate Injured Persons to a Crash				R				R	R					X															
Associate Non-Motorist to a Crash								R	R						X														
Associate Passengers to a Crash								R	R							X													
List Objects Damaged in Crash									R			R					X												
Assign Person Contributing Circumstances of the Crash								R				R						X											
List Citations received by a Person								R	R			R							X										
List the Conditions of a Person								R	R			R								X									

Legend:
X = Create, Read, Update, & Delete
R = Read
U = Update (implied Read)

Logical Process/Entity Matrix

Logical Process/Entity Matrix	Driver History (external)	Driver License (external)	(external)	EMS Trip (external)	GIS (external)	RES Roadway (external)		Various Code/Lookup Entities	Crash	Crash Weather Condition	Crash	Crash Person	Crash Person Driver	Crash Person Injured	Crash Person Non-Motorist	Crash Person Occupant	Damaged Object	Crash Person	Crash Person Citation	Crash Person Condition	Driver Related Conviction	Used	Carrier	Crash Vehicle	Crash Vehicle	Crash Vehicle Event			
Associate Previous Related Convictions to the Driver	R	R										R									X								
List Safety Equipment Used by Non-Motorist								R				R										X							
Identify Carrier responsible for Commercial Vehicle								R															X						
List Vehicles involved in Crash								R	R			R	R										R	X		R			
Assign Vehicle Contributing Circumstances of the Crash								R	R															R	X				
List the Events that occurred for a Crash Vehicle								R																R		X			
Review/Approve Accident Information (by Police Agency)	R	R	R	R	R	R		R	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U			
Accident Reporting																													
Review/Approve Accident Information (by OAR)	R	R	R	R	R	R		R	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U			

Legend: X = Create, Read, Update, & Delete R = Read U = Update (implied Read) Logical Process/Entity Matrix	Driver History (external)	Driver License (external)	(external)	EMS Trip (external)	GIS (external)	RES Roadway (external)		Various Code/Lookup Entities	Crash	Crash Weather Condition	Crash	Crash Person	Crash Person Driver	Crash Person Injured	Crash Person Non-Motorist	Crash Person Occupant	Damaged Object	Crash Person	Crash Person Citation	Crash Person Condition	Driver Related Conviction	Used	Carrier	Crash Vehicle	Crash Vehicle	Crash Vehicle Event			
Assign Location to Crash					R	R		R	U																				
Assign Codes to Crash				R		R			U																	R			
Update Changes made to SD Accident Records System									U	U		U	U										U	U		U			
Populate/Feed the SAFETYNET System via ASCII file						R			R	R		R	R										R	R		R			
Populate/Feed the FARS System via printed coding sheets	R					R			R	R	R	R	R	R	R	R		R		R				R		R			
Update Driver History	U	R	R																										
Accident Analysis																													
Create Standard Reports	R	R	R	R	R	R		R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R			
Create Customized Queries, ASCII data files, and Provide Data	R	R	R	R	R	R		R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R			
Create multidimensional database for OLAP (Online Analytical Processing)								R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R			

Appendix M. Data Dictionary

The highlighted rows in the table below denote the beginning of a new entity and describe the entity rather than describing a data element.

Ref#	Entity	Data Element	Definition	Note
1	Carrier		An individual, partnership or corporation responsible for the transportation of persons or property. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998)	
2	Carrier	Carrier	Carrier id assigned by the computer behind the scenes. The user will never see this number. This is here because some carrier may not have an USDOT # or an ICC #. Therefore a surrogate key is required.	
3	Carrier	Name Source	The source from which the Carrier Name was determined. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V7	Code: Shipping papers (truck) trip manifest (bus) logbook (Record of Duty Status) Other Not reported Unknown
4	Carrier	Carrier Identification Issuing Authority	The authority that issued the Carrier Identification Number. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V9	Code: US DOT ICC State Mexico Canada
5	Carrier	State Census Number	Definition Source: SAFETYNET 2000 S14	

Ref#	Entity	Data Element	Definition	Note
6	Carrier	State Census Issue State	The state, commonwealth, territory, Indian nation, U.S. Government, foreign country, etc. issuing the registration plate and the year of registration as indicated on the registration plate displayed on the vehicle. For foreign countries, MMUCC requires only the name of the country. Border states may want to collect the name of individual Canadian Provinces or Mexican States. Rationale: This element is critical in providing linkage between the crash and vehicle registration files to access the vehicle identification number. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V2, P11 This is the State that issued the State Census Number to this carrier. Definition Source: SAFETYNET 2000 S15	Code: Identifier of the state, foreign country U.S. government Indian Nation Canadian Province Mexican State International License Not Reported Unknown (See Appendix A of US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998))

Ref#	Entity	Data Element	Definition	Note
7	Carrier	Name Last	The name of an individual, partnership or corporation responsible for the transportation of persons or property. (**currently mandated by Federal Highway Administration's Office of Motor Carriers.) Rationale: The Federal Highway Administration's Office of Motor Carriers has the authority to fine and sanction truck and bus companies that are judged to be unsafe. A key way to identify such carriers is to collect crash data by the name of the company. Carrier crash data allows the OMC to focus enforcement efforts on truck and bus companies that have the largest number of crashes. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V7	Code: Carrier Name See Appendix C of US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998)
8	Carrier	Name First	The name of an individual, partnership or corporation responsible for the transportation of persons or property. (**currently mandated by Federal Highway Administration's Office of Motor Carriers.) Rationale: The Federal Highway Administration's Office of Motor Carriers has the authority to fine and sanction truck and bus companies that are judged to be unsafe. A key way to identify such carriers is to collect crash data by the name of the company. Carrier crash data allows the OMC to focus enforcement efforts on truck and bus companies that have the largest number of crashes. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V7	Code: Carrier Name See Appendix C of US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998)

Ref#	Entity	Data Element	Definition	Note
9	Carrier	Name Middle	The name of an individual, partnership or corporation responsible for the transportation of persons or property. (**currently mandated by Federal Highway Administration's Office of Motor Carriers.) Rationale: The Federal Highway Administration's Office of Motor Carriers has the authority to fine and sanction truck and bus companies that are judged to be unsafe. A key way to identify such carriers is to collect crash data by the name of the company. Carrier crash data allows the OMC to focus enforcement efforts on truck and bus companies that have the largest number of crashes. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V7	Code: Carrier Name See Appendix C of US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998)
10	Carrier	Name Suffix	The name of an individual, partnership or corporation responsible for the transportation of persons or property. (**currently mandated by Federal Highway Administration's Office of Motor Carriers.) Rationale: The Federal Highway Administration's Office of Motor Carriers has the authority to fine and sanction truck and bus companies that are judged to be unsafe. A key way to identify such carriers is to collect crash data by the name of the company. Carrier crash data allows the OMC to focus enforcement efforts on truck and bus companies that have the largest number of crashes. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V7	Code: Carrier Name See Appendix C of US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998)

Ref#	Entity	Data Element	Definition	Note
11	Carrier	Carrier Identification Number	A unique number, found on the power unit, and assigned by the U.S. Department of Transportation, Interstate Commerce Commission, or by the state to a motor carrier. (**currently mandated by Federal Highway Administration's Office of Motor Carriers.) Rationale: Important for management/administration, evaluation, and linkage. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V9	Code: USDOT # or ICC #
12	Carrier	Address Street A	The street address of the carrier. (**currently mandated by Federal Highway Administration's Office of Motor Carriers.) Rationale: Since the Office of Motor Carriers has the authority to visit carriers to conduct review of compliance with FMCSRs, the street address of the carrier is important. The street address is also a way to cross-check the correct identity of the carrier. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V8	Code: See Appendix D of US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998)
13	Carrier	Address Street B	The street address of the carrier. (**currently mandated by Federal Highway Administration's Office of Motor Carriers.) Rationale: Since the Office of Motor Carriers has the authority to visit carriers to conduct review of compliance with FMCSRs, the street address of the carrier is important. The street address is also a way to cross-check the correct identity of the carrier. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V8	Code: See Appendix D of US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998)

Ref#	Entity	Data Element	Definition	Note
14	Carrier	Address City	The street address of the carrier. (**currently mandated by Federal Highway Administration's Office of Motor Carriers.) Rationale: Since the Office of Motor Carriers has the authority to visit carriers to conduct review of compliance with FMCSRs, the street address of the carrier is important. The street address is also a way to cross-check the correct identity of the carrier. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V8	Code: See Appendix D of US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998)
15	Carrier	Address State	The street address of the carrier. (**currently mandated by Federal Highway Administration's Office of Motor Carriers.) Rationale: Since the Office of Motor Carriers has the authority to visit carriers to conduct review of compliance with FMCSRs, the street address of the carrier is important. The street address is also a way to cross-check the correct identity of the carrier. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V8	Code: See Appendix D of US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998)

Ref#	Entity	Data Element	Definition	Note
16	Carrier	Address Zip	The street address of the carrier. (**currently mandated by Federal Highway Administration's Office of Motor Carriers.) Rationale: Since the Office of Motor Carriers has the authority to visit carriers to conduct review of compliance with FMCSRs, the street address of the carrier is important. The street address is also a way to cross-check the correct identity of the carrier. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V8	Code: See Appendix D of US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998)
17	Carrier	Colonia	Name of Colonia for Mexican and Central American Carriers only. Definition Source: SAFETYNET 2000 S21	
18	Carrier	City	The city/place identifier. Rationale: Important for analyses of local area programs such as "Safe Communities." Critical for data linkage of the crash file to other state data files (such as EMS, hospital, roadway, etc.). Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) The codes used should be the FIPS City Codes.	Code: Record the name identifying the city/place in which a crash occurred. If codes are used instead of narrative, use the Federal Information Processing Standards #8-6 (FIPS) Code for city or place (Pub 55DC-4/ 87). If state specific code used, it should be convertible to the FIPS format.
19	Carrier	Interstate Carrier	Yes or No. Is this carrier an interstate carrier? Definition Source: SAFETYNET 2000 S18	
20	City		Code/Lookup Table	

Ref#	Entity	Data Element	Definition	Note
21	City	City	The city/place identifier. Rationale: Important for analyses of local area programs such as "Safe Communities." Critical for data linkage of the crash file to other state data files (such as EMS, hospital, roadway, etc.). Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) The codes used should be the FIPS City Codes.	Code: Record the name identifying the city/place in which a crash occurred. If codes are used instead of narrative, use the Federal Information Processing Standards #8-6 (FIPS) Code for city or place (Pub 55DC-4/ 87). If state specific code used, it should be convertible to the FIPS format.
22	City	City Name	Name of the City.	
23	City	Population Group	The population size group of the area in which the accident took place. Definition Source: ACCIDENT RECORDS A59	Code: 1-499 500-999 1000-2499 2500-4999 5000-9999 10000-24999 25000-49999 50000-99999 100000 and over
24	Contributing Circumstance Crash		An apparent environmental and/or road conditions which contributed to the crash. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998)	

Ref#	Entity	Data Element	Definition	Note
25	Contributing Circumstance Crash	Circumstance	Apparent person, vehicle, environmental, or road conditions which contributed to the crash. Rationale: Important to determine existence of unusual conditions that could be useful in determining the need for additional traffic control devices or geometric improvements. (Pedestrians and pedalcyclists are covered in traffic units.). Important to determine highway maintenance and possible engineering needs. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C14, C15, P14, P24, FARS 2000-V34	Environment Codes: None; Weather conditions; Physical obstruction; Glare; Animal in roadway; Other; Not reported; Unknown Road Codes: Road surface condition (wet, icy, snow, slush, etc.); Debris; Rut, holes, bumps; Work zone (construction/maintenance/utility); Worn, travel-polished surface; Obstruction in roadway; Traffic control device inoperative, missing or obscured; Shoulders (none, low, soft, high); Non-highway work; Other; Not reported; Unknown Driver Codes No Improper driving; Failed to yield right of way; Disregarded traffic signs, signals, road markings; Exceeded authorized speed limit; Driving too fast for conditions; Made an improper turn; Wrong side or wrong way; Followed too closely; Failure to keep in proper lane or running off road; Operating vehicle in erratic, reckless, careless, negligent or aggressive manner; Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist in roadway, etc.; Over-correcting/over-steering; Visibility obstructed; Inattention; Distracted; Fatigued/asleep; Operating defective equipment; Other Improper action; Not reported; Unknown Vehicle Codes: Tires; Brake System; Steering System; Suspension; Power Train (see FARS 2000 coding manual for more)

Ref#	Entity	Data Element	Definition	Note
26	Contributing Circumstance Crash	Crash	The unique identifier that identifies a given crash. Rationale: Facilitates linkage of traffic record sub-files back to the crash data file. If this identifier is available at the scene, it can also be recorded on the EMS record for linkage purposes. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C1 Crash Report Number (Definition Source: SAFETYNET 2000 Data Dictionary, December 2000)	Code: State specific identifier
27	Contributing Circumstance Crash Person		The actions of the driver or other persons involved in the crash which may have contributed to the crash. Rationale: Important for evaluating the effect that dangerous driver behavior has on the crash. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) P14, P24	Code: No Improper driving; Failed to yield right of way; Disregarded traffic signs, signals, road markings; Exceeded authorized speed limit; Driving too fast for conditions; Made an improper turn; Wrong side or wrong way; Followed too closely; Failure to keep in proper lane or running off road; Operating vehicle in erratic, reckless, careless, negligent or aggressive manner; Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist in roadway, etc.; Over-correcting/over-steering; Visibility obstructed; Inattention; Distracted; Fatigued/asleep; Operating defective equipment; Other Improper action; Not reported; Unknown
28	Contributing Circumstance Crash Person	Person	Person Identifier. This is an unique sequential number that is assigned to each person involved in the crash, whether they be a driver, passenger, bicyclist, pedestrian, etc...	

Ref#	Entity	Data Element	Definition	Note
29	Contributing Circumstance Crash Person	Circumstance	Apparent person, vehicle, environmental, or road conditions which contributed to the crash. Rationale: Important to determine existence of unusual conditions that could be useful in determining the need for additional traffic control devices or geometric improvements. (Pedestrians and pedalcyclists are covered in traffic units.). Important to determine highway maintenance and possible engineering needs. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C14, C15, P14, P24, FARS 2000-V34	Environment Codes: None; Weather conditions; Physical obstruction; Glare; Animal in roadway; Other; Not reported; Unknown Road Codes: Road surface condition (wet, icy, snow, slush, etc.); Debris; Rut, holes, bumps; Work zone (construction/maintenance/utility); Worn, travel-polished surface; Obstruction in roadway; Traffic control device inoperative, missing or obscured; Shoulders (none, low, soft, high); Non-highway work; Other; Not reported; Unknown Driver Codes No Improper driving; Failed to yield right of way; Disregarded traffic signs, signals, road markings; Exceeded authorized speed limit; Driving too fast for conditions; Made an improper turn; Wrong side or wrong way; Followed too closely; Failure to keep in proper lane or running off road; Operating vehicle in erratic, reckless, careless, negligent or aggressive manner; Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist in roadway, etc.; Over-correcting/over-steering; Visibility obstructed; Inattention; Distracted; Fatigued/asleep; Operating defective equipment; Other Improper action; Not reported; Unknown Vehicle Codes: Tires; Brake System; Steering System; Suspension; Power Train (see FARS 2000 coding manual for more)

Ref#	Entity	Data Element	Definition	Note
30	Contributing Circumstance Crash Person	Crash	The unique identifier that identifies a given crash. Rationale: Facilitates linkage of traffic record sub-files back to the crash data file. If this identifier is available at the scene, it can also be recorded on the EMS record for linkage purposes. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C1 Crash Report Number (Definition Source: SAFETYNET 2000 Data Dictionary, December 2000)	Code: State specific identifier
31	Contributing Circumstance Crash Vehicle		An apparent vehicle conditions which contributed to the crash. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998)	
32	Contributing Circumstance Crash Vehicle	Crash	The unique identifier that identifies a given crash. Rationale: Facilitates linkage of traffic record sub-files back to the crash data file. If this identifier is available at the scene, it can also be recorded on the EMS record for linkage purposes. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C1 Crash Report Number (Definition Source: SAFETYNET 2000 Data Dictionary, December 2000)	Code: State specific identifier

Ref#	Entity	Data Element	Definition	Note
33	Contributing Circumstance Crash Vehicle	Circumstance	Apparent person, vehicle, environmental, or road conditions which contributed to the crash. Rationale: Important to determine existence of unusual conditions that could be useful in determining the need for additional traffic control devices or geometric improvements. (Pedestrians and pedalcyclists are covered in traffic units.). Important to determine highway maintenance and possible engineering needs. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C14, C15, P14, P24, FARS 2000-V34	Environment Codes: None; Weather conditions; Physical obstruction; Glare; Animal in roadway; Other; Not reported; Unknown Road Codes: Road surface condition (wet, icy, snow, slush, etc.); Debris; Rut, holes, bumps; Work zone (construction/maintenance/utility); Worn, travel-polished surface; Obstruction in roadway; Traffic control device inoperative, missing or obscured; Shoulders (none, low, soft, high); Non-highway work; Other; Not reported; Unknown Driver Codes No Improper driving; Failed to yield right of way; Disregarded traffic signs, signals, road markings; Exceeded authorized speed limit; Driving too fast for conditions; Made an improper turn; Wrong side or wrong way; Followed too closely; Failure to keep in proper lane or running off road; Operating vehicle in erratic, reckless, careless, negligent or aggressive manner; Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist in roadway, etc.; Over-correcting/over-steering; Visibility obstructed; Inattention; Distracted; Fatigued/asleep; Operating defective equipment; Other Improper action; Not reported; Unknown Vehicle Codes: Tires; Brake System; Steering System; Suspension; Power Train (see FARS 2000 coding manual for more)

Ref#	Entity	Data Element	Definition	Note
34	Contributing Circumstance Crash Vehicle	Vehicle Number	Number assigned to uniquely identify within the crash each vehicle involved in the crash. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V1	Code: Sequential number
35	Crash		Crash is a motor vehicle accident as defined by ANSI D16.1. 2.4.12 motor vehicle accident: A motor vehicle accident is a transport accident that (1) involves a motor vehicle in transport, (2) is not an aircraft accident or watercraft accident, and (3) does not include any harmful event involving a railway train in transport prior to involvement of a motor vehicle in transport. Definition Source: ANSI D16.1-1996	Exclusions: - Any school bus accident in which no school bus is directly involved and which involves no other motor vehicle (See 2.8.2.) Example: If a child approaching a school bus, stopped with its red lights flashing, is struck by a pedalcycle, but neither the pedalcycle nor the child come in contact with the school bus, then there is (1) a school bus accident that is not a motor vehicle accident and (2) an other road vehicle accident (collision involving pedestrian). Characteristics of Motor Vehicle Traffic Accidents Motor vehicle traffic accidents have a number of characteristics which are used to distinguish between motor vehicle traffic accidents and other events such as non-accidents, aircraft or railway accidents and other motor vehicles, cataclysms and nontraffic accidents. The questions below address all of the distinguishing characteristics of motor vehicle traffic accidents. If the answer to each of the questions below is "yes", the incident is a motor vehicle accident. 1) Did the incident include one or more occurrences of injury (2.3.1) or damage (2.3.7)? 2) Was there at least one occurrence of injury or damage which was not a direct result of a cataclysm (2.4.5)? 3) Did the incident involve one or more motor

Ref#	Entity	Data Element	Definition	Note
				vehicles (2.2.7)? 4) Of the motor vehicles involved, was at least one in transport (2.2.34)? 5) Was the incident an unstabilized situation (2.4.4)? 6) Did the unstabilized situation originate on a trafficway (2.2.1) or did injury or damage occur on a trafficway? 7) If the incident involved a railway train (2.2.5) in transport, did a motor vehicle in transport become involved prior to any injury or damage involving the train? 8) Is it true that neither an aircraft (2.1.5) in transport nor a watercraft (2.1.6) in transport was involved in the incident?
36	Crash	Crash	The unique identifier that identifies a given crash. Rationale: Facilitates linkage of traffic record sub-files back to the crash data file. If this identifier is available at the scene, it can also be recorded on the EMS record for linkage purposes. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C1 Crash Report Number (Definition Source: SAFETYNET 2000 Data Dictionary, December 2000)	Code: State specific identifier
37	Crash	Filing Officer Badge Number	The law enforcement official completing the accident investigation. Definition Source: ACCIDENT RECORDS A52	

Ref#	Entity	Data Element	Definition	Note
38	Crash	Crash Date Time Zone**	Time zone that the Crash Date Time is reported in. Derived from the location of the accident.	Code: (for South Dakota) Either Central Standard Time (CST), or Mountain Time (MT)
39	Crash	Police Date Time Arrival	The date and time when a law enforcement officer arrives at the scene of the accident. Definition Source: ACCIDENT RECORDS A55, A56	
40	Crash	Police Date Time Notified	The date and time at which the call was placed notifying the police agency about the crash. Rationale: Useful as a surrogate for time of the crash. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) The date and time when a law enforcement agency was notified of the occurrence of the accident. Definition Source: ACCIDENT RECORDS A57, A58	Code: YYYYMMDDHHMM
41	Crash	Police Date Time Notified Time Zone	Time zone that the Police Date Time Notified is reported in. This may be different from the Crash Date Time Zone because the agency may be in a different time zone than the crash.	Code: (for South Dakota) Either Central Standard Time (CST), or Mountain Time (MT) Can this be derived? Maybe a rule should be made that all times are reported in terms of the Time Zone that the Crash occurred.

Ref#	Entity	Data Element	Definition	Note
42	Crash	Crash County	The county in which a crash occurred. Rationale: Important for analyses of county area programs such as "Safe Communities." Critical for data linkage of the crash file to other state data files (such as EMS, hospital, roadway, etc.). Important for intrastate comparisons. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C3	Code: Record the name of the county in which a crash occurred. If codes are used instead of narrative, use the Federal Information Processing Standards #6-4 (FIPS) Code for county (Pub 55DC-4/87). If state specific codes are used, they should be convertible to the FIPS format.
43	Crash	Crash City	The city/place in which a crash occurred. Rationale: Important for analyses of local area programs such as "Safe Communities." Critical for data linkage of the crash file to other state data files (such as EMS, hospital, roadway, etc.). Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C4	Code: Record the name identifying the city/place in which a crash occurred. If codes are used instead of narrative, use the Federal Information Processing Standards #8-6 (FIPS) Code for city or place (Pub 55DC-4/ 87). If state specific code used, it should be convertible to the FIPS format.
44	Crash	Road Surface Condition	The roadway surface condition at the time and place of a crash. Rationale: Important to identify and correct high wet-surface crash locations and provide information for setting coefficient of pavement friction standards. Critical for prevention programs and engineering evaluations. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C13	Code: Dry Wet Snow Ice Sand, mud, dirt, oil, gravel Water (standing, moving) Slush Other Not reported Unknown

Ref#	Entity	Data Element	Definition	Note
45	Crash	Crash Impact Manner	The identification in a crash of the manner in which two vehicles in transport initially came together without regard to the direction of force. Rationale: Important for evaluation of occupant injuries and structural defects. This data element can be used in conjunction with Vehicle Maneuver/Action (V21) to describe the crash. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C8	Not collision between two vehicles in transport Rear-end Head-on Rear-to-rear Angle Sideswipe, same direction Sideswipe, opposite direction Not reported Unknown
46	Crash	Information Source	Identity of the source providing the information on the crash report. Rationale: This data element is important for quality control and identification purposes. The Police Reporting Agency Identifier is used to track the reporting of SafetyNet crashes for quality control and training purposes. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C9	Subfield 1: Source of Information Police agency Motorist Other Subfield 2: Police Reporting Agency Identifier Subfield 3: Type of Police Agency State police/highway patrol City police Sheriff department BIA/Tribal Other
47	Crash	Information Source Name	The name of the agency filing the report. Definition Source: ACCIDENT RECORDS A06	

Ref#	Entity	Data Element	Definition	Note
48	Crash	Ambient Light	The type of light that exists at the time of a motor vehicle crash. Rationale: Important for management/administration and evaluation. Critical for preventive programs and engineering evaluations. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C12	Code: Daylight Dawn Dusk Dark - lighted roadway Dark - roadway not lighted Dark - unknown roadway lighting Other Not reported Unknown
49	Crash	Roadway Junction Type	A junction is either an intersection or the connection between a driveway access and a roadway other than a driveway access. Rationale: Important for site specific safety studies to identify actual or potential safety problem locations. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C16	Code: Not at junction; Interchange (see Interchange Location); Intersection; Intersection Related; Crossover Related; Right Turn Radius; Four-way intersection; T-intersection; Y-intersection; Traffic circle/roundabout; Five-point, or more; On ramp; Off ramp; Crossover; Driveway; Railway grade crossing; Shared-use paths or trails; Not reported; Unknown

Ref#	Entity	Data Element	Definition	Note
50	Crash	Interchange Location	If the crash occurred on the Roadway Junction Type of "Interchange", then this data element must be coded. The interchange location is the location in the interchange that the crash occurred. (see Roadway Junction Type) Rationale: This is important so that the Traffic Analysis can query for accident by this data elements. Also see Roadway Junction Type. Definition Source: DOT Local Government Assistance.	Officers do not code this data element. This is derived from the crash diagram in the Office of Accident Records at the state. NB - North Bound SB - South Bound EB - East Bound WB - West Bound Code: These codes describe the part of the interchange used to change directions. Example: SB-WB interchange location is the part of the interchange that changes traffic flow from south bound to west bound. A = SB-WB B = WB-NB C = NB-EB D = EB-SB E = WB-SB F = NB-WB G = EB-NB H = SB-EB
51	Crash	School Bus Related	Indicates if a school bus is related to the crash. The "school bus", with or without a pupil on board, must be directly involved as a contact vehicle or indirectly involved as a non-contact vehicle. Rationale: Important in determining where and how school children are at the greatest risk of injury when being transported by school bus and the extent to which school bus operations affect overall traffic safety. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C17	Code: No Yes, school bus directly involved Yes, school bus indirectly involved Not reported Unknown

Ref#	Entity	Data Element	Definition	Note
52	Crash	Work Zone Related	A crash that occurs in or near a construction, maintenance, or utility work zone, whether workers were actually present at the time of the crash or not. "Work zone related" crashes may also include those involving vehicles slowed or stopped because of the work zone, even if the first harmful event was before the first warning sign. (See Appendix J for diagram of work zone areas.) Rationale: This data element needs to be collected at scene because work zones are relatively short term or moving operations that are not recorded in permanent road inventory files. The information is important for assessing the impact of various types of on-highway work activity on traffic safety and evaluating Traffic Control Plans used at work zones and to make adjustments to the traffic control plans to enhance safety to workers and traveling public. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C18	Was the crash in or near a construction, maintenance or utility work zone? No Unknown Yes (3 other Work Zone fields must be populated)
53	Crash	Worker Present In Work Zone	Indicates if there were workers present in the work zone. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C18	Code: Yes No Unknown

Ref#	Entity	Data Element	Definition	Note
54	Crash	Work Zone Type	A crash that occurs in or near a construction, maintenance, or utility work zone, whether workers were actually present at the time of the crash or not. "Work zone related" crashes may also include those involving vehicles slowed or stopped because of the work zone, even if the first harmful event was before the first warning sign. (See Appendix J for diagram of work zone areas.) Rationale: This data element needs to be collected at scene because work zones are relatively short term or moving operations that are not recorded in permanent road inventory files. The information is important for assessing the impact of various types of on-highway work activity on traffic safety and evaluating Traffic Control Plans used at work zones and to make adjustments to the traffic control plans to enhance safety to workers and traveling public. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C18	Code: Type of work zone Lane closure Lane shift/crossover Work on shoulder or median Intermittent or moving work Other

Ref#	Entity	Data Element	Definition	Note
55	Crash	Work Zone Location	A crash that occurs in or near a construction, maintenance, or utility work zone, whether workers were actually present at the time of the crash or not. "Work zone related" crashes may also include those involving vehicles slowed or stopped because of the work zone, even if the first harmful event was before the first warning sign. (See Appendix J for diagram of work zone areas.) Rationale: This data element needs to be collected at scene because work zones are relatively short term or moving operations that are not recorded in permanent road inventory files. The information is important for assessing the impact of various types of on-highway work activity on traffic safety and evaluating Traffic Control Plans used at work zones and to make adjustments to the traffic control plans to enhance safety to workers and traveling public. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C18	Code: Before the first work zone warning sign Advance warning area (after the first warning sign but before the work area) Transition area (where lanes are shifted or tapered for lane closure) Activity Area (adjacent to actual work area, whether workers and equipment were present or not) Termination area (after the activity area but before traffic resumes normal conditions)
56	Crash	Agency Approval Date	The date on which the accident report was approved for submission to the Office of Accident Records by the investigating agency. Definition Source: ACCIDENT RECORDS A07	
57	Crash	Approval Officer Badge Number	The officer approving the accident report prior to submission to the Office of Accident Records. Definition Source: ACCIDENT RECORDS A51	

Ref#	Entity	Data Element	Definition	Note
58	Crash	Crash Date Time	The date (year, month, and day) and time (hour and minute) at which a crash occurred. Rationale: Important for management/administration, valuation, and linkage Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C2	Subfield 1: Year nnnn Year 7777 Permanent 8888 Indefinite 9999 Unknown Subfield 2: Month 01-12 = January - December 77 Permanent 88 Indefinite 99 Unknown Subfield 3: Day nn Day of Month 77 Permanent 88 Indefinite 99 Unknown
59	Crash	Damaged Object Amount**	The total dollar amount of damage to objects damaged as a result of the accident. (Excludes vehicle and contents of the vehicle damage). Definition Source: ACCIDENT RECORDS A19 This can be derived by summing the Damage Amount for all of the Damaged Object records for this Crash.	
60	Crash	Crash Scene Diagram**	This attribute is shown here for logical representation. The Crash Scene Diagram will actually be stored in the Crash Attachment entity. This the diagram of the accident either hand drawn or computer drawn online. Either way the image is scanned and put into an "electronic" format and stored here with the Crash record.	

Ref#	Entity	Data Element	Definition	Note
61	Crash	Hit And Run	This attribute refers to cases where a vehicle is a contact (i.e. striking) vehicle in the accident and does not stop to render aid. This can include drivers who flee the scene on foot. Definition Source: FARS 2000 A33	
62	Crash	Location Roadway	The route number of the trafficway on which the accident occurred. Definition Source: ACCIDENT RECORDS A30, A31	
63	Crash	Location Special	An indication of whether or not an accident occurred at a special location. Definition Source: ACCIDENT RECORDS A71	Code: Not Special Location Bridge - Vehicle Traveling Over Bridge - Vehicle Traveling Under Railroad Crossing Entrance or Exit Ramp Unknown
64	Crash	Location Coordinate	Definition: Exact location on the roadway indicating where the crash occurred. Rationale: Important for problem identification, prevention programs, engineering evaluations, and linkage purposes. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C5	The optimum definition of crash roadway location is a route name and GPS (Global Positioning System/GIS(Geographic Information System) if a highway agency has a linear referencing system that allows them to relate GPS coordinates to specific locations in road inventory, traffic, driver, and other files. The location information in a crash file must have the capability to be linked to location information in these other important files required in studying site-specific safety issues. A GPS/GIS provides latitude/longitude coordinates. States without GPS/GIS should indicate location using their current system including route name/number and milepoint/link-node. (See Appendix G for other roadway linkage data elements.)

Ref#	Entity	Data Element	Definition	Note
65	Crash	Location Mile Reference Marker	The mileage reference marker (commonly called milepost) to which an accident occurring on a state truck rural trafficway is referenced. Definition Source: ACCIDENT RECORDS A37	
66	Crash	Location Mile Reference Marker Displacement	The distance in feet or tenths of a mile from the accident location to the cited MRM. (see Location Mile Reference Marker) Definition Source: ACCIDENT RECORDS A38	
67	Crash	Narrative	This is the narrative of the accident that the reporting officer writes.	
68	Crash	Photos Taken	An indication of whether or not photos were taken at the accident scene. Definition Source: ACCIDENT RECORDS A54	
69	Crash	Rail Grade Crossing	A unique number assigned to a railroad crossing by a state highway agency in cooperation with the American Association of Railroads for identification purposes. (US DOT/AAR number) Rationale: The data is used in high crash locations as well as high risk corridors. Important for determining the need for additional controls and evaluating the efficacy of various types of controls. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998)	Code: State specific number assigned by a state in cooperation with the American Association of Railroads
70	Crash	Scene Investigation Location	A code indicating whether or not the accident was investigated at the scene. Definition Source: ACCIDENT RECORDS A53	Code: On Scene - one or more vehicles present On Scene - no vehicle present Off Scene Not Stated.

Ref#	Entity	Data Element	Definition	Note
71	Crash	RES Key	A 17 character key which identifies the accident location according to the State RES (Roadway Environment System). Used to identify accident location within the state truck system, to identify high accident locations, and to relate accidents to roadway features. Definition Source: ACCIDENT RECORDS A64	Position 1: Highway Class (State Road Data, County Road Data, City Road Data, Federal Domain Road Data, Sioux Falls, Rapid City) Position 2-4: Highway Number Position 5-7: Highway Suffix Position 8-12: Mileage Reference Marker Position 12-17: Mileage Reference Marker Displacement.
72	Crash	South Dakota Highway System	The relationship of the road on which the accident took place to the SD highway system. Used to classify accidents by highway system for comparison and problem analysis. Definition Source: ACCIDENT RECORDS A70 This seems to be derivable from: 1. Population Group. 2. Highway Class	Code: State Trunk Highway System Rural Road - (non-State Trunk) City Street - (non-State Trunk, population less than 5000) Small Urban (population 5000-49999) Sioux Falls Rapid City Alleys Other
73	Crash	Agency Use Only	This attribute provides a "generic" place for the Reporting Agency to store whatever they want. Note: This attribute is totally meaningless to the central office. It is placed here to give agencies a mechanism to link their widely differing system to the State's central database.	Some examples uses of this attribute are: 1. Some agencies will broadly categorize (wild animal hit, non-injury, injury, fatality, etc) their reports by placing a code at the top of the form. 2. An agency could put their agency specific CC#, Dispatch Call Number, etc in this data element. 3. Maybe the agency would do both by placing <category>-<Call Number> 4. An agency can basically use it as they see fit.
74	Crash	Coordinate Latitude	GPS (Global Positioning System) coordinate to specific locations in road inventory, traffic, driver, and other files. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998)	

Ref#	Entity	Data Element	Definition	Note
75	Crash	Coordinate Longitude	GPS (Global Positioning System) coordinate to specific locations in road inventory, traffic, driver, and other files. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998)	
76	Crash	Status	This is the status of the Crash information.	Code: New/Open - This crash report is in the process of being created. The crash report data is not complete. Report Close - The reporting officer has completed filling out this crash report. This crash report still needs to be reviewed. Agency Review - The reporting agency has reviewed and approved the crash report. This crash report can now be considered by the State's Office of Accident Records. OAR Review - The Office of Accident Records has reviewed and approved the crash report. Approved Complete - The crash report is now ready for external entities to access it, get reports of it, etc... At this stage the crash report information should be relatively static.
77	Crash	First Harmful Event Location	The location of the First Harmful Event as it relates to its position within or outside the trafficway. (See Appendix H of MMUCC Final Report August 1998 showing diagram defining the sections of the trafficway.) Rationale: Important to identify highway geometric deficiencies. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C7	Roadway Shoulder Median Roadside Gore Outside trafficway Not reported Unknown

Ref#	Entity	Data Element	Definition	Note
78	Crash	First Harmful Event Vehicle Number	Number assigned to uniquely identify within the crash each vehicle involved in the crash. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V1	Code: Sequential number
79	Crash	First Harmful Event Sequence	The events in sequence for this vehicle. Rationale: Important for use in conjunction with most harmful event to generate complete information about the crash. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V23	MMUCC requires 4 events.
80	Crash	NGA SafetyNet Reportable**	Yes or No is the Crash is NGA reportable. The Crash is NGA (National Governor's Association) SafetyNet Reportable if the Crash is recordable under FMCSR, Part 394.3 (i.e., if fatalities were greater than 0, injuries were greater than 0, or a Crash vehicle was a towaway); AND the Vehicle is a "Commercial Motor Vehicle". NOTE: This is derivable from the number of injured/killed person(s) and the Leave Scene Method of the vehicle. This is shown here just for the logical view of this data model. Definition Source: FMCSR, Part 394.3	

Ref#	Entity	Data Element	Definition	Note
81	Crash Attachment		The entity stores of other crash related files (i.e. Attachments). This allows for all related information even "non-tabular data" to be stored in the central database, rather than placing these files on network file servers and storing a pointer to the file in the database. The actual file is stored in this entity in the database.	
82	Crash Attachment	Attachment Number	Sequential attachment number used to create a primary key.	
83	Crash Attachment	Crash	The unique identifier that identifies a given crash. Rationale: Facilitates linkage of traffic record sub-files back to the crash data file. If this identifier is available at the scene, it can also be recorded on the EMS record for linkage purposes. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C1 Crash Report Number (Definition Source: SAFETYNET 2000 Data Dictionary, December 2000)	Code: State specific identifier
84	Crash Attachment	Attachment	This a binary large object (BLOB). The attribute allows for the storage of other crash related files. This allows for all related information even "non-tabular" to be stored in the central database, rather than placing these files on network file servers and storing a pointer here. The actual file is stored here.	Examples include: picture files (*.jpg, *.gif, *.tiff, etc...), audio files (*.wav, *.mp3), audio/video files (*.mpg) Also this is where the image of the paper accident form can be stored. Crash Scene Diagram will be stored here.
85	Crash Attachment	Attachment Description	This is a textual description of what the attachment is.	Example: This is an audio recording taken from witness John Doe at the accident scene.

Ref#	Entity	Data Element	Definition	Note
86	Crash Attachment	Vehicle Number	Number assigned to uniquely identify within the crash each vehicle involved in the crash. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V1	Code: Sequential number
87	Crash Attachment	Person	Person Identifier. This is an unique sequential number that is assigned to each person involved in the crash, whether they be a driver, passenger, bicyclist, pedestrian, etc...	
88	Crash Person		Crash Person is anyone involved in the Crash. Whether a pedestrian, occupant, driver, witness, property owner, etc.	
89	Crash Person	Person	Person Identifier. This is an unique sequential number that is assigned to each person involved in the crash, whether they be a driver, passenger, bicyclist, pedestrian, etc...	
90	Crash Person	Crash	The unique identifier that identifies a given crash. Rationale: Facilitates linkage of traffic record sub-files back to the crash data file. If this identifier is available at the scene, it can also be recorded on the EMS record for linkage purposes. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C1 Crash Report Number (Definition Source: SAFETYNET 2000 Data Dictionary, December 2000)	Code: State specific identifier
91	Crash Person	Address State	Address of the person somehow involved in the Crash. Person could be a driver, pedestrian, bicyclist, passenger, owner of a damaged property. Definition Source: ACCIDENT RECORDS B01, V03, O01, R01,P03	

Ref#	Entity	Data Element	Definition	Note
92	Crash Person	Sex	The sex of person involved in a crash. Rationale: Necessary to evaluate the effect of gender on occupant protection systems and vehicle design characteristics. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) P2	Code: Male Female Not reported Unknown
93	Crash Person	Name First	The full name of the individual driver, or other person some how involved in this Crash. Rationale: This data element should be collected to corroborate the driver license number and to facilitate linkage when names are available in the health and insurance files. When possible, obtain this information from the driver license (via a bar code or "smart" license or via on-line linkage if the technology exists at the state level). Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) P13	Code: See Appendix C of US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998)

Ref#	Entity	Data Element	Definition	Note
94	Crash Person	Name Last	The full name of the individual driver, or other person some how involved in this Crash. Rationale: This data element should be collected to corroborate the driver license number and to facilitate linkage when names are available in the health and insurance files. When possible, obtain this information from the driver license (via a bar code or "smart" license or via on-line linkage if the technology exists at the state level). Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) P13	Code: See Appendix C of US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998)
95	Crash Person	Name Middle	The full name of the individual driver, or other person some how involved in this Crash. Rationale: This data element should be collected to corroborate the driver license number and to facilitate linkage when names are available in the health and insurance files. When possible, obtain this information from the driver license (via a bar code or "smart" license or via on-line linkage if the technology exists at the state level). Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) P13	Code: See Appendix C of US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998)

Ref#	Entity	Data Element	Definition	Note
96	Crash Person	Name Suffix	The full name of the individual driver, or other person some how involved in this Crash. Rationale: This data element should be collected to corroborate the driver license number and to facilitate linkage when names are available in the health and insurance files. When possible, obtain this information from the driver license (via a bar code or "smart" license or via on-line linkage if the technology exists at the state level). Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) P13	Code: See Appendix C of US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998)
97	Crash Person	Birth Date	The year, month, and day of birth of person involved in a crash. Rationale: Uses of accurate reporting of age include assessing effectiveness of occupant protection systems for specific age groups, and identifying the need for safety programs directed toward them. This element is also critical in providing linkage between the crash, EMS, and hospital records. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) P1	Code: YYYYMMDD
98	Crash Person	Injury Status	The injury severity level for a person involved in crash. Rationale: Necessary for injury outcome analysis and evaluation. This element is also critical in providing linkage between the crash, EMS, and hospital records. Injury severity as indicated by KABCO is also desirable for states to collect. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) P4	Code: Fatal Injury (K) Nonfatal Injury Incapacitating (A) Non-incapacitating (B) Possible (C) No injury (O) Not reported Unknown

Ref#	Entity	Data Element	Definition	Note
99	Crash Person	Address Street	Address of the person somehow involved in the Crash. Person could be a driver, pedestrian, bicyclist, passenger, owner of a damaged property. Definition Source: ACCIDENT RECORDS B01, V03, O01, R01,P03	
100	Crash Person	Address City	Address of the person somehow involved in the Crash. Person could be a driver, pedestrian, bicyclist, passenger, owner of a damaged property. Definition Source: ACCIDENT RECORDS B01, V03, O01, R01,P03	
101	Crash Person	Person Type	Type of person involved in a crash. Rationale: Need to know person type for classification purposes to evaluate specific countermeasure designed for specific people. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) P3	Code: Driver Passenger Non-motorist Property Owner Not reported Unknown
102	Crash Person	Address Zip Code	Address of the person somehow involved in the Crash. Person could be a driver, pedestrian, bicyclist, passenger, owner of a damaged property. Definition Source: ACCIDENT RECORDS B01, V03, O01, R01,P03	
103	Crash Person	Other Drug Involvement Police	This element excludes nicotine, aspirin, alcohol and drugs known to be administered post-crash. Definition Source: FARS 2000 P19	Code: No Yes Not Reported Unknown

Ref#	Entity	Data Element	Definition	Note
104	Crash Person	Other Drug Determination Method Police	This is the method by which the police made the determination as to whether other drugs were involved or not. Definition Source: FARS 2000 P20	Code: Evidential Test (blood, urine) Drug Recognition Technician (DRT) Behavioral Other (e.g., Saliva test) Not Reported
105	Crash Person	Alcohol Determination Method Police	This is the method by which the police made the determination as to whether alcohol was involved or not. Definition Source: FARS 2000 P17	Code: Evidential Test (breath, blood, urine) Preliminary Breath Test Behavioral Passive Alcohol Sensor Observed Other (e.g., Saliva test) Not Reported
106	Crash Person	Alcohol Drug Suspected	Investigating police officer's assessment of whether alcohol or drugs were used by the vehicle driver or non-motorist. Rationale: Alcohol and drug related crashes remain a serious traffic safety problem. Identifying crashes in which alcohol or drugs may have been involved will help evaluate the effectiveness of programs to decrease the incidence of drunk driving or to identify problem areas. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) P18	Code: Neither alcohol nor drugs suspected Yes - alcohol suspected Yes - drugs suspected Yes - alcohol and drugs suspected Not reported Unknown

Ref#	Entity	Data Element	Definition	Note
107	Crash Person	Alcohol Test Type	The type of alcohol test given. Rationale: Alcohol remains the most prevalent drug involved in motor vehicle crashes. Capturing alcohol concentration whenever a driver or non-motorist is tested will provide an accurate assessment of the extent of involvement. The type of test used to obtain the alcohol concentration also is important information to collect. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) P19	Code: Blood Serum Breath Urine
108	Crash Person	Alcohol Test Status	The Status of the alcohol test. Rationale: Alcohol remains the most prevalent drug involved in motor vehicle crashes. Capturing alcohol concentration whenever a driver or non-motorist is tested will provide an accurate assessment of the extent of involvement. The type of test used to obtain the alcohol concentration also is important information to collect. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) P19	Code: None given Test refused Test given, contaminated sample/unusable Test given, results known Test given, results unknown Unknown

Ref#	Entity	Data Element	Definition	Note
109	Crash Person	Alcohol Test Result	The alcohol test result. Rationale: Alcohol remains the most prevalent drug involved in motor vehicle crashes. Capturing alcohol concentration whenever a driver or non-motorist is tested will provide an accurate assessment of the extent of involvement. The type of test used to obtain the alcohol concentration also is important information to collect. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) P19	
110	Crash Person	Cited	Indication of whether driver received a motor vehicle citation as a result of the crash. Rationale: Important for evaluation of enforcement programs. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) P16	Code: Yes No Pending Unknown
111	Crash Person Condition		The condition that a person has that may have contributed to the crash. Key word here is "MAY HAVE". Having a condition does not necessarily mean that it did contribute to the cause of the crash. Rationale: Important for evaluating the effect that driver fatigue, medications/alcohol/drugs, or other conditions have on the crash. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) P15	

Ref#	Entity	Data Element	Definition	Note
112	Crash Person Condition	Person	Person Identifier. This is an unique sequential number that is assigned to each person involved in the crash, whether they be a driver, passenger, bicyclist, pedestrian, etc...	
113	Crash Person Condition	Person Condition	The condition of the non-motorist or driver immediately prior to a crash. The condition that a person has that may have contributed to the crash. Key word here is "MAY HAVE". Having a condition does not necessarily mean that it did contribute to the cause of the crash. Rationale: Important for evaluating the effect that driver fatigue, medications/alcohol/drugs, or other conditions have on the crash. Information about the condition of the non-motorist is needed to develop engineering, educational, and enforcement countermeasures to reduce crashes involving non-motorists. Needed to determine "fault" of crash. Needed to evaluate effect of existing, if any, countermeasures that have been applied. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) P15	Code: Apparently normal Physical impairment Emotional (e.g., depressed, angry, disturbed) Illness Fell asleep, fainted, fatigued, etc. Under the influence of medications/ drugs/ alcohol Other Not reported Unknown
114	Crash Person Condition	Crash	The unique identifier that identifies a given crash. Rationale: Facilitates linkage of traffic record sub-files back to the crash data file. If this identifier is available at the scene, it can also be recorded on the EMS record for linkage purposes. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C1 Crash Report Number (Definition Source: SAFETYNET 2000 Data Dictionary, December 2000)	Code: State specific identifier

Ref#	Entity	Data Element	Definition	Note
115	Crash Person Driver		2.2.37 driver: A driver is an occupant who is in actual physical control of a transport vehicle or, for an out-of-control vehicle, an occupant who was in control until control was lost. Definition Source: ANSI D16.1-1996	
116	Crash Person Driver	Person	Person Identifier. This is an unique sequential number that is assigned to each person involved in the crash, whether they be a driver, passenger, bicyclist, pedestrian, etc...	
117	Crash Person Driver	Crash	The unique identifier that identifies a given crash. Rationale: Facilitates linkage of traffic record sub-files back to the crash data file. If this identifier is available at the scene, it can also be recorded on the EMS record for linkage purposes. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C1 Crash Report Number (Definition Source: SAFETYNET 2000 Data Dictionary, December 2000)	Code: State specific identifier

Ref#	Entity	Data Element	Definition	Note
118	Crash Person Driver	Driver License State Province	The state, commonwealth, territory, Indian nation, U.S. Government, foreign country, etc. issuing the registration plate and the year of registration as indicated on the registration plate displayed on the vehicle. For foreign countries, MMUCC requires only the name of the country. Border states may want to collect the name of individual Canadian Provinces or Mexican States. Rationale: This element is critical in providing linkage between the crash and vehicle registration files to access the vehicle identification number. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V2, P11	Code: Identifier of the state, foreign country U.S. government Indian Nation Canadian Province Mexican State International License Not Reported Unknown (See Appendix A of US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998))
119	Crash Person Driver	Driver License Type Compliance	This refers to the type of license possessed or not possessed by the driver for the class of vehicle being driven involved in the accident. Definition Source: FARS 2000 D10	Code: Not Licensed No license required for this class vehicle No valid license for the class vehicle Valid license for this class vehicle Unknown if CDL and/or CDL endorsement required for this vehicle. Unknown
120	Crash Person Driver	Driver License Endorsements Compliance	This indicates whether the vehicle involved in the accident requires endorsement(s) on a Commercial Driver's License (CDL) and whether this driver is complying with the CDL endorsements. Definition Source: FARS 2000 D09	Code: No Endorsements required for this vehicle Endorsements required, complied with Endorsements required, not complied with Endorsements required, compliance unknown Unknown, if required

Ref#	Entity	Data Element	Definition	Note
121	Crash Person Driver	Driver License Restrictions Compliance	Refers to both physical restrictions (corrective lenses, automatic transmission, etc.) and imposed restrictions (limited driving) but does not include any limitations imposed on learner's permits (e.g., driving without a licensed driver is not a restriction). Definition Source: FARS 2000 D11	Code: Blank No restrictions or not applicable Restrictions complied with Restrictions not complied with Restrictions compliance unknown Unknown
122	Crash Person Driver	Height	The driver's height in inches. Definition Source: FARS 2000 D12	
123	Crash Person Driver	Weight	The driver's weight in pounds. Definition Source: FARS 2000 D13	
124	Crash Person Driver	Driver License Number	A unique number assigned by the authorizing agent issuing a driver license to the individual. Rationale: This element is critical in providing linkage between the crash and driver license files at the state level. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) P12	Code: Alphanumeric identifier assigned by the state, foreign country, U.S. government, Indian Nation, etc.
125	Crash Person Drug Involvement		Drug tests for the person involved in the crash. A single person can have many drug test performed. This entity stores this drug test/involvement information Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) P20	The FARS system allows up to 3 drug test to be submitted for each person involved in the accident. Rationale: Drugs other than alcohol are increasingly involved in traffic crashes. Identifying drug related crashes will help develop and evaluate programs directed at reducing their involvement. Whenever evidence of other drug use is available, it should be captured.

Ref#	Entity	Data Element	Definition	Note
126	Crash Person Drug Involvement	Person	Person Identifier. This is an unique sequential number that is assigned to each person involved in the crash, whether they be a driver, passenger, bicyclist, pedestrian, etc...	
127	Crash Person Drug Involvement	Drug Involvement Number	These is a sequential number used to identify a unique Crash Person Drug Involvement test. The FARS system allows for up to 3 tests for drugs to be submitted.	
128	Crash Person Drug Involvement	Crash	The unique identifier that identifies a given crash. Rationale: Facilitates linkage of traffic record sub-files back to the crash data file. If this identifier is available at the scene, it can also be recorded on the EMS record for linkage purposes. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C1 Crash Report Number (Definition Source: SAFETYNET 2000 Data Dictionary, December 2000)	Code: State specific identifier
129	Crash Person Drug Involvement	Drug Test Status	Indication of the presence of drugs through drug testing. Status of the drug test. Rationale: Drugs other than alcohol are increasingly involved in traffic crashes. Identifying drug related crashes will help develop and evaluate programs directed at reducing their involvement. Whenever evidence of other drug use is available, it should be captured. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) P20	Code: Test not given Test given, no drugs reported Test given, drugs reported Test given, contaminated sample/unusable Not reported Unknown

Ref#	Entity	Data Element	Definition	Note
130	Crash Person Drug Involvement	Drug Test Result	Indication of the presence of drugs through drug testing. Rationale: Drugs other than alcohol are increasingly involved in traffic crashes. Identifying drug related crashes will help develop and evaluate programs directed at reducing their involvement. Whenever evidence of other drug use is available, it should be captured. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) P20	Code: (Drugs regulated for commercial motor vehicle drivers and others.) Marijuana Cocaine Opiates Amphetamines PCP Other
131	Crash Person Drug Involvement	Drug Test Type	Indication of the presence of drugs through drug testing. Type of drug test given. Rationale: Drugs other than alcohol are increasingly involved in traffic crashes. Identifying drug related crashes will help develop and evaluate programs directed at reducing their involvement. Whenever evidence of other drug use is available, it should be captured. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) P20	Code: Blood Urine Serum
132	Crash Person Injured		Any person involved in the Crash that sustained an injury as defined by ANSI D16.1. 2.3.1 injury: An injury is bodily harm to a person. Definition Source: ANSI D16.1-1996	Exclusions: - Persons suffering from the effects of diseases such as stroke, heart attack, diabetic coma, epileptic seizure, and others
133	Crash Person Injured	Person	Person Identifier. This is an unique sequential number that is assigned to each person involved in the crash, whether they be a driver, passenger, bicyclist, pedestrian, etc...	

Ref#	Entity	Data Element	Definition	Note
134	Crash Person Injured	Crash	The unique identifier that identifies a given crash. Rationale: Facilitates linkage of traffic record sub-files back to the crash data file. If this identifier is available at the scene, it can also be recorded on the EMS record for linkage purposes. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C1 Crash Report Number (Definition Source: SAFETYNET 2000 Data Dictionary, December 2000)	Code: State specific identifier
135	Crash Person Injured	Death Location City	The city where death occurred. Definition Source: FARS 2000 SP01	
136	Crash Person Injured	Medical Facility	Medical Facility ID number for medical facility receiving patient. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) P29	
137	Crash Person Injured	Death Certificate Number	Death Certification Number as assigned by State Vital Statistics Department. Definition Source: FARS 2000 SP01	
138	Crash Person Injured	Death Date Time	The death must occur within thirty 24 hour time periods (i.e. 30 days) from the time of the accident in order to be an applicable FARS death. Definition Source: FARS 2000 P25, P26	

Ref#	Entity	Data Element	Definition	Note
139	Crash Person Injured	Death Location	The location where the person died.	Code: Blank Died at Scene Died En Route Unknown
140	Crash Person Injured	Injured Transport Method	Type and identity of unit providing transport to medical facility receiving patient. Rationale: Important to trace victim from the scene of crash through the health care system. Will facilitate linkage of injured crash victims with Emergency Medical Services data files. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) P29	Code: Not transported EMS Police Other Not reported Unknown
141	Crash Person Injured	Death Location State	The state where death occurred. Definition Source: FARS 2000 SP01	
142	Crash Person Injured	EMS Run Number	EMS Response Run Number of EMS run report. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) P29 Emergency Medical Service system number. This is the trip number that the EMS system uses to identify an EMS trip. This is not the key to the entity because the EMS trip number may not be able to be collected at the scene, but may be collected later. This is the LINK into the EMS system.	

Ref#	Entity	Data Element	Definition	Note
143	Crash Person Injured	Fatal Injury At Work	Indicates that the injury that caused death occurred at work or not. Note: Fatal injury at work should only be determined from the death certificate, not from any other source. Definition Source: FARS 2000 SP02	Code: 0 - No 1 - Yes 8 - Not Applicable (not a fatality) 9 - Unknown
144	Crash Person Injured	Race	Race of the person that died. Definition Source: FARS 2000 SP03	Code: 00 - Not Applicable 01 - White 02 - Black 03 - American Indian (see the FARS Coding Manual for more)
145	Crash Person Injured	Hispanic Origin	Indicates the Hispanic Origin of the person that died. Definition Source: FARS 2000 SP03	Code: 00 - Not Applicable 01 - Mexican 02 - Puerto Rican 03 - Cuban (see the FARS Coding Manual for more)
146	Crash Person Non-Motorist		2.2.41 non-motorist: A non-motorist is any person other than a motorist. 2.2.36 pedestrian: A pedestrian is any person who is not an occupant. 2.2.39 pedalcyclist: A pedalcyclist is any occupant of a pedalcycle in transport. Definition Source: ANSI D16.1-1996	Inclusions: - Pedestrians - Occupants of motor vehicles not in trans- port - Occupants of transport vehicles other than motor vehicles
147	Crash Person Non-Motorist	Person	Person Identifier. This is an unique sequential number that is assigned to each person involved in the crash, whether they be a driver, passenger, bicyclist, pedestrian, etc...	

Ref#	Entity	Data Element	Definition	Note
148	Crash Person Non-Motorist	Crash	The unique identifier that identifies a given crash. Rationale: Facilitates linkage of traffic record sub-files back to the crash data file. If this identifier is available at the scene, it can also be recorded on the EMS record for linkage purposes. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C1 Crash Report Number (Definition Source: SAFETYNET 2000 Data Dictionary, December 2000)	Code: State specific identifier
149	Crash Person Non-Motorist	Non-Motorist Type	The type of non-motorist involved in a crash. Rationale: Used by management/administration to differentiate type of non-motorist involved in crash and to evaluate extent of non motorist involvement in motor vehicle crashes. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) P22	Code: Pedestrian Pedalcyclist (bicycle, tricycle, unicycle, pedal car) Skater Other non-motorist (wheelchair, etc.) Not reported Unknown
150	Crash Person Non-Motorist	Non-Motorist Action	The actions of the non-motorist prior to the crash. Rationale: Needed to develop engineering, educational, and enforcement countermeasures to reduce non-motorist crashes. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) P23	Code: Entering or crossing specified location Walking, running, jogging, playing, cycling Working Pushing vehicle Approaching or leaving vehicle Playing or working on vehicle Standing Other Not reported Unknown

Ref#	Entity	Data Element	Definition	Note
151	Crash Person Non-Motorist	Non-Motorist Location Before Impact	The non-motorist's location with respect to the roadway prior to impact. Rationale: Preceding non-motorist location information used in developing engineering, educational, and enforcement countermeasures for both motorists and non-motorists to reduce non-motorist crashes. Needed to determine "fault" of crash. Needed to evaluate effect of existing, if any, countermeasures that have been applied. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) P26	Code: Marked crosswalk at intersection; At intersection but no crosswalk; Non-intersection crosswalk; Driveway access crosswalk; In roadway; Not in roadway; Median (but not on shoulder); Island; Shoulder; Sidewalk; Within 10 feet of roadway (but not shoulder, median, sidewalk, or island); Beyond 10 feet of roadway (within trafficway); Outside trafficway; Shared-use path or trails; Not reported; Unknown
152	Crash Person Non-Motorist	Non-Motorist Struck By Vehicle Number	Number assigned to uniquely identify within the crash each vehicle involved in the crash. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V1	Code: Sequential number
153	Crash Person Occupant		2.2.35 occupant: An occupant is any person who is part of a transport vehicle. 2.2.38 passenger: A passenger is any occupant of a road vehicle other than its driver. 2.2.40 motorist: A motorist is any occupant of a motor vehicle in transport. Definition Source: ANSI D16.1-1996	
154	Crash Person Occupant	Person	Person Identifier. This is an unique sequential number that is assigned to each person involved in the crash, whether they be a driver, passenger, bicyclist, pedestrian, etc...	

Ref#	Entity	Data Element	Definition	Note
155	Crash Person Occupant	Crash	The unique identifier that identifies a given crash. Rationale: Facilitates linkage of traffic record sub-files back to the crash data file. If this identifier is available at the scene, it can also be recorded on the EMS record for linkage purposes. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C1 Crash Report Number (Definition Source: SAFETYNET 2000 Data Dictionary, December 2000)	Code: State specific identifier
156	Crash Person Occupant	Ejection	The location of each occupant's body as being completely or partially thrown from the vehicle as a result of a crash. Rationale: Occupant protection systems prevent or mitigate ejections to different extent. Crash injury outcome may depend on information from this element. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) P9	Code: Not ejected Totally ejected Partially ejected Not applicable Not reported Unknown
157	Crash Person Occupant	Ejection Path	This indicates the path by which the person was ejected from the vehicle. Definition Source: FARS 2000 P13	Code: Blank; Not Ejected; Side Door Opening; Side Window; Windshield; Back Window; Back Door/Tailgate Opening; Roof Opening (sunroof, convertible top down); Roof (convertible top up); Other Path (e.g. back of pick-up truck); Unknown

Ref#	Entity	Data Element	Definition	Note
158	Crash Person Occupant	Air Bag Deployment	Deployment status of an air bag relative to position of the occupant. Rationale: Necessary to evaluate the effectiveness of air bags and other occupant protection equipment, especially at a time when air bags are rapidly increasing in the vehicle population and when consumers are allowed to have the air bag disconnected under certain conditions. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) P8	Code: Deployed-front Deployed-side Deployed-both front/side Not-deployed Not applicable Not reported Deployment unknown
159	Crash Person Occupant	Extrication	Persons who are mechanically restrained in the vehicle by damaged vehicle components as a result of a crash, and are freed from the vehicle. Rationale: This element would be used to evaluate vehicle integrity and the impact of the need for Jaws of Life or other mechanical means on medical outcome for victims who are entrapped. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) P10	Code: Not trapped Extricated by mechanical means Freed by nonmechanical means Not reported Unknown

Ref#	Entity	Data Element	Definition	Note
160	Crash Person Occupant	Seating Position	The location for this occupant in, on, or outside of the motor vehicle prior to the impact of a crash Rationale: Without known seating position for each person in the vehicle, it is not possible to fully evaluate the effect of occupant protection programs. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) P6	Code: Front seat - left side (or motorcycle driver) Front seat - middle Front seat - right side Second seat - left side (or motorcycle passenger) Second seat - middle Second seat - right side Third row - left side (or motorcycle passenger) Third row - middle Third row - right side Sleeper section of cab (truck) Passenger in other enclosed passenger or cargo area (non-trailing unit such as a bus, etc.) Passenger in unenclosed passenger or cargo area (non-trailing unit such as a pickup, etc.) Trailing unit Riding on vehicle exterior (non-trailing unit) Not reported Unknown
161	Crash Person Occupant	Air Bag Switch Status	Deployment status of an air bag relative to position of the occupant. Rationale: Necessary to evaluate the effectiveness of air bags and other occupant protection equipment, especially at a time when air bags are rapidly increasing in the vehicle population and when consumers are allowed to have the air bag disconnected under certain conditions. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) P8	Code: Switch in ON position Switch in OFF position ON-OFF switch not present Unknown if ON-OFF switch present Not reported Unknown position

Ref#	Entity	Data Element	Definition	Note
162	Crash Person Occupant	Occupant Vehicle Number	Number assigned to uniquely identify within the crash each vehicle involved in the crash. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V1	Code: Sequential number
163	Crash Person Occupant Protection System Used		For the occupant of a vehicle involved in the crash this entity stores the restraint equipment in use by occupant at the time of the crash Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) P7	Rationale: Proper classification of the use of available occupant protection systems would be used to evaluate the effectiveness of such equipment.
164	Crash Person Occupant Protection System Used	Person	Person Identifier. This is an unique sequential number that is assigned to each person involved in the crash, whether they be a driver, passenger, bicyclist, pedestrian, etc...	
165	Crash Person Occupant Protection System Used	Protection System	The restraint equipment in use by occupant at the time of the crash, or the helmet use by a motorcyclist. Rationale: Proper classification of the use of available occupant protection systems would be used to evaluate the effectiveness of such equipment. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) P7	Code: None used - vehicle occupant Shoulder belt only used Lap belt only used Shoulder and lap belt used Child safety seat used Helmet used Not reported Restraint use unknown

Ref#	Entity	Data Element	Definition	Note
166	Crash Person Occupant Protection System Used	Crash	The unique identifier that identifies a given crash. Rationale: Facilitates linkage of traffic record sub-files back to the crash data file. If this identifier is available at the scene, it can also be recorded on the EMS record for linkage purposes. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C1 Crash Report Number (Definition Source: SAFETYNET 2000 Data Dictionary, December 2000)	Code: State specific identifier
167	Crash Person Violation		Citation issued as a result of the accident. State and Local violations with which an accident involved vehicle driver is charged as a result of the accident. Definition Source: ACCIDENT RECORDS V33	
168	Crash Person Violation	Person	Person Identifier. This is an unique sequential number that is assigned to each person involved in the crash, whether they be a driver, passenger, bicyclist, pedestrian, etc...	
169	Crash Person Violation	Violation Code	All violation codes that apply to indicate the type of violations for which driver was cited. Rationale: Important for evaluation of safety laws and enforcement practices. This information is not available from the driver license file. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) P17	Code: No violation (Violation Code) Not reported Unknown

Ref#	Entity	Data Element	Definition	Note
170	Crash Person Violation	Crash	The unique identifier that identifies a given crash. Rationale: Facilitates linkage of traffic record sub-files back to the crash data file. If this identifier is available at the scene, it can also be recorded on the EMS record for linkage purposes. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C1 Crash Report Number (Definition Source: SAFETYNET 2000 Data Dictionary, December 2000)	Code: State specific identifier
171	Crash Vehicle		A Crash Vehicle is a motor vehicle as defined by ANSI D16.1. 2.2.7 motor vehicle: A motor vehicle is any motorized (mechanically or electrically powered) road vehicle not operated on rails. (See 2.2.9- 2.2.26.) Definition Source: ANSI D16.1-1996	
172	Crash Vehicle	Vehicle Number	Number assigned to uniquely identify within the crash each vehicle involved in the crash. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V1	Code: Sequential number

Ref#	Entity	Data Element	Definition	Note
173	Crash Vehicle	Crash	The unique identifier that identifies a given crash. Rationale: Facilitates linkage of traffic record sub-files back to the crash data file. If this identifier is available at the scene, it can also be recorded on the EMS record for linkage purposes. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C1 Crash Report Number (Definition Source: SAFETYNET 2000 Data Dictionary, December 2000)	Code: State specific identifier
174	Crash Vehicle	Impact Point Initial	The portion of the vehicle that is damaged in a crash. Rationale: Important for use in evaluating injury severity in relation to vehicle impact and crash severity. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V22	Code: 00 None; 01 Center front; 02 Right front; 03 Right side; 04 Right rear; 05 Rear center; 06 Left rear; 07 Left side; 08 Left front; 09 Top and windows; 10 Undercarriage; 11 Total (All areas); 12 Other; 99 Unknown
175	Crash Vehicle	Person Driver	Person Identifier. This is an unique sequential number that is assigned to each person involved in the crash, whether they be a driver, passenger, bicyclist, pedestrian, etc...	
176	Crash Vehicle	Person Owner	Person Identifier. This is an unique sequential number that is assigned to each person involved in the crash, whether they be a driver, passenger, bicyclist, pedestrian, etc...	

Ref#	Entity	Data Element	Definition	Note
177	Crash Vehicle	Registration State	The state, commonwealth, territory, Indian nation, U.S. Government, foreign country, etc. issuing the registration plate and the year of registration as indicated on the registration plate displayed on the vehicle. For foreign countries, MMUCC requires only the name of the country. Border states may want to collect the name of individual Canadian Provinces or Mexican States. Rationale: This element is critical in providing linkage between the crash and vehicle registration files to access the vehicle identification number. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V2, P11	Code: Identifier of the state, foreign country, U.S. government, Indian Nation, etc. (See Appendix A)
178	Crash Vehicle	Registration Year	The state, commonwealth, territory, Indian nation, U.S. Government, foreign country, etc. issuing the registration plate and the year of registration as indicated on the registration plate displayed on the vehicle. For foreign countries, MMUCC requires only the name of the country. Border states may want to collect the name of individual Canadian Provinces or Mexican States. Rationale: This element is critical in providing linkage between the crash and vehicle registration files to access the vehicle identification number. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V2	Code: YYYY for the year

Ref#	Entity	Data Element	Definition	Note
179	Crash Vehicle	License Plate Number	The alphanumeric identifier or other characters, exactly as displayed, on the registration plate or tag affixed to the vehicle. For combination trucks, vehicle plate number is obtained from the power unit or tractor. Rationale: This element is critical in providing linkage between the crash and vehicle registration files to access the vehicle identification number. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V3	Code: Alphanumeric identifier assigned by the state, foreign country, U.S. government, Indian Nation
180	Crash Vehicle	Carrier	Carrier id assigned by the computer behind the scenes. The user will never see this number. This is here because some carrier may not have an USDOT # or an ICC #. Therefore a surrogate key is required.	
181	Crash Vehicle	Carrier Identification Source	The source from which the Carrier Identification Number was determined.	Code: Shipping papers (truck) trip manifest (bus) logbook (Record of Duty Status) Other Not reported Unknown
182	Crash Vehicle	No Carrier Identification Available**	Yes or No? Was Carrier identification available. Definition Source: SAFETYNET 2001 S17	

Ref#	Entity	Data Element	Definition	Note
183	Crash Vehicle	Commercial Motor Vehicle	Yes or No is this a "Commercial Motor Vehicle" as defined by CFR 49, Part 390.5 Commercial motor vehicle means any self-propelled or towed motor vehicle used on a highway in interstate commerce to transport passengers or property when the vehicle-- (1) Has a gross vehicle weight rating or gross combination weight rating, or gross vehicle weight or gross combination weight, of 4,537 kg (10,001 lb) or more; whichever is greater; or (2) Is designed or used to transport more than 8 passengers (including the driver) for compensation; or (3) Is designed or used to transport more than 15 passengers, including the driver, and is not used to transport passengers for compensation; or (4) Is used in transporting material found by the Secretary of Transportation to be hazardous under 49 U.S.C. 5103 and transported in a quantity requiring placarding under regulations prescribed by the Secretary under 49 CFR, subtitle B, chapter I, subchapter C. Definition Source: CFR 49, Part 390.5	
184	Crash Vehicle	Commerce Use	Yes or No was this vehicle involved in commerce. This indicates if a vehicle is being used for commerce or transporting passengers for compensation.	

Ref#	Entity	Data Element	Definition	Note
185	Crash Vehicle	Bus Use	This indicates if a vehicle is being used for common forms of bus service (i.e. public school bus, scheduled service bus, tour bus, etc.) The vehicle body type does not have to be a bus. Definition Source: FARS 2000 V12	Code: Blank Not used as a Bus Used as a Public School Bus Used as a Private School Bus Used as a School Bus, Public or Private Unknown Used as Scheduled Service Bus Used as a Tour bus Used as a Commuter Bus Used as a Shuttle Bus Modified for Personal/Private Use Unknown Bus Use
186	Crash Vehicle	Gross Vehicle Weight Rating of Power Unit	A gross vehicle weight rating (GVWR) is a value, specified by the manufacturer of a motor vehicle, that indicates the capacity of the vehicle to tow or carry loads. (**currently mandated by Federal Highway Administration's Office of Motor Carriers.) Rationale: Three categories used for DOT regulation. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V12	Code: Weight Rating of Power Unit of the Motor Vehicle less than or equal to 10,000 pounds 10,001-26,000 more than 26,000

Ref#	Entity	Data Element	Definition	Note
187	Crash Vehicle	Hazardous Material Placard**	Indication that a motor vehicle had a hazardous materials placard as required by federal/state regulations. (**currently mandated by Federal Highway Administration's Office of Motor Carriers.) Rationale: Getting good data on crashes involving trucks carrying hazardous materials (HM) is important to the OMC. As a result, OMC imposes tighter regulations on carriers that operate vehicles that transport HM, pulls over sample HM carrying vehicles for roadside inspections, and conducts compliance reviews on a higher percent of HM carriers. This data element asks the reporting officer to observe: (1) whether or not the vehicle has a hazardous material placard, and (2) record what is on the placard. By recording this information, the FHWA will obtain good information about the types of hazardous materials involved in a crash and the crash scenes which were potential hazards. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V16 This can be derived from Hazardous Material Placard Number. i.e. If there is one, then Yes there was a Hazardous Material Placard.	Code: Did this vehicle have a hazardous materials placard? Yes No Not reported Unknown

Ref#	Entity	Data Element	Definition	Note
188	Crash Vehicle	Hazardous Material Placard Number	Indication that a motor vehicle had a hazardous materials placard as required by federal/state regulations. (**currently mandated by Federal Highway Administration's Office of Motor Carriers.) Rationale: Getting good data on crashes involving trucks carrying hazardous materials (HM) is important to the OMC. As a result, OMC imposes tighter regulations on carriers that operate vehicles that transport HM, pulls over sample HM carrying vehicles for roadside inspections, and conducts compliance reviews on a higher percent of HM carriers. This data element asks the reporting officer to observe: (1) whether or not the vehicle has a hazardous material placard, and (2) record what is on the placard. By recording this information, the FHWA will obtain good information about the types of hazardous materials involved in a crash and the crash scenes which were potential hazards. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V16	Code: If yes, record from the hazardous materials placard: (1) 4-digit placard number or name taken from the middle of the diamond or from the rectangular box; and (2) 1-digit placard number from bottom of diamond
189	Crash Vehicle	Hazardous Material Name	NOTE: This is NOT derivable from the Placard Number. The name of the hazardous material listed on the placard. Definition Source: SAFETYNET 2000 S42	

Ref#	Entity	Data Element	Definition	Note
190	Crash Vehicle	Hazardous Material Released	Indication whether hazardous materials were released from the cargo compartment. (**currently mandated by Federal Highway Administration's Office of Motor Carriers.) Rationale: Getting good data on crashes involving trucks carrying hazardous materials (HM) is important to the OMC. As a result, OMC imposes tighter regulations on carriers that operate vehicles that transport HM, pulls over sample HM carrying vehicles for roadside inspections, and conducts compliance reviews on a higher percent of HM carriers. This data element asks the reporting officer to indicate for those trucks carrying hazardous material, if the hazardous material spilled out of the cargo compartment. This information will indicate the crash scenes which were potential hazards because HM material escaped its packaging. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V17	Code: Not applicable Yes - hazardous materials released No - hazardous materials not released Not reported Unknown
191	Crash Vehicle	Speed Authorized Limit	Authorized speed limit for the vehicle at the time of the crash. The authorization may be indicated by the posted speed limit, blinking sign at construction zones, etc. Rationale: Important for evaluation purposes in spite of the fact that the speed of the vehicle at the time of the crash may differ significantly from the authorized speed limit. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V18	Code: Authorized Value
192	Crash Vehicle	Speed Authorized Limit Unit of Measure	Valid units of measure to describe speed. V18	Code: Miles per hour Kilometers per hour

Ref#	Entity	Data Element	Definition	Note
193	Crash Vehicle	Speed Estimated Travel Speed	This is the speed the vehicle was traveling prior to the occurrence of the accident. This is not "impact speed". Definition Source: FARS 2000 V15	
194	Crash Vehicle	Speed Estimated Travel Speed Determination Method	The manner in which estimated travel speed was determined. Definition Source: ACCIDENT RECORDS V26	
195	Crash Vehicle	Vehicle Maneuver	What the vehicle was doing prior to the crash. This the maneuver that is prior to the "unstabilizing event". Rationale: Important for evaluation purposes, particularly when combined with Direction of Travel. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V21	Code: Movements essentially straight ahead; Backing; Changing lanes; Overtaking/passing; Turning right; Turning left; Making U-turn; Entering traffic lane; Leaving traffic lane; Parked; Slowing or stopped in traffic; Other; Not reported; Unknown
196	Crash Vehicle	Vehicle Maneuver Avoidance	This element indicates if an avoidance maneuver was taken by the driver to avoid the crash. This is different from Vehicle Maneuver (which is prior to the unstabilizing event). Definition Source: FARS 2000 V17	Code: No Avoidance Maneuver Reported Braking (skidmarks evident) Braking (no skidmarks; driver stated) Braking (other reported evidence) Steering (evidence or stated) Steering and Braking (evidence or stated) Other avoidance maneuver Not reported/Inconclusive
197	Crash Vehicle	Impact Point Most Damaged	The portion of the vehicle that is damaged in a crash. Rationale: Important for use in evaluating injury severity in relation to vehicle impact and crash severity. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V27	Code: 00 None; 01 Center front; 02 Right front; 03 Right side; 04 Right rear; 05 Rear center; 06 Left rear; 07 Left side; 08 Left front; 09 Top and windows; 10 Undercarriage; 11 Total (All areas); 12 Other; 99 Unknown

Ref#	Entity	Data Element	Definition	Note
198	Crash Vehicle	Event Sequence Most Harmful	Event which produced the most severe injury or greatest property damage for this vehicle. Rationale: Important for use in conjunction with the Sequence of Events in Crash Vehicle Event to generate complete information about the crash. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V24	
199	Crash Vehicle	Direction of Force to Vehicle	The direction of force in the crash which caused the most harmful event to this vehicle. Rationale: Important for evaluation of occupant injuries and structural defects. This data element can be used in conjunction with Most Harmful Event Sequence to describe the crash. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V25	Code: Not applicable for non-collision events (rollover, fire, etc.) Unknown clock position indicating direction of force Clock position indicating direction of force.
200	Crash Vehicle	Underride Override	An underride refers to this vehicle sliding under another vehicle during a crash. An override refers to this vehicle riding up over another vehicle. Either can occur with a parked vehicle. Rationale: This information is needed to identify the magnitude of crashes in which an underride or override occurs to support NHTSA rulemaking activities. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V26	Code: No underride or override Underride, compartment intrusion Underride, no compartment intrusion Underride, compartment intrusion unknown Override, motor vehicle in transport Override, other vehicle Unknown if underride or override

Ref#	Entity	Data Element	Definition	Note
201	Crash Vehicle	Damage Extent	Estimation of total damage to vehicle from crash Rationale: Disabling or severe/vehicle-totaled damage implies damage to the vehicle that is sufficient to require the vehicle to be towed or carried from the scene. Determining whether a vehicle sustained this type of damage from a crash is key to consistent collection of crash data. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V28	Code: None/minor damage Functional damage Disabling damage Severe/vehicle totaled Not reported Unknown
202	Crash Vehicle	Damage Amount	The total dollar amount of damage to a vehicle and it contents that were involved in the Accident. Excludes occupants. Definition Source: ACCIDENT RECORDS V34	
203	Crash Vehicle	Travel Direction Before Crash	The direction of a vehicle's normal, general travel on the roadway before the crash. Notice that this is not a compass direction but a direction consistent with the designated direction of the road. For example, the direction of a state designated north-south highway must be either northbound or southbound even though a vehicle may have been traveling due east as a result of a short segment of the highway having an east-west orientation. Rationale: Important to indicate direction the vehicle was traveling before the crash for evaluation purposes. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V19	Code: Northbound Southbound Eastbound Westbound Not on roadway Not reported Unknown

Ref#	Entity	Data Element	Definition	Note
204	Crash Vehicle	Vehicle Role	Indicates vehicle role in single and multi-vehicle crashes. Role does not imply fault. Rationale: Important to determine role of vehicle in a crash for management, research and evaluation. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V14	Code: Non-contact Non-collision Striking Struck Both striking and struck Not reported Unknown
205	Crash Vehicle	Body Type Cargo	The type of body for buses and trucks over 10,000 pounds GVWR. (**currently mandated by Federal Highway Administration's Office of Motor Carriers.) Rationale: This data element provides more information about the vehicle, including all major cargo body types. The information it provides can be important in helping OMC make decisions on regulatory strategies for different types of vehicles. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V11	Code: Not applicable; Bus (seats for more than 15 people, including driver); Bus (seats for 7 - 15 people, including driver; Van/enclosed box; Grain/chips/gravel; Pole; Cargo tank; Flatbed; Dump; Concrete mixer; Auto transporter; Garbage/refuse; Other; Not reported; Unknown
206	Crash Vehicle	Body Type Vehicle	The general configuration or shape or a vehicle distinguished by characteristics such as number of doors, seats, windows, roof line, hard top or convertible. Source: Derived from the Vehicle Identification Number (VL1). Rationale: Important for use in identifying specific type of vehicle involved in a crash for evaluation and comparison purposes. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) VD03	Code: AM Ambulance; CB Cab & Chassis (Luv); CP Coupe; CV Convertible; HB Hatchback*; HR Hearse; HT Hardtop*; LB Liftback; LM Limousine; NB Notchback; PK Pickup**; PN Panel** (There are many more codes. see US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) VD3) * Used only when number of doors is unknown. ** To code trucks commonly registered as passenger vehicles

Ref#	Entity	Data Element	Definition	Note
207	Crash Vehicle	Vehicle Configuration	Indicates the general configuration of vehicle. (See Appendix I of US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) for types of truck configurations.) (**currently mandated by Federal Highway Administration's Office of Motor Carriers.) Rationale: This data element provides information about the general configuration of the vehicle which is important to evaluate the types of vehicles that have the most crashes and the effectiveness of various safety countermeasures. It should be collected for all crashes, not just those involving trucks. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V10	Code: Passenger car; Light truck(van, mini-van, panel, pickup, sport utility) with only four tires; Single-unit truck (2-axle, 6-tire); Single-unit truck (3-or-more axles); Truck/trailer; Truck tractor (bobtail); Tractor/semi-trailer; Tractor/doubles; Tractor/triples; Unknown heavy truck, cannot classify Motor home/recreational vehicle; Motorcycle; Bus (seats for more than 15 people, including driver); Bus (seats for 7 - 15 people, including driver); Other; Not reported; Unknown vehicle configuration
208	Crash Vehicle	Vehicle Identification Number	A unique combination of alphanumeric characters assigned to a specific vehicle and formulated by the manufacturer. When the technology is available, this number also can be obtained by using a bar code reader while the vehicle is at the scene. Rationale: Important for evaluation of specific vehicle design characteristics and occupant protection systems. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) VL1	Code: A manufacturer assigned number permanently affixed to the vehicle.

Ref#	Entity	Data Element	Definition	Note
209	Crash Vehicle	Vehicle Make	The distinctive (coded) name applied to a group of vehicles by a manufacturer. Rationale: Important for use in identifying vehicle make, for evaluation, research and crash comparison purposes. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V4	Code: Assigned by vehicle manufacturer
210	Crash Vehicle	Vehicle Model	The manufacturer assigned code denoting a family of vehicles (within a make) which has a degree of similarity in construction, such as body, chassis, etc. Source: Derived usually from positions 4, 5, 6 and 7 of the Vehicle Identification Number (VL1) for 1981 to present. Prior to 1981, the position for the model varied by manufacturer. This information also can be obtained separately from the Vehicle Registration File. Rationale: Important for use in identifying vehicle model, for evaluation, research and crash comparison purposes. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) VD2	Code: Assigned by vehicle manufacturer

Ref#	Entity	Data Element	Definition	Note
211	Crash Vehicle	Vehicle Model Year	The year which is assigned to a vehicle by the manufacturer. Source: Derived from the 10th position of the Vehicle Identification Number (VL1) for 1981 to present. Prior to 1981, the position for the model year varied by manufacturer. This information also can be obtained separately from the Vehicle Registration File. Rationale: Important for use in identifying vehicle model year, for evaluation, research and crash comparison purposes. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) VD1	Code: Assigned by vehicle manufacturer
212	Crash Vehicle	Emergency Use	Indicates vehicles, such as military, police, ambulance, fire, etc., which are on an emergency response. Emergency refers to a vehicle that is traveling with physical emergency signals in use-typically red light blinking, siren sounding, etc. Code yes only if the vehicle was on an emergency response. Rationale: Important for determining if vehicles on emergency runs are over-involved in crashes. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V15	Code: No Yes Not reported Unknown

Ref#	Entity	Data Element	Definition	Note
213	Crash Vehicle	Special Use	Indicates whether the vehicle was used for a function other than the primary function for that type of vehicle. Definition Source: FARS 2000 V13	Code: No Special Use Taxi Vehicle used as School Bus Vehicle used as Other Bus Military Police Ambulance Fire truck Unknown
214	Crash Vehicle	Axle Count	The total number of axles on the vehicle (and converter dolly), including the trailing units. Definition Source: FARS 2000 V28	
215	Crash Vehicle	Insurance Company Name	This is the name of the insurance company that insures this vehicle.	
216	Crash Vehicle	Insurance Effective Date	This is the effective date of the insurances insuring this vehicle.	
217	Crash Vehicle	Insurance Expiration Date	This is the expiration date of the insurances insuring this vehicle.	
218	Crash Vehicle	Insurance Policy Number	This is the policy number of the insurance policy that is insuring this vehicle.	
219	Crash Vehicle	Leave Scene Method	Refers to the disposition of the vehicle at the accident scene. Definition Source: FARS 2000 V24	Code: Blank Towed Away Abandoned/Left at Scene Unknown

Ref#	Entity	Data Element	Definition	Note
220	Crash Vehicle	Registered Owner Type	This identifies the type of registered owner of the vehicle. The type of ownership, "loan vs. lease", does not impact this attribute. Definition Source: FARS V06	Code: Blank N/A, Vehicle not registered Driver (in this crash) was registered owner Driver (in this crash) was not registered owner Vehicle registered as Business, Company, or Government vehicle. Vehicle registered as rental vehicle Vehicle was stolen (reported by police) Driverless Vehicle Unknown
221	Crash Vehicle	Vehicle Trailing	A trailing unit applies to any device connected to a motor vehicle by a hitch, including tractor-trailer combinations, boat hitched onto a vehicle, etc. A converter dolly is a device used to hitch a trailer to another semi-trailer or straight truck and is not counted as a separate trailing unit. Towed vehicles such as a tow truck pulling a vehicle, a vehicle towed by a rope or chain, or saddle-mount units are not considered to be trailing units. Definition Source: FARS 2000 V27	Code: No Yes, one trailing unit Yes, two trailing units Yes, three or more trailing units Yes, number of trailing units unknown Unknown
222	Crash Vehicle	Total Occupant In Vehicle Count**	DERIVED via "Crash Participant" The count of occupants in this vehicle involved in the crash, including persons in or on the vehicle at the time of the crash. Rationale: Important for use in evaluating total involved in crash and injury/severity. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V13	Code: Total number of occupants including the driver Unknown

Ref#	Entity	Data Element	Definition	Note
223	Crash Vehicle	Damage Area	The location of damage, to the vehicle, sustained in the crash. Rationale: Accident severity determination, potentially useful to officers in court cases. To verify direction of travel when diagram is not available or incorrect. Definition Source: PS-ACCIDENT V46	
224	Crash Vehicle Event		This entity stores all the Crash Event(s) that could occurred for a vehicle. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V23 Also see FARS 2000 V18 (Rollover), V19 (Fire Occurrence), V32 (Jackknife)	Rationale: Important for use in conjunction with most harmful event to generate complete information about the crash.
225	Crash Vehicle Event	Vehicle Number	Number assigned to uniquely identify within the crash each vehicle involved in the crash. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V1	Code: Sequential number
226	Crash Vehicle Event	Event Sequence	The events in sequence for this vehicle. Rationale: Important for use in conjunction with most harmful event to generate complete information about the crash. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V23	MMUCC requires 4 events.

Ref#	Entity	Data Element	Definition	Note
227	Crash Vehicle Event	Crash	The unique identifier that identifies a given crash. Rationale: Facilitates linkage of traffic record sub-files back to the crash data file. If this identifier is available at the scene, it can also be recorded on the EMS record for linkage purposes. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C1 Crash Report Number (Definition Source: SAFETYNET 2000 Data Dictionary, December 2000)	Code: State specific identifier
228	Crash Vehicle Event	Crash Event	Crash Event that could occur for a vehicle. Rationale: Important for use in conjunction with most harmful event to generate complete information about the crash. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C06, V23 Also see FARS 2000 V18 (Rollover), V19 (Fire Occurrence), V32 (Jackknife)	Code: Non-collision Overturn/rollover; Fire/explosion; Immersion; Jackknife; Cargo/equipment loss or shift; Equipment failure (blown tire, brake failure, etc.); Separation of units; Ran off road right; Ran off road left; Cross median/centerline; Downhill runaway; Other non-collision Unknown non-collision; Collision with person, vehicle, or object not fixed; Pedestrian; Pedalcycle; Railway vehicle (e.g., train, engine); Animal; Motor vehicle in transport; Parked motor vehicle; Work zone maintenance equipment; Other movable object; Unknown movable object Collision with fixed object Impact attenuator/crash cushion; Bridge overhead structure; Bridge pier or abutment; Bridge parapet end; Bridge rail; Guardrail face; Guardrail end; Median barrier; Highway traffic sign post; Overhead sign support; Light/luminaire

Ref#	Entity	Data Element	Definition	Note
				support; Utility pole; Other post, pole, or support; Culvert; Curb; Ditch; Embankment; Fence; Mail box; Tree; Other fixed object (wall, building, tunnel, etc.); Work zone maintenance equipment; Unknown fixed object Other Not reported Unknown (see US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) for more codes)
229	Crash Vehicle Traffic Control		The type of traffic control device (TCD) applicable to vehicle at crash location. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V20	Rationale: This element needs to be collected at the scene because the presence of specific devices is better verified at the time of the crash. It is also important for ascertaining the relationship between the use of various TCDs and crashes and identifying the need for upgraded TCDs at specific crash locations.
230	Crash Vehicle Traffic Control	Crash	The unique identifier that identifies a given crash. Rationale: Facilitates linkage of traffic record sub-files back to the crash data file. If this identifier is available at the scene, it can also be recorded on the EMS record for linkage purposes. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C1 Crash Report Number (Definition Source: SAFETYNET 2000 Data Dictionary, December 2000)	Code: State specific identifier

Ref#	Entity	Data Element	Definition	Note
231	Crash Vehicle Traffic Control	Traffic Control Device Type	The type of traffic control device (TCD) applicable to vehicle at crash location. Pavement markings are included under Pavement Markings, Longitudinal (RL14). Rationale: This element needs to be collected at the scene because the presence of specific devices is better verified at the time of the crash. It is also important for ascertaining the relationship between the use of various TCDs and crashes and identifying the need for upgraded TCDs at specific crash locations. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V20	Code: No controls Traffic control signal Flashing traffic control signal School zone signs Stop signs Yield signs Warning signs Railway crossing device Not reported Unknown
232	Crash Vehicle Traffic Control	Vehicle Number	Number assigned to uniquely identify within the crash each vehicle involved in the crash. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V1	Code: Sequential number
233	Crash Vehicle Traffic Control	Traffic Control Device Functioning	Indicates whether the traffic control device was functioning properly, not functioning, functioning improperly, unknown, or no control. Definition Source: FARS 2000 A30	Code: No Controls Device Not Functioning Device Functioning - Functioning Improperly Device Functioning Properly Unknown
234	Crash Vehicle Trailer		A vehicle involved in a crash can have zero, one, to many Trailer in tow. This entity stores the trailer specific information.	

Ref#	Entity	Data Element	Definition	Note
235	Crash Vehicle Trailer	Crash	The unique identifier that identifies a given crash. Rationale: Facilitates linkage of traffic record sub-files back to the crash data file. If this identifier is available at the scene, it can also be recorded on the EMS record for linkage purposes. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C1 Crash Report Number (Definition Source: SAFETYNET 2000 Data Dictionary, December 2000)	Code: State specific identifier
236	Crash Vehicle Trailer	Trailer Sequence	1 for the first trailer behind the power unit. 2 for the second 3 for the third and so on.	
237	Crash Vehicle Trailer	Vehicle Number	Number assigned to uniquely identify within the crash each vehicle involved in the crash. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V1	Code: Sequential number

Ref#	Entity	Data Element	Definition	Note
238	Crash Vehicle Trailer	Registration State	The state, commonwealth, territory, Indian nation, U.S. Government, foreign country, etc. issuing the registration plate and the year of registration as indicated on the registration plate displayed on the trailer. For foreign countries, MMUCC requires only the name of the country. Border states may want to collect the name of individual Canadian provinces or Mexican States. Rationale: This element is critical in providing linkage between the crash and vehicle registration files to access the vehicle identification number. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V5	Code: Identifier of the state, foreign country, U.S. government, Indian Nation, etc. (See Appendix A)
239	Crash Vehicle Trailer	Registration Year	The state, commonwealth, territory, Indian nation, U.S. Government, foreign country, etc. issuing the registration plate and the year of registration as indicated on the registration plate displayed on the trailer. For foreign countries, MMUCC requires only the name of the country. Border states may want to collect the name of individual Canadian provinces or Mexican States. Rationale: This element is critical in providing linkage between the crash and vehicle registration files to access the vehicle identification number. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V5	Code: YYYY for the year

Ref#	Entity	Data Element	Definition	Note
240	Crash Vehicle Trailer	License Plate Number	The alphanumeric identifier exactly as displayed, on the registration plate or tag affixed to the trailer. Rationale: This element is critical in providing linkage between the crash and vehicle registration files to access the vehicle identification number. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V6	Code: Alphanumeric identifier assigned by the state, foreign country, U.S. government, Indian Nation
241	Crash Vehicle Trailer	Person Owner	Person Identifier. This is an unique sequential number that is assigned to each person involved in the crash, whether they be a driver, passenger, bicyclist, pedestrian, etc...	
242	Crash Weather Condition		The prevailing atmospheric conditions that existed at the time of the crash. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C11	According to MMUCC there are 2 weather conditions. Rationale: Important for management/administration and evaluation. Critical for preventive programs and engineering evaluations.
243	Crash Weather Condition	Weather Condition	The prevailing atmospheric conditions that existed at the time of the crash. Rationale: Important for management/administration and evaluation. Critical for preventive programs and engineering evaluations. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C11	Clear Cloudy Fog, smog, smoke Rain Sleet, hail (freezing rain or drizzle) Snow Severe crosswinds Blowing sand, soil, dirt, snow Other Not reported Unknown

Ref#	Entity	Data Element	Definition	Note
244	Crash Weather Condition	Crash	The unique identifier that identifies a given crash. Rationale: Facilitates linkage of traffic record sub-files back to the crash data file. If this identifier is available at the scene, it can also be recorded on the EMS record for linkage purposes. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C1 Crash Report Number (Definition Source: SAFETYNET 2000 Data Dictionary, December 2000)	Code: State specific identifier
245	Damaged Object		Any Object that was damaged as a result of the accident. Damage is defined by ANSI D16.1 as 2.3.7 damage: Damage is harm to property that reduces the monetary value of that property. Definition Source: ACCIDENT RECORDS A20	Excludes: Vehicles and the contents of vehicles. Inclusions: - Harm to wild animals, or birds, which have monetary value - And others Exclusions: - Harm to wild animals, or birds, which have no monetary value - Harm to a snowbank unless, for example, additional snow removal costs are incurred because of the harm - Mechanical failure during normal operation, such as tire blowout, broken fan belt, or broken axle - And others
246	Damaged Object	Crash	The unique identifier that identifies a given crash. Rationale: Facilitates linkage of traffic record sub-files back to the crash data file. If this identifier is available at the scene, it can also be recorded on the EMS record for linkage purposes. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C1 Crash Report Number (Definition Source: SAFETYNET 2000 Data Dictionary, December 2000)	Code: State specific identifier

Ref#	Entity	Data Element	Definition	Note
247	Damaged Object	Damaged Object	Unique identifier for an object damaged as a result of this crash.	
248	Damaged Object	Damage Amount	The dollar amount of damage to this object that was damaged as a result of the accident. Definition Source: ACCIDENT RECORDS A19	
249	Damaged Object	Person Owner	Person Identifier. This is an unique sequential number that is assigned to each person involved in the crash, whether they be a driver, passenger, bicyclist, pedestrian, etc...	
250	Damaged Object	Object Description	Description of the object that was damaged as a result of the accident. Definition Source: ACCIDENT RECORDS A20	
251	Driver History (external)		EXTERNAL ENTITY. This entity is shown here in this model merely for illustration of where "logically" certain data attributes exist. This entity is not necessarily fully normalized or attributed.	
252	Driver History (external)	Driver History	Driver History record identifier.	
253	Driver History (external)	Suspension	Counter for number of previous suspensions and revocations. Definition Source: FARS 2000 D14-D18	
254	Driver History (external)	Conviction	Counter for number of previous DWI convictions. Definition Source: FARS 2000 D14-D18	
255	Driver History (external)	Speeding	Counter for number of previous speeding citations. Definition Source: FARS 2000 D14-D18	

Ref#	Entity	Data Element	Definition	Note
256	Driver History (external)	Other Harmful Moving Violation	Counter for number of previous other harmful moving violations. Definition Source: FARS 2000 D14-D18	
257	Driver History (external)	Date	Date of accident, suspension, conviction, speeding, other harmful moving violation. Definition Source: FARS 2000 D19-D20	
258	Driver History (external)	Accident	Counter for number of previous accidents. Definition Source: FARS 2000 D14-D18	
259	Driver History (external)	Driver License State Province	The state, commonwealth, territory, Indian nation, U.S. Government, foreign country, etc. issuing the registration plate and the year of registration as indicated on the registration plate displayed on the vehicle. For foreign countries, MMUCC requires only the name of the country. Border states may want to collect the name of individual Canadian Provinces or Mexican States. Rationale: This element is critical in providing linkage between the crash and vehicle registration files to access the vehicle identification number. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V2, P11	Code: Identifier of the state, foreign country U.S. government Indian Nation Canadian Province Mexican State International License Not Reported Unknown (See Appendix A of US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998))

Ref#	Entity	Data Element	Definition	Note
260	Driver History (external)	Driver License Number	A unique number assigned by the authorizing agent issuing a driver license to the individual. Rationale: This element is critical in providing linkage between the crash and driver license files at the state level. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) P12	Code: Alphanumeric identifier assigned by the state, foreign country, U.S. government, Indian Nation, etc.
261	Driver History (external)	Class	The type of commercial or noncommercial vehicle that a licensed driver has been examined on and/or approved to operate. Rationale: Used to identify those drivers who were not complying with the limitations of their operators license. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) PL01	Code: Class "A" vehicles - any combination of vehicles with a GVWR of 26,001 or more pounds, provided the GVWR of the vehicle(s) being towed is in excess of 10,000 pounds. (Holders of Class A license may with the appropriate endorsement operate all class B & C vehicles.) Class "B" vehicles - any single vehicle with a GVWR of 26,001 or more pounds, or any such vehicle towing a vehicle not in excess of 10,000 pounds. (Holders of Class B license may with the appropriate endorsement operate all class C vehicles.) Class "C" vehicles - any single vehicle less than 26,001 pounds GVWR, or any such vehicle towing a vehicle not in excess of 10,000 pounds GVWR. Class "M" vehicles - Motorcycles, Mopeds, Motor-driven cycles. Never held a license or state can no longer provide this information

Ref#	Entity	Data Element	Definition	Note
262	Driver History (external)	Status	The current status of an individual's driver license. Rationale: Used to identify drivers involved in crashes who are not in compliance with the limitations of their operators license. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) PL03	Code: Normal, within restrictions Violation, beyond restrictions Violation, under suspension Violation, revoked Violation, no license endorsement for this vehicle type Violation, no license Violation, expired license No license required Unknown
263	Driver License Restriction (external)		EXTERNAL ENTITY. This entity is shown here in this model merely for illustration of where "logically" certain data attributes exist. This entity is not necessarily fully normalized or attributed.	
264	Driver License Restriction (external)	Driver License State Province	The state, commonwealth, territory, Indian nation, U.S. Government, foreign country, etc. issuing the registration plate and the year of registration as indicated on the registration plate displayed on the vehicle. For foreign countries, MMUCC requires only the name of the country. Border states may want to collect the name of individual Canadian Provinces or Mexican States. Rationale: This element is critical in providing linkage between the crash and vehicle registration files to access the vehicle identification number. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) V2, P11	Code: Identifier of the state, foreign country U.S. government Indian Nation Canadian Province Mexican State International License Not Reported Unknown (See Appendix A of US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998))

Ref#	Entity	Data Element	Definition	Note
265	Driver License Restriction (external)	Driver License Number	A unique number assigned by the authorizing agent issuing a driver license to the individual. Rationale: This element is critical in providing linkage between the crash and driver license files at the state level. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) P12	Code: Alphanumeric identifier assigned by the state, foreign country, U.S. government, Indian Nation, etc.
266	Driver License Restriction (external)	License Restriction	Restrictions assigned to an individual's driver license by the license examiner. Rationale: Used to identify drivers who with limitations on their operators license and who were involved in crashes. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) PL02	Code: None; Corrective lenses; Mechanical devices (Special brakes, hand controls, or other adaptive devices); Prosthetic aid; Automatic transmission; Outside mirror; Limit to daylight only; Limit to employment; Limited - other; Other; CDL Intrastate only; Vehicles without air-brakes; Except Class A bus; Except Class A and Class B bus; Except tractor-trailer; Farm waiver
267	Driver Related Conviction		This entity identifies a driver's previous convictions, suspensions, and accidents that can be considered to be related to this accident. (see FARS 2000 D19, D20 and CVARS for more detail on why this information is important)	
268	Driver Related Conviction	Person	Person Identifier. This is an unique sequential number that is assigned to each person involved in the crash, whether they be a driver, passenger, bicyclist, pedestrian, etc...	
269	Driver Related Conviction	Driver History	Driver History record identifier.	

Ref#	Entity	Data Element	Definition	Note
270	Driver Related Conviction	Crash	The unique identifier that identifies a given crash. Rationale: Facilitates linkage of traffic record sub-files back to the crash data file. If this identifier is available at the scene, it can also be recorded on the EMS record for linkage purposes. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C1 Crash Report Number (Definition Source: SAFETYNET 2000 Data Dictionary, December 2000)	Code: State specific identifier
271	EMS Trip (external)		EXTERNAL ENTITY. This entity is shown here in this model merely for illustration of where "logically" certain data attributes exist. This entity is not necessarily fully normalized or attributed.	
272	EMS Trip (external)	EMS Run Number	EMS Response Run Number of EMS run report. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) P29 Emergency Medical Service system number. This is the trip number that the EMS system uses to identify an EMS trip. This is not the key to the entity because the EMS trip number may not be able to be collected at the scene, but may be collected later. This is the LINK into the EMS system.	
273	EMS Trip (external)	EMS Time Arrival	The time that Emergency Medical Services arrived to the accident scene. Definition Source: FARS 2000 A37	

Ref#	Entity	Data Element	Definition	Note
274	EMS Trip (external)	EMS Time Notification	The time the Emergency Medical Service was notified. Definition Source: FARS 2000 V36	
275	EMS Trip (external)	EMS Time at Hospital	The time that the Emergency Medical Service arrived at the treatment facility to which it was transporting victims of the accident. Definition Source: FARS 2000 V38	
276	EMS Trip (external)	Injury Area	The primary or most obvious area of the person's body injured during the crash. Rationale: This type of information will help to distinguish between multiple injured in the same crash. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) PL04	Code: Types of areas are indicated by a matrix or narrative in the EMS records or as an injury or billing code (ICD-9-CM, etc.) in the emergency department, hospital or insurance records. The following list represents the major areas of the body subject to injury. Head Face Neck Thorax (chest) Abdomen and pelvis Spine Upper extremity Lower extremity Unspecified
277	EMS Trip (external)	Injury Description	Type of injury inflicted to primary Injury Area (PL4). Rationale: This type of information will help to distinguish between multiple injured in the same crash. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) PL05	Code: Describe injury according to data elements included in the files being linked.

Ref#	Entity	Data Element	Definition	Note
278	EMS Trip (external)	EMS Agency Identifier	EMS Response Agency Identifier ID for EMS agency that responds. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) P29	
279	GIS (external)		EXTERNAL ENTITY. This entity is shown here in this model merely for illustration of where "logically" certain data attributes exist. This entity is not necessarily fully normalized or attributed.	
280	GIS (external)	Coordinate Latitude	GPS (Global Positioning System) coordinate to specific locations in road inventory, traffic, driver, and other files. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998)	
281	GIS (external)	Coordinate Longitude	GPS (Global Positioning System) coordinate to specific locations in road inventory, traffic, driver, and other files. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998)	
282	GIS (external)	Special Jurisdiction	Indicates that the road is under the regulation of SPECIAL JURISDICTION, although it may be patrolled by the state, county, or local police agencies. Definition Source: FARS 2000 A16	Code: No Special Jurisdiction National Park Service Military Indian Reservation College/University Campus Other Federal Properties Other Unknown

Ref#	Entity	Data Element	Definition	Note
283	Non-Motorist Safety Equipment Used		The safety equipment(s) used by the Non-motorist. Rationale: Used to evaluate effectiveness of non-motorist safety equipment. Important to calculate usage statistics for the development and evaluation of effectiveness of educational countermeasures. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) P27	
284	Non-Motorist Safety Equipment Used	Person	Person Identifier. This is an unique sequential number that is assigned to each person involved in the crash, whether they be a driver, passenger, bicyclist, pedestrian, etc...	
285	Non-Motorist Safety Equipment Used	Non-Motorist Safety Equipment	The safety equipment(s) used by the Non-motorist. Rationale: Used to evaluate effectiveness of non-motorist safety equipment. Important to calculate usage statistics for the development and evaluation of effectiveness of educational countermeasures. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) P27	Code: Subfield 1: Safety Equipment Used by Non-motorist None used Helmet used Protective pads used (elbows, knees, shins, etc.) Reflective clothing Lighting Not applicable Other Not reported Unknown Subfield 2: Safety Equipment Used by non-motorist See Subfield 1

Ref#	Entity	Data Element	Definition	Note
286	Non-Motorist Safety Equipment Used	Crash	The unique identifier that identifies a given crash. Rationale: Facilitates linkage of traffic record sub-files back to the crash data file. If this identifier is available at the scene, it can also be recorded on the EMS record for linkage purposes. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) C1 Crash Report Number (Definition Source: SAFETYNET 2000 Data Dictionary, December 2000)	Code: State specific identifier
287	RES Roadway (external)		EXTERNAL ENTITY. This entity is shown here in this model merely for illustration of where "logically" certain data attributes exist. This entity is not necessarily fully normalized or attributed. Roadway as defined by ANSI D16.1. 2.2.28 roadway: A roadway is that part of a trafficway designed, improved, and ordinarily used for motor vehicle travel or, where various classes of motor vehicles are segregated, that part of a trafficway used by a particular class. Separate roadways may be provided for northbound and southbound traffic or for trucks and automobiles. See Figure 1. Definition Source: ANSI D16.1-1996	Exclusions: - Bridle paths, bicycle paths - And others NOTE - The above definition of "roadway" is consistent with definitions in general use by police and by traffic engineers. See the Uniform Vehicle Code and the Manual on Uniform Traffic Control Devices (ANSI D6.1e-1989, page 1A-8). Other highway engineers commonly use the term "roadway" as the term "road" is defined in 2.2.33 below. See AASHO Highway Definitions, American Association of State Highway Officials (now American Association of State Highway and Transportation Officials), January 1968. For a more recent reference, see the definition of "shoulder" in A Policy on Geometric Design of Highways and Streets, AASHTO, 1984, page 362.

Ref#	Entity	Data Element	Definition	Note
288	RES Roadway (external)	RES Key	A 17 character key which identifies the accident location according to the State RES (Roadway Environment System). Used to identify accident location within the state truck system, to identify high accident locations, and to relate accidents to roadway features. Definition Source: ACCIDENT RECORDS A64	Position 1: Highway Class (State Road Data, County Road Data, City Road Data, Federal Domain Road Data, Sioux Falls, Rapid City) Position 2-4: Highway Number Position 5-7: Highway Suffix Position 8-12: Mileage Reference Marker Position 12-17: Mileage Reference Marker Displacement.
289	RES Roadway (external)	Width Median	Average width of portion of divided highway separating the traveled way for traffic in opposing directions where crash occurred. Rationale: Important to monitor the unmet need for medians to protect motorists from oncoming traffic. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998)	Code: Average width of median in feet (meters)
290	RES Roadway (external)	Delineator Presence	The presence or absence of a series of reflecting devices mounted at regular intervals along the side of the road to indicate the alignment of the roadway. Rationale: Important for determining the effectiveness of delineation on night time and run-off-the-road crashes and guide future installations. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998)	Code: None Delineators, right Delineators, left Delineators, both sides Not reported Unknown

Ref#	Entity	Data Element	Definition	Note
291	RES Roadway (external)	Intersection Mainline Approach Volume	Total traffic volume for the mainline approaches of an intersection. Rationale: Important to understand volume of crashes in relation to exposure for the mainline approaches. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) RL21	Code: Report actual or estimated traffic volume expressed as an average annual daily count.
292	RES Roadway (external)	Intersection Mainline Lane Count	Number of "thru" lanes on the mainline approaches of an intersection, including all lanes with "thru" movement ("thru" and left-turn, or "thru" and right-turn) but not exclusive turn lanes. Rationale: Important to describe the intersection. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998)	Code: One lane Two lane Three lanes Four to six lanes Seven to nine lanes Unknown
293	RES Roadway (external)	Intersection Side Road Lane Count	Number of "thru" lanes on the side-road approaches at intersection including all lanes with "thru" movement ("thru" and left-turn, or "thru" and right-turn) but not exclusive turn lanes. Rationale: Important to describe the intersection. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998)	Code: One lane Two lane Three lanes Four to six lanes Seven to nine lanes Unknown

Ref#	Entity	Data Element	Definition	Note
294	RES Roadway (external)	Lane Count	Total number of lanes in the trafficway, regardless of function or direction of travel, at the particular cross section of the trafficway where the crash occurred. Rationale: Used in studying broad categories as well as identifying the environment of a particular crash. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998)	Code: Total number of lanes in the trafficway
295	RES Roadway (external)	Horizontal Alignment	(see FARS 2000 A24)	Code: Straight Curve Unknown
296	RES Roadway (external)	Grade/Profile	(see FARS 2000 A25) The inclination of a roadway, expressed in the rate of rise or fall in feet (meters) per 100 feet (meters) of horizontal distance. Rationale: Grade is used in diagnosing possible causes and countermeasures for a high crash site. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) RL03	Code: Level Grade Hillcrest Sag Unknown

Ref#	Entity	Data Element	Definition	Note
297	RES Roadway (external)	Surface Type	(see FARS 2000 A26)	Code: Concrete Blacktop, Bituminous, or Asphalt Brick or Block Slag, Gravel or Stone Dirt Other Unknown
298	RES Roadway (external)	Route Signing	(see FARS 2000 A12)	Code: Interstate; U.S. Highway; State Highway; County Road; Township; Municipality; Frontage Road; Other; Unknown
299	RES Roadway (external)	Trafficway Description	Indication of whether or not a trafficway is divided and whether it serves one-way or two-way traffic. (A divided trafficway is one on which roadways for travel in opposite directions are physically separated by more than an easily traversable centerline.) Rationale: Used in classifying crashes as well as identifying the environment of a particular crash. Note that data must be in a road inventory file or collected by the reporting officer. It is not readily derived from the other road data such as classification or route. Important to guide future trafficway design and traffic control. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) RL08	Code: Two-way, not divided Two-way, divided, unprotected median Two-way, divided, positive median barrier One-way, not divided Not reported Unknown

Ref#	Entity	Data Element	Definition	Note
300	RES Roadway (external)	Width Lane	Average widths of the lane(s) where crash occurred. Rationale: Important to monitor the association of shoulder/lane widths and the frequency of crashes. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998)	Code: Average lane width in feet
301	RES Roadway (external)	Bikeway	Any road, path, or way which in some manner is specifically designated as being open to bicycle travel, regardless of whether such facilities are designated for the exclusive use of bicycles or are to be shared with other transportation modes. Rationale: Needed to determine usage of bicycle facilities. Needed to determine location of bicycle crashes in relation to bicycle facility. Information is used to design facilities to more safely accommodate both bicycles and motor vehicles. Important for ascertaining the relative safety performance of various types/classes of bike paths to guide future design/operation decisions. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998)	Code: No Bikeway Bicycle Route (signed) Bicycle Lane (striped) - right only Bicycle Lane (striped) - both sides Bicycle Lane (striped) - left only Separate Bicycle Path/Trail Not reported Unknown
302	RES Roadway (external)	Width Shoulder	Average widths of the shoulder(s) where crash occurred. Rationale: Important to monitor the association of shoulder/lane widths and the frequency of crashes. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998)	Code: Average shoulder width in feet

Ref#	Entity	Data Element	Definition	Note
303	RES Roadway (external)	National Highway System	Designation as part of the National Highway System. Rationale: Important to monitor highway safety on National Highway System. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998)	Code: Yes No Not reported Unknown
304	RES Roadway (external)	Access Control	The degree that access to abutting land in connection with a highway is fully, partially or not controlled by public authority. Rationale: Access control is highly correlated with crash rates. Road inventory files or police reported data on access control is used in identifying high hazard locations. Important to guide future highway design and traffic control. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) RL11	Code: Full Access Control Partial access Control No Access Control
305	RES Roadway (external)	Annual Average Daily Traffic	The average number of vehicles passing a point on a trafficway in a day, for all days of the year, during a specified calendar year. Rationale: Important to normalize crash data to account for the exposure. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) RL07	

Ref#	Entity	Data Element	Definition	Note
306	RES Roadway (external)	Bridge Structure Identification	A unique identifier assigned to a bridge, underpass, overpass, or tunnel. Rationale: Identifying the bridge can link to the specific geometric data describing the bridge for problem identification analysis. Important for determining the relationship between structure characteristics and crashes. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) RL01	Code: Number as described in Recording and Coding guide for the Structure Inventory and Appraisal of the National's Bridges, December 1988, Federal Highway Administration, item 8. HPMS/90, item 77.
307	RES Roadway (external)	Highway Class	The type of political subdivision which controls the trafficway on which the accident took place. Definition Source: ACCIDENT RECORDS A29	Code: State Road Data County Road Data City Road Data Federal Domain Road Data Sioux Falls Rapid City

Ref#	Entity	Data Element	Definition	Note
308	RES Roadway (external)	Federal Highway System	The character of service or function of streets or highways. The classification of rural and urban is determined by state and local officials in cooperation with each other and approved by the Federal Highway Administration, U.S. Department of Transportation. Rationale: Important for comparing crash rates/safety experience of highways of similar design characteristics so as to identify those highways or highway sections that have abnormal rates/experience for future improvements as well as generalized study of the highways in a region or state. Knowledge of the land use is needed in analyzing crashes as part of a network analysis. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) RL05 Type of road on which accident occurred with respect to the Federal Highway System. Used to identify highway system on which the accident took place for the purposes of analyzing various highway types. Definition Source: ACCIDENT RECORDS A24	Code: Rural Principal arterial-interstate Principal arterial-other Minor arterial Major Collector Minor Collector Local Urban Principal arterial-interstate Principal arterial-other freeway or expressway Principal arterial-other Minor arterial Collector Local Unknown

Ref#	Entity	Data Element	Definition	Note
309	RES Roadway (external)	Intersection Traffic Control Type	Type of traffic control device at intersection where crash occurred. Rationale: Important to understand the relationship between crashes at intersections and the type of traffic control device present. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) RL18	Code: No control; Stop signs on cross street only; Stop signs on mainline only; Four-way stop signs; Four-way flasher (Red on cross street); Four-way flasher (Red on mainline); Four-way flasher (Red on all); Yield signs on cross street only; Yield signs on mainline only; Signals pretimed (2 phase); Signals pretimed (multi-phase); Signals semi-actuated (2 phase); Signals semi-actuated (multi-phase); Signals fully-actuated (2 phase); Signals fully-actuated (multi-phase); Other; Unknown
310	RES Roadway (external)	Longitudinal Pavement Marking Function	The longitudinal markings (paint, plastic, or other) used on the roadway surface to guide or control the path followed by drivers. Rationale: Knowledge of the existence of pavement markings is necessary to the analysis of crash data. Important for determining the affects of various types of longitudinal markings on various types of crashes to guide future applications. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) RL14	Code: Centerline, skip-dash; Centerline, solid; Centerline, solid double; No passing barrier, right or left; Lane line, skip-dash; Lane line, solid; Edge line, left; Edge line, right; Left turn lane lines, combination of solid and skip-dash; Turn arrow symbols, right, through, left, or combination of two; Not reported; Unknown

Ref#	Entity	Data Element	Definition	Note
311	RES Roadway (external)	Longitudinal Pavement Marking Color	The longitudinal markings (paint, plastic, or other) used on the roadway surface to guide or control the path followed by drivers. Rationale: Knowledge of the existence of pavement markings is necessary to the analysis of crash data. Important for determining the affects of various types of longitudinal markings on various types of crashes to guide future applications. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) RL14	Code: yellow white
312	RES Roadway (external)	Longitudinal Pavement Marking Material	The longitudinal markings (paint, plastic, or other) used on the roadway surface to guide or control the path followed by drivers. Rationale: Knowledge of the existence of pavement markings is necessary to the analysis of crash data. Important for determining the affects of various types of longitudinal markings on various types of crashes to guide future applications. Definition Source: US DOT Final Report Model Minimum Uniform Crash Criteria (August 1998) RL14	Code: Paint Thermoplastic Raised markers Permanent inlay Tape Other Not reported Unknown

Appendix N. IRB Meeting Notes

Les Myrah, Mark Kirk, & Robin Schumacher met with Linda Peterson to get the Information Review Board's (IRB's) perspective on the Information Technology direction at the DOT and how that impacts the proposed Migration Plan for the Accident Reporting system. Below are the highlights of the discussion:

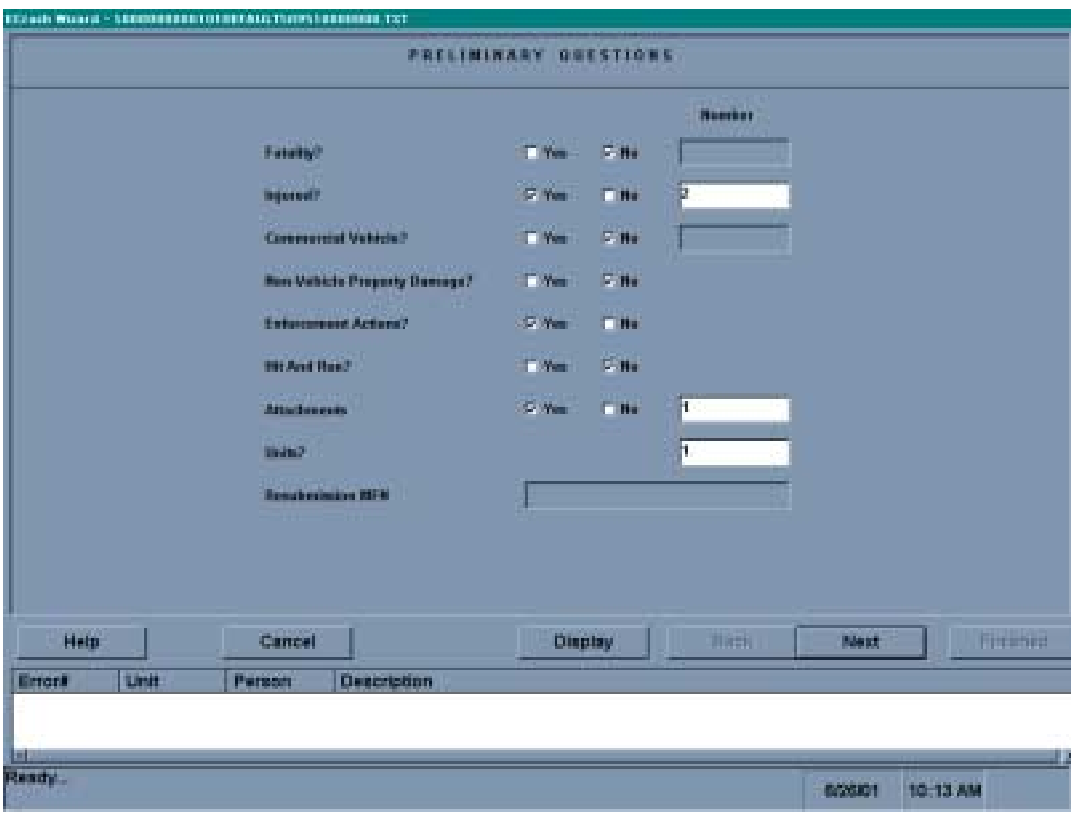
- For the systems involved with the Accident Reporting system, there is no immediate plan to replace the current mainframe systems. These systems include: RES, PONTIS, dROAD, and Driver License Update. For this reason, it is necessary that these existing legacy systems continue to be supported by any "new" Accident Reporting system that is developed. This basically means the "new" system must continue to supply PS-ACCIDENT data to these systems as it has done in the past (as shown in Phase I diagrams above).
- For the first phase of the "new" system an "upload process" must be used to continue to supply data to the PS-ACCIDENT database. This is the database that is used by all of the current legacy systems.
- The second phase would consist of replacing the mainframe PS-ACCIDENT database with a software system that provides integration between applications regardless of hardware platform. These systems are known under the description of "Enterprise Application Integration (EAI). BIT is currently evaluating the software systems from 5 vendors to provide this functionality. The BIT task force's plan is to choose a vendor and pilot their application during the 3rd and 4th quarter 2001. Upon completion of the pilot and acceptance of the results, the software would be available to all BIT teams to incorporate into production systems as required. Our recommendation is to modify the existing mainframe applications to utilize this new software as soon as the new software system is available which would then obsolete the Accident database upload process.
- Linda agreed with the System Migration Diagrams as illustrated in the SD2000-14 Final Report.

Appendix O. Kentucky's eCRASH Review Notes

Overview

The eCRASH system is a front-end data collection system for entering traffic accident reports only. Unlike Iowa's TraCS, eCRASH does not provide any other functionality, such as DUIs or citations. Also unlike TraCS, Kentucky's system was not designed to be a system that would be shared with other states. What this means to us, is that eCRASH was developed specifically for Kentucky without regard for making it easy for other states to use it, modify it, enhance it, support it, etc. This is simply a difference in initial direction.

The system presents multiple panels to the user, each with a group of related information such as location, injuries, fatalities, commercial vehicle info, etc. The navigation between data fields and panels is fairly easy. Below is a screen print showing the initial panel presented for entering a crash report. Based on the information entered on this screen, the system will edit input information (such as total number of people entered must equal what is on this screen) and will gray out certain panels (such as fatality info if fatalities = "N" on this window).



Entered reports can be viewed on a list window. Upon completion of the data entry process, a virtual paper report is displayed for review and print purposes.

Overall, we found this system to be slightly less easy to use than the Iowa system and far less feature-rich and flexible. The user interface is not fully Windows-compliant, resulting in some strange system behaviors (such as, we could not see other active applications or the "Start" button at the bottom of the screen).

Functionality Review Matrix

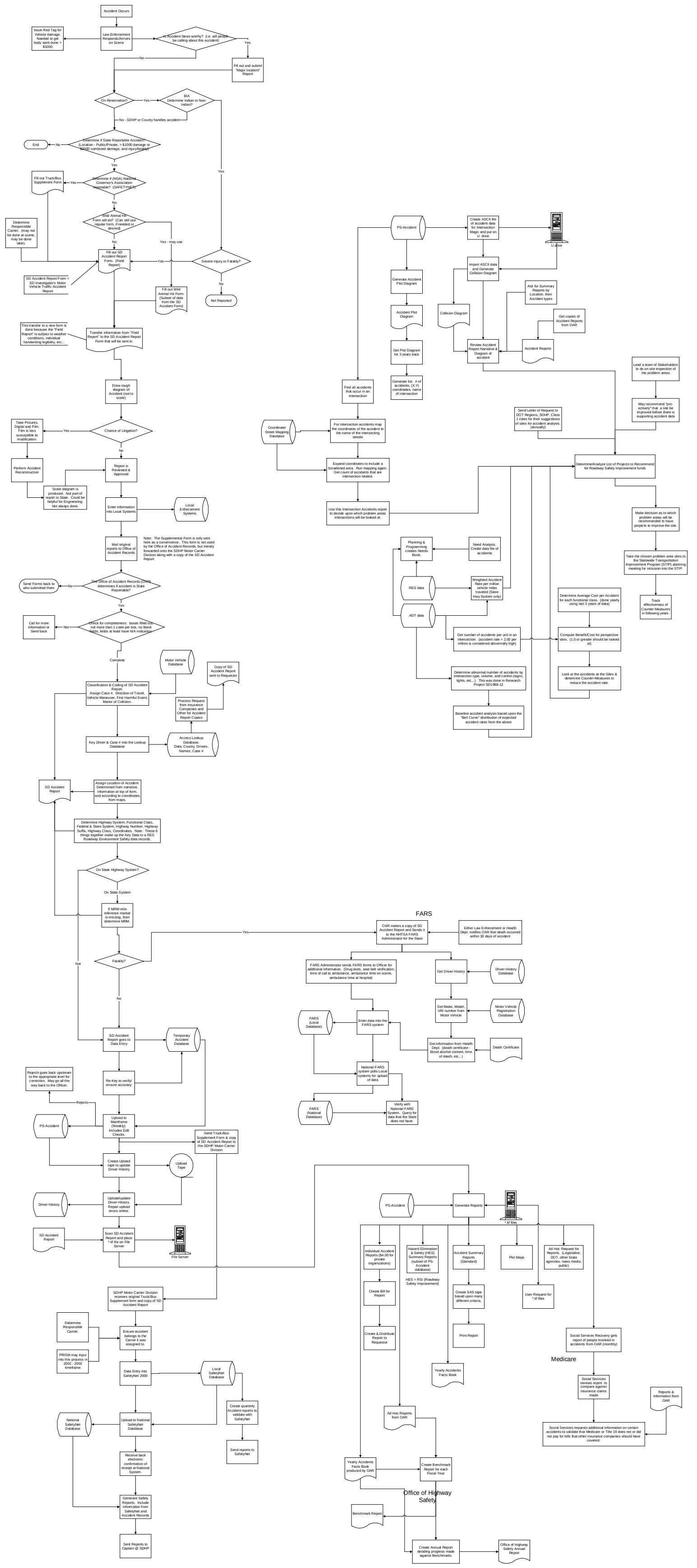
An overview of the features and functions that were reviewed is found in the table below.

Function-ality Area	**Comments**
Kentucky Contact Info	Sgt. John R. Carrico, Assistant Commander Kentucky State Police Records Branch johnr.carrico@mail.state.ky.us (502) 227-8700
Common Information Manager	Unlike Iowa's TraCS, there is no CIM in eCRASH. Info such as carrier name/address must be re-entered for each new accident.
Data Flow/Data Entry	The flow was logical and well organized. However, there was no way to save information on a partially completed report, if you got interrupted or needed to lookup something.
Edits	As each panel is completed by the user, edits are performed real-time and displayed in the error area at the bottom of each panel.
Help	Not terribly helpful. I could not find any field level help. The Help function only contained an example (filled in) screen shots with no narrative.
Find	There is a handy "find" function that allows you to find all locally stored reports (on this workstations hard drive) containing specific text specified by the user. This might be a handy feature to add to the Iowa TraCS system for use in SD.
Modifications	There is no SDK with this system. Apparently, any modifications/customizations will be done natively (hard-coded) rather than done externally through a toolkit.

Function-ality Area	Comments
Training Availability	None provided that we are aware of.
Accident Location	Location coordinates were available data fields but no hint of GPS-enablement was evident.
Consistency of data fields between Kentucky's data model and SD's new data model	The data fields looked virtually identical to those used by SD's new model, although I'm sure that a detailed evaluation would uncover some minor differences.
Accident Diagram	An existing diagram can be attached to the report or you can launch a drawing tool from the system. No drawing/sketching tools are provided or built-in. I tried to launch Visio 2000, but Visio hung up and never completely launched.
Report Export	The system has a "submit" function that appears to work by uploading reports to an FTP site.
Printed reports	From any panel, a completed report can be displayed a "paper" view of the report and/or print the report form. Reports are also printable/accessible from a Kentucky web site. Access requires user id and password. Presumably, these reports are not available directly to the public. Accident records are not available to the public per KY state law. Directly involved parties, minors' parents, attorneys do get access.
FARS support	Fatality information is available on a separate fatality panel.
Witness Info	Witness information is an available/optional panel.
Attachments	Attachments may be attached to the report. The only two file types supported are JPG and TIF and the max. file size allowed is 200K.
Review/ Approval	There is an accept/reject function that I could not review (probably due to the security of the user id available on the demo CD).
EMS data	EMS data fields are made available on the injury panel.
GPS Support	None detected
GIS Support	None detected
Signature	No provision for electronic signatures

Appendix P. "As Is" Workflow Diagram

During the "As Is" workshop analysis sessions, we developed a diagram depicting the current processes and general flow of information for the Accident Reporting business area. This diagram does not purport to display every single piece of information or step in the process, but provides a starting point for understanding the business area. The diagram can be found on the following page. (Please note that in order to view this diagram, you'll need to increase the "view percentage" to approximately 500%. The software used for this diagram was incapable of splitting it up into multiple pages for better viewing.)


FARS
Medicare
Office of Highway Safety

Appendix Q. Backup Research Notes

South Dakota Research Literature Review

Please note that much of this document contains direct quotes and excerpts from other documents and from various web sites. Therefore, the following needs to be pointed out:

- Direct excerpts were not edited for form, grammar, punctuation, etc.
- Direct quotes are not always in quotation marks
- The material here is purely for reference, background material and support purposes

SD's CVISN Top Level Design Study SD1999-16 (January, 2001)

Representatives of the state agencies involved in Commercial Vehicle Regulation are members of South Dakota's CVISN Advisory Committee. FMCSA and the South Dakota Trucking Associates also participate in the committee. This committee is established and operational. The accident reporting project will primarily involve committee members as follows:

- ✓ CVISN Program Facilitator – Hal Rumpca (Office of Research)
- ✓ CVISN System Architect – Ron Knecht (BIT)
- ✓ Safety Information Exchange – Capt. Myron Rau (SD Highway Patrol)
- ✓ CV Information Exchange Window – Ron Knecht (BIT)

SD's CVISN Goals and objectives derive from its ITS/CVO Business Plan. The referenced study clearly lists the mission, governing principles, and goals and objectives of the SD ITS/CVO program. These goals recognize state needs and are consistent with CVISN Level I requirements. Level 1 is the first stage of a 3-level program designed to gradually meet total CVISN requirements. The 3 levels are set by the CVISN (not by SD).

There are six project areas identified as part of the state's CVISN initiative. They are:

- ✓ Program management
- ✓ System engineering and integration
- ✓ Safety information exchange
- ✓ Credentials administration
- ✓ Electronic screening

- ✓ Commercial vehicle information exchange window (CVIEW)

Commercial accident reporting falls under the safety information exchange initiative/project. Accident reporting should be improved in two ways – 1) combine the standard AR form with the CV accident supplemental form and enhance the AR database to allow AR data to be stored along with other accident data and to export CV accident data to MCMIS; and 2) mobile computers will be able to record accident data. The first step in this improvement project was identified as the study Shupe is now performing.

Also within the SIE initiative is the Motor Carrier Safety Profile project. SD intends to provide motor carriers with access to their own safety performance information (including accident data) via the Internet.

CVIEW is a key component of the SD CVISN infrastructure. CVIEW will be used to transfer information among various state information systems and between state systems and national CVISN systems. From a CVISN perspective then, CVIEW will be the single system to receive data from the new/revised AR system, thereby presumably eliminating individual interface to individual systems such as CDLIS, MCMIS, and SAFER. From a non-CVISN perspective, there will still be additional system interactions between the AR system and other systems/initiatives such as FARS.

CVIEW will be built upon commercially available multi-platform data access software, which will be selected by BIT by Spring, 2001. A new architecture plan for SD's CV information systems will then be developed.

Identification for Truck Crash Reduction (SD1999-05)

One-third of CV accidents in SD go unreported to the national MCMIS database largely because CV accident supplement forms are often overlooked by local law enforcement agencies.

Documentation of SD's ITS/CVO Data Architecture Study SD1999-07 (September, 1999)

The FHWA's Office of Motor Carriers initiated the ITS/CVO program to promote the deployment of ITS/CVO technology that would ensure electronic information sharing and exchange among states, federal agencies carriers, shippers and third-party service providers. The implementation of this program and vision takes the form of the CVISN, which envisions that by 2005, the majority of CVO transactions will be conducted electronically.

CVISN Level I deployment requires that the following three capability areas are implemented using applicable architectural guidelines, operational concepts and standards. This is necessary to ensure consistency with the national model deployment initiative. CVISN Level I capability refers to the following specific items:

- ✓ An organizational framework for cooperative system deployment has been established among state agencies and motor carriers.
- ✓ A state CVISN System design has been established that conforms to the CVISN Architecture and can evolve to include new technology and capabilities.
- ✓ Elements of the three capability areas below have been implemented using applicable architectural guidelines, operational concepts, and standards:

Credentials Administration

- ✓ End-to-end processing (i.e., carrier application, state application processing, payment, credentials, credential issuance) of at least IRP and IFTA credentials; ready to extend to other credentials (interstate, titling, OS/OW, carrier registration).
- ✓ Connection to IRP and IFTA Clearinghouses.
- ✓ At least 10 percent of transaction volume handled electronically; ready to bring on more carriers as carriers sign up; ready to extend to branch offices where applicable.

Electronic Screening

- ✓ Electronic screening implemented at a minimum of one fixed or mobile inspection site.
- ✓ Ready to replicate at other sites.

Safety Information Exchange

- ✓ ASPEN (or equivalent) at all major inspection sites.
- ✓ Connection to SAFER.
- ✓ CVIEW (or equivalent) for snapshot exchange within state and to other states.

There are 3 major CVISN elements: administrative processes, electronic roadside screening, and safety information exchange. Equipment packages are the building blocks of the physical architecture subsystems. EP's groups like processes together into an implementation package. The EP's for CVO are:

- ✓ Credentials and taxes administration
- ✓ Commercial vehicle safety administration
- ✓ CV information exchange
- ✓ Roadside electronic screening
- ✓ Roadside safety inspections

- ✓ Roadside weigh-in-motion
- ✓ Citation/Accident electronic recording

Most state agencies involved with CVO's in SD are unable to share CV-related information and some agencies collect the same data from motor carriers.

Apart from CVISN, other programs present opportunities for ITS technologies in SD, which need to be taken into account in designing the architecture associated with the CVISN initiative. Several are mentioned in the study. The two that affect the accident reporting BAA are: 1) PRISM – This system is designed to improve highway safety by linking registration to safety performance so unsafe carriers can be identified and entered into safety improvement programs. 2) Automated Inspection, Citation and Accident Reporting Software – SD is exploring installing software that was specially developed for Iowa DOT for entering accident and other data electronically (presumably at the scene). This software will be installed on laptops equipped with cellular communications capability (but, remember, that SD has limited cellular service).

The study documents the general lack of the current SDDOT systems' ability to connect to or interact/interface with each other. Their lack of ability to support CVISN initiatives is also documented. The study notes that the current process to resolve information queries between agencies involves email, phone and fax.

For automated safety inspections, most CVISN pilot states plan to use the ASPEN or similar software loaded on laptop or pen-based computers. This data will be uploaded daily to the states' SAFETYNET systems, which then transmits the info to the MCMIS, which then forwards it to SAFER. This entire process lasts about 1 week. Other CVISN states will accelerate the process by establishing a link between SAFER and the state's CVIEW system, as well as a link between ASPEN and CVIEW. This latter approach is supported by the SD CVISN Top Level Design Study SD1999-16.

This study developed several models using BPwin and Erwin using the CVISN templates to ensure compatibility with the national CVISN architecture. Process and data models were developed for the accident reporting function. The study documented (high-level) all of the processes related to CVO/ITS. The current accident reporting process is documented as follows:

Agency – Department of Transportation (DOT)

Process – Accident data reporting

Definition – The Office of Accident Records of the DOT processes accident records. The major items of accident record processing include reviewing the accident report, assigning additional information, entering and verify data, correcting electronic data and updating the accident database. They supply DCR with driver accident information. (An automated DCR mainframe job updates the

DCR driver history.) They route the Truck/Bus Supplemental form from Law Enforcement to the HP Motor Carrier Division

Interacting agencies – Police, HP (Highway Patrol), DCR (Dept. of Commerce and Regulation)

Databases – PS-Accident, SDDLIS, RV01, FARS, MRM file

The DCR interaction occurs as commercial licenses are issued, verification of safe driving history through CDLIS occurs.

Agency – Highway Patrol (HP)

Process – Accident data processing

Definition – The Highway Patrol also processes accident data for purposes of safety enforcement. Accident records received from the DOT and law enforcement agencies are reviewed and coded to conform to the SAFETYNET standard. The information is then loaded into SAFETYNET database.

Interacting agencies – DOT, Law enforcement agencies

Databases – SDDLIS, CDLIS, MCMIS, SAFETYNET

Later in the study, the above two accident reporting processes are identified by 3 sub-processes: 1) process accident data, 2) review and code accident reports, 3) generate files and upload

The Process-Organization Interaction Matrix included in this study, shows that the accident reporting process has the following agency/department interactions:

- ✓ DCR – supports the process (SU)
- ✓ DOR – SU
- ✓ DOT – both sets policy and performs the process (BO)
- ✓ HP – performs the process (PE)
- ✓ BIT – SU
- ✓ Law enforcement – PE

The entities listed for accident reports are:

- ✓ Carrier
- ✓ Vehicle
- ✓ Driver
- ✓ Insurance
- ✓ Trip
- ✓ Location
- ✓ Accident report
- ✓ Accident data

The current systems assessment describes the systems involved with accident reporting. The Office of Accident Records of the DOT uses the PS01 system (also referred to as the PS-Accident system) ADABAS DBMS in processing accident records. Specialized PC-based applications, Keyentry 3 and Intersection Magic, ArcView and common applications such as MS Access, MS Excel, are used in processing and reporting accident records. The DOT is part of the WAN in South Dakota in addition to LAN within the department. E-mail, fax and telephone are the primary communication linkages for data exchange with other agencies. HP has access to accident database (PS01). During roadside operations, access to carrier, vehicle, and driver information is obtained through the State Radio. The FHWA/OMC uses desktop and laptop PCs for compliance reviews and related safety enforcement activities. Access to external databases (i.e. PS01) relies on modem connections. ASPEN, a PC based software, is used for conducting compliance reviews.

For our reference, the current SD system design is diagrammed in Figure 3. THIS NEEDS TO BE UPDATED

The system limitations and opportunities matrix for the Office of Accident Reporting in the DOT, indicates that:

- ✓ The accident reporting form needs to be updated and is currently in paper form only.
- ✓ It is desirable to electronically capture the accident data.
- ✓ There should be an electronic data transfer between the DOT and the HP.
- ✓ There is a potential for GIS based database of accident data.
- ✓ Use of bar codes for coding accident forms may be desirable..

SD98-12 Identification of Abnormal Accident Patterns at Intersections

This report presents the findings and recommendations based on the Identification of Abnormal Accident Patterns at Intersections. This project used a statistically valid sampling method to determine whether a specific intersection has an abnormally high number of accidents. The department researcher located intersections throughout the state and categorized them by geometric type, stop control type, and traffic volume. A sample of each intersection category was taken and coordinates for each intersection were found. Accident reports were obtained for the sampled intersections, and the data was entered into a spreadsheet for analysis. The mean and 90th and 95th percentile were calculated, and the expected value analysis tables were created for each category of intersections. A total of fourteen (14) expected value analysis tables were produced for the various intersection types and compared to those received from other states. Recommendations were suggested for identifying abnormal accident patterns based on information that was received from other state Department of Transportation's, local agencies, and the South Dakota Expected Value Analysis Tables.

The 14 tables that were generated during this study need to be updated every 3 years in order to stay current. As updates are made, a comparison between the new and old tables needs to be made in order to determine if our safety programs are working.

The tables can be used for analysis - if there are more accidents occurring than are "normal" per the tables, then safety precautions can be taken to help reduce the number of accidents.

Since the method of creating the expected value analysis tables is reliable, the information that the tables provide will be very useful in assisting the South Dakota Department of Transportation (SDDOT) with the identification of abnormal accident patterns at certain intersections. If a certain type of intersection seems to have a higher number of a particular type of accident, then the coinciding table may be looked at to determine if this is in fact true. If there are more accidents than in the table, safety precautions can be taken to help reduce the number of accidents.

In the future, updating of the expected value analysis tables will be necessary. (So, we need to incorporate the tables, formulas, resulting analysis and updating of these tables in the new system). The Office of Local Government Assistance should update the tables every three (3) years. The tables will consist of new accident records so the numbers stay up to date with the changing times. The new tables would then be compared with the old tables in determining if the necessary actions are being taken to make the roads safer.

SD98-13 Development of SD Accident Reduction Factors

This report offers the methodology and findings of the first project to develop Accident Reduction Factors (ARFs) and Severity Reduction Ratios (SRRs) for the State of South Dakota. The ARFs and SRRs of this project focused on Hazard Elimination and Safety (HES) projects located within the state of South Dakota. Department researchers used project plans and accident data from each of the HES projects, from 1986 to 1994, in developing Accident Reduction Factors and Severity Reduction Ratios. The technical panel for SD98-13 developed a Severity Reduction Formula, which was used to compute Severity Reduction Ratios. A benefit/cost analysis was performed on each project to determine the project's cost effectiveness. Recommendations were made to use the Accident Reduction Factors and Severity Reduction Ratios to aid in determining the effectiveness of Hazard Elimination and Safety projects. The recommendations were based on the literature review and the results from SDDOT research project, SD98-13.

South Dakota, like many other states, has been involved in Hazard Elimination and Safety (HES) projects for many years. The federal government has placed requirements on states to evaluate their HES projects and report the findings to the Federal Highway Administration (FHWA). The states have also been encouraged to produce their own Accident Reduction Factors (ARFs). South Dakota has a need to develop its own ARFs and determine the effectiveness of its HES projects. In the past, South Dakota has relied heavily on resources from other states to aid in preparing information regarding Accident Reduction Factors.

An Accident Reduction Factor (ARF) is a value used to determine the degree to which accidents decrease. ARFs usually focus on locations that have been improved in order to lower accident frequency and severity. The number of accidents after the improvement is divided by the number of accidents before the improvement to calculate the ARF. Ideally, and Accident Reduction Factor would be less than 1.00, indicating a decrease in accidents. An ARF of greater than 1.00 indicates an increase of accidents, and an ARF of 1.00 signifies no change in the number of accidents. The percentage decrease of an Accident Reduction Factor is calculated by subtracting the ARF from 1.00. For example, an ARF of .71 is a 29 percent accident reduction. The percentage increase is calculated by subtracting 1.00 from the ARF. For example, an ARF of 1.43 is a 43 percent increase. Accident Reduction Factors almost always cover the same conditions and accident types. The factors consider driver, weather, and road conditions, collision and improvement types, and time of day/week/month/year. Accident severity was also a major issue in this study. South Dakota classifies accident severity by five different types: fatalities, incapacitating injury, non-incapacitating injury, possible injury, and "property damage only" (PDO). All severity types were considered in this study. The severity types were used in a Severity Reduction Formula. The Severity Reduction Formula computes a Severity Reduction Ratio (SRR). The SRR is a ratio of overall accident severity before a project takes place to the overall accident severity after that project is completed. Traffic safety specialists can use this ratio to aid in determining the effectiveness of that project. To calculate the Severity Reduction Ratio, the Severity Reduction Formula multiplies the number of each fatality, incapacitating injury, non-incapacitating injury, possible injury, and PDO severity-type accident by a corresponding factor. The multiplied factors are then added. The three years following an improvement and the three years preceding the improvement are formulated in this way. The following three years' sum is then divided by the sum for the three years before the improvement project. The result is the Severity Reduction Ratio. An ideal ratio is less than 1.00. Due to the availability of accident severity information and improvement project costs, a cost/benefit analysis was performed on projects where funding came solely from the Hazard Elimination and Safety program. The analyses of these projects help to determine if a particular project has been cost effective. The researcher used the Bailey Formula 1 in computing the cost/benefit. This formula is used and recommended by the FHWA.

The accuracy of the results of this study increases with the number of projects studied. Results are more accurate for improvement types with a greater number of project locations. The lack of uniformity in some of the results would reinforce the need to update all Accident Reduction Factors so that more accurate results can be obtained.

Findings - Future Hazard Elimination and Safety projects should be analyzed and added to the existing data as the projects are completed. (We assume this means that we need to update the average ratios as projects are completed. This will make the ratios better and better over time). The South Dakota Department of Transportation should continue to use Accident Reduction Factors obtained from outside sources until South Dakota Accident Reduction Factors have a minimum of ten (10) accident locations per improvement type (so, we should include the capability of entering the comparison data into our database). The Microsoft Access™ database used by the researcher should be redesigned to streamline the data-entry and calculation process. The design should include a form to enter and display all relevant data and calculations. (So, we should include a database design for these functions).

FMCSA Literature Review

The Large Truck Crash Picture (August, 2000)

http://spp.fmcsa.dot.gov/fmcsa/motorcar.nsf/9ba8442069238e44852568fe00708985/bfab658feebaec7585256982006a1001?OpenDocument

In 1996, the Michigan State Police began collecting crash data in a program called the Fatal Accident Complaint Team (FACT). The FACT program collects data on vehicle and driver contribution to crashes. The data are collected by state police officers using a special crash reporting form. In the 332 crashes, the actions of the other vehicle involved, including speed and loss of control, were the critical events that caused the crash in 59 percent of the cases. In another 28 percent, the action of the truck driver -- including speed, loss of control, and failure to adjust to road conditions -- was the critical event. Pedestrians and bicyclists caused seven percent of the crashes. Altogether, human factors caused about 94 percent of the crashes. Truck vehicle failure was blamed as the crash cause in only 0.9 percent of the crashes. Factors relating to a previous collision accounted for the remainder of the cases.

National Automotive Sampling System (NASS) - State inspectors will assist NASS researchers by completing a Level 1 post-crash inspection of the truck and truck driver. FMCSA has contracted with other nationally-recognized truck crash experts to assist with the project. Data for the study will be collected in 24 sites around the country. A pilot test of the study began in June 2000 in four sites: Chicago, Philadelphia, Prince George's and Charles counties in Maryland, and La Paz and Yuma counties in Arizona. The full study in all 24 sites will begin in 2001.he MCMIS Crash File is intended to be a census of all large truck and bus crashes that result in a fatality, injury, or tow-away. However, not all States send FMCSA reports on all trucks and buses involved in crashes that meet the reportable crash criteria. In addition, many of the reports received are incomplete or contain incorrect data. FMCSA and NHTSA have embarked on a cooperative effort to improve crash reporting. The effort will build on NHTSA's successful experience of collection of fatal crash data from the States. The effort will involve FMCSA representatives, State agencies that receive truck and bus safety funds from FMCSA, police agencies that collect crash data, and other State and local agencies involved in traffic records collection.Thirty-eight percent of large truck drivers compared to two-thirds of passenger vehicle drivers involved in fatal crashes from 1994 through 1998 had at least one driver-related factor coded. The most common factors for both types of drivers were running off the road or out of the traffic lane, and driving too fast for conditions or exceeding the posted speed limit. Almost three-quarters of the trucks involved in fatal crashes in 1994 to 1998 were combination-unit trucks.

Driver Background Paper: Current and Future Trends (November, 2000)

http://spp.fmcsa.dot.gov/fmcsa/motorcar.nsf/9ba8442069238e44852568fe00708985/acf51ba303021deb852569ad0070c6e4?OpenDocument

The major source of the truck safety problem lies in the quality of the workforce and the incentives used to motivate and reward them. The safety issue arises as an immediate corollary of the driver pay and driver shortage issue. The safety problem has two possible roots. One root is well established in the area of human fatigue and the like. The rationale for the hours-of-service rulemaking amply demonstrates this issue and extensive research has been reviewed in this area.

Data sets generally are not linkable to one another and do not have common carrier numbers. We could compare many operating and financial characteristics against safety criteria, but the data sets still are not linked. The MCMIS master file should be updated more aggressively. MCMIS is the master database for all operators of commercial motor vehicles--everyone with a DOT number. A record is established when a DOT number is issued, and then it is only updated when there is a compliance review or similar enforcement activity (covering only about 10,000 reviews per year). This is a weak data foundation on which to base policy analysis. The MCMIS data file also ought to be linkable to the Form M data file as well as others.

Commercial Vehicle Safety - Strategic Issues and Potential Solutions (October, 2000)

http://spp.fmcsa.dot.gov/fmcsa/motorcar.nsf/9ba8442069238e44852568fe00708985/275d497f4ba533ca852569850071407c?OpenDocument

There has been a significant increase in the number of carriers registered with the U.S. Department of Transportation as interstate carriers. New entrants have poorer safety performance and significantly less knowledge about and compliance with key safety regulations than do carriers who are more established. Previous research has documented the existence of a safety learning curve among new entrants such that observed safety and compliance problems diminish after a carrier has been involved in interstate operations for at least five years.

Some of the previous empirical studies have documented crash rates for new entrants that are on the order of 15 to 20 percent higher than are the crash rates of established carriers. Some rough calculation based on the number of carriers involved and their mileage would yield estimates of crashes that could be avoided by eliminating or substantially reducing the safety learning curve of the new entrants.

There is empirical evidence documenting that carrier size is correlated with safety performance with poorer performance (as measured by driver performance, vehicle performance, and crash rates) associated with smaller carrier size.

The FMCSA has invested significant resources over the past decade in centralizing and enhancing information about a carrier's safety performance in its Motor Carrier Management Information Systems (MCMIS). The MCMIS system centralized information regarding each carrier's roadside inspections, its compliance reviews, its enforcement cases, and its crash records. In addition, FMCSA worked with the Volpe National Transportation Systems Center to develop a methodology, SafeStat (Safety Status Measurement System), to evaluate and rank carriers based on their performance if four key areas: vehicle, driver, crash rate, and safety management.

Forty percent of all large truck miles are driven on Interstate highways, but only twenty-four percent of large truck-involved fatal crashes occur on those roadways. In contrast, nearly three-fifths of large truck fatal crashes occur on undivided highways. The question of relevance to the FMCSA is whether or not there are opportunities to control the use of this nation's highway capacity to shift an even greater share of total truck miles to divided as opposed to undivided roads. Clearly, by removing large truck traffic from two lane roads and shifting it to divided highways, major reductions in truck crashes are feasible.

The FMCSA's responsibilities relating to commercial driver safety include the establishment and enforcement of licensing standards for interstate commercial drivers (the Commercial Drivers License (CDL) Program) and the maintenance of safety records of commercial drivers (through the Commercial Drivers License Information System or CDLIS). There are many concerns about the implementation of these programs and their success in denying CDL's to unqualified drivers or those who have poor driving records in one state from getting a CDL in another state.

Insuring the Safety of Motor Carrier Operations (August, 2000)

http://spp.fmcsa.dot.gov/fmcsa/motorcar.nsf/9ba8442069238e44852568fe00708985/92e8d0985cd762ff85256982006a174a?OpenDocument

The Interstate Commerce Commission (ICC) required that each motor carrier file documentation from its insurance carrier(s) that the carrier was in compliance with the legislated requirements for insurance coverage and levels. The ICC mandated that insurance companies notify it if, at any time, it ceased to provide insurance coverage to a carrier. When the ICC was abolished, the insurance information responsibility transferred to the Department of Transportation.

With the emergence of MCMIS and SafeStat, there has been significant progress in developing comprehensive safety performance profiles of individual carriers. Furthermore, in December 1999, the FMCSA launched its Analysis and Information Online system, which can be accessed over the Internet at www.fmcsa.dot.gov. This Internet site provides each carrier’s SafeStat performance, including detailed information for each one of the safety evaluation areas—driver, vehicle, crash record, and safety management policies.

There is great opportunity in the Internet’s power to provide complete access to a carrier’s safety performance record. There is no better incentive for a carrier to improve its performance than the realization that the marketplace will punish carriers with poor safety records. Clearly, the information access through the Internet will bring the power of the marketplace into the equation. The marketplace, both for insurance purposes and for shipper selection decisions as well, will consider a carrier’s comprehensive safety performance as an integral component in deciding to do business with the carrier.

Review of National Initiatives Related to Accident Reporting

The National Model for the Statewide Application of Data Collection & Management Technology to Improve Highway Safety (State of Iowa Crash Reporting Data Collection System)

http://www.dot.state.ia.us/natmodel/index.htm

The National Model for the Statewide Application of Data Collection & Management Technology to Improve Highway Safety is a program for sharing information, resources, and technologies to improve highway safety. The focus of the National Model is improving data acquisition for roadway incidents, leveraging proven technology for law enforcement, streamlining the communication of safety information to key stakeholders, and extending the use of this information for short and long-range safety and law enforcement programs.

The National Model is a consortium effort. The initial members of the consortium include: the Iowa Department of Transportation, Motor Vehicle Division (MVD); the Iowa Department of Public Safety, Iowa State Patrol; and the Federal Highway Administration (FHWA). The Iowa DOT and FHWA are the lead organizations in this effort.

The following is a list of tasks undertaken during the three-year period of the agreement.

- ✓ Develop and Implement a Procedure for using the Global Information System (GIS) and the Global Position System (GPS) for Acquiring Accident Location

  GIS/GPS is thought to be the ideal solution for decreasing the time required to obtain the location of an accident and improve the accuracy of the location.

- ✓ Reengineer the Crash Data Collection Process

  The entire onsite crash data collection process has the potential to be significantly improved through the use of a variety of existing and emerging technologies. These include bar code, laser measurement, digital cameras, voice recognition, etc. This task reviews the current data collection process and improves the process by reengineering it for cost-effective use of technology. Specifically, the task includes new accident diagramming, police incident reporting, citation disposition form, contact management, time and activity reporting, and selective end shift options.

- ✓ Evaluate the Advantages of a "Smart" Police Vehicle
- ✓ Systems Integration

The goal of the National Model is to demonstrate, in a statewide operational environment, how new technologies and techniques can be cost effectively used to improve highway safety data collection and management processes.

While the data is critical in improving highway safety, the collection of this data is secondary to law enforcement's role of serving and protecting the public. It has been proven that when law enforcement is given the right tools to collect this data - tools that enable them to collect this information in less time, with less effort - the quality and effectiveness of this data increases.

TraCS consists of a mobile client Microsoft Windows-based application which allows law enforcement officers to collect, validate, print, and receive information in the vehicle using either a notebook or pen-based computer. Information gathered with TraCS Mobile can be transferred to the TraCS Office and the TraCS Enterprise database applications for reporting, analysis and retrieval.

This approach enables the distribution of TraCS Mobile and TraCS Office to any participating state seeking to increase their data collection effectiveness. The nature and complexity of agency specific data collection needs prohibits any one "off-the-shelf" application from satisfying all aspects of these needs. Therefore, TraCS has been designed to be both modular and agency customizable which allows the flexibility to meet the majority of the data collection requirements without depending on a vendor to make these modifications.

TraCS - Mobile is the only incident reporting software that can be tailored to display information the way it appears on your existing paper reports.

TraCS – Mobile includes a sophisticated, drag-and-drop-diagramming tool for use in collecting crash data.

These transmission methods include Internet, direct connect, diskette, modem and radio frequency (RF).

National Model Program resources are available to an agency at no cost. Iowa TraCS software executables developed through the National Model Program are available royalty-free to interested agencies.

Definitions for Various Systems/Initiatives

http://www.inspector.org/fhwafsg1.htm

SAFETYNET

The State level Information management system for motor carrier safety. SAFETYNET captures inter and intra state driver/vehicle inspection data, accident data, carrier compliance reviews, enforcement data, and carrier identification data. SAFETYNET operates in every State and routinely transfers data to and from MCMIS. Originally designed as a manual data entry system, SAFETYNET now allows electronic data collection. The system is central to successful management and operation of the Motor Carrier Safety Assistance Program (MCSAP). It contains many report generating, prioritizing and task tracking routines. The next generation "SAFETYNET 2000" will be available in 1998 and provide a robust client-server, SQL database management system.

MCMIS (Motor Carrier Management Information System)

The National data warehouse of safely performance information on over 350,000 Interstate motor carriers, MCMIS Is the authoritative source of safety information used to drive National Motor Carrier Safety programs and to feed other information systems. MCMIS is currently accessed directly by Federal and State offices but routine access will soon be transferred to SAFER.

SAFER

A Safety data access system now in development, SAFER will facilitate electronic collection and distribution of data between front-end systems like ASPEN and management information systems like SAFETYNET and MCMIS. SAFER will also serve as the interface between authoritative data sources and outside customers like motor carriers, insurers, shippers, and the public. It will provide carrier snapshots and profiles as well as providing recent past inspections based on vehicle plate # or driver CDL#. SAFER will allow automated data and program refresh (replication) to many remote user systems. SAFER will also have links through the Internet.

ASPEN

Driver / Vehicle safety Inspection software improves the entire inspection process by providing roadside access to various safety performance information including, the last recent inspection results, the driver's CDL status (see CDLIS) and the safety performance and past safety problems of the carrier (see ISS). ASPEN can be seen as an intelligent assistant which ensures complete and accurate data collection at the roadside. Inspectors select applicable violations from lists of possible citations and add descriptive notes as needed. The program is highly customizable for use by different States. ASPEN prints an inspection report on site which is given to the driver. A copy also can be faxed to carrier management. ASPEN inspection data is electronically transferred to State information systems via AVALANCHE & SAFER. Optimized for use with pen-computers, ASPEN can also be run on Mobile Data Terminals and laptop computers.

SAFESTAT

SafeStat, a national system of selecting motor carriers for on-site safety inspections, concentrates on a carrier's safety performance to identify and prioritize carriers that are "at risk". The system focuses on carriers posting the highest potential risk to highway safety, making it possible for the Office of Motor Carriers and the Indiana State Police to better utilize their limited resources.

SafeStat evaluates carrier performance in four areas: crashes, driver violations, vehicle violations, and safety management. SafeStat recognizes that a carrier's recent crash history is the most significant indicator of safety performance.

NASS

http://www-nass.nhtsa.dot.gov/nass/

The National Automotive Sampling System (NASS). NASS is under the auspices of the National Highway Traffic Safety Administration's (NHTSA) National Center for Statistics and Analysis. The NASS program, formerly known as the National Accident Sampling System, is the mechanism through which NHTSA collects nationally representative data on motor vehicle traffic crashes to aid in the development, implementation, and evaluation of motor vehicle and highway safety countermeasures. NASS was originally designed and implemented in 1979 to support highway and motor vehicle safety programs. The NASS program was reevaluated in the mid-1980's. The evaluation team concluded that the program should be redesigned to focus on enhanced in-depth analysis of passenger vehicle crash protection performance. This reevaluation resulted in changes which NHTSA implemented in January 1988. To enhance its applicability in addressing crashworthiness issues, the NASS was divided into two components: (1) the General Estimates System (GES) which collects data from an annual sample of approximately 55,000 police- reported motor vehicle traffic crash reports; and (2) the Crashworthiness Data System (CDS) which collects additional detailed information on an annual sample of approximately 5,000 police-reported motor vehicle traffic crashes involving a towed passenger car, light truck or van that is less than or equal to 10,000 pounds (4,536 kilograms) gross vehicle weight rating (GVWR).

The following are short descriptions of the NASS GES and CDS:

1. NASS General Estimates System

The NASS GES obtains its data from a nationally representative probability sample of approximately 55,000 police reported motor vehicle traffic crashes annually. The data are obtained by GES data collectors in 60 geographic sites across the United States. These data collectors make weekly, biweekly, or monthly visits to approximately 400 police agencies within the 60 sites. During the visit, the data collectors list all police traffic crash reports not previously listed and then select a sample of the listed police traffic crash reports. The collector obtains copies of these selected police traffic crash reports and sends them to their regional NASS Zone Center for coding. Trained personnel interpret and code data directly from the police traffic crash reports onto an electronic file. To protect individual privacy, no personal information such as names, addresses, specific crash location, etc., is coded.

2. NASS Crashworthiness Data System

In the NASS Crashworthiness Data System, a national representative sample of motor vehicle traffic crashes is selected for the collection of data in sufficient detail to support the Agency's standards development and evaluation programs. The NASS CDS collects data on approximately 5,000 motor vehicle traffic crashes annually, selected from police traffic crash reports at 24 sites.

The information on the sample of motor vehicle traffic crashes is collected by researchers under contract to NHTSA. The researcher relies upon three sources of data:

- ✓ Official documents (e.g., police traffic crash reports, and vehicle, highway and medical records);
- ✓ Physical evidence (e.g., scene characteristics and vehicle damage profile);
- ✓ Interviews with individuals associated with the traffic crashes.

Cooperation is established with police agencies and hospitals to provide copies or transcripts of official records. Tow yards, police impound yards, and crash involved parties are contacted to obtain permission to inspect vehicles. Personal or telephone contact is made with vehicle occupants or surrogates to obtain information about occupant characteristics and crash circumstances. Researchers assure cooperating agencies and individuals that any information obtained that identifies the individual will be held CONFIDENTIAL.

The program employs trained, professional crash research teams that conduct in-depth crash investigations following professional procedures and scientific protocols. NASS data are used by government, industry, and the private sector to conduct research, identify injury patterns and mechanisms, provide a basis for regulatory decision making, and provide a means of establishing and evaluating the association between occupant injury and various crash related characteristics

For detailed information on the data they collect, under the NASS CDS heading, click on the Data Collection, Coding and Editing Manuals, click on 1997 (the latest year they have loaded) and review section “7.0 Coding Instructions”.

FARS

http://www.nhtsa.dot.gov/people/ncsa/fars.html

Fatality information is derived from the Fatality Analysis Reporting System (FARS). FARS includes motor vehicle traffic crashes that result in fatality to a vehicle occupant or non-motorist, from injuries resulting from a traffic crash, that occur within 30 days of the crash. The final FARS file is normally completed around Memorial Day, at which time the final quality control procedures are implemented. When these procedures are completed, NCSA (National Center for Statistics and Analysis) can begin to create our fact sheets and release the new data.

NHTSA has a contract with an agency in each state to provide information on fatal crashes. FARS analysts are state employees who extract the information and put it in a standard format. Each FARS analyst attends a formal training program, and also receives on-the-job training.

Data on fatal motor vehicle traffic crashes are gathered from the state's own source documents, and are coded on standard FARS forms. The analysts obtain the documents needed to complete the FARS forms, which generally include some or all of the following:

- ✓ Police Accident Reports (PARS)
- ✓ State vehicle registration files
- ✓ State driver licensing files
- ✓ State Highway Department data
- ✓ Vital Statistics
- ✓ Death certificates
- ✓ Coroner/Medical examiner reports
- ✓ Hospital medical records
- ✓ Emergency medical service reports

To be included in FARS, a crash must involve a motor vehicle traveling on a traffic way customarily open to the public, and result in the death of a person (either an occupant of a vehicle or a non-motorist) within 30 days of the crash. The FARS file contains descriptions of each fatal crash reported. Each case has more than 100 coded data elements that characterize the crash, the vehicles, and the people involved. The specific data elements may be modified slightly at times, in response to users' needs and highway safety emphasis areas. All data elements are reported on four forms:

The Accident Form asks for information such as the time and location of the crash, the first harmful event, whether it is a hit-and-run crash, whether a school bus was involved, and the number of vehicles and people involved.

The Vehicle and Driver Forms call for data on each crash-involved vehicle and driver. Data include the vehicle type, initial and principal impact points, most harmful event, and drivers' license status.

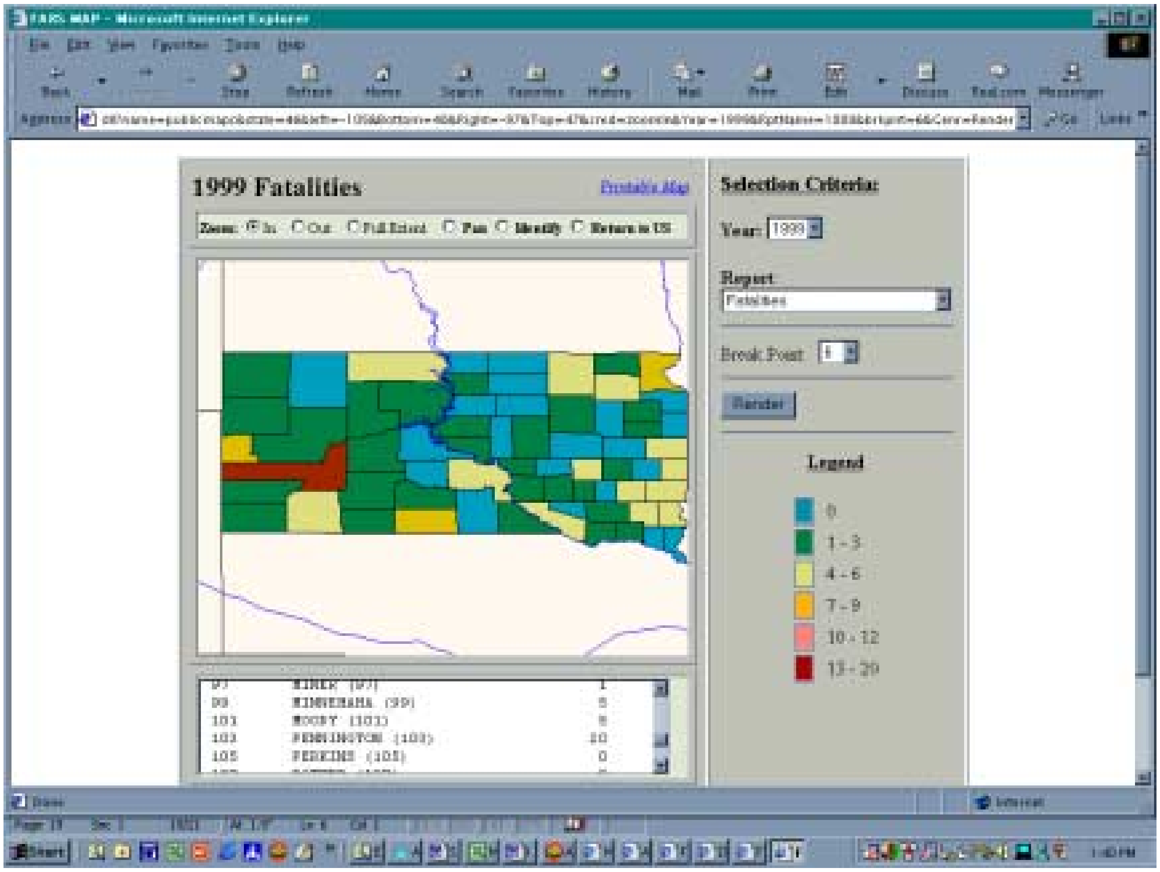
The Person Form contains data on each person involved in the crash, including age, gender, role in the crash (driver, passenger, non-motorist), injury severity, and restraint use.

In addition, there are FARS Alcohol files which contain driver and non-occupant BAC estimates, as well as overall crash alcohol estimates, which are used to supplement the data files when no alcohol information would otherwise be available. Information on these files are available in two reports, A Method for Estimating Posterior BAC Distributions for Persons Involved in Fatal Traffic Accidents (DOT HS 807 094) and A Guide to Using the Fatal Accident Reporting System BAC Distribution Files (DOT HS 807 095) available from NTIS.

Quality Control

Quality Control is a vital system feature. One important part of the quality control program is a series of consistency checks, which ensure that no inconsistent data are entered. For example, if an analyst codes 11:00 am as the time of the crash and "dusk" as the light condition, these codes would be rejected as inconsistent. Other checks are for timeliness, completeness, and accuracy. Statistical control charts are also employed to monitor the coding of key data elements over time.

FARS data by state is located at http://www-fars.nhtsa.dot.gov/. There you can see that Pennington County, SD had by far the most fatal accidents within SD in 1999, as illustrated below:



MMUCC

http://www.nhtsa.dot.gov/people/ncsa/codes/MinData/minstand.html

Lists available MMUCC documents.

Reporting Thresholds – Background

State data have limitations because of reporting thresholds. When all crashes are not included in a state's file, any analysis is limited by those, which are. For example, when only crashes that result in an injured person are included on a statewide database, the lack of information about the uninjured makes it impossible to measure the downward shift from injured to not injured resulting from the implementation of some safety program or safety measure. When the less serious or no injury cases are excluded, the exclusion results in eliminating some of the highway safety success stories and cases for those not affected (persons who do not use the countermeasure and receive no injury). The same is true if the data include only fatalities or even the most seriously injured, such as those persons treated at trauma centers. Also, when states and different agencies within a state choose different levels of property damage for reporting, the mix of crashes in each state will vary. Police vary in their estimate of damage and, over time, the same repair may cost more because of inflation. Finally, regardless of the threshold levels, sometimes the data collector may find it easier to ignore them and avoid the demands of data collection.

Which Crashes Should Be Reported?

From the point of view of the police collecting crash data, less is better. Police officers are responsible for investigating the crash at the scene and documenting information about the crash, vehicles, and persons involved. Police, understandably, resent expanding the scope of data collection to meet users' needs because the extra data are perceived as not related to police functions and as too time consuming.
From the point of view of the evaluator/user, more is better. Information is needed about all crashes and all persons involved to accurately monitor the status of highway safety. Incomplete data greatly limit the usefulness of the state's crash data as a source of information for supporting highway safety program efforts.

Types of Reporting Thresholds

States have initiated reporting thresholds to balance data collection demands with available staff time and funds. Thresholds focus on the type of roadway (public/private), the level of property damage or vehicle damage, the occurrence of an injury, and/or the absence of an injury. Implementation of these threshold criteria is not uniform among the states.

- ✓ **Type of Road**: Most states limit reporting to crashes which occur on public roads. Thus, crashes and/or injuries occurring in private driveways or parking lots are not included in these crash files.
- ✓ **Property or Vehicle Damage**: Most states limit reporting to those crashes that involve $500-$1,000 of property damage and exclude fender benders, perceived as insignificant. Larger states are more likely to choose the higher property damage threshold or even to go beyond property damage to include only those crashes in which at least one vehicle had to be towed away.
- ✓ **Occurrence of Injury**: Almost all states report crashes that involve an injured person as defined by use of a functional measure (KABCO) that indicates need for help from the scene. Information is collected identifying the person by age, sex, injury severity, position in vehicle, vehicle number and whether the person was using safety equipment (belts, helmets, etc.).
- ✓ **Absence of an injury**: In an effort to save time and money, some states do not collect data about the uninjured person involved in a motor vehicle crash.

Recommended Minimum Reporting Threshold

As a minimum, states should collect data for motorists, injured and uninjured, and for non-motorists involved in crashes in which at least one vehicle is disabled by damage severe enough to prevent driving it.

Voluntary Implementation of the Guideline

In its final form, this Guideline will be available to assist states in the process of revising their crash reporting forms and crash data processing systems. Except for the data elements required by the Office of Motor Carriers, implementation of the data elements included in the Guideline will be voluntary and according to state-specific specifications without any mandates by either NHTSA or FHWA. Instead, FHWA and NHTSA will encourage and support:

- ✓ Development of curriculum for training programs to present the Guideline, discuss its various components, describe how it would be used in a crash data system, and demonstrate its usefulness to highway safety;
- ✓ Investigation of the feasibility of implementing the Guideline using computerized data collection devices; and,
- ✓ Development of standardized data analysis and reporting programs using data from a system based on the Guideline.

MMUCC – Final Guidelines File

http://www.nhtsa.dot.gov/people/ncsa/Codes/MinData/MMUCCaugust98.pdf

Printed page number 25 (not PDF page number) is the beginning of a description of the data elements.

Other related sites

http://www.nhtsa.dot.gov/people/ncsa/

ANSI D16.1 Standard

www.nsc.org/public/mem/ansid16_1.pdf

Document Number: ANSI D16.1-1996
Title: Manual on Classification of Motor Vehicle Traffic Accidents (revision of ***ANSI D16***.1-1989)

Scope: The purpose of this American National Standard is to provide a common language for reporters, classifiers, analysts, and users of traffic accident data. The Manual on Classification of Motor Vehicle Traffic Accidents and its predecessor, Uniform Definitions of Motor Vehicle Accidents, have provided classification assistance for more than half a century. The Manual is designed to facilitate the development of data on accidents involving motor vehicles and other road vehicles in and out of traffic. It is a standard for statistical classifications of motor vehicle traffic accidents for nationwide use.

The standard provides definitions that the SDARS project could incorporate for things like roadway, vehicle, roadside, occupant, etc. IT also provides standard values for certain attributes.

It is unclear to us whether agencies/systems such as FARS, NASS, SAFETYNET are using this standard. We will probably come across some conflicting standards.

Highway Safety Information System

http://www.tfhrc.gov/safety/hsis/hsisbrochure.htm

The Need:

Highway engineers and administrators are continually faced with decisions concerning the design and operation of the highway system. An important part of the decision-making process is the potential impact on the safety of the highway users. Informed decision-making requires an understanding of how safety is affected by the geometric design of the roadway, the selection and placement of roadside hardware, the use of traffic control measures, the size and performance capabilities of the vehicles, and the needs and abilities of the users. This understanding can be developed through sound analysis of information about accidents, roadway geometrics, traffic control devices, traffic volume data, and the location of hardware and obstacles on the roadside. These data must be present in computerized files and easily linked so that data can be rapidly assembled and prepared for analysis.

A Solution: HSIS

The Federal Highway Administration (FHWA) has developed a highway safety database that can meet this need -- the Highway Safety Information System (HSIS).

The HSIS uses data already being collected by States for the management of the highway system, for the study of highway safety. The HSIS is a roadway-based system, which provides quality data on a large number of accident, roadway, and traffic variables. The data are acquired annually from a select group of States, processed into a common computer format, documented, and prepared for analysis.

The HSIS can be used to analyze a large number of safety problems. They can range from the more basic "problem identification" issues to identify the size and extent of a safety problem to modeling efforts that attempt to predict future accidents from roadway characteristics and traffic factors.

The HSIS is used in support of the FHWA safety research program and as input to program and policy decisions. The HSIS is also available to analysts conducting research under the National Cooperative Highway Research Program, university researchers, and others involved in the study of highway safety.

The Highway Safety Information System

Participating States

In 1987, five States were chosen to be included in the HSIS: Illinois, Maine, Michigan, Minnesota, and Utah. The primary criteria used in selecting the states were the data availability (the range of data variables collected), quantity, and quality. In 1995, California, North Carolina, and Washington, were added to increase the amount of data available and provide better geographic coverage.

Data Files

All of the selected States maintain basic crash files, roadway inventory files, and traffic files. In addition, individual states also collect other types of data. Depending on the particular problem being studied, files from one or more States may be used by the analyst. The following table indicates the files that are available.

	CA	IL	ME	MI	MN	NC	UT	WA
Crash	X	X	X	X	X	X	X	X
Roadway	X	X	X	X	X	X	X	X
Traffic Volume	X	X	X	X	X	X	X	X
Curve and Grade		X		X			X	X
VIN		X		X		X	X	
Intersection	X			X	X			
Interchange/Ramp	X		X	X	X			X

Crash - Contains basic accident, vehicle, and occupant information on a case-by-case basis. Typical data includes type of accident, types of vehicle, sex and age of occupants, fixed object struck, accident severity, and weather conditions.

Roadway Inventory - Contains information on roadway cross-section, types of roadway and other roadway characteristics. Data includes the number of lanes, lane width, shoulder width and type, median width, rural/urban designation, and functional classification.

Traffic Volume - Contains Annual Average Daily Traffic (AADT) data. Additional data on hourly volumes and percent trucks is also available in selected States and/or locations.

Roadway Geometrics - Contains horizontal curve and vertical grade information. Data includes degree of curve, length of curve, percent grade.

Intersection - Contains information on highway intersections. Data includes traffic control type, intersection type, signal phasing, and turn lanes.

Interchange - Contains information on highway interchanges. Data includes interchange type and ramp characteristics.

Vehicle Identification Number (VIN) - Contains VIN data decoded using the VINDICATOR program. Data includes make and model, body style, body type, curb weight, and wheelbase.

Guardrail/Barrier - Contains an inventory of guardrail. Data include guardrail type, post type, rail height, and terminal type.

Data Format

All of the data files are stored in the SYBASE relational database. Data can be extracted in an ASCII format or converted to Statistical Analysis System (SAS) format for use in analysis. Data can be provided via different mediums. Currently we provide data on floppy diskettes, 8 mm tapes, CD-ROM, Optical disk, FTP, E-mail and spread sheet format. The data can be requested by filling out HSIS data request form.

Data Quantity

The HSIS contains only police reported accident data on the state-maintained highway system. The size of the state-maintained system depends on the policies of the State and is not necessarily proportional to the size of the State. Data for the original five HSIS States is available from 1985 while data for the three new HSIS States is available from 1991. The following table provides an indication of the quantity of data available.

	First Year Available	Average Crashes/Year	Roadway Mileage
California	1991	45,000	7,000
Illinois	1985	150,000	16,000
Maine	1985	39,000	22,000

Michigan	1985	140,000	9,600
Minnesota	1985	85,000	49,600
North Carolina	1991	118,000	31,000
Utah	1985	50,000	12,900
Washington	1991	34,000	8,600

The Guidebooks

Detailed guidebooks for each HSIS State are available to HSIS users. The purpose of the guidebooks is to provide sufficient information for both the analyst and the programmer to effectively use the system. The guidebooks document data quality issues uncovered through annual quality control checks or reported by system users. The guidebook for each State consists of two volumes. Volume I contains a basic description of the State data system, an alphabetized listing (by file type) of all available variables, detailed definitions of each category present within each variable, and notes on the quality of the variable. Volume II contains single variable tabulations for a large number of "key" variables within each of the files. The tables include data for the previous five years. The HSIS guidebooks are updated on a two-year cycle.

The Generic Variable Tables

Besides the Volume I and Volume II of the guidebooks for all States, a set of two generic variable tables have been developed for all the States. The first table lists the crash related variables for each State side-by-side and the second table lists the roadway related variables. The purpose of developing these tables was to give the ability to HSIS data requester to compare between States the availability of variables.

Before viewing the tables, please read the directions for using the tables.
View Table 1 - For Accident, Vehicle, and Occupant Files
View Table 2 - For Roadway and Roadway Related Files

The HSIS Laboratory

The HSIS is operated by the University of North Carolina Highway Safety Research Center (HSRC) and LENDIS Corporation, under contract with FHWA. The HSRC and LENDIS staff conducts research with the HSIS and provides guidance to users on the application of the HSIS for the study of highway safety problems. The LENDIS Corporation is also responsible for the operation of the HSIS Laboratory at the FHWA's Turner-Fairbank Highway Research Center in McLean, Virginia. The

HSIS Laboratory contains a variety of computer hardware and software including:

PCS and Workstations - to store, maintain, and analyze HSIS data. HSRC and LENDIS staff, FHWA staff, and visiting researchers can access the HSIS files, extract pertinent data, and conduct analysis using the latest computer hardware and statistical analysis software.

Videodisc Photologs - to access roadway images for selected HSIS States. The videodisc photologs allow on-site users to quickly access images for visual verification of existing data and/or collection of supplemental data. Currently, coverage includes the Michigan, Minnesota, Utah, Washington and California state-maintained highway systems. Additional States will be added as the photologs become available.

Geographic Information Systems (GIS) - to manipulate and display HSIS data. Several GIS software packages are available for use in analyzing HSIS data. The HSIS laboratory provides support for the development and testing of GIS-based safety applications, resulting from other FHWA-funded efforts.

HSIS Summary Reports

Since its inception the HSIS has been used in a wide variety of research efforts. Significant results from these efforts are documented in 2 to 4 page HSIS Summary Reports. Hard copies are available by calling the HSIS Report Center at (202) 493-3464. Suggested reading for the SD project:

> http://www.tfhrc.gov/safety/hsis/99-119.pdf - Using GIS in the Analysis of Truck Crashes
>
> http://www.tfhrc.gov/safety/hsis/99-081.pdf - GIS-Based Crash Referencing and Analysis System

For more information contact:

Michael S. Griffith
Federal Highway Administration
Office of Safety R&D
6300 Georgetown Pike, T-303
McLean, Virginia 22101-2296
(202) 493-3316

SYSTEM TOOLS - This area is still under development.

DATA REQUEST
(To request HSIS data, click here)

Geographical Information Systems (GIS) Review

www.gis.com

What is GIS?

This is probably the most asked question posed to those in the Geographic Information Systems (GIS) field and is probably the hardest to answer in a succinct and clear manner.

GIS is a rapidly growing technological field that incorporates graphical features with tabular data in order to assess real-world problems. What is now the GIS field began around 1960, with the discovery that maps could be programmed using simple code and then stored in a computer allowing for future modification when necessary. This was a welcome change from the era of hand cartography when maps had to be painstakingly created by hand; even small changes required the creation of a new map. The earliest version of a GIS was known as computer cartography and involved simple line work to represent land features. From that evolved the concept of overlaying different mapped features on top of each other to determine patterns and causes of spatial phenomenon.

The capabilities of GIS are a far cry from the simple beginnings of computer cartography. At the simplest level, GIS can be thought of as a high-tech equivalent of a map. However, not only can paper maps be produced far quicker and more efficiently, the storage of data in an easily accessible digital format enables complex analysis and modeling not previously possible. The reach of GIS expands into all disciplines and has been used for such widely ranged problems as prioritizing sensitive species habitat to determining optimal real estate locations for new businesses.

The key word to this technology is Geography - this usually means that the data (or at least some proportion of the data) is spatial, in other words, data that is in some way referenced to locations on the earth. Coupled with this data is usually data known as attribute data. Attribute data generally defined as additional information, which can then be tied to spatial data. An example of this would be schools. The actual location of the schools is the spatial data. Additional data such as the school name, level of education taught, school capacity would make up the attribute data. It is the partnership of these two data types that enables GIS to be such an effective problem solving tool.

GIS operates on many levels. On the most basic level, GIS is used as computer cartography, i.e. mapping. The real power in GIS is through using spatial and statistical methods to analyze attribute and geographic information. The end result of the analysis can be derivative information, interpolated information or prioritized information.

Other quotes to answer "What is GIS?"

"In the strictest sense, a GIS is a computer system capable of assembling, storing, manipulating, and displaying geographically referenced information, i.e. data identified according to their locations. Practitioners also regard the total GIS as including operating personnel and the data that go into the system." USGS

"A geographic information system (GIS) is a computer-based tool for mapping and analyzing things that exist and events that happen on earth. GIS technology integrates common database operations such as query and statistical analysis with the unique visualization and geographic analysis benefits offered by maps." ESRI

"GIS is an integrated system of computer hardware, software, and trained personnel linking topographic, demographic, utility, facility, image and other resource data that is geographically referenced." NASA

GIS has already affected most of us in some way without us even realizing it. If you've ever using an Internet mapping program to find directions, congratulations, you've personally used GIS. The new supermarket chain on the corner was probably located using GIS to determine the most effective place to meet customer demand.

Components of GIS

This article has briefly explained what GIS is. The next step in understanding GIS is to look at each component of GIS and how they work together. These components are:

Hardware

Hardware comprises the equipment needed to support the many activities of GIS ranging from data collection to data analysis. The central piece of equipment is the workstation, which runs the GIS software and is the attachment point for ancillary equipment. Data collection efforts can also require the use of a digitizer for conversion of hard copy data to digital data and a GPS data logger to collect data in the field. The use of handheld field technology is also becoming an important data collection tool in GIS. With the advent of web-enabled GIS, web servers have also become an important piece of equipment for GIS.

Software

Different software packages are important for GIS. Central to this is the GIS application package. Such software is essential for creating, editing and analyzing spatial and attribute data, therefore these packages contain a myriad of GIS functions inherent to them. Extensions or add-ons are software that extends the capabilities of the GIS software package. For example, Xtools is an ArcView extension that adds more editing capabilities to ArcView 3.x. Component GIS software is the opposite of application software. Component GIS seeks to build software applications that meet a specific purpose and thus are limited in their spatial analysis capabilities. Utilities are stand-alone programs that perform a specific function. For example, a file format utility that converts from on type of GIS file to another. There is also web-GIS software that helps serve data through Internet browsers.

Data

Data is the core of any GIS. There are two primary types of data that are used in GIS. A geodatabase is a database that is in some way referenced to locations on the earth. Geodatabases are grouped into two different types: vector and raster. Coupled with this data is usually data known as attribute data. Attribute data is generally defined as additional information, which can then be tied to spatial data. Documentation of GIS data sets is known as metadata.

People

Well-trained people knowledgeable in spatial analysis and skilled in using GIS software are essential to the GIS process. There are three factors to the people component: education, career path, and networking. The right education is key; taking the right combination of classes. Selecting the right type of GIS job is important. A person highly skilled in GIS analysis should not seek a job as a GIS developer if they haven't taken the necessary programming classes. Finally, continuous networking with other GIS professionals is essential for the exchange of ideas as well as a support community.

What Do You Need to Use GIS?

A full GIS, or geographic information system, requires:

- ✓ Hardware (computers and peripherals)
- ✓ Software
- ✓ Data
- ✓ People
- ✓ Training

and sound analysis methods for interpreting the results generated by the GIS

GIS software provides the functions and tools needed **to store, analyze, and display** information about places. The key components of GIS software are

- ✓ Tools for entering and manipulating geographic information such as addresses or political boundaries
- ✓ A database management system (DBMS)
- ✓ Tools that create intelligent digital maps you can analyze, query for more information, or print for presentation
- ✓ An easy-to-use graphical user interface (GUI)

GIS software ranges from low-end business-mapping software appropriate for displaying sales territories to high-end software capable of managing and studying large protected natural areas.

Commercial GIS Software

Following are several excellent Web directories to help you find GIS software to meet your needs:

- ✓ About.com GIS Software Resources—Software is also listed under different subject listings in the left sidebar, so browse around.

- ✓ Directions Magazine Product Directory—Search for software by type, name, or company.
- ✓ ESRI's GIS Solutions Directory—Solutions built using ESRI software and focused on a particular application area such as city planning or telecommunications.
- ✓ ESRI Software—A complete guide to our software.
- ✓ GISLinx.com—Links to more than 100 software companies.
- ✓ Tenlinks.com "Ultimate GIS Directory"—An A-to-Z listing of GIS software.

This article summarizes stand-alone GIS packages currently on the market. Included are commercial and freeware packages. Which vendor do you use? Cast your vote in the ongoing poll.

AGISMap

AGIS for Windows is a mapping and simple GIS package specifically designed to be easy to use, and distributed as shareware via the world wide web. The available 32 bit version is designed for Windows 95, 98 and NT.

Autodesk

Autodesk has a series of software applications designed to meet GIS needs in a variety of areas. AutoCAD Map 2000i - delivers specialized functionality for creating, maintaining, and producing maps and geographic data. Built on AutoCAD® 2000i, AutoCAD Map 2000i adds new Internet tools to keep you in touch with your colleagues, customers, and data. Autodesk MapGuide 5.0 - get live, interactive access to your designs, maps, and data from the Internet, your intranet, or in the field. Autodesk MapGuide® Release 5 software makes it all possible. Autodesk VISION* - a one-stop GIS solution for large enterprises that integrates your engineering and spatial data with the rest of your business information in a highly scalable, open, organization-wide IT framework. Platforms: UNIX, PC, Macintosh, WinCE, and Palm devices.

Chart-Write

Chart-Write has created a GIS application mostly tailored to crop management. Data-on-the-Map works with AgriMapper 1.1. It also includes raster based soil mapping and it is easy to transfer data from any other Windows-software (spreadsheet, database etc) to the maps. AgriMapper is delivered together with Data-on-the-Map 3.0. With DM 3.0 you can make your own farm maps or import maps in a range of different formats. The software package (AgriMapper and DM 3.0) is delivered on CD-ROM, including manuals for reading by web browser (for example Netscape or MS Internet Explorer). Platforms: Windows 95/98.

DeLorme

DeLorme is the producer of XMap, a GIS application *"with 80% of the functionality found in a traditional GIS at 15% of the cost"*. Performs such functions as geocoding, image rectification, 3D visualization and coordinate transformation. Platforms: Windows 95/98/Me/NT/2000

Enghouse

Enghouse offers AM/FM specialized GIS products. Enghouse provides spatial network asset management by offering a collection of robust applications for telephone, power, cable and gas companies.

EPPL7

EPPL7 is a raster-based GIS package, which runs directly in DOS. EPPL7 enables the user to do far more than simply view data. The program can be used to create, manage, analyze and display spatial (geographic) data; and to create and work with tabular and attribute data. EPPL7 also allows users to digitize vectors, convert vector data to raster format and integrate the vector and raster data for on-screen display and print-outs. EPPL7 also provides many routines for converting vector and raster data to and from a standard format. EPIC is the windows-based desktop GIS package that can work in conjunction with data from EPPL7. EPIC quickly and simply makes maps, but is also an analytical tool. It can reclassify data, generate two-layer models, perform cross-tab analysis with up to five layers, import "point" data using the Public Land Survey or GPS points, model uniform and directional buffers, and interpolate a continuous surface from point data.

ESRI – ArcInfo and ArcView

Environmental Systems Research Incorporated is celebrating its thirtieth anniversary this years. Recognized as the leader in GIS software, it's been estimated that about seventy percent of GIS users use ESRI products. The three main GIS software packages available from ESRI are: ArcInfo, ArcView and MapObjects. ArcInfo was the first software product available from ESRI and is also the most comprehensive analytical and mapping software of the four. ArcView originally emerged as an out-of-the box desktop mapping software product for the end user. More user friendly than ArcInfo, ArcView's editing and data manipulation capabilities are extended with each update. In addition, ESRI has developed plug-ins called extensions which add to the functionality of ArcView. MapObjects is a relatively young product from ESRI designed with the developer in mind. A Visual Basic component, MapObjects allows programmers to build cartographic applications from the ground up. While this may seem like re-inventing the wheel with all the mapping programs available, MapObjects allows the developer to create custom applications. There are other products available from ESRI and can be investigated by visiting their software site. Demo and light versions of ESRI software are available for downloading. You can also find free data to use with ESRI products. Platforms: UNIX, Win 95/98, Win NT Further Resources: ArcInfo, ArcView

Geo/SQL

Geo/SQL is a low cost, full function Microsoft Windows based GIS. An AutoCAD add-in version is also available. Works with many GIS data formats as well as Oracle Spatial Cartridge. Platforms: Windows 95/98, NT.

Idrisi32

Idrisi32 is one of the most popular desktop raster GIS and Image Processing systems in the world. It is developed and distributed on a non-profit basis by the Clark Labs, a project within the Graduate School of Geography at Clark University in Worcester, Mass. Idrisi32 is COM compliant. Platforms: Windows NT, 2000, 95 or 98. Further Resources: Idrisi Resources

Ilwis

Ilwis is a GIS and Remote Sensing package offering orthorectification, geostatistics and overlay capabilities. Platforms: Windows 3.1/95

Intergraph

Intergraph makes several GIS applications. Most of the GIS packages are designed with an Open GIS in mind and therefore can work with a variety of other GIS software formats. Intergraph has developed products that help merge GIS with information technology (IT) and business process improvement tools. Intergraph offers the GeoMedia family of solutions and Modular GIS Environment MGE Suite of mapping and GIS applications.

Using an open architecture, the GeoMedia product suite integrates geospatial information throughout the enterprise and provides the tools needed to develop business-to-business and custom client applications using industry standard development tools. GeoMedia offers uninhibited access to all geospatial data formats without the need for data translations. Currently in Version 4.0 the GeoMedia family is made up of GeoMedia, GeoMedia Professional, GeoMedia WebMap, and GeoMedia WebEnterprise.

- ✓ GeoMedia is the universal information integrator, serving as a visualization and analysis tool and as an open platform for custom GIS solution development.
- ✓ GeoMedia Professional is a product specifically designed to collect and manage spatial data using standard databases.
- ✓ GeoMedia WebMap is a Web-based map visualization tool with real-time links to one or more GIS data warehouses.
- ✓ GeoMedia WebEnterprise creates dynamic, custom web-mapping applications that can analyze and manipulate geographic data.

- ✓ In addition to these products, Intergraph offers MFworks for GeoMedia which provides users of grid-based software the power of visualization, mapping, and analysis. Intergraph also offers SMMS for GeoMedia which is a desktop tool for geographic metadata creation and geographic data management.

The Modular GIS Environment (MGE) product suite provides production-ready capabilities for automating, managing, analyzing, and presenting GIS data, and is completely interoperable with GeoMedia. Platform: Windows NT. Further Resources: Intergraph

MapGrafix

MapGrafix is a GIS/Graphics package offered for Mac platforms by ComGraphix. The program offers basic GIS data manipulation and display. In addition, MapGrafix supports many standard vector formats: USGS DLG3, AutoCAD DXF, TIGER, ETAK, World Data Bank II and others. Platforms: Macintosh

Manifold

Manifold System GIS creates a GIS mapping application. For a list of the capabilities visit their product description site. Platforms: Windows 95/98

MapInfo

A leading competitor is MapInfo which produces a suite of GIS software. MapInfo Professional is their leading GIS product containing the most advanced analytical tools. MapInfo also offers plug-ins called add-ons to enhance the functionality of MapInfo Professional. For the development side, MapInfo offers Map-X. Through an Active X component, developers can embed mapping applications into other applications such as Excel. Although it can be used for a variety of analysis, the makers of MapInfo market the software more towards the business sector. Demo versions are available for downloading for some of MapInfo's products. Platforms: Windows 95/98, Windows NT Further Resources: MapInfo, MapBasic, MapInfo Tutorials

Maptitude

Maptitude is a full-featured mapping package for Windows. Designed for data visualization and geographic analysis, Maptitude comes with a comprehensive library of nationwide and worldwide maps on CD, including complete US street maps, and Census tract and ZIP Code boundaries and demographics. Caliper also produces GIS+ and TransCAD for transportation and logistics. TransCAD is used for solving key analytical problems in transportation planning, management, and operations. TransCAD is used extensively for transportation database development and maintenance, demand forecasting, operations management, and vehicle routing and scheduling. Platforms: Windows 95/98

Map Maker

Map Maker Pro is a low-cost and easy to use, yet powerful, map making and Geographical Information System for Windows. It is designed to enable non-expert users to start producing useful maps after only a few hours study. A variety of tools allow you to navigate around a map, measure distances and areas, draw polygons, lines and symbols, and display and edit data. Platforms: Win95/98, Win NT4.0

MetaMAP

MetaMAP is a full featured PC-based GIS. With MetaMAP, the user can add and maintain their own data layers and use them in conjunction with imported GIS data. MetaMAP also includes several graphic and non-graphic data translators (including DXF, Arc-Info Export format, Tiger, ETAK, dBase, and FoxPro). MetaMAP can also be extended to meet any projected need through its internal scripting engine, allowing for new program functionality to be added by writing 'C-like' code. In addition, MapVUE is an 'inquiry only' version of MetaMAP. With this system, the user can view, query, report, and plot or print data generated by MetaMAP. Platforms: Windows 95/98

Terrain Tools

Terrain Tools, produced by Softree, is a software package for surveying and mapping. It is ideal for the forester, geologist, surveyor or resource scientist who is not a GIS specialist, but who needs to quickly produce working maps and site plans. Platforms: Windows 3.1, 95, 98 or NT

ThinkSpace

ThinkSpace creates a variety of raster-based GIS packages. MFWorks is the only raster GIS capable of true network analysis and least-cost path analysis. Also available is MFCom, a collection of component objects used to import, manipulate, and analyze spatial data. Platforms: Windows OS, Macintosh.

TNT Products

Created by Microimages, The TNT Products is a suite of GIS applications for fully integrated GIS, image processing, CAD, TIN, desktop cartography, and geospatial database management. Platforms: Windows 95/98, Windows NT, UNIX, Macintosh

ArcExplorer

ArcExplorer is the free GIS application offered by ESRI products. A lighter version of ArcView this application allows basic mapping and spatial querying. Platforms: Windows 95/98, Windows NT

FlowMap

FlowMap is a freeware application designed to analyze and display flow data. This application was developed at the Faculty of Geographical Sciences of the Utrecht University in the Netherlands.
Platforms: Windows 3.11/95/98/NT/2000

GMT Mapping Tools

GMT is a free, public-domain collection of ~60 UNIX tools that allow users to manipulate (x,y) and (x,y,z) data sets (including filtering, trend fitting, gridding, projecting, etc.) and produce Encapsulated PostScript File (EPS) illustrations ranging from simple x-y plots through contour maps to artificially illuminated surfaces and 3-D perspective views in black and white, gray tone, hachure patterns, and 24-bit color.

GRASS

GRASS is probably the most well-known and original GIS software applications. GRASS is a raster-based GIS, vector GIS, image processing system, graphics production system, data management system, and spatial modeling system. GRASS can be downloaded for free at their Download Area. Platforms: Linux, Sun Solaris, Silicon Graphics Irix, HP-UX, DEC-Alpha, and Windows 95/98/NT Further Resources: Grass

SPRING

SPRING is a state-of-the-art GIS and Remote Sensing Image Processing system with an object-oriented data model which provides for the integration of raster and vector data representations in a single environment. Platform support includes: Windows95/NT, Linux, Solaris, HPUX, IRIX and AIX.

TNTLite

TNTLite MicroImages, Inc. provides TNTlite as a free version of TNTmips , the professional software for geospatial data analysis. The free TNTlite product has all the features of the professional version, except TNTlite limits the size of Project File objects, and TNTlite enables data sharing only with other copies of TNTlite (export processes are disabled). Can either be downloaded or ordered on CD. Platforms: Windows 95/98, Windows NT.

MapInfo vs. ArcView – a Comparison

by: Glenn Letham (April 1999)

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Boy, I didn't know what I was getting myself into when I posed the question: "What do you think are the pros and cons of MapInfo and ArcView. If you responded to us don't be upset because I didn't reply - my mailbox has been very full for the past 3 weeks!

Let us start by clarifying a few things. I did not specify what versions I am comparing so keep in mind that many people are griping about MapInfo 4.5 and ArcView 3.0 issues when there are fixes to their problems in the latest version. In case you're not aware, both products released upgrades last year - MapInfo 5.0 and ArcView 3.1.I feel its worthwhile hearing from the MI 4.5 and AV 3.0 users because there are many users that have not upgraded yet.

Products that were excluded from this comparison are not presumed inferior or superior. I simply wanted to get some real users opinions on what they liked about the 2 products. I'm on the-L and ESRI-L and read threads from both sides on a daily basis. What occurred to us was that there are many people, like myself, that use both products on a daily basis (I also use Genamap, AutoCAD Map and PC ARC). Each product has its ups and downs so I'm going to relay to you what REAL USERS feel are the strengths and weaknesses of the two products.

MapInfo Pros:

- ✓ Popular in the business community
- ✓ Relatively short learning curve
- ✓ Relatively simple programming language (MapBasic)
- ✓ Simple to alter attribute table structure
- ✓ Excellent mail list (-L) a real community
- ✓ Good re-projection utilities
- ✓ Areas, lines, points, text can be stored in same table (.TAB)
- ✓ Ad-ons (i.e. Vertical Mapper) are relatively cheap
- ✓ Lots of users in Geology community
- ✓ Easy to edit/manipulate workspace file (a workspace is a group of tables, map layouts etc. basically a saved session)
- ✓ Nice 3-D add on (Vertical Mapper)
- ✓ Simple Query building
- ✓ Superior Object Linking & Embedding (OLE)
- ✓ Nice Layer control

MapInfo Cons:

- ✓ Mapbasic (programming language) is a separate purchase
- ✓ AutoCAD (DWG & DXF) import/export seems unstable
- ✓ Lots of confusion between text and labels. Problems sizing.

- ✓ Gridding, graticule functions are poor
- ✓ Poor Topological editing/creation
- ✓ Difficult Layout Legend manipulation
- ✓ Price for upgrades
- ✓ Layout is not always WYSIWYG
- ✓ Gripes about Website (especially the redesign)

ArcView Pros:

- ✓ Popular in Resource sector
- ✓ Simple to Join attribute tables
- ✓ Window handling (i.e. The way it manages views, scripts and layout windows is very tidy)
- ✓ Avenue (programming language) comes bundled with ArcView
- ✓ Large user base - world wide community
- ✓ Lots of available data and utilities (scripts)
- ✓ Lots of pre-defined analytical functions
- ✓ Many pre-defined symbols and line-styles
- ✓ Easily reads all Arc data formats
- ✓ Simple menu/tool bar editing
- ✓ Thematic mapping wizards
- ✓ Nice website

ArcView cons:

- ✓ Won't re-project on the fly - to view multiple themes they
- ✓ Must all have the same projection definition
- ✓ Redraw when turning themes on/off
- ✓ Lengthy directory scan when adding themes
- ✓ Program locks-up
- ✓ Only re-projects from lat/longs.
- ✓ Non-standard menu structure (difficult to locate commands)
- ✓ Clunky to import or use a script
- ✓ Probs. With long file names/directories
- ✓ More difficult programming environment

Common gripes about both:

- ✓ Layout window complaints (this is where you arrange your maps for cartographic output)
- ✓ Documentation
- ✓ Price
- ✓ Labeling/annotation

These essentially summarize how actual users feel about MapInfo and ArcView. Basically, it all depends on your level of expertise, your learning curve, and what you expect when you start out.

Here are my perceptions. MI seems to appeal more to novice GISers, whereas people that have been around GIS for some time are more likely to become ARC users. I'm not a die hard programmer type, but I do find that MapBasic is simpler to learn than Avenue. I really like the way you can have a Mapbasic window open in MapInfo and simply watch the code scroll by (or copy and paste it) as you invoke commands - what a great way to learn the code. MapInfo labeling gives us head aches all the time and the non-WYSIWYGness (is that a word!) is a pain. Here in B.C. it is common to have data stored in several projections including lat/long, UTM and Albers Equal Area. This poses a real problem when using ArcView because all coverages must be stored in the same projection - talk about filling up your network drive in a hurry! Well that's my 2 cents worth.

I have seen ArcView 3.1 in action but I haven't seen MapInfo 5.0. I can say that the ArcView upgrade is HUGE. They have fixed a lot of problems and I expect that they will get many new users as a result. I haven't heard as much positive feedback regarding MapInfo 5.0 and it seems that many users are reluctant to upgrade mostly for financial reasons. The real MapInfo keeners seem to be embracing the new version though so you may want to get on the-L and discuss it. I use both products but I likely use MapInfo more and have used it longer. If I seem biased it was not intentional. To get the answers you are seeking I would recommend taking the products for a test drive yourself!

Here are the main features promoted in the upgrades:

- ✓ ArcView 3.1 - Price $1,195
- ✓ Hundreds of new symbols
- ✓ Will convert Shape files to Projected units
- ✓ Thematic wizards
- ✓ ESCape key stops redraw - YAY, FINALLY!!!!!
- ✓ ESCape key stops directory search for themes
- ✓ Label/Text menu Tool
- ✓ Neatline Button
- ✓ Graticule extension - this is slick!
- ✓ Export layout to JPG, WMF, BMP, EPS
- ✓ Crystal Reports report generator
- ✓ Mr. SID support extension
- ✓ Expanded data included

Go to the ESRI web site to find out more

MapInfo 5.0 - Price $1,295

- ✓ Continuous Thematic Shading

- ✓ Improved ODBC Connectivity
- ✓ Improved CAD import/export
- ✓ 498 Page Reference manual on CD

Go to the MapInfo web site to find out more.

A 1997 Review of 4 Inexpensive, Easy GIS Packages

MapInfo's MapInfo Professional

MapInfo is the dean of desktop mapping. While ESRI and Caliper cut their teeth on high-end, workstation-based GIS and worked their way down to the desktop, MapInfo made its reputation on the desktop and, specifically, on Windows desktops. It's not a coincidence that MapInfo Professional, while not the most powerful program, is arguably the most balanced program in terms of power, ease of use, support and price. That's why it came in first place, with an overall score of 7.2 in our comparison.

MapInfo's interface is the most intuitive of the bunch, at least for experienced Windows users. And the program is a fast, 32-bit application that runs well under any version of Windows. Its tools for creating maps are well-developed. Finally, MapInfo's long presence in the market means there is a large base of consultants and third-party application developers available for users to call on.

Installation/Configuration

Installing a single-user version of MapInfo is a no-brainer. The program's setup routine does a good job of leading you through the options and keeps you fully informed about the amount of disk space needed and available.

MapInfo also earns extra points for being available in versions for the Power Mac and Unix, although it must be noted that only the 3.0 version of the program is available for these platforms.

MapInfo runs well on a network, although it provides only standard file locking rather than object locking. In other words, if one user is editing a data file and another user tries to open it, the second user will only be able to access it in read-only mode.

The program picks up some extra points thanks to MapInfo ProServer. This application lets administrators provide multi-user access to MapInfo via World Wide Web browsers. The ProServer package, which includes MapInfo 4.1, costs $500 for each user, and you can purchase an unlimited-user license for $59,000.

MapInfo also offers at extra cost a powerful and flexible programming language, MapBasic, which will be familiar to anyone who knows Basic. While the scripting language is powerful, however, MapBasic does not include visual programming elements, such as lookup lists, nor does it offer step-through debugging. Instead, you have to manually enter stop commands before compiling. We rated installation very good.

Map Creation

MapInfo offers several surprises in this category, combining some unusually strong tools with some unexpected gaps. That's why we rated it good.

On the plus side, MapInfo offers the most complete set of drawing tools of any desktop program. In addition to the usual line, polyline and rectangle tools, MapInfo offers tools for creating curves and ellipses. You'll also find a polyline smoothing feature for simplifying objects. The program also offers a snap-to-node feature that makes it easy to align regions on the map you're creating.

Turning raster maps or photographs into MapInfo maps is also easy because you can bring in raster images as backgrounds and trace directly over them. You can also bring raster images in as insets.

MapInfo offers a wide array of pre-designed symbols. Most of them are TrueType fonts, for which you can also specify boldness and drop shadows. You can edit any of MapInfo's symbols in a compatible font editor, although none is provided. And you can import any bitmap you like, such as a company logo, to use as symbols.

The program offers an easy-to-use and effective geocoding utility for attaching points to the map according to street address, boundary or ZIP code. You can, of course, also attach objects to specified coordinates.

On the downside, users have to overcome a few hurdles in making maps. For starters, MapInfo's line tool is hobbled by an offering of only seven different line widths. You can extend the choices only by turning to a third-party utility or writing your own in MapBasic.

Also, MapInfo's symbols, including street and other object labels, are not scalable. When you zoom in or out on a map, the labels remain the same size, shrinking or expanding in relation to the rest of the map.
Otherwise, MapInfo's controls over labels are very strong. You can specify anchor points and offsets, and it's easy to grab and rotate any label to fit. The auto-label feature is effective, and it will even prevent label overlaps if you specify it to do so. Unfortunately, it does this by prioritizing and doesn't allow the user to view or change priorities.
Finally, because you can only select map objects from a single layer at a time, cropping and copying maps requires several steps.

Querying and Data Management

MapInfo scored quite well in this category, thanks to its solid set of query and database tools, an easy-to-use interface and a couple of unusual extras.

As expected, MapInfo can open data files in MapInfo, dBase and delimited ASCII formats directly. But MapInfo also can open Lotus 1-2-3 and Microsoft Excel files--a big plus for shops that have stored extensive data in spreadsheets. And the program provides the tools you need to connect to other databases via Open Database Connectivity (ODBC) and to link or join tables.

Just as important, MapInfo provides easy-to-use query builders for internal and SQL queries, and both are equipped with lookup tables to help you enter operators, including a handful of geographic operators, and functions in short order. However, we were disappointed to see that there is no way to look up values from within the query builder. MapInfo does not allow you to save queries for reuse either.

In addition to a generally solid set of selection tools, including radius and rectangle tools, MapInfo also offers flexible buffers. While the program can't match Maptitude's trick of generating multiple buffers around a single object in a single action, MapInfo can create point, line or area buffers. And MapInfo, like Atlas GIS, lets you generate a buffer on the basis of a user-specified value. For example, you might generate buffers around cities to reflect their populations.

But where MapInfo really shines is in thematic mapping capabilities. The program, of course, supports the expected ranged fills, dot density, population growth in one color ramp and falling population growth in another.

MapInfo also earns extra points for two special features. First, the program offers a nifty redistricting tool that lets you assign objects to groups, monitoring totals as you go. This is a quick way to reconfigure school or voter districts. Second, the program comes with a bundled Global Positioning System application. Overall, we rated the package very good in querying and data management.

Reporting

MapInfo provides a strong set of reporting tools, although we did find some things missing. We gave it a good score. The program's Layout window makes it easy to arrange map elements on the page using drag-and-drop techniques, and you can create templates by making a layout in a blank worksheet and saving the worksheet. Furthermore, MapInfo is one of the few programs that let you justify and rotate annotations on the page.
However, resizing table and legend frames to display just the contents we wanted was a bit difficult, as was resizing and formatting legend frames. We were disappointed to find that MapInfo doesn't provide a north arrow for pages; in addition, to insert a scale bar, you have to run a MapBasic program. Even then, it's tricky to move and align the scale bar. Also, the program makes no provision for mosaic printing of maps too large for a single page.

MapInfo does pick up extra points for letting you generate a wide variety of stand-alone charts, although it doesn't include the ability to create exploded pie, scatter or column charts as ArcView does.

Caliper's Maptitude

Maptitude is without question the value leader of the pack. With a list price about one-third that of MapInfo and ArcView, Maptitude provides a set of GIS tools that is very competitive. Indeed, in some areas--such as its built-in routing, smart labeling, powerful buffering tools and object selection on multiple layers--the program goes beyond the others. Its overall score was 6.8.

Maptitude also earned high marks for ease of use, although the program still needs some work. For starters, the program's dialog boxes are not as intuitive as they could be, and we often found ourselves going down blind alleys while learning the program. Also, while Maptitude will run on Windows 95 and NT, the program is not fully 32-bit. You'll rarely notice the program lagging, however.

We suggest you look at Maptitude first to see if it will meet your needs. For example, if you need a Macintosh or Unix client--or if you want to generate charts to accompany maps--you're out of luck. Otherwise, Maptitude could easily be your best buy.

Installation/Configuration

Installation and configuration are generally easy, although Maptitude does leave some room for improvement. To begin with, the setup routine doesn't tell you how much disk space it needs and how much is available on drives. Indeed, the program doesn't even let you browse for the drive and directory you want to use. You have to enter the drive information manually at a prompt.

On the plus side, Maptitude is relatively easy to set up for network use, allowing you to share the application itself as well as data and map files on the network. Expect somewhat reduced performance, however, if you run the application from a server.

Maptitude automatically limits users' editing capabilities for tables, disallowing the saving of changes if the table is opened by multiple users. If you want to share Maptitude's editable geography files, you'll need to load the Lock Manager utility. For the fastest performance, you can run the utility on a dedicated server. Alternatively, you can install a Terminate and Stay Resident version.

Maptitude runs only on Windows, and it is not fully 32-bit. Nevertheless, the program will run on Windows 95 and NT. It should be noted, however, that we experienced a couple of unexplained crashes when running under NT 4.0. And we had to go find older 16-bit ODBC drivers to install because Maptitude would not recognize or use the 32-bit drivers installed on our NT system. Maptitude got a good score for installation and configuration.

Map Creation

Maptitude uses two types of map formats: standard and compact. Compact maps take up less disk space, making map projects more portable, and they open faster. The downside is that compact maps can't be edited. You can add objects and layers on top, but before you can actually edit the original objects in the map, you have to save the map as a standard geographic file. Unfortunately, when you open a project, it's not immediately clear whether you're working with compact or standard map files--a confusion that can lead to wasted time.

Nevertheless, Maptitude is one of the stronger programs for creating and editing maps, and it's arguably a bit easier to use than the competition for basic operations. In addition, Maptitude offers an unusual degree of control over map elements. The program has 100 line styles, each of which can be up to 36 points in width, and 17 fill patterns from which to choose.

One minor snag is that a single map layer can contain only one kind of map object: point, line or area. You can create as many layers as you like, but you can't, for example, combine areas and points on the same layer. This results in a proliferation of layers that require more management, and we didn't find Maptitude's layer manager to be as easy to use as that found in the competition.

Like MapInfo and ArcView, Maptitude earns extra points for offering a snap-to-node feature that will place object nodes on top of each other if you bring them within seven pixels of each other--a capability that makes creating adjacent regions much easier. Unfortunately, you can't change the tolerance of the snap-to feature, so you may encounter trouble if you want nodes very close but not touching.

Maptitude offers a wide array of symbols, which are TrueType fonts, although it doesn't offer the controls found in some of the competition. There are, for example, no drop shadows, and the symbols and labels are not scalable. We also found it irritating that instead of allowing you to select a default symbol, you're required to specify a symbol each time you try to place one.

Maptitude offers an auto-labeling feature in addition to manual labeling, and the program allows you to set the anchor point. There's even an automatic overlap-prevention feature, and the user can control which labels receive priority. Unfortunately, you can't specify an offset for labels. Even more awkward, if you use the auto-label feature, you can't grab and rotate the symbol for a better fit.

Maptitude is unusually flexible at importing map files from other applications. For example, the program can import AutoCAD DXF files as well as Arc/Info and TIGER (Topologically Integrated Geographic Encoding and Referencing) files without requiring you to buy a special utility. Overall, Maptitude got a good score for map creation.

Querying and Data Management

Maptitude got a very good score in this category. The program really shines when it comes to making theme maps and buffering, although it is not quite so facile at managing data.

No program makes it easier to generate theme maps than Maptitude. Whenever you've got a map window selected, you can simply click on the ranged-fill, dot-density, proportional symbol or chart theme icons in the toolbar to get under way.

You can select from six methods for creating ranged-fill maps: equal number, equal size, equal area, list of values, standard deviation and nested average. Maptitude is the only package that lets you create multi-variant dot-density maps. The program automatically picks contrasting colors for each value displayed.

Maptitude earns extra points for providing chart theme maps. Thanks to the program's nifty wizards, constructing the charts is easy. And Maptitude offers a good selection of chart types, including pie charts, and various alignments of 3-D and standard bar charts.

Maptitude is generally strong at performing direct queries on data. The Select by Condition dialog box lets users compose complex search and selection arguments that specify values for selected fields of data. The program offers a respectable 15 operators, including an assortment of range and relative operators, and it provides 38 functions--fewer than those provided by Atlas GIS but more than those provided by MapInfo--for operating on data; these functions include averaging, sum, minimum and maximum.

The Select by Condition dialog box is well-designed for building queries, including multivariable queries, and it automatically retains the argument made previously during the session. You can also save any argument permanently for later use. The only thing missing is a Verify button to confirm the syntax of arguments. Thus, if you forgo the lookup tables in favor of manual entry at the command line, you may find yourself having to re-enter arguments.

Also, we found the program to be notably slow at performing some of our searches. Maptitude's special forte relative to the other programs is its flexible buffering capabilities. Buffers are easy to create, and you can even build multiple buffers in a single stroke. Performing multi-layer queries that split regions is also easy. We simply selected the buffer we had created, chose Overlay from the Tools menu and specified the layer we wanted to query. Maptitude divided all the data in the underlying regions according to the buffer coverage and placed the data in a table.

Maptitude earns extra points for being the only program in this comparison to offer built-in routing tools. Once you've entered stop points on the map using the Routing utility, the program can find the "best" route according to distance, travel time or any other value that you've stored in the data table attached to your road map. The program does not, however, support GPS.

Reporting

Maptitude offers the same kind of drag-and-drop layout utility as MapInfo and ArcView, although it doesn't offer live windows like the others. If you change something in the original map, you'll have to refresh the layout window to see the changes. Maptitude does allow you to annotate pages, but it doesn't allow you to justify or rotate the text. More importantly, Maptitude lacks any means of creating stand-alone charts.
On the plus side, Maptitude makes it easy to generate north arrows and scales, and it does allow you to mosaic large maps for printing. We rated its reporting tools as good.

ESRI's ArcView

If money is no object--and especially if you're looking for a program designed for enterprise-wide network use--ArcView is the product of choice. It came in a close third place, with an overall score of 6.5.

Truth be told, we found ArcView's interface to be quirky. Many features aren't as obvious as they should be. For example, the icon that looks like the layers control is actually a zoom control. And if you want to create a theme map, you'll search in vain for an option on the toolbar. Eventually, you'll turn to the documentation to find that you bring up the appropriate tools by double-clicking on the appropriate layer in the box to the left of the map. Calling up a project window that's covered up is awkward because no icons or menu selections are available.

But once you get used to the way ArcView works, you'll find it very powerful. And it's the most extensible package on the market. The basic package, which is what we reviewed, lacks routing tools, buffers and a few other features available in the competition. But if you're prepared to buy ArcView's extensions, you can enhance the program's power set beyond the limits of the other programs. With ArcView Spatial Analyst, you can even perform sophisticated topographical analyses. (However, the extensions to ArcView cost more than the base package and essentially turn it into more than a desktop package, both in terms of cost and training required.)

ArcView integrates tightly with Arc/Info, ESRI's high-end GIS solution. And ArcView is not only optimized for high-performance on a network, it offers clients for Macintosh and Unix platforms. The bottom line: ArcView costs more and requires more training, but it is the most powerful desktop GIS program available. And like MapInfo, the program is backed up by an extensive network of consultants and application developers.

Installation/Configuration

Installing ArcView is painless, except for the fact that it comes in so many pieces. If you want all the capabilities provided by the other applications in this comparison, you'll have to install two additional programs: ArcView Spatial Analyst and ArcView Network Analyst. Fortunately, the setup routine is automated and easy to follow.

ArcView earned high marks for being a full-fledged client/server program with feature-complete clients for Windows, Macintosh and Unix platforms.

What's more, ArcView is optimized for use on a network. The program's Lock Manager utility, which can be run on a client or a server, monitors users' access of map and data files and prevents one user from saving changes to a file that is open on another user's system. The system administrator has to follow certain rules for naming shared drives to ensure that the Lock Manager works properly, but the task is not onerous.

ArcView's programming language, Avenue, is bundled with the program. It is a strong programming language, although it does not support Object Linking and Embedding 2.0. One edge that Avenue has over the competition is that it provides a visual interface. You can customize ArcView's menus and other features, often without doing any programming at all, relying instead on the visual interface to simply add or delete icons or menu options. We rated ArcView's installation excellent.

Map Creation

ArcView is great for working with existing maps, but it's not quite as well-suited to creating maps from scratch. The program offers a basic set of drawing tools, including those for creating lines, circles and polygons, and you can import raster images. But there's no tool for creating curves. What's even more troublesome is the fact that you can't mix points, lines and polygons on the same map layer or, in ArcView's terminology, "theme."

One other irritation: In editing maps, we encountered sporadic redraw failures and had to manually refresh the screen. Unfortunately, the program doesn't offer a single command for refreshing the entire screen. You can turn layers off in a single stroke, but you have to turn them on again one by one--a tedious process if you have many layers.

Working with the program's selection tools is, unfortunately, rather difficult. Performing chores such as cropping and copying map features is an exercise in trial-and-error learning that is not helped by the program's rather turgid on-line help. On the plus side, ArcView is fast and accurate when it comes to geocoding. We found it very easy to set address matching criteria, and ArcView allows you to selectively relax criteria.

ArcView also shines when it comes to symbols and labels. First, it's one of the few programs available that can scale symbols and labels. Second, the program provides a large array of pre-designed symbols; if they don't suffice, you can always import bitmaps to use as symbols. And ArcView has an intelligent approach to dealing with overlapping labels: They are simply highlighted in green so you can move them to a better location. We find this to be a better approach than simply eliminating labels. Of course, you can also specify anchor points and offsets for labels. Overall, we gave ArcView a good score for map creation.

Querying and Data Management

ArcView earned high marks for its thematic mapping, which is very flexible and easy to use. You can quickly and easily generate attractive ranged-filled and dot-density maps as well as proportional symbol and even graph maps. And ArcView is flexible in the methods it provides for analyzing the data, offering equal area, equal interval, standard deviation, natural breaks and quantiles. You can't create your own custom formulas, however, without turning to the Avenue programming language.

However, several gaps in the program's query toolset prevent the program from scoring higher. For example, the basic ArcView package does not include a buffering tool for generating regions of a specified distance around map objects, such as buildings or roads. Nor is there a radius-select tool. Instead, you must use the circle-drawing tool to draw a circle and then go to the main toolbar and click on the Select Feature Using Shape button. This procedure involves extra steps and is far from intuitive. What's more, the program doesn't let you specify whether all features enclosed by the circle or touched by the circle should be selected. Nor will you find any routing or GPS capabilities.

If you're willing to pay for ArcView's Network Analyst and Spatial Analyst extensions, you can more than fill in the gaps. These products let you produce buffers, routing and proximity maps as well as conduct sophisticated topological analyses. For example, you'll find built-in tools for using shading and hydrological analysis functions.

ArcView supports internal and SQL queries, although the procedures for making internal queries are decidedly easier to use and more powerful. The query builder provides lookup tables for operators and even for values from the open tables. There are, however, no geographic operators. The SQL query builder, on the other hand, doesn't provide lookup tables for operators.

Finally, we encountered one constant irritation in working with queries: Querying maps involves frequent redraws of the display, and ArcView does not handle redraw interrupts well. You can interrupt the redraw by hitting the Escape key, but if you do so, the program automatically turns off the display of all map layers. You have to manually turn them on again and wait for them to draw. We gave ArcView a good score for this category.

Reporting

ArcView's reporting tools are very similar to those found in MapInfo, with a few extras thrown in. That's why we rated them very good. The program offers an easy-to-use drag-and-drop layout utility that you can use to arrange map elements in WYSIWYG fashion. ArcView adds to this by making it easier to save layouts as templates and by providing north arrows, scales and a wider variety of charts.

On our wish list is mosaic printing of large maps and automatic borders for frames. Also, we were disappointed to find that we couldn't change fonts in legends without changing the Windows default font.

ESRI's Atlas GIS

Atlas GIS feels like an orphan. During the last year, the program has had three owners; its original owner, Strategic Mapping, was purchased by Claritas, which kept Strategic Mapping's databases and sold Atlas GIS to ESRI. The confusion this has caused is one of the reasons Atlas GIS scored only 4.2 in our comparison.

Indeed, Atlas GIS doesn't even seem to be fully comfortable with its operating system. While the program works under Windows, it has the look and feel of a DOS program. Even the basic Windows conventions, such as pop-up cues for icons and other screen features, are ignored. And although Atlas GIS will work under Windows 95 and NT, it's really a 16-bit application.

ESRI is positioning Atlas GIS as a lower-cost alternative to ArcView for people whose mapping needs are relatively basic. While Atlas GIS is easy to use and fully capable of creating attractive theme maps, it's hard to see the product as an attractive buy unless your shop is already standardized on the product and you're putting off making a change. You can actually get more power and ease of use by moving to the significantly less expensive Maptitude.

Installation/Configuration

Atlas GIS' troubled family history is evident from the start. During installation, you'll encounter repeated references to Strategic Mapping, which no longer owns the program. Also, the setup program tells you to find the registration number on Disk 1, but it isn't there. Instead, you'll find it on a separate card. Additionally, the setup program offers a screen that lets you select what to install, including tutorial and sample data files, but the program doesn't immediately tell you how much room the data files will require or offer you the chance to bail out.

Atlas GIS is not well-suited for network use. You can run the program across a network, and multiple users can access data files so long as the DOS Share command has been used on each system, but no tools for managing edit control of files are provided. Instead, you have to mark all files as Read Only.

Customization of Atlas GIS is accomplished through either Atlas Script/VB or Atlas Script/C.
The program is available in DOS and Windows versions, although even the Windows version has the look and feel of a DOS program. We rated its installation satisfactory.

Map Creation

Atlas GIS has two major limitations that make it a bad choice for some users who need to generate maps from scratch. First, the program can only accommodate 4,000 nodes per polygon. Second, although Atlas GIS offers a solid set of basic drawing tools--including lines, circles and polygons--it gives you very limited opportunities for editing what you've drawn. All you can do is reshape the object using the six-point bounding box and the rotation handle. You cannot select individual vertices and move them.

If those limitations don't deter you, however, you'll find Atlas GIS very competitive with the other programs in this comparison. The program's labeling capabilities are strong, and like its big brother, ArcView, Atlas GIS even supports scalable symbols and labels.

Atlas GIS also offers an easy-to-use geocoding utility that lets you relax specified criteria, although it is not as adjustable as the one you'll find in ArcView. A new bundled utility lets you bring in raster images as backgrounds for maps, but you can't append raster images to points on a map. Overall, we rated map creation as poor.

Querying and Data Management

Atlas GIS handles most basic query and data management tasks with ease, although it's not quite the match of the other programs in this comparison. That's why we gave it only a satisfactory score for this category.

To begin with, the program's internal database is limited to 255 fields. You can query external databases via a built-in SQL search tool, although no query builder is provided. If you use SQL to access external data, the results will be dumped into an Atlas GIS table. If you want to open or import external tables, you'll have to join them to an Atlas GIS table. That's where you'll bump into more limitations.

First, while Atlas GIS supports one-to-one joins, it doesn't allow you to perform many-to-one joins. Second, while the other desktop GIS programs employ relational databases, Atlas GIS uses a flat-file database. The primary consequence of this is that you can't share data columns across tables, so you wind up occupying more disk space. You'll also find you spend a bit more time copying data from one table to another.

On the plus side, the program's internal query builder is very easy to use. The program was able to handle our multivariable queries with ease, and the Expression Builder lets you construct complex arguments using your mouse to enter fields, functions and operators. The only data you need to enter manually is values.

Atlas GIS makes creating theme maps a snap. You can choose from four types of themes: ranged fill, proportional fill, proportional symbol and dot density. In addition, by using a newly bundled utility, you can generate chart themes. And you can use any of eight methods of calculating the data for ranges: quantiles, equal size, standard deviation, counts, percentages, continuous, discontinuous and list of values.
Atlas GIS' point, line and area buffer tools are in the same league as those in MapInfo, although the program can't match Maptitude's trick of creating multiple buffers around an object in a single operation. Alas, Atlas GIS does not support either routing or GPS, and no third-party applications are available to provide these functions.

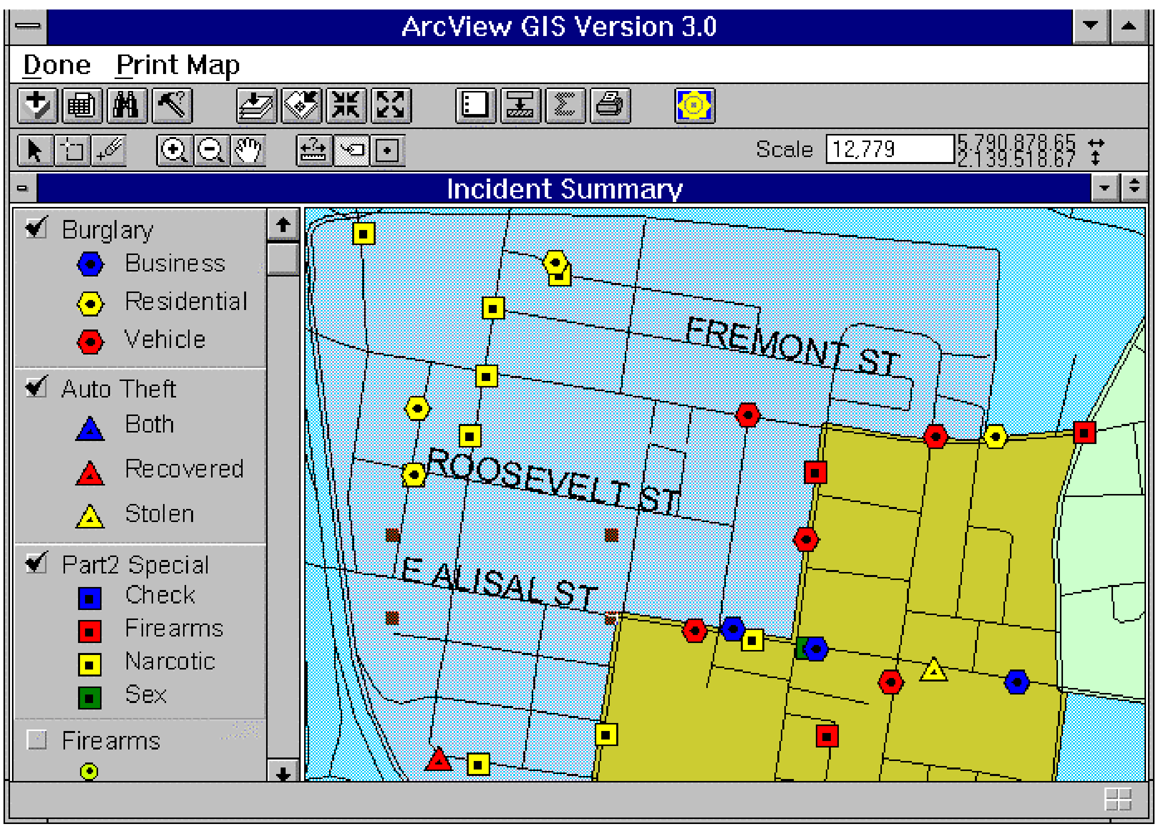
Reporting

Atlas GIS works a bit differently than the other programs in that the primary work area is the layout window. While we appreciated not having to manage opened and closed frames, we found the manipulation of page elements to be a tad less intuitive.
We were disappointed to find no north arrow and, especially, no stand-alone charting capability. On the other hand, we appreciated the ease of making annotation and the program's ability to mosaic large maps. We rated its reporting capabilities satisfactory.

Salinas, California Police Department: Law Enforcement Use Of Geographic Information Systems

http://www.salinaspd.com/gis_vb.html

Salinas is using a GIS application for crime statistics and analysis. The application was written by the software developer Environmental Systems Research Institute (ESRI), of Redlands, California. The system is known as ArcView and ArcInfo. A sample screen shot from their custom system follows, giving us an idea of how GIS might also be applied to the area of accident reporting and analysis:



The Salinas Police Department is researching additional items for the GIS project. They can be divided into two categories. Tools to enhance the current GIS application and items to further expand it's use. Some ideas follow:

Tools to enhance and expand the Police GIS Application:

- ✓ Use geo-statistics to predict future hot spots of criminal and gang activity
- ✓ Building probability maps based on distribution and dot density techniques
- ✓ Beat boundary distribution based on calls for service, workload, demographics, natural barriers, etc.
- ✓ Linking street level maps with parcel maps and photographic images and building footprints
- ✓ 3-d rendering areas
- ✓ Incorporate our video mug shot system into GIS
- ✓ Apply Digital Camera technology to place photographic images of locations into GIS (gang hangouts, graffiti, layouts of homes from search warrants, etc.)
- ✓ Adding the capability of searching the CAD data through GIS

Montgomery County (Rockville, MD) Dept. of Police - GIS and GPS Emerging Technologies In Law Enforcement

http://www.co.mo.md.us/services/police/Tech/geoconf2.htm

In discussing the application of GIS/GPS technology to the law enforcement community, it is first necessary to make a distinction between "time-critical" and "historical" GIS. Law enforcement officers are classified as "first responders." That is, they are called to respond quickly to the scene of a crime or traffic accident to contain the incident, protect lives, prevent injury, and reduce property damage or loss. It is therefore necessary to distinguish between this role and that of data gatherer and investigator.

First responders require timely information that will direct and assist their handling of critical incidents. This is where "time-critical" GIS comes into play. It is very important that precise time and geo-reference stamps be applied throughout the response, management, documentation, and investigation of a law enforcement incident, whether it be a crime, traffic accident, or natural disaster. "Time-critical" GIS refers to those applications that assist the first responder in managing and documenting the incident as it unfolds. As the incident is concluded and documented, the data collected become "historical" in nature and can then be applied to some of the more standard GIS applications.

Beginning the Data Record - Effective Case Management

Effective response to calls for service and complete investigative records management are two important components of law enforcement operations. The response component and the investigative record usually begin with a call to the Enhanced 911 Center. When the call comes in, it is compared against the Automatic Location Identifier (ALI) and the

Automatic Number Identifier (ANI) tables in the Computer Aided Dispatch (CAD) system. These look-up tables provide the first spatial components associated with the case by populating the call taker's dispatch entry screen with caller identification and location.

It is with this first information link that advances in cellular technology and Personal Communications Systems have begun to clash with established practices in emergency response. With a fixed telephone, it is easy to assign coordinates to the data record that indicates the location of the caller. This is not the case with mobile communications. The ALI and ANI tables become irrelevant when a call is made from a cell phone. The only fixed spatial component of that communication transaction is the cell from which the call originates. The spatial equation becomes even more complicated as the caller is handed off from one cell to another.

One of the emerging challenges to law enforcement will be the initial capture of spatial data from mobile communications devices. Several solutions have been proposed, including the use of GPS data to provide an accurate fix on the location of calls for service originating from mobile communications devices.

Another important requirement of dispatch operations is accurate time stamping at all points in the dispatch (case) record. Coordinating a number of systems and clocks is essential to maintaining the temporal integrity of the case record. The use of GPS time data to ensure this temporal integrity is an emerging application of this technology. From a technical perspective, GPS timing information finds several uses in supporting the precise coordination requirements of the modern simulcast trunked radio system.

Wireless mobile computing provides the front end data collection capability that efficiently captures timely information for a variety of investigative and analytical purposes, not the least of which are GIS records management and analysis. Adding GPS data to the case record means that the GIS applications will run more efficiently, and with fewer spatial data translation errors.

Field reporting and data capture enables investigators to assemble case files containing information that was previously next to impossible to obtain and adequately correlate. With the use of differential GPS (DGPS), investigators can precisely relate evidence placement to crime scene reconstruction diagrams. The same applies to accident investigation and reconstruction. By tying evidentiary information into a GIS format, cases can be graphically displayed to show the temporal and spatial relationships of crime reports, witness statements, evidence, and crime scene drawings. GIS provides for a variety of presentation formats. These presentation formats can be easily and automatically displayed for court, training, and briefing purposes.

Field capture of traffic citation and accident data supplies law enforcement managers with valuable information to be used for selective enforcement and resource management purposes. For traffic managers and engineers, this type of data provides information for traffic engineering or flow management needs. Once again, a GPS component added to the data record, gives the users valuable information about the exact location of particular problems when used with the appropriate GIS application.

The advent of GIS makes this information come alive in easy to comprehend presentation formats. GPS data, tagged onto the case record, supplies the key to effectively supporting the capabilities of GIS.

Mobile computing, linked to AVL, provides the basis for responsive, flexible planning and analysis through the use of historical GIS. It is with mobile computing that the process begins, is enhanced, and ends with valuable operational, investigative, analytical, and planning benefits.

Sokkia GIS and Measurement Systems

Midas *GIS*™- GIS / Mapping Field

Full featured GIS Data Collection

Midas GIS™ software enhances the efficiency and functionality of the Axis DGPS system. Also, working with both GPS and conventional total stations, Midas GIS combines a user-friendly graphical mapping interface with a customizable database to enable complete GIS data acquisition.

Midas GIS™ software enhances the efficiency and functionality of the Axis DGPS system. Also, working with both GPS and conventional total stations, Midas GIS combines a user-friendly graphical mapping interface with a customizable database to enable complete GIS data acquisition.

Functionality enhances efficiency

Running on a powerful pen computer with the familiar Windows operating system, Midas GIS enables you to collect point, line and area features and to see your data graphically as you collect it.

The user interface offers large, easy-to-read buttons to perform common field operations and a Guide Box feature to prompt you step-by-step through the entire data collection process. Additionally the prompts can be turned off in order to streamline data collection.

Midas GIS software includes a wealth of tools to create, edit and query field data. You have complete control of your data in the field—eliminating the need for editing back at the office.

Midas GIS software features include:

- ✓ Flexibility to fit your every application.
- ✓ Easy-to-use, WYSIWYG process for designing customizable database interfaces.
- ✓ Add your own vector or raster background maps.
- ✓ Data import and export formats for common programs such as ArcView®, Map-Info® and AutoCAD®.

- ✓ Ability to import data such as design plans and aerial photos.
- ✓ Ability to use Midas GIS with RTK and RTCM GPS, total stations and laser range finders.
- ✓ Planning module to provide satellite visibility and geometry information to determine best conditions for data acquisition.

Axis™ - GIS Data Acquisition System Flexible data collection options

Never before has there been such a straightforward, effective solution for mapping and GIS data acquisition as the one that Sokkia offers in Axis. Sokkia's Axis system uses GPS technology for GIS data acquisition.

Axis features a fully integrated DGPS receiver and an optional software field solution with real-time mapping capabilities. Combined with either IMap, Midas GIS or other Sokkia data collection software, Axis offers ease of use with valuable cartographic and database functionality. Axis is designed to increase data acquisition productivity and efficiency—creating a noticeable difference in your bottom line.

With Axis you are sure to get the best available results—without the purchase of a second receiver for post-processing.

The Axis system features the Axis receiver—a 12-channel GPS receiver with an integrated, dual channel beacon receiver. The Axis system's beacon capabilities provide correction to the autonomous GPS signal to improve accuracy to sub-meter horizontal positions. With Axis you are sure to get the best available results—without the purchase of a second receiver for post-processing.

Seated within a comfortable backpack and with enough rechargeable battery life to last a whole day, the rugged, lightweight and compact Axis system is designed to withstand all the challenges of the field.

Comprehensive and convenient, IMap software offers the power of GIS in an affordable package! Even if you're not computer savvy, IMap's sensible workflow and intuitive interface will make you feel right at home in the field. Complete with efficient point, line and area capture capabilities and robust attribute functions, IMap's intuitive workflow walks you through every step of the way.

Midas GIS puts total GIS functionality at your fingertips. Working with GPS and even conventional total stations, Midas GIS combines a user-friendly, graphical mapping interface with a customizable database. Midas GIS software includes a wealth of tools to create, edit and query field data, giving you complete control of the data while in the field so that editing back in the office is unnecessary.

Midas GIS data acquisition involves two objectives—mapping an accurate position and collecting the attributes for that position. With Midas/GIS your possibilities are limitless. Some applications include:

- ✓ Traffic sign inventory
- ✓ Drainage surveys
- ✓ Lighting inspection

Building inspection

- ✓ In-vehicle, route surveys and navigation
- ✓ Agriculture, forestry and land use surveys
- ✓ Land survey

IMap - GIS / Mapping Field Software - Entry-Level GIS Data Collection

Whether you are mapping natural resources or assessing municipal gas utilities—with the Axis system featuring IMap data collection software, you can enjoy simplicity without sacrificing control or confidence.

IMap offers comprehensive GIS mapping tools with a remarkably simple interface. Complete with efficient data capture capabilities, robust attribute functions and easy-to-interpret GPS status—IMap's intuitive workflow walks you through every step of the way.

Whether you use IMap field software, or combine it with the optional office software utilities, you can expect the data integrity that only a true field-to-finish solution can offer.

Simplicity without sacrificing control - IMap features include:

- ✓ Capabilities to create feature and attribute files, edit your data, navigate and even export in industry standard formats including ESRI™ SHP, AutoCAD ® DXF, ASCII and more.
- ✓ Pinpoint features to sub-meter accuracy with the powerful Axis receiver.
- ✓ IMap runs under Windows CE® 2.0, which has many of the same features as your home or office PC.
- ✓ IMap is available on a palm size Windows CE device, complete with a reflective liquid crystal display for enhanced readability even in bright sunlight.
- ✓ Extend IMap's functionality with optional office software utilities, including graphical waypoint selection, waypoint importing, printing and customizable coordinate systems.
- ✓ IMap gives you the up-to-the second positional information you need— when you need it—to ensure accuracy.
- ✓ Configure IMap to collect GPS data on the go, at designated times or distance intervals.
- ✓ Load SHP or MIF files for in-field data verification to improve your data collection efforts.

AIMS - Accident Information Management System / GIS System.

http://www.jmwengineering.com/

AIMS - the 1st GIS accident software with 3-D mapping. You can:

- Manage millions of accident records. AIMS contains a database system for data management.
- Display accidents on map in 3 dimensions. AIMS contains a GIS system for mapping.
- Retrieve data by clicking area(s) on map or by querying/sorting.
- Analyze intersection & non-intersection accidents.
- Customize accident reports and summaries by adding texts, symbols, lines and curves.
- Display results in bar, pie, area, or line graph.
- Export data/results to other software.
- More! (See AIMS Capabilities or AIMS Fact sheet.)

What Makes AIMS Unique:
3-Dimension Mapping
AIMS is the first, and possibly the only, GIS accident software which plots accident locations on map in 3-dimensions. With 3-D, you can visualize where the accidents are and which location has the most accidents. Whether you retrieve accident data by clicking one or more areas on map, or by query/sorting, AIMS plots the accident data you have retrieved on map in 3-dimensions on-the-fly. Click Sample Output to see AIMS 3-dimension map, or download a free demo (click Demo) to see how it works.

No Change In Your Data
We customize AIMS to use and interpret your existing data. Whatever database or data structure you are using, we will customize AIMS to adapt to it. Hence you do not need to change your data structure, format or coding definition. You may maintain and update your data using your existing system, or using AIMS's updating function, or both. Customization of AIMS is included in the price. Click Customize AIMS for more details.

You Don't Have To Know GIS To Use AIMS
AIMS is a complete, executable software with extensive, friendly user-interfaces. It is designed for people to use it without GIS knowledge. You get what you want by click-and-pick operations. You learn how to plot accidents on map and how to create collision diagrams in a few minutes.

You Don't Need Other Software To Run AIMS
Except Windows and a GIS map of your jurisdiction. AIMS has a stand-alone version which includes GIS capabilities. All it needs is Windows and a GIS map of your jurisdiction. A GIS map for a county in United States costs only a few hundred dollars. Hence it is very affordable to move to GIS.

Multiple GIS Platforms
AIMS can use data and map from ARC/INFO®, ArcView®, Atlas GIS®, AutoCAD®, Intergraph®, MapInfo Professional®, or MicroStation®. ArcView and MapInfo Versions of AIMS are also available.

Powerful Accident Data Management and Analysis Tool
AIMS produces many standard reports to meet your day to day needs. It also generates unlimited number of reports and statistics, through its powerful query & re-query capabilities, to satisfy your special needs. You can use AIMS for many accident analyses, including high accident location identification, scenario analysis, spot/intersection analysis, strip analysis, cluster analysis, corridor analysis, etc. For more information on AIMS capabilities, click AIMS Capabilities.

Easy To Maintain
You can add, delete or modify data by clicking a few buttons or typing a few letters.
Easy Expansion To Include Other Traffic Data
AIMS is modular structured. You can add other traffic data (traffic volumes, signs, signals, etc.) to the system at any time. For more detail about adding other data, click

Options.
You Get Both Product & Service
We do not simply sell you a software product. We also cater to your needs. When you purchase our software, we will contact you to understand your needs and requirements, including your data source, data format, data structure, coding definition, data input and output, etc., which may be unique to you. We then start customizing the software to meet your needs. When we have finished customization, we will deliver the final product to you. To see more detail on how it works, Click Customize AIMS. Customization is included in the price. We provide on-site training and on-site installation as options.

AIMS Versions

ArcView Version
AIMS interfaces with ArcView® 3.0 or later. It can use data and map from ArcView. User can send outputs to be used by ArcView, or switch back and forth between AIMS and ArcView.

MapInfo Version
AIMS interfaces with MapInfo Professional® 4.1 or later. It can use data and map from MapInfo. User can send outputs to be used by MapInfo, or switch back and forth between AIMS and MapInfo.

1. **Stand-Alone Version**
    a. **For non-GIS users** ----- It includes a GIS module, hence you will get a full-function GIS system. You don't need other software to run AIMS except Windows® 9x, 2000, Me or NT.

   b. **For other GIS users** --- It can use map and data from ARC/INFO®, ArcView®, Atlas GIS®, AutoCAD®, Intergraph®, MapInfo® or MicroStation®.
2. **Collision Diagram***
   a. **Non-GIS Version** ------ If you are not using any GIS system and you want to plot collision diagrams, this is for you. We customize it to use and interpret your existing data. It runs on Windows® 9x, 2000, Me or NT.
   b. **GIS Version** ------------ This is for GIS users of ARC/INFO®, ArcView®, Atlas GIS®, AutoCAD®, Intergraph®, MapInfo® or MicroStation® or who want to add collision diagram capability to their system. We customize it to use and interpret your GIS map and data.

*Collision Diagram can be a separate software, or as AIMS option.

Users
Agencies from over 10 states in USA and agencies from 3 countries are using AIMS or have ordered it.

Traffic Engineering In A GIS Environment

Highlighting Progress Of The County of Riverside Geographic Information System Based Accident Records System (GIS-BARS)

by Ron Filian and Jeff Higelin

Abstract

The County of Riverside Geographic Information System Based Accident Records System (GIS-BARS) is being developed to provide more effective and efficient accident reporting capabilities to identify high accident roadway segments and intersections for traffic safety improvements. The project is funded through a grant from the State of California Office of Traffic and Safety as well as County funds. Accident data can be obtained from the State Wide Integrated Traffic Records System (SWITRS), but is not available until 3-6 months after the end of each quarter. Initial phases of project development has involved a substantial amount of communication and co-operation between the County, Cities, and Law Enforcement agencies to determine data entry and transfer options for improving accident information retrieval via GIS-BARS.

Automated data conversion routines for converting SWITRS data to ArcInfo data-files and point topology have been completed. Current development includes expansion of the existing Centerline layer to include Traffic Volumes, Pavement Management data (such as Surface Types and Number of Lanes), and the creation of a Traffic Control Device Inventory (TCDI). These layers will improve accident analysis capabilities using ArcInfo Routing, Dynamic Segmentation, Statistics and Buffering functions for over 12,000 miles of roadway. The project is scheduled to examine emerging technologies including Digital

Imagery for video-log applications, and GPS systems for vehicle location and accident reconstruction applications.

Introduction

The County of Riverside Geographic Information System Based Accident Records System (GIS-BARS) Office of Traffic Safety Grant Project is laying the foundation for expandable Traffic Engineering applications and models through a complex frame work necessary to accommodate a progressive traffic accident reporting and analyses system. GIS-BARS has allowed the County of Riverside Traffic Division to make the leap from CADD based systems to a GIS based operation.

The Project has hinged on inter-agency cooperation at three levels of Government and has required individual Multi-agency agreements and prototype projects. Accommodations for a variety of software, hardware and networking requirements have been taken into consideration as development has progressed.

Project development has required the review of traffic engineering computer programs on a commercial level, existing agency applications and reporting practices, cooperative multi-agency data collection and assembly efforts, and extensive ArcInfo applications development to accommodate a wide variety of accident reporting systems.

The project is scheduled to examine emerging technologies in the final project year including Digital Imagery for video-log applications, Global Positioning Satellite systems for vehicle location and accident reconstruction applications, and the preliminary development of Transportation Planning and Design models.

History

Franklin Sherkow, currently the Director of the County of Riverside's Transportation and Land Management Agency, joined the Transportation Department in July 1990. Mr. Sherkow's previous position was with the Cleveland Metropolitan Organization. Upon arrival Mr. Sherkow noticed a lesser degree of inter-jurisdictional cooperation than he was accustomed to in Ohio. Frank knew from previous experience that increased interaction between County, City and State Law Enforcement and Transportation Agencies could only serve to benefit all concerned parties, particularly in the fields of Traffic Safety and Transportation Engineering.

Mr. Sherkow formed the County of Riverside Transportation Ways and Means Committee to serve as a forum through which law enforcement and transportation agencies in the area could work cooperatively to overcome mutual transportation related problems.

One of the first issues addressed by the Ways and Means Committee was the absence of a County-wide accident records system. The County-wide Accident Records System Sub-committee found that many of the local agencies were interested in the concept, especially with the development of the County of Riverside's Geographic Information System. Unfortunately, due to funding restrictions and manpower limitations, few agencies were able to actively participate in the development of such a project. The Sub-committee then searched for a source to fund a project as meaningful and necessary as a County-wide Accident Records System. Fortunately the State of California Office of Traffic Safety was very interested in the development of such a system, which held potential of expansion for use on a State-wide basis.

The Sub-committee returned these findings to the Ways and Means Committee, which in turn formed The County of Riverside Geographic Information System Based Accident Records System (GIS-BARS) Advisory Committee to secure OTS grant funding and oversee GIS-BARS project development throughout the grant period.

The GIS-BARS grant project officially commenced in July 1993, after more than eighteen months of negotiation and refinement of grant objectives. The Office of Traffic Safety allocated $621,410.00 to fund the three year GIS-BARS project.

GIS-BARS Objectives

The overall project objective is to develop and implement an efficient, ongoing, County-wide, GIS-based accident records system that will provide surveillance and identification of significant accident locations through the use of sophisticated display modeling and analysis tools through the integration of diverse engineering information on the GIS. The system will help to identify high accident rates for locations including intersections and roadway segments for deployment of Federal, State, County, and City resources to do the following within one year after the three-year project:

A. To lower the County fatality frequency.
B. To lower the County fatality rate per 100,000 population to that rate of the entire State, or lower.
C. To lower the County injury frequency .
D. To lower the County injury rate per 100,000 population to that rate of the entire State, or lower.

Two main objectives of the GIS-BARS grant are to install accident records and traffic volumes county-wide, and to develop state and city prototypes. Other engineering-related layers of information may also be developed under the grant. These include traffic sign inventory, pavement markings, and traffic control devices.

GIS-BARS Project Objectives - Specific

1. To develop a cooperative working relationship with the appropriate agencies county-wide: all 24 of the incorporated Cities, Riverside County Sheriff's Department, the California Highway Patrol and Caltrans.

2. To receive authorization from the Cities for the County to receive and share their SWITRS data.

3. To write software applications and programs to integrate existing SWITRS data collected and disseminated by the California Highway Patrol into the existing County GIS. To examine and prototype improvements to existing SWITRS data to include all accident data collected by local jurisdictions for inclusion into the GIS data base. This phase will include the examination of methods to compile data at local levels in a consistent manner.

4. To increase/improve analysis methods, modeling methods and reporting capabilities.

5. To input all the necessary layers of information into a County-wide GIS data base for efficient accident retrieval: traffic counts, accidents by location, and roadway files (street network).

6. To develop a City prototype program with a selected City within the County.

7. To investigate the feasibility and benefits of installing other traffic and transportation-demand-management related layers of information into the GIS-based system: traffic control devices, pavement markings, pavement management, risk management, etc.

8. To mobilize efforts toward using Global Positioning Satellite (GPS) hardware within the County, to speed collection of accident data on site. This can be achieved by the officer using a combination of portable computers, video and GPS in the field to develop the reports and information in a form compatible with SWITRS formats and available for direct entry into the GIS system.

9. To investigate and initiate other new technological forms of data input/output and communication to record and display accident related data and records including the use of; optical disk information (still photography), video, and other information and communication system links.

10. To explore and identify other data entry options. An example would

be to have a system link directly from the police officer/unit directly to the public agencies: the Cities, the County and the State.

11. To build an expandable, renewable system which will accept many different data input methods to provide information in a timely manner.

Considerations

In the development of a project which contends to allow for the electronic linking of the transportation engineering and law enforcement agencies of 26 cities, 4 surrounding counties and the State of California (over 60 individual offices) many considerations had to be taken into account.

Data Security

An initial obstacle which had to be overcome was the issue of data security. No public agency is, or will be, willing to expose itself to potential liability posed by the availability of sensitive data through a central records database. Accordingly, the cities and the State of California needed guarantees that if they were to release their accident data to the County of Riverside that the County would not in turn disseminate the data to third parties.

Two safeguards were used to establish these guarantees. First each agency was requested to sign a release for accident data which contains the following disclaimer: " It is understood that the accident information is for the development of the County of Riverside's Geographic Information System - Based Accident Records System (GIS-BARS) only and is not to be distributed by the County of Riverside, in any form, to any media, individuals, the public, other agencies or jurisdiction, without prior consent of the undersigned.". The second guarantee was to limit the amount of sensitive information stored by GIS-BARS. The State of California collects all data on reported accidents from accident reports filed by all jurisdictions the information is processed into the State- wide Integrated Traffic Records System (SWIRTS), and redistributed to the reporting agencies with the exclusion of such sensitive data as victim names and physical characteristics, addresses and drivers license numbers. Thus, the data-file format established as the standard for the GIS-BARS project excludes these items.

Hardware and Software Compatibility

Surveys were provided to each prospective participating agency office to accumulate data regarding existing automated accident reporting programs, use of GIS, hardware configurations and software platforms and programs. The surveys revealed a variety of custom software applications in use for reporting accident records reports. Examples range from a BASIC program written to interpret SWITRS data files, to one developing

and one existing GIS accident reporting system in which the agency provides for manual data entry on site.
The ability to transfer data has developed as another issue worthy of note. A variety of networks (Internet, Lawnet, Cornet, Calnet, etc...) are currently in use by agencies within the realm of the GIS-BARS project. Some of the agencies, however, have no immediate plans to link to a Super- information highway network. These agencies will be accommodated by the GIS-BARS project through the use of telephone modems or floppy disk/tape transfer.

Multi-Jurisdictional Prototype Development

Five major prototype projects are proposed to facilitate the entire scope of accident record collection.

1. State of California Highway Patrol (CHP) Headquarters, for SWITRS electronic data transfer to and from local agency and CHP area offices.
2. CHP area office C*STARS electronic data transfer to GIS-BARS.
3. City agency with police station reporting through a local area network.
4. City agency contracting traffic enforcement through the Riverside County Sheriff Office for reporting through a network.
5. City agency without network access to developing network interface for reporting through telephone modem.

Prototype Development Progress

Prototype Project 1 - initial meetings have been held with CHP Headquarters. The County of Riverside has offered it's services to aid in the development of programming to accommodate the importing and exporting of data through a network. Currently, SWITRS receives copies of hand written accident reports, then manually codes and physically enters the data. Due to the sheer volume of data this process takes a minimum of three months to process.

Accommodating a network data transfer routine will require software programming for the coding of data from the C*STARS accident reporting program. C*STARS software is emerging as the state-wide accident reporting standard for laptop and Mobile Display Computers. Software and Training is provided at no cost to the law enforcement agency through another OTS grant project.

Prototype Project 2 - The County of Riverside through grant funding will be providing the CHP Banning Area Office with three laptops and one desktop computer to initiate automated accident reporting at the station and to develop a link to the County of Riverside GIS-BARS Project. The computer equipment will be returned to the County of Riverside for redeployment to other agencies for continued project development when the CHP office can provide their own equipment. Delivery of the computers from the State to the Banning CHP Office is expected in 1996, but efforts to take earlier delivery are in progress.

Prototype Project 3 - The City of Murrieta is requesting a reallocation of funds designated for Aerial Photography (to develop a centerline network for a P.C. based GIS system through a similar OTS grant project) to purchase workstation equipment, software and network connection costs to the County of Riverside GIS. This prototype project will allow for accident data and geographic data transfer for the GIS-BARS project. The Murrieta Police Department is motivated to the development of Global Positioning Satellite coordination through GIS. Currently county and city accident location data is referenced on a primary street and a distance from a cross street. In the GIS environment non-standardized street name references are causing headaches for programmers trying to determine geo- points for accident locations. The County of Riverside may provide assistance with the GPS unit development project at the City of Murrieta to further develop our own C*STARS and GIS-BARS GPS interfacing.

Prototype Project 4 - Two primary cities are currently being considered for the Sheriff traffic enforcement prototype project. This project will link and standardize sheriff reporting functions county-wide.

Prototype Project 5 - No progress has been made on this project to date. Once the standards for reporting have been established by the other four prototype projects the telephone modem transfers should be easily accommodated.

SWITRS Data Conversion
Geo-coding Accident Locations

One of the initial programming challenges we faced was to develop a process for uploading SWITRS ASCII files into an ArcInfo data file. Since the accident records provided by SWITRS are delivered on 3-1/2" floppy disks, we first needed to copy the files from a PC to our UNIX workstation. Next, we created an INFO data file with all the necessary items based on the format of the SWITRS accident records, and used the ADD FROM command to import the data. Finally, we began to develop the necessary geocoding processes to create point topology for each accident record. Lacking GPS or other coordinate reference to the accident location, several other items had to be considered when converting the data.

We chose an area between the cities of Riverside and Perris as a prototype area to begin testing. Our prototype area goals were to be able to geocode the accident locations in this area, query the database, and produce an accident pin map. Included in all accident records are the PRIMARY street (the street on which the accident occurred) the Secondary street (the street which the accident is referenced from) the Direction from the secondary street (i.e. north, east etc...) and the Distance from the secondary street. Using our existing centerline network we developed several AMLs that reselect the Primary and Secondary streets, determine the nodes at which they intersect, and use an inverse routine to traverse each Primary road in the specified Direction and for the specified Distance from the Secondary road. The coordinates of this point are recorded and keyed to the accident record and can then be plotted.

Several issues became immediately apparent upon testing in the prototype area. First, we found grave inconsistencies in the way street names were being spelled and/or abbreviated on the accident records. This made it difficult to reselect the arcs in our existing centerline layer. ADDRESSPARSE helped somewhat and we were able to create points for about 65% of the records in our test area automatically. We then found that we could get about an 80% success rate if we were to manually clean up some of the commonly misspelled street names, but this we are trying to avoid.

Secondly, through error routines we discovered that in many other instances either the Direction or Distance are inconstant with arc topology, or the Primary and Secondary streets either intersect in more than one place or don't intersect at all. We are developing sub-routines to manage these problems, some of which must involve interactive processing to error check and clean-up obvious mistakes. A significant effort is being made by ourselves, the California Highway Patrol, and other local agencies to develop systems and procedures which will minimize these kinds of errors. The development of C*STARS as a standard data entry tool, and the introduction of GPS units in patrol cars are some examples.

Traffic Control Device Inventory

The development of a Traffic Control Device Inventory (TCDI) layer is expected to be handled in the same way as the conversion of SWITRS data. TCDI is currently being stored in INFOS file format and carries location information similar to SWITRS including cross-street location, which side of right-of-way, and distance from the intersection. Conversion of the TCDI layer has not yet begun and will probably be undertaken after we convert our centerline layer to a route system.

Pavement Management System

The County of Riverside also currently maintains a Pavement Management System (PMS) in INFOS file format which can be keyed by street name. Eventually, we do intend to convert the PMS database to ArcInfo routes but development has not yet begun. PMS data is important to conversion of traffic volume data and will be given much more consideration in the next several months.

Traffic Volume Assignment

The grant project will employ a Traffic Volume Layer to determine accident rates and perform related traffic collision analyses. One of the most aggressive goals in the development of this layer is to calculate traffic volume values for all public highways. The basic steps to be used in assigning values to roadways for which we do not have actual traffic volume counts are as follows:

1. Assignment of actual traffic volume counts at point locations.

2. Assignment of estimated point and road segment volumes in relation to physical count points based on similar point/segment attributes and a set of predetermined conditions which include the following:
   A. Pavement Management System (PMS) roadway classification.
   B. Number of lanes
   C. Land use category of Rural or Urban
3. Test for confidence and revise methodology as necessary.

In order to test for confidence in the assignment process we plan to physically count the traffic volume on a sample of roadways to determine degree of confidence and any applicable adjustment factor. If the degree of confidence is at an acceptable level we will allow the system to remain in place. If the degree of confidence is unacceptable we will employ other factor schemes to develop an accurate estimation program.

Applications Development

Overall the field of traffic engineering is dependant on localized and limited historical data for the development of traffic warrant standards. The GIS-BARS project will track the use and effect of traffic device installation and removal to provide substantial data for determining the future of traffic engineering. The GIS-BARS project should eventually be capable of providing accurate and timely forecasting data for use in advanced planning.

The development of these models will refine application requirements and account for factors which currently require detailed and often multiple field reviews. The proposed improvements will provide Traffic Engineers and Law Enforcement personnel with the opportunity make more informed decisions and to provide an increased number of highway and intersection investigations. The GIS-BARS project proposes to provide accident data and analysis within 72 hours from the time the accident report leaves the initiating agency, eliminating the necessity to wait a minimum of six months from the beginning of the reporting quarter to receive data through the existing SWITRS system.

Report and Map Creation

In an on-going effort to provide Riverside County traffic engineers with critical information, applications are being developed to produce the following standardized reports and maps, most of which can be produced in INFO without the need for geocoding. This is itself a significant advancement.

- Report of Intersection Collision Locations by Accident Rate
- Report of Highway Segment Collision Locations by Accident Rate
- Report of Intersection Collision Locations by Accident Occurrence
- Report of Highway Segment Collision Locations by Accident Occurrence
- Intersection Ranking Report
- Segment Ranking Report
- Motor Vehicle Involved with; For Collisions and Victims by Severity (SWITRS RPT 1)

- Primary Collision Factors for Collisions and Victims by Severity (SWITRS RPT 3)
- Motorcycle, Moped, Bicycle, and Pedestrian Collisions and Victims by Hour of Day (SWITRS RPT 4)
- Alcohol Involvement by Age of Involved Parties (SWITRS RPT 5)
- Collisions Involving Pedestrians; Location Details and Victim Data (SWITRS RPT 6)
- Collisions Involving Bicyclists; Location Details and Victim Data (SWITRS RPT 7)
- Collision Location Details; Involved Party and Victim Data (SWITRS RPT 8)
- Average Intersection Accident Rate; by Intersection Category
- Average Road Segment Accident Rate; by Segment Category
- Collision Severity Summary Report
- Societal Loss Summary Report
- Primary Collision Factor Summary Report
- Drug and Alcohol Impairment Summary Report
- Safety Device Usage Summary Report
- Traffic Accident Trend Report
- Jurisdiction Map
- Precinct/District Map
- Collision Pin Map
- Traffic Flow Map
- Collision Diagrams
- Traffic Control Device Diagram
- Video Log Services

Presenters

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Global Positioning Satellite (GPS) Review

GPS Tutorial

The Global Positioning System (GPS) is a worldwide radio-navigation system formed from a constellation of 24 satellites and their ground stations.

GPS uses these "man-made stars" as reference points to calculate positions accurate to a matter of meters. In fact, with advanced forms of GPS you can make measurements to better than a centimeter!

In a sense it's like giving every square meter on the planet a unique address.

GPS receivers have been miniaturized to just a few integrated circuits and so are becoming very economical. And that makes the technology accessible to virtually everyone.

These days GPS is finding its way into cars, boats, planes, construction equipment, movie making gear, farm machinery, even laptop computers.

Soon GPS will become almost as basic as the telephone. Indeed, at Trimble, we think it just may become a universal utility.

Here's how GPS works in five logical steps:

1. The basis of GPS is "triangulation" from satellites.
2. To "triangulate," a GPS receiver measures distance using the travel time of radio signals.
3. To measure travel time, GPS needs very accurate timing which it achieves with some tricks.
4. Along with distance, you need to know exactly where the satellites are in space. High orbits and careful monitoring are the secret.
5. Finally you must correct for any delays the signal experiences as it travels through the atmosphere.

We'll explain each of these points in the next five sections of the tutorial. We recommend you follow the tutorial in order. Remember, science is a step-by-step discipline!

Step 1: Triangulating from Satellites

Improbable as it may seem, the whole idea behind GPS is to use satellites in space as reference points for locations here on earth.

That's right, by very, very accurately measuring our distance from three satellites we can " triangulate " our position anywhere on earth.

Forget for a moment how our receiver measures this distance. We'll get to that later. First consider how distance measurements from three satellites can pinpoint you in space.

The Big Idea Geometrically:

Suppose we measure our distance from a satellite and find it to be 11,000 miles.

Knowing that we're 11,000 miles from a particular satellite narrows down all the possible locations we could be in the whole universe to the surface of a sphere that is centered on this satellite and has a radius of 11,000 miles.

Next, say we measure our distance to a second satellite and find out that it's 12,000 miles away.

That tells us that we're not only on the first sphere but we're also on a sphere that's 12,000 miles from the second satellite. Or in other words, we're somewhere on the circle where these two spheres intersect.

If we then make a measurement from a third satellite and find that we're 13,000 miles from that one, that narrows our position down even further, to the two points where the 13,000 mile sphere cuts through the circle that's the intersection of the first two spheres.

So by ranging from three satellites we can narrow our position to just two points in space.

To decide which one is our true location we could make a fourth measurement. But usually one of the two points is a ridiculous answer (either too far from Earth or moving at an impossible velocity) and can be rejected without a measurement.

A fourth measurement does come in very handy for another reason however, but we'll tell you about that later.

Next we'll see how the system measures distances to satellites.

In Review: **Triangulating**

1. Position is calculated from distance measurements (ranges) to satellites.
2. Mathematically we need four satellite ranges to determine exact position.
3. Three ranges are enough if we reject ridiculous answers or use other tricks.
4. Another range is required for technical reasons to be discussed later.

Step 2: Measuring Distance from a Satellite

The Big Idea Mathematically

In a sense, the whole thing boils down to those “velocity times travel time” math problems we did in high school. Remember the old: “If a car goes 60 miles per hour for two hours, how far does it travel?”

Velocity (60 mph) x Time (2 hours) = Distance (120 miles)

In the case of GPS we're measuring a radio signal so the velocity is going to be the speed of light or roughly 186,000 miles per second.

The problem is measuring the travel time.

The timing problem is tricky. First, the times are going to be awfully short. If a satellite were right overhead the travel time would be something like 0.06 seconds. So we're going to need some really precise clocks. We'll talk about those soon.

But assuming we have precise clocks, how do we measure travel time? To explain it let's use a goofy analogy:

Suppose there was a way to get both the satellite and the receiver to start playing "The Star Spangled Banner" at precisely 12 noon. If sound could reach us from space (which, of course, is ridiculous) then standing at the receiver we'd hear two versions of the Star Spangled Banner, one from our receiver and one from the satellite.

These two versions would be out of sync. The version coming from the satellite would be a little delayed because it had to travel more than 11,000 miles.

If we wanted to see just how delayed the satellite's version was, we could start delaying the receiver's version until they fell into perfect sync.

The amount we have to shift back the receiver's version is equal to the travel time of the satellite's version. So we just multiply that time times the speed of light and BINGO! we've got our distance to the satellite.

That's basically how GPS works.

Only instead of the Star Spangled Banner the satellites and receivers use something called a "Pseudo Random Code" - which is probably easier to sing than the Star Spangled Banner.

A Random Code?

The Pseudo Random Code (PRC, shown above) is a fundamental part of GPS. Physically it's just a very complicated digital code, or in other words, a complicated sequence of "on" and "off" pulses as shown here:

The signal is so complicated that it almost looks like random electrical noise. Hence the name "Pseudo-Random."

There are several good reasons for that complexity: First, the complex pattern helps make sure that the receiver doesn't accidentally sync up to some other signal. The patterns are so complex that it's highly unlikely that a stray signal will have exactly the same shape.

Since each satellite has its own unique Pseudo-Random Code this complexity also guarantees that the receiver won't accidentally pick up another satellite's signal. So all the satellites can use the same frequency without jamming each other. And it makes it more difficult for a hostile force to jam the system. In fact the Pseudo Random Code gives the DoD a way to control access to the system.

But there's another reason for the complexity of the Pseudo Random Code, a reason that's crucial to making GPS economical. The codes make it possible to use "information theory" to " amplify " the GPS signal. And that's why GPS receivers don't need big satellite dishes to receive the GPS signals.

We glossed over one point in our goofy Star-Spangled Banner analogy. It assumes that we can guarantee that both the satellite and the receiver start generating their codes at exactly the same time. But *how* do we make sure everybody is perfectly synced? Stay tuned and see.

In Review: **Measuring Distance**

1. Distance to a satellite is determined by measuring how long a radio signal takes to reach us from that satellite.
2. To make the measurement we assume that both the satellite and our receiver are generating the same pseudo-random codes at exactly the same time.
3. By comparing how late the satellite's pseudo-random code appears compared to our receiver's code, we determine how long it took to reach us.
4. Multiply that travel time by the speed of light and you've got distance.
5.

Step 3: Getting Perfect Timing

If measuring the travel time of a radio signal is the key to GPS, then our stop watches had better be darn good, because if their timing is off by just a thousandth of a second, at the speed of light, that translates into almost 200 miles of error!

On the satellite side, timing is almost perfect because they have incredibly precise atomic clocks on board.

But what about our receivers here on the ground?

Remember that both the satellite and the receiver need to be able to precisely synchronize their pseudo-random codes to make the system work. (to review this point click here)

If our receivers needed atomic clocks (which cost upwards of $50K to $100K) GPS would be a lame duck technology. Nobody could afford it.

Luckily the designers of GPS came up with a brilliant little trick that lets us get by with much less accurate clocks in our receivers. This trick is one of the key elements of GPS and as an added side benefit it means that every GPS receiver is essentially an atomic-accuracy clock.

The secret to perfect timing is to make an *extra* satellite measurement.

That's right, if three perfect measurements can locate a point in 3-dimensional space, then four *imperfect* measurements can do the same thing.

This idea is so fundamental to the working of GPS that we have a separate illustrated section that shows how it works. If you have time, cruise through that.

Extra Measurement Cures Timing Offset

If our receiver's clocks were perfect, then all our satellite ranges would intersect at a single point (which is our position). But with imperfect clocks, a fourth measurement, done as a cross-check, will NOT intersect with the first three.

So the receiver's computer says "Uh-oh! there is a discrepancy in my measurements. I must not be perfectly synced with universal time."

Since any offset from universal time will affect all of our measurements, the receiver looks for a single correction factor that it can subtract from all its timing measurements that would cause them all to intersect at a single point.

That correction brings the receiver's clock back into sync with universal time, and bingo! - you've got atomic accuracy time right in the palm of your hand.

Once it has that correction it applies to all the rest of its measurements and now we've got precise positioning.

One consequence of this principle is that any decent GPS receiver will need to have at least four channels so that it can make the four measurements simultaneously.

With the pseudo-random code as a rock solid timing sync pulse, and this extra measurement trick to get us perfectly synced to universal time, we have got everything we need to measure our distance to a satellite in space.

But for the triangulation to work we not only need to know distance, we also need to know exactly where the satellites are.

In the next section we'll see how we accomplish that.

In Review: **Getting Perfect Timing**

1. Accurate timing is the key to measuring distance to satellites.
2. Satellites are accurate because they have atomic clocks on board.

3. Receiver clocks don't have to be too accurate because an extra satellite range measurement can remove errors.

4.

Step 4: Knowing Where a Satellite is in Space

A high satellite gathers no moss

That 11,000 mile altitude is actually a benefit in this case, because something that high is well clear of the atmosphere. And that means it will orbit according to very simple mathematics.

The Air Force has injected each GPS satellite into a very precise orbit, according to the GPS master plan.

On the ground all GPS receivers have an almanac programmed into their computers that tells them where in the sky each satellite is, moment by moment.

The basic orbits are quite exact but just to make things perfect the GPS satellites are constantly monitored by the Department of Defense.

They use very precise radar to check each satellite's exact altitude, position and speed.

The errors they're checking for are called "ephemeris errors" because they affect the satellite's orbit or "ephemeris." These errors are caused by gravitational pulls from the moon and sun and by the pressure of solar radiation on the satellites.

The errors are usually very slight but if you want great accuracy they must be taken into account.

Getting the message out

Once the DoD has measured a satellite's exact position, they relay that information back up to the satellite itself. The satellite then includes this new corrected position information in the timing signals it's broadcasting.

So a GPS signal is more than just pseudo-random code for timing purposes. It also contains a navigation message with ephemeris information as well.

With perfect timing and the satellite's exact position you'd think we'd be ready to make perfect position calculations. But there's trouble afoot. Check out the next section to see what's up.

In Review: **Satellite Positions**

1. To use the satellites as references for range measurements we need to know exactly where they are.

2. GPS satellites are so high up their orbits are very predictable.

3. Minor variations in their orbits are measured by the Department of Defense.
4. The error information is sent to the satellites, to be transmitted along with the timing signals.

Step 5: Correcting Errors

First, one of the basic assumptions we've been using throughout this tutorial is not exactly true. We've been saying that you calculate distance to a satellite by multiplying a signal's travel time by the speed of light. But the speed of light is only constant in a vacuum.

As a GPS signal passes through the charged particles of the ionosphere and then through the water vapor in the troposphere it gets slowed down a bit, and this creates the same kind of error as bad clocks.

There are a couple of ways to minimize this kind of error. For one thing we can predict what a typical delay might be on a typical day. This is called modeling and it helps but, of course, atmospheric conditions are rarely exactly typical.

Another way to get a handle on these atmosphere-induced errors is to compare the relative speeds of two different signals. This " dual frequency" measurement is very sophisticated and is only possible with advanced receivers.

Trouble for the GPS signal doesn't end when it gets down to the ground. The signal may bounce off various local obstructions before it gets to our receiver.

This is called multipath error and is similar to the ghosting you might see on a TV. Good receivers use sophisticated signal rejection techniques to minimize this problem.

Problems at the satellite

Even though the satellites are very sophisticated they do account for some tiny errors in the system.

The atomic clocks they use are very, very precise but they're not perfect. Minute discrepancies can occur, and these translate into travel time measurement errors.

And even though the satellites positions are constantly monitored, they can't be watched every second. So slight position or " ephemeris" errors can sneak in between monitoring times.

Basic geometry itself can magnify these other errors with a principle called "Geometric Dilution of Precision" or GDOP.

It sounds complicated but the principle is quite simple.

There are usually more satellites available than a receiver needs to fix a position, so the receiver picks a few and ignores the rest.

If it picks satellites that are close together in the sky the intersecting circles that define a position will cross at very shallow angles. That increases the gray area or error margin around a position.

If it picks satellites that are widely separated the circles intersect at almost right angles and that minimizes the error region.

Good receivers determine which satellites will give the lowest GDOP

Intentional Errors!

As hard as it may be to believe, the same government that spent $12 billion to develop the most accurate navigation system in the world intentionally degraded its accuracy. The policy was called "Selective Availability" or "SA" and the idea behind it was to make sure that no hostile force or terrorist group can use GPS to make accurate weapons.

Basically the DoD introduced some "noise" into the satellite's clock data which, in turn, added noise (or inaccuracy) into position calculations. The DoD may have also been sending slightly erroneous orbital data to the satellites which they transmitted back to receivers on the ground as part of a status message.

Together these factors made SA the biggest single source of inaccuracy in the system. Military receivers used a decryption key to remove the SA errors and so they're much more accurate.

Turning Off Selective Availability

On May 1, 2000 the White House announced a decision to discontinue the intentional degradation of the GPS signals to the public beginning at midnight. Civilian users of GPS are now able to pinpoint locations up to ten times more accurately. As part of the 1996 Presidential Decision Directive goals for GPS, President Clinton committed to discontinuing the use of SA by 2006. The announcement came six years ahead of schedule. The decision to discontinue SA was the latest measure in an on-going effort to make GPS more responsive to civil and commercial users worldwide.

The bottom line

Fortunately all of these inaccuracies still don't add up to much of an error. And a form of GPS called "Differential GPS" can significantly reduce these problems. We'll cover this type of GPS later.

To get an idea of the impact of these errors click here for a typical error budget:

In Review: **Correcting Errors**

1. The earth's ionosphere and atmosphere cause delays in the GPS signal that translate into position errors.

2. Some errors can be factored out using mathematics and modeling.
3. The configuration of the satellites in the sky can magnify other errors.
4. Differential GPS can eliminate almost all error.

Differential GPS

Basic GPS is the most accurate radio-based navigation system ever developed. And for many applications it's plenty accurate. But it's human nature to want MORE!

So some crafty engineers came up with "Differential GPS," a way to correct the various inaccuracies in the GPS system, pushing its accuracy even farther.

Differential GPS or "DGPS" can yield measurements good to a couple of meters in moving applications and even better in stationary situations.

That improved accuracy has a profound effect on the importance of GPS as a resource. With it, GPS becomes more than just a system for navigating boats and planes around the world. It becomes a universal measurement system capable of positioning things on a very precise scale.

How Does DGPS Work?

Differential GPS involves the cooperation of two receivers, one that's stationary and another that's roving around making position measurements.

The stationary receiver is the key. It ties all the satellite measurements into a solid local reference.

Here's how it works:

The problem

Remember that GPS receivers use timing signals from at least four satellites to establish a position. Each of those timing signals is going to have some error or delay depending on what sort of perils have befallen it on its trip down to us.

[For a complete discussion of all the errors review the "Correcting Errors " section of the tutorial]

Since each of the timing signals that go into a position calculation has some error, that calculation is going to be a compounding of those errors.

An extenuating circumstance

Luckily the sheer scale of the GPS system comes to our rescue. The satellites are so far out in space that the little distances we travel here on earth are insignificant.

So if two receivers are fairly close to each other, say within a few hundred kilometers, the signals that reach both of them will have traveled through virtually the same slice of atmosphere, and so will have virtually the same errors

That's the idea behind differential GPS: We have one receiver measure the timing errors and then provide correction information to the other receivers that are roving around. That way virtually all errors can be eliminated from the system, even the pesky Selective Availability error that the DoD puts in on purpose.

The idea is simple. Put the reference receiver on a point that's been very accurately surveyed and keep it there.

This reference station receives the same GPS signals as the roving receiver but instead of working like a normal GPS receiver it attacks the equations ***backwards***.

Instead of using timing signals to calculate its position, it uses its known position to calculate timing. It figures out what the travel time of the GPS signals *should* be, and compares it with what they actually *are*. The difference is an "error correction" factor.

The receiver then transmits this error information to the roving receiver so it can use it to correct its measurements.

Since the reference receiver has no way of knowing which of the many available satellites a roving receiver might be using to calculate its position, the reference receiver quickly runs through all the visible satellites and computes each of their errors.

Then it encodes this information into a standard format and transmits it to the roving receivers.

It's as if the reference receiver is saying: "OK everybody, right now the signal from satellite #1 is ten nanoseconds delayed, satellite #2 is three nanoseconds delayed, satellite #3 is sixteen nanoseconds delayed...." and so on.

The roving receivers get the complete list of errors and apply the corrections for the particular satellites they're using.

Where to Get Corrections?

In the early days of GPS, reference stations were established by private companies who had big projects demanding high accuracy - groups like surveyors or oil drilling operations. And that is still a very common approach. You buy a reference receiver and set up a communication link with your roving receivers.

But now there are enough public agencies transmitting corrections that you might be able to get them for free!

The United States Coast Guard and other international agencies are establishing reference stations all over the place, especially around popular harbors and waterways.

These stations often transmit on the radio beacons that are already in place for radio direction finding (usually in the 300kHz range).

Anyone in the area can receive these corrections and radically improve the accuracy of their GPS measurements. Most ships already have radios capable of tuning the direction finding beacons, so adding DGPS will be quite easy.

Many new GPS receivers are being designed to accept corrections, and some are even equipped with built-in radio receivers.

Other Ways to Work with DGPS

Post Processing DGPS

Not all DGPS applications are created equal. Some don't need the radio link because they don't need precise positioning immediately.

It's one thing if you're trying to position a drill bit over a particular spot on the ocean floor from a pitching boat, but quite another if you just want to record the track of a new road for inclusion on a map.

For applications like the later, the roving receiver just needs to record all of its measured positions and the exact time it made each measurement.

Then later, this data can be merged with corrections recorded at a reference receiver for a final clean-up of the data. So you don't need the radio link that you have to have in real-time systems.

If you don't have a reference receiver there may be alternative source for corrections in your area. Some academic institutions are experimenting with the Internet as a way of distributing corrections.

Inverted DGPS

There's another permutation of DGPS, called "inverted DGPS," that can save money in certain tracking applications.

Let's say you've got a fleet of buses and you'd like to pinpoint them on street maps with very high accuracy (maybe so you can see which side of an intersection they're parked on or whatever).

Anyway, you'd like this accuracy but you don't want to buy expensive "differential-ready" receivers for every bus.

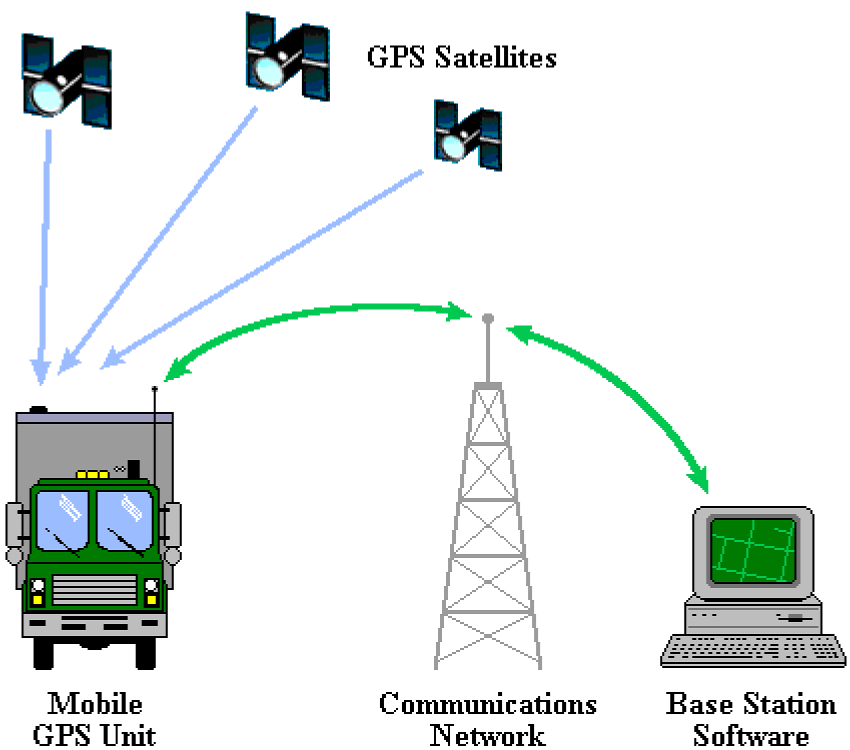
With an inverted DGPS system the buses would be equipped with standard GPS receivers and a transmitter and would transmit their standard GPS positions back to the tracking office. Then at the tracking office the corrections would be applied to the received positions.

It requires a computer to do the calculations, a transmitter to transmit the data but it gives you a fleet of very accurate positions for the cost of one reference station, a computer and a lot of standard GPS receivers. Such a deal!

AVL Tutorial

What is AVL?

Automatic Vehicle Location (AVL) is a technology used for tracking vehicles, vessels, and mobile assets such as trailers, containers, and equipment. Each mobile unit has a GPS receiver that reports its position to the base station over a communications network. This allows the base station to monitor the entire fleet and manage the mobile assets.



Components of AVL

GPS Satellites
There are 24 GPS Satellites orbiting the entire globe, transmitting positioning and timing data day and night in all weather conditions -- all courtesy of the U.S. Government. To

learn how GPS works, see the GPS Tutorial.

Mobile GPS Unit
In each vehicle you need a GPS receiver to track the satellites and calculate your position. But actually Trimble's mobile GPS units do a lot more than just that. Altogether they:

- Receive GPS satellite signals.
- Calculate your position, speed, heading and altitude.
- Communicate with the base station -- using either built-in communications or interfacing with an external radio.
- CrossCheck products use the IQ*EventEngine* to decide when to report, etc.
- Log data.
- Receive the precise time (the satellites use atomic clocks).

Communications Network
You need some sort of communications network so that the vehicle can transmit its position and other information to the base station. The communication goes both ways so that the base station can check the status of its vehicles and perhaps send new instructions for the IQ*EventEngine*.

Base Station Software
The base station needs a computer system and software to handle all the position reports and communications. Altogether it:

- Manages communications over the communications network.
- Processes position & status reports from all the vehicles.
- Displays the vehicles on a map in real time.
- Stores incoming data for analysis.
- Interfaces with 3rd party software for extended functionality.

Why Use AVL?
Return on Investment

AVL gives you the information you need to manage your fleet more efficiently, which means you get greater performance without having to expand your resources. As a result your operating costs are driven down and you get a greater return on investment.

Quicker Dispatch

AVL makes dispatch much quicker, especially when integrated with Computer Aided Dispatch systems (CAD). Because AVL tells you the actual location and status of the vehicles, rather than the general area where they are supposed to be, you can make much more informed dispatch decisions. For emergency services, AVL often reduces dispatch time from about a minute to less than 15 seconds -- a significant difference that saves lives!

Driver & Passenger Safety

In the event of a threatening situation or medical emergency, the driver hits a panic button which immediately reports the alarm and the vehicle's location to the base station. Or in a marine emergency, a distress message is sent reporting the ship's position and heading.

Security Against Theft

In the event of theft, AVL helps you quickly locate and recover your vehicle and cargo.

Navigation Guidance

The real-time map display capabilities of AVL allow your dispatchers to help guide drivers through unfamiliar areas, thereby getting vehicles to their destinations faster.

Mobile Data -- Digital Messaging

By integrating your AVL system with mobile data terminals (MDT) or computerized devices, you can benefit from the advantages of digital messaging. For example, with voice communications the driver must be in the vehicle to respond, and then he or she must remember or write down the information. With digital messaging, however, the driver does not have to be present and the information remains on the display terminal. Also, digital messaging can be sent to a specific vehicle, rather than broadcast to the entire fleet. Altogether these benefits can improve the speed and efficiency of communications.

Documenting Compliance

The data logging capabilities of AVL make it easier for you to document response time, schedule adherence, driver performance, and any other obligations you may have as a contracted service provider.

Build Dynamic Routes

With all the information AVL provides, you can make much more efficient decisions whenever you need to add a pickup stop for a vehicle that is already en route.

Optimize Routes

By analyzing the performance data of your fleet recorded by AVL, you are better able to optimize routes and schedules.

Extended Capabilities

Trimble's AVL systems can also integrate third-party applications. For example, your drivers could use mobile data terminals and customized software to submit field reports electronically after each job, rather than filing paperwork at the end of the day. This reduces paperwork and makes information available immediately.

Better Time Estimates

With AVL you can also give your customers better estimates for time to arrival.

Customer Service

AVL can also be used as a convenient service for customers. For example, auto clubs may install AVL equipment so that their members can call for guided navigation in case they get lost. Or the auto club could remotely unlock the car doors in case the motorist gets locked out, or dispatch a tow truck to the vehicle's exact location if needed.

Compliance to Regulations

In some cases AVL may be used to comply with regulations, such as the International Marine Organization's requirement for a Global Maritime Distress and Safety System, or local requirements for taxi fleets to install a driver safety system.

Monitoring Driver Compliance

In some businesses AVL can be used to help ensure that their drivers and field service technicians are where they are supposed to be.

Who Uses AVL?

Vehicles

Ambulances	Long-haul Trucking	Utility Companies
Fire Depts.	Delivery / Couriers	Cable Companies
Police	Armored Cars	Private Security
Public Buses	Taxis	Tow Trucks
Paratransit	Limousines	Snow Plows
Postal Services	Airport Shuttles	Auto Clubs
Waste Disposal	Rental Vehicles	Roadside Service

Vessels

Merchant Shipping
Fishing Fleets

Other

High-Value Cargo Trailers
Railway Cars
Construction Equipment
SCADA

AVL Communication Networks

AVL can be used on a number of different communication networks. The selection of a network depends largely on how frequently you need to check the positions of your fleet or assets, your coverage area, and the cost.

Cellular & PCS

The costs of these networks are advantageous for infrequent reporting, such as a few reports *per day* per vehicle. Applications use **exception reporting** and **data logging** for post-analysis and security. (See IQ*Event Engine* for explanations of exception reporting and data logging.)

AMPS Cellular

Advanced Mobile Phone System
An analog cellular air interface standard specified by the EIA/TIA. (Not to be confused with Digital AMPS (DAMPS) or Narrowband AMPS (NAMPS).)

Coverage:
Western Hemisphere, parts of Asia and Africa

Capability:
Voice and Data

Cost:
Pay for time used or amount of data transferred.

Supported by:
CrossCheck AMPS Cellular

GSM (800 MHz & 1900 MHz)

Global System for Mobile communications
A digital cellular network.

Coverage:
900 MHz and 1800 MHz covers Europe, most of Asia, and a few other countries;
1900 MHz currently covers portions of the U.S.

Capability:
Voice and Data
(Future products will support data only)

More Info:
Overview of GSM

Not supported yet

Packet Data & Trunked Radio

The costs of these networks are advantageous for **near-real-time** reporting, such as a few reports *per hour* per vehicle. Near-real-time applications use occasional updates throughout the day for monitoring and security.

CDPD Radio Modem
Cellular Digital Packet Data
A wireless extension of the Internet or private intranet.
For high security applications, use a private intranet. Compared to cellular and trunked radio, there is more latency in CDPD transmissions.

Coverage:
North America; emerging in Central & South Americas

Capability:
Data only

Cost:
Pay for amount of data transferred.

More Info:
Wireless Data Forum

Supported by:
Placer GPS 450/455-CDPD

MPT1327 Trunked Radio (MAP27 protocol)

Mobile Access Protocol for MPT1327 equipment
An open-protocol trunked radio system.

Coverage:
Europe, Asia

Capability:
Voice and Data
(Placer supports data only)

Cost:
Depends on your service provider

More Info:
Trunked Radio Forum

Supported by:
Placer GPS 450/455-MAP27

Ericsson EDACS Trunked Radio (RDI protocol)

Enhanced Digital Access Communications System
(*Radio Data Interface*)
A trunked radio system designed and manufactured by Ericsson, Inc.

Coverage:
Contact Ericsson, Inc.

Capability:
Voice and Data
(Placer supports data only)

Cost:
Depends on your service provider

More Info:
Ericsson, Inc.
Trunked Radio Forum

Supported by:
Placer GPS 450/455-RDI

Dedicated Radio

The costs of dedicated radio are advantageous for **real-time** reporting, such as a few reports *per minute* per vehicle. Real-time applications include emergency dispatch and high security monitoring.

UHF/VHF Conventional Radio

Privately licensed radio frequencies. Reporting is most efficient when the frequency is dedicated to AVL data only. Conventional radio is typically used by public safety and utility companies.

Coverage:
Depends on licensing restrictions

Capability:
Voice and Data
(AVL Subsystem and Placer support data only)

Cost:
Large capital outlay for infrastructure; usage is virtually unlimited.

Supported by:
AVL Subsystem
Placer GPS 450-TAIP

Satellite Networks

Satellite networks are advantageous where **wide coverage** is required, such as long-haul trucking, merchant shipping and fishing fleets.

Inmarsat

Inmarsat-C two-way messaging.

Coverage:
Global
(for land applications in the U.S. use AMSC)

Capability:
Data only

Cost:
Positions approx. $0.05 per report
Messages approx. $0.01 per character
(in U.S. dollars)

More Info:
See overview of Inmarsat

Supported by:
Galaxy Sentinel Inmarsat-C/GMDSS Package
Galaxy Inmarsat-C/GPS Marine Package
Galaxy Inmarsat-C/GPS Land Package

AMSC

American Mobile Satellite Corporation
Standard-C two-way messaging.

Coverage:
U.S.

Capability:
Data only
(voice not supported by Standard-C)

Cost:
Contact AMSC

More Info:
See overview of AMSC

Supported by:
Galaxy Model TNL 7003 Transceiver

Movisat-Datos

Standard-C two-way messaging by Mexico Telecomm.

Coverage:
Mexico

Capability:
Data only

Cost:
Contact Mexico Telecomm

More Info:
See overview of Movisat-Datos

Supported by:
Galaxy Model TNL 7003 Transceiver

AVL Accuracy

How much accuracy do you need?

Do you need to know on which side of the road a vehicle is parked, or just what block? Do you need to track it every minute, every hour, or every second? There are many flavors of AVL systems, so questions like these will help you determine how much accuracy you need.

GPS -- *What block are they on?*

Regular GPS is accurate enough to tell you what block a vehicle is on, and for many AVL applications that's good enough. Using plain GPS, your accuracy will be within the 58 meter* error imposed by Selective Availability (SA). (For more information on SA, see the GPS Tutorial.)

DR -- *Where did they disappear to?*
Some environments are very unfriendly to GPS, such as big cities where the GPS signals are blocked by tall buildings (known as the "urban canyon"), or in tunnels where no satellites can be seen at all. This can cause your vehicle to "disappear", sometimes for several blocks. (Actually it doesn't disappear from the map; it just appears to park at its last known location, then suddenly jump several blocks when GPS is regained.) These temporary lapses may not be a problem for many AVL applications, but if you need more continuous positioning, Dead Reckoning (DR) can help you. By installing Dead Reckoning equipment in your vehicles, you can get position reports even when GPS is blocked, and it also improves your position accuracy to within 33 meters.*

DGPS -- *What side of the street are they on?*
If you need to know not only what street a vehicle is on, but also what *side* of the street it is on, or the specific street address, then you need the accuracy of Differential GPS (DGPS). This technology compensates for the errors imposed by Selective Availability (SA) and reduces some other errors inherent in GPS, bringing your accuracy up to 2 meters,* depending how often you apply the DGPS corrections.

DGPS + DR -- *The best of both*
For continuous positioning and maximum accuracy, you can use Dead Reckoning and Differential GPS together. This brings your accuracy to 2 meters.*

Limitations -- *Let's be realistic*
On the other hand, you may end up with more accuracy than you need. For example, many maps used for map display software can be off by over 40 meters. Or you may have trucks over 10 meters long, so exactly which part of the truck do you wish to track? There are a lot of exciting advances that bring GPS to sub-meter accuracy, but these are more applicable to land surveyors and others than they are to AVL.

Reporting Frequency -- *When were they there?*
How often do you need your vehicles to report? If the most you ever need to hear from them is every five minutes or so, then you probably don't need the enhanced accuracy of Dead Reckoning or Differential GPS. After all, do you really need to know the exact street address five minutes *after* the vehicle passed it? In fact, after just 2 minutes, if a vehicle is moving at 35 miles per hour, the position report may be off by 1877 meters!

Communications Latency -- *Every second counts*
One last thing to consider: Even if your vehicles report several times a minute, the position report at the base station may still be a few seconds old due to communications latency. This is the time it takes for the vehicle's position report to be passed all the way through the communications network and finally arrive at the base station. Depending on

the type of network you are using and the amount of communications traffic at the time, this may take several seconds. So let's say a vehicle is moving at 60 miles per hour and the latency is 5 seconds, the position report will already be off by 134 meters the moment it hits the screen at the base station!

Summary of AVL Accuracy*

GPS 58 m
(No reports when GPS is blocked)

GPS + DR 33 m

DGPS 2 m
(No reports when GPS is blocked)

DGPS + DR 2 m

* At least 65% of the time (1 sigma), under SA conditions

Differential GPS for AVL
\

What is Differential GPS?
Differential GPS ("DGPS" for short) is a way to make GPS much more accurate. It does this by comparing the GPS measurements in the mobile units (such as the vehicles in your fleet) with GPS measurements taken at a reference station. Since the reference station is at a fixed location, it can find the difference between its known position and the information received from the satellites. It then uses this difference (hence "Differential" GPS) to calculate the errors in each satellite's signals -- mostly the errors imposed by Selective Availability (SA). This information can then be used to correct the satellite signals received by the mobile units and get much more accurate positions. Accuracy can be improved from 58 meters to 2 meters,* depending how often corrections are applied.

For a more thorough explanation of DGPS, see the GPS Tutorial.

For even greater accuracy and reliability, you can use DGPS in combination with Dead Reckoning (DR).

* At least 65% of the time (1 sigma), under SA conditions.

Why use DGPS?
Differential GPS is used when you need to know very specific locations of the vehicles in your fleet. With non-differential GPS you get enough accuracy to know which block a vehicle is on, and for many AVL applications that's just fine. But if you want to narrow it down to a specific street address, or to know on what side of the street the vehicle is

parked, then DGPS is your solution. DGPS is generally used for critical applications, such as emergency services and armored cars.

Requirements of DGPS

•

Since DGPS works by correcting for the errors specific to each satellite, the mobile unit should be in the same general area as the reference station so that they are in view of the same satellites. This area can extend up to hundreds of miles in relatively flat regions, or it can be restricted to less than 100 miles in mountainous terrain.

•

GPS errors may vary quite a bit within a minute, so to maintain accuracy GPS corrections should be received and applied every 1 to 20 seconds, depending on how much accuracy you need. The older the correction data, the less confidence you can have in its accuracy.

Three kinds of DGPS

Trimble supports three different ways of using DGPS for Automatic Vehicle Location (AVL). The main difference is *where* the corrections are applied. Click on each for more information:

□

RTCM Input -- Corrections applied *in mobile unit* using data received from reference station.

□

TAIP Broadcast -- Corrections applied *in mobile unit* using data transmitted from Trimble reference station at base.

□

Inverted Differential™ -- Corrections applied *at base station* using data from Trimble reference station at base.

Dead Recknoning

What is Dead Reckoning?

Dead Reckoning (affectionately nicknamed "DR") is a way to make GPS more accurate and reliable when tracking vehicles. It uses extra sensors installed in the vehicle to measure your speed and direction. By combining this information with GPS, it can figure out your current position based on your last known position, even when GPS signals are blocked.

Advantages of Dead Reckoning

•

Continuous Positioning

DR continues to report positions when GPS signals are blocked, such as in tunnels or when surrounded by tall buildings.

•

Greater Accuracy
By comparing the GPS and DR data, inaccuracies caused by blocked GPS signals can be compensated, increasing accuracy from 58 meters to 33 meters*

For even greater accuracy, you can use Dead Reckoning with Differential GPS.

* At least 65% of the time (1 sigma), under SA conditions.

Applications of Dead Reckoning
Dead Reckoning is used for applications that need continuous positioning, even in places where GPS is limited, such as tunnels, parking garages, and "urban canyons". Typical users of DR include emergency vehicles, public buses, armored cars, and others.

Urban Canyon
Big cities pose many problems for GPS. Satellite signals are often blocked by tall buildings, and reflections of signals cause multipath errors. This causes the vehicle's position appear to jump around, but DR can prove that the vehicle made no such jump, so the errors are compensated.

Requirements & Limitations of Dead Reckoning

•

The GPS receiver must be capable of DR. Compatible models include the Placer GPS 455DR and the AVL Subsystem.

•

A heading sensor must be installed in the vehicle.

•

An input from the vehicle's odometer/speed signal is required. If the vehicle's signal is inadequate, additional hardware may be required.

•

DR requires at least occasional GPS fixes. The farther you travel without a GPS fix, the less accuracy you get.

•

DR technology does not measure changes in elevation; therefore accuracy may degrade on parking garage ramps and in graded tunnels.

Not Just a Backup System
It is important to understand that DR is not just a backup system for when GPS is blocked. DR is always active, and its positioning data is used to improve the accuracy of GPS, providing a blended solution.

Think of DR as a second opinion. When GPS is available with several satellites in good positions, the vehicle's position may be based on 70% GPS and 30% DR. But when GPS is somewhat limited, such as when only three satellites are visible or the satellites are not in ideal positions, the solution may use up to 50% DR. This provides you with the optimal position accuracy under varying conditions.

Dead Reckoning Inputs

- The **Heading Sensor** uses a gyro to measure how much the vehicle is turning to the left or right.
- The input from the **odometer** indicates the vehicle's speed.

The input from the **backup signal** (the tail lamp that lights when the transmission is in reverse) indicates whether the odometer speed is forward or reverse.

AVL Maps

One of the more visible features of AVL is that you can use base station software to automatically display all your fleet vehicles on a map in real time (or in replay). Depending on your map display software, maps can be zoomed in and out to virtually any level of detail, and can be set to automatically scroll to follow a designated vehicle. You can have all your vehicles displayed, or just selected vehicles.

While this graphic representation is helpful in most AVL applications, it is not always necessary. In emergency 911 dispatch, for example, an AVL system usually shares the vehicle position data with the Computer Aided Dispatch system (CAD), which then automatically identifies the closest emergency vehicle(s). In this application the dispatcher does not need to refer to the map on a regular basis.

Map Display Software

FleetVision
The FleetVision base station AVL software includes map display features that can be used with CrossCheck AMPS and Placer. It supports two formats of maps:

- ***Etak*** produces vector maps for the U.S. and Europe. Their maps are accurate within 12.2 meters in urban areas and 48.8 meters rural (meets U.S. Geological Survey Map Accuracy Standards).
Etak website: www.etak.com
- ***MapInfo*** produces a map engine which allows you to develop your own vector maps, or to read maps created by other 3rd-party suppliers.
MapInfo website: www.mapinfo.com

Third-Party Software
Trimble encourages and provides support for third-party developers to produce end-user software applications compatible with Trimble mobile GPS units and base station software tools. Many third-party software applications include their own map displays.

Geographic Information Systems (GIS)

Many AVL users have a need to use their own customized map databases, typically created using GIS software. Popular vendors of GIS software include:

ESRI
www.esri.com

Intergraph
www.intergraph.com/gis

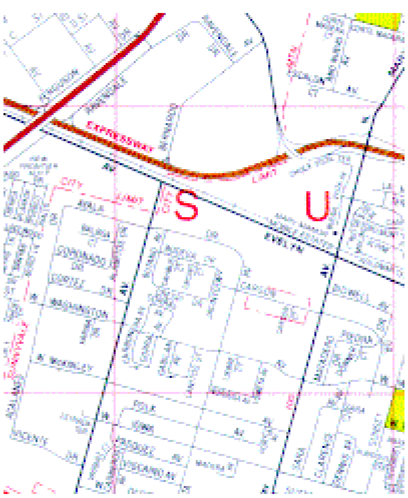
MapInfo
www.mapinfo.com

Autodesk
www.autodesk.com/solution/gis/gis.htm

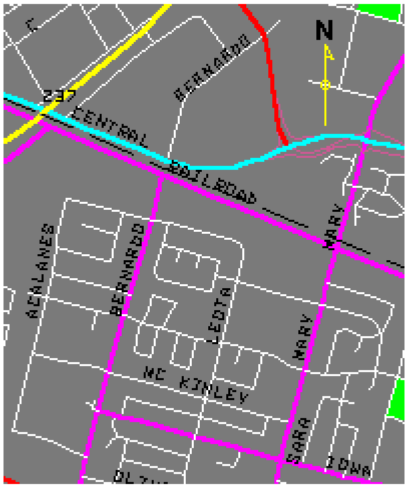
NOTE: If custom maps are to be used with FleetVision, save your map data in MapInfo format.

Raster vs. Vector Maps

There are two basic types of digital maps:



Raster Map



Vector Map

Raster Maps (also known as **Image Maps** or **Scanned Maps**) are simply digital images of maps, usually created by scanning a printed map. While raster map data is not very flexible, it does have a few advantages:

- Widely available, especially in remote areas.
- Easy to convert from printed maps.
- Shows terrain features.

The disadvantage of raster maps is that they do not zoom in and out very legibly, so several images need to be scanned for different scales. Raster maps also take longer for a computer to draw, which can be especially noticeable in AVL applications. For these reasons raster maps are not common for AVL.

Vector Maps are actually databases of map information, such as street names and the latitude and longitude of street intersections, fire hydrants, etc. The map display software then draws a map based on this information. Vector maps have many advantages for AVL applications:

- *Varying detail for zooming* -- When you zoom out to cover a wide area of the map, only the highways and major roads are shown so that it does not appear cluttered. As you zoom in, more streets are shown, as well as specific details such as street addresses.
- *Custom features* -- Vector map databases can include any kind of information, such as the location of fire hydrants, bus stops, traffic lights, sewage pipes, gas lines, telephone poles, property boundaries, aqueducts, etc. They may also include traffic attributes such as one way streets and turn restrictions at intersections, which can be used to calculate routes.
-

Seamless maps -- By using several vector map databases, you can map a larger region without any apparent seams. For example, you may have three detailed maps to cover your county plus a highway map of the entire nation all integrated together.

•

Geo-coding -- Because all the map data uses latitude and longitude, the software can use the AVL positioning information to identify which street a vehicle is on and the nearest cross street, etc. It also allows you to click the mouse anywhere on the map to get the exact coordinates in latitude and longitude. (*Note:* FleetVision does not implement this feature yet.)

Hybrid Vector-Raster Maps appear like raster map images, but they also include vector data to support geo-coding features.

Mobile Data Integration

What is Mobile Data?

Mobile Data is when you send digital messages or data over a wireless network, such as sending e-mail from the base station to a truck. Because mobile data applications and AVL both use wireless communication networks, they are often integrated together.

Mobile Data Applications

Fleets may use mobile data for a variety of applications:

□

Dispatch -- A Computer-Aided Dispatch (CAD) system at the base station uses the AVL data to identify the closest available vehicle in your fleet. This is often used by 911 for emergency dispatch. Commercial applications include delivery, taxis, limousines, etc.

□

Work Order Management -- The base station sends an electronic work order to one of their vehicles, including the address of the job site. After finishing the job, the driver may complete an electronic report and transmit it back to the base for automatic processing. Since the GPS position and time are automatically included with the report, the base station can use this information to help verify the work order.

□

Database Inquiries -- The driver may request information from a database at the base station, such as the registration information for a license plate number, or the phone number for a particular street address.

□

Credit Card Verification -- A card-swipe reader in the vehicle can be used to get authorization numbers via the base station for credit card transactions.

□

- ***Two-way Messaging*** -- A display and keyboard can be used for sending text messages between the vehicle and base.
- ***E-Mail*** -- Mobile Data applications may connect with the Internet for e-mail capabilities.
- Plus many more applications, depending on the needs of your business.

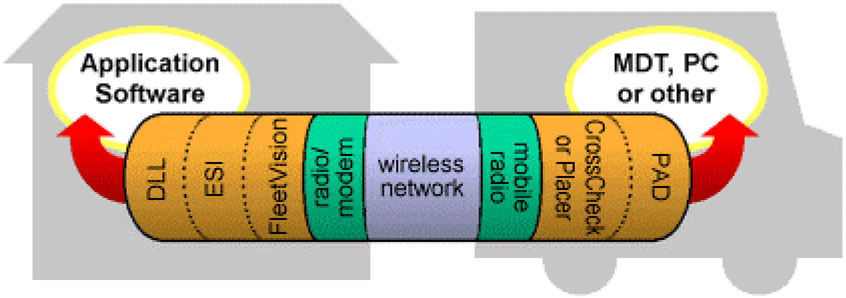
Mobile Data Hardware

Most mobile data applications integrate specialized hardware in the vehicle:

- ***Mobile Data Terminal (MDT)*** -- This is a display of some kind, usually mounted to the dashboard. It may have a few pre-programmed buttons or a full keyboard. Some MDT's are hard-wired for a specific application; others run on an open platform, such as Microsoft Windows CE, and may be reprogrammed for other applications.
- ***Portable Computer*** -- It is also possible to use a regular laptop PC for mobile data applications.
- ***Bar Code Scanner*** -- A hand-held bar code scanner may be docked to transfer its data.
- ***Card Swipe Reader*** -- For credit cards, etc.
- ***Portable Emergency Transmitter*** -- Drivers may carry a key-chain transmitter for emergencies. A receiver in the vehicle passes the signal to the mobile data system.
- ***Printer*** -- To print receipts, shipping labels, etc.
- Plus many others, depending on the needs of your business.

Integrating Mobile Data

To integrate mobile data applications in an AVL system, you need to install application software at the base station and mobile hardware in the vehicles. The AVL system is used as a communications pipeline to pass data between the base station and vehicles.



Mobile Data Pipeline

The mobile data **application software** at the base interfaces with Trimble's FleetVision software through the External System Interface (ESI). This allows the application software to communicate with the mobile equipment and to access all the AVL data, such as the vehicle's position and status.

The **MDT** or other **mobile data hardware** connects to the CrossCheck AMPS Cellular or Placer GPS 450/455 mobile units through the MDT/Aux port or the digital input/output lines.

AVL System Components

An AVL System requires equipment at the base station and in each vehicle.

Base Station Components

Radio or Modem -- Communications hardware that connects your base station computer network to a communications network

•

DGPS (*optional*) -- Differential GPS equipment interfaces with your AVL software.

•

AVL Software -- Manages communications with vehicles, handles position reports, and displays vehicles on maps.
For public safety applications, see the AVL Subsystem. For other applications, see FleetVision.

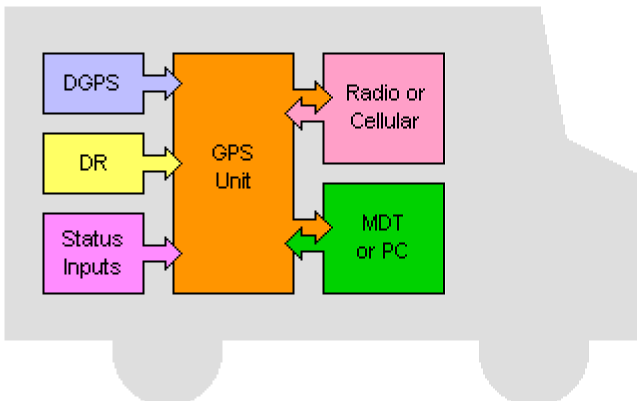
•

Application Software (*optional*) -- Handles custom applications, such as Computer Aided Dispatch (CAD), work order management, mobile data digital messaging, etc.

Mobile Components

There are two basic ways to configure your mobile AVL equipment: You can either have your GPS unit handle the communications directly, or it can just pass the GPS information to an MDT or computer which in turn handles the communications. There are certain advantages for each setup:

AVL with Mobile Data



•

GPS Unit -- In this configuration the GPS unit handles communications directly with the radio. Because the GPS unit does not depend on the MDT or computer for communications, this setup is advantageous when AVL or security is the priority, or when the MDT/PC is removable, unreliable, or to be added later.

For product-specific details see:
■Diagram of CrossCheck AMPS Cellular
■Diagram of Placer GPS 450/455
■Product description of Trimble GPS/AVL Subsystem
■Product description of Galaxy Inmarsat-C/GPS Land Package

•

MDT or PC (*optional*) -- Any mobile data equipment, such as a mobile data terminal (MDT), computer, or other, plugs into a port on the GPS unit. Data communications are passed through the GPS unit to the communications equipment.

•

Radio or Cellular -- Communications equipment depends on the network you are using. Most GPS units interface with an external radio, but some Trimble products use a built-in communications such as cellular or Inmarsat-C.

•

DGPS (*optional*) -- Differential GPS equipment plugs into a port on the GPS unit.

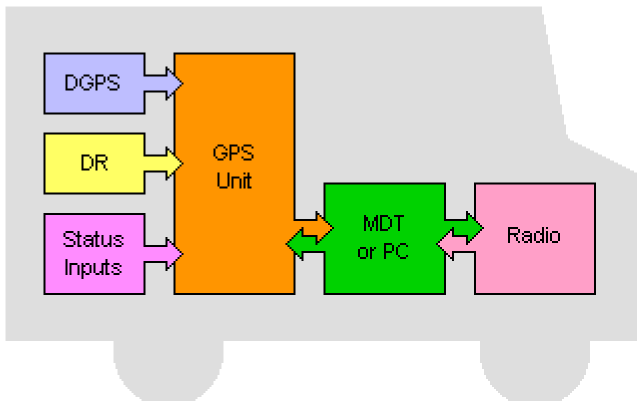
•

DR (*optional*) -- Dead Reckoning equipment plugs into a port on the GPS unit.

•

Status Inputs (*optional*) -- Switches and sensors may be used to report vehicle status to the base station. These may be attached to either the GPS unit or the MDT/PC, or both.

Mobile Data with Added AVL



- **GPS Unit** -- In this configuration the GPS unit sends communications to the MDT or computer, which in turn passes the communications to the radio. This setup is advantageous when Mobile Data is the priority, when the radio is built into the MDT or installed permanently in the vehicle, or the GPS equipment is to be added later.

For product-specific details see:
Diagram of Placer GPS 450/455 TAIP

- **MDT or PC** -- The mobile data terminal (MDT) or computer controls communications with the radio. Any communications to or from the GPS unit is passed through the MDT/PC.
- **Radio** -- Communications equipment depends on the network you are using. In this setup an external radio is connected to the MDT or PC.
- **DGPS** (*optional*) -- Differential GPS equipment plugs into a port on the GPS unit.
- **DR** (*optional*) -- Dead Reckoning equipment plugs into a port on the GPS unit.
- **Status Inputs** (*optional*) -- Switches and sensors may be used to report vehicle status to the base station. These may be attached to either the MDT/PC or the GPS unit, or both.

Trimble

http://www.trimble.com/trimble.htm?splash

Provides a large selection of GPS-related devices and software.

Trimble Products Distributor
Wireless Technology Equipment Company, Inc.
Phone: 407-644-8907 ext. 109

Cost is approximately $1,500 per unit. They were supposed to send pricing information and details on the various devices and accuracy, but they did not.

Sokkia

Interview with Todd Holden – 972-661-3556

Sokkia has a GPS-related system to gather the data on the map and then export to an ArcView shapefile.

Consumer GPS receivers are only accurate to within a 30 foot radius. The location jumps around because the receiver is not that accurate. For accuracy, you need two receivers. Second receiver is used for stabilizing/correcting the GPS receiver. Sokkia has 2 levels of products -$7,300/unit and $40K/unit. Low-end one gets you within a meter of accuracy (about 3 feet). The $40 K gets you within a centimeter (used more for accident reconstruction).

Sokkia's receiver accepts real-time differential corrections from all three of the available correction sources: 1) Coast Guard beacon (accuracy not dependable), 2) WAAS (FAA experimental service) – accepts corrections on the ground, transmits them to a non-GPS satellite, which broadcasts corrections that can be received by the device, 3) OmniStar – a commercial company that does the same thing as WAAS.

The Sokkia receiver is in a backpack. The receiver itself is about 6x8 inches and 2 inches deep but there is also a large antenna pole up to 4 feet long x 4 inches in diameter plus 2 camcorder batteries and cables. Sokkia does not have a handheld receiver model. From the backpack, a cable connects to a handheld iPaq Windows CE device, which collects the data and exports it to an ArcView shapefile. The iPaq also collects data the officer inputs about the cars, obstacles, etc. This is the Axis 3 system. The software is iMap, which comes with Axis 3. There are no solutions on the market today that operate in-between the 3 foot and 30 foot accuracy.

OmniStar is the best correction option. There is a fee of $800/year per GPS receiver. This is a far superior option than the other two. Sokkia has done tests using all 3 options.

They tested a ten-foot line to find which option was the most accurate in finding the correct length. It is also more reliable when there are trees, etc. above you.

There are other law enforcement applications that the system could be used for such as accident reconstruction, crime scene use, SWAT team location of team members during a raid, shootout, etc.

Much of the price of the Axis 3 product involves the software. If we don't need all of that functionality and we just need the GPS coordinates (corrected and accurate) so that the data can be written onto a paper form or entered onto the electronic form, then we should consider a receiver-only product from a company called Garmin. They have a receiver that makes WAAS corrections, which does not come with any software for data capture. Garmin is represented (sold) by a lot of people. Sokkia referred us to Bob Miller of Miller Blueprint Co. 512-478-8793 in Austin, TX.

Garmin

Interview with Bob Miller - 512-478-8793

Garmin Venture handheld GPS device – least expensive GPS receiver with WAAS - $169.

Garmin GPS76 handheld - $219 – has a better antenna to help pick-up location and WAAS correction a little better, would work better in remote areas. This unit is easier to tell you when you are getting the WAAS correction.

WAAS gives accuracy within 10 feet. Without correction, you could be as much as 75 feet off. GPS works best when there are no obstructions around you (e.g. works best in the desert and the ocean). WAAS is an experimental system and is not even publicly known about, but is free.

These devices would be suitable to our application of an inexpensive handheld device that provides reasonably accurate display of latitude/longitude that can then be manually recorded onto the paper or electronic-based accident form.

Mobile Data Systems (MDS) Review

Aether Government Systems

Aether Mobile Government provides market leading mobile computing products for federal, state and local government. Our mission is to make Mobile Government a reality across all of government - to be the key that unlocks the power of wireless information and the Internet for all mobile professionals in the public sector.

The Mobile Government Division of Aether was created by combining pioneering state and local government products such as PacketCluster and FireRMS that were acquired through the acquisitions of Cerulean Technology and Sunpro Corp., with Aether products such as ScoutSync, Blackberry by Aether and others that are used by such Federal agencies as the U.S. Navy and U.S. Postal Service. Having seen the productivity, economic, safety and community relations benefits derived from deploying mobile data technology, other government agencies are now moving to adopt mobile computing. Aether Mobile Government will continue to offer additional wireless mobile applications and services to meet those needs.

Aether products are being used by Montgomery County, MD (see related article under "State Reviews" section).

IACP Technology Clearinghouse High Tech Patrol Car With Police Cruiser Mobile Computers by Datalux

http://www.iacptechnology.org/LEIM/TechCar/TechnologyCar.htm and
http://www.datalux.com/mobile.html

Many police departments are looking for a computer system that is more versatile and more tailored to mobile data access in the form of a vehicle mounted system. Access local, state, and federal databases in seconds directly from the vehicle with the Datalux System F – specifically designed for Ford Crown Victoria cruisers and System H – designed for Chevy Luminas. These rigid, air bag compliant, forward mounted computer systems keep the monitor near eye level and still leave room for the complete center console. Combined with multiple backbone compatible wireless communication software, the Datalux Systems are perfect mobile data solutions. There is nothing else like it on the market – it is the only complete hardware solution for mobile data.

Datalux System F and System H are both solid metal one-piece units which bolt into the console and dashboard. Initially, the system can be installed within two hours (only using three bolts) and easily replaced in 15 minutes. The Datalux LMV10CX capacitive touch screen monitor is mounted securely on a hinge, enabling it to flip down for accessing the dashboard controls. The monitor is a very bright 500 nit sunlight readable screen. The Datalux Space-saver Keyboard is held securely to the mount but is removable for data input anywhere in the front seat of the car. For nighttime use, we've added your choice of an attached night light or a keyboard with back-lit keys.

All of these features were engineered in direct response to the demands of law enforcement and road safety. Datalux systems are airbag compliant. FCC certified, the systems will not interfere with radio frequencies. The sturdy fixed-mount keeps the unit secure and eliminates vibration.

The Ocean City Police Department of Ocean City, Maryland has a full installation of Datalux System Fs. They currently have 40 cruisers fully equipped with plans to buy more units. They are using the Datalux System F in conjunction with RADCOM; communications software developed by Public Safety Technologies in Herndon, Virginia.

Public Safety Technologies
http://www.pst911.com/

The PST Message Switch and RADCOM product line is a total hardware/software solution that can place your mobile fleet in constant real time communication with your Computer Aided Dispatch, Records Management, and Federal/State/Regional database systems. The wireless communication is reliable and efficient and has been field proven since 1989 with the original RADCOM system. It is available for the Windows 95/98 and NT operating systems environment.

PST designed RADCOM around industry-standard components, avoiding dependence on proprietary solutions. This allows for the purchase of components from competitive sources and assures future cost effectiveness.

RADCOM Mobile fully supports Windows-based laptop computers, as well as the growing number of "mission designed" computers engineered specifically for mobile use. With RADCOM, you can mix different types of computers within the same fleet to reflect the purpose of each vehicle, such as command, patrol, and traffic units. RADCOM mobile combines the functions long associated with traditional mobile data terminals with the ease-of-use now expected in modern personal computer applications.

Accident Diagramming Software Review

Note – for purposes of the SD 2000-14 project, we use the term "accident diagramming" to indicate the process of drawing an individual accident at the accident scene. This varies from "collision diagramming" or "multiple accident diagramming" which is an analysis function performed at the state level and usually involves multiple accidents.

Visual Statement Accident Scene Diagramming Software

http://www.visualstatement.com/

Go to their web site for a demo of their software. Main functions – scene interview form, scene diagramming tool.

Product Demonstration:
http://www.visualstatement.com/Software/VS2000/VSAccInvDemo.exe

Product Download: http://www.visualstatement.com/Software/vs2000/VSAISetup.exe

Drawing Tutorial
http://www.visualstatement.com/Software/VS2000/VSAIDrawingTutorial.exe

The tool looks like a very robust accident diagramming tool that is easy to use. It has an extensive library of car makes and models to choose from. It also has the ability to drag various points on the car body to show accident damage. My only complaint is that r did not see any street type templates/objects. You had to manually draw each line and arc of your diagram. Other products allow you to select the type of street or intersection you need (such as 4-line intersection) and then apply that to your drawing.

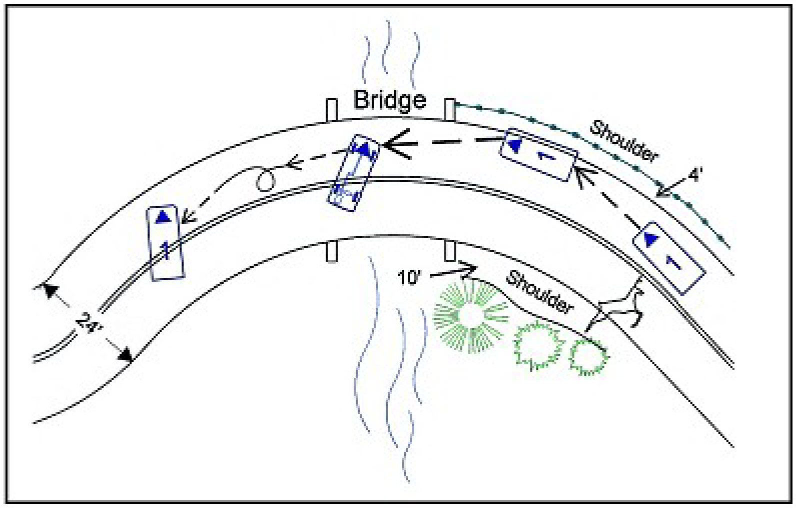
The Crash Zone

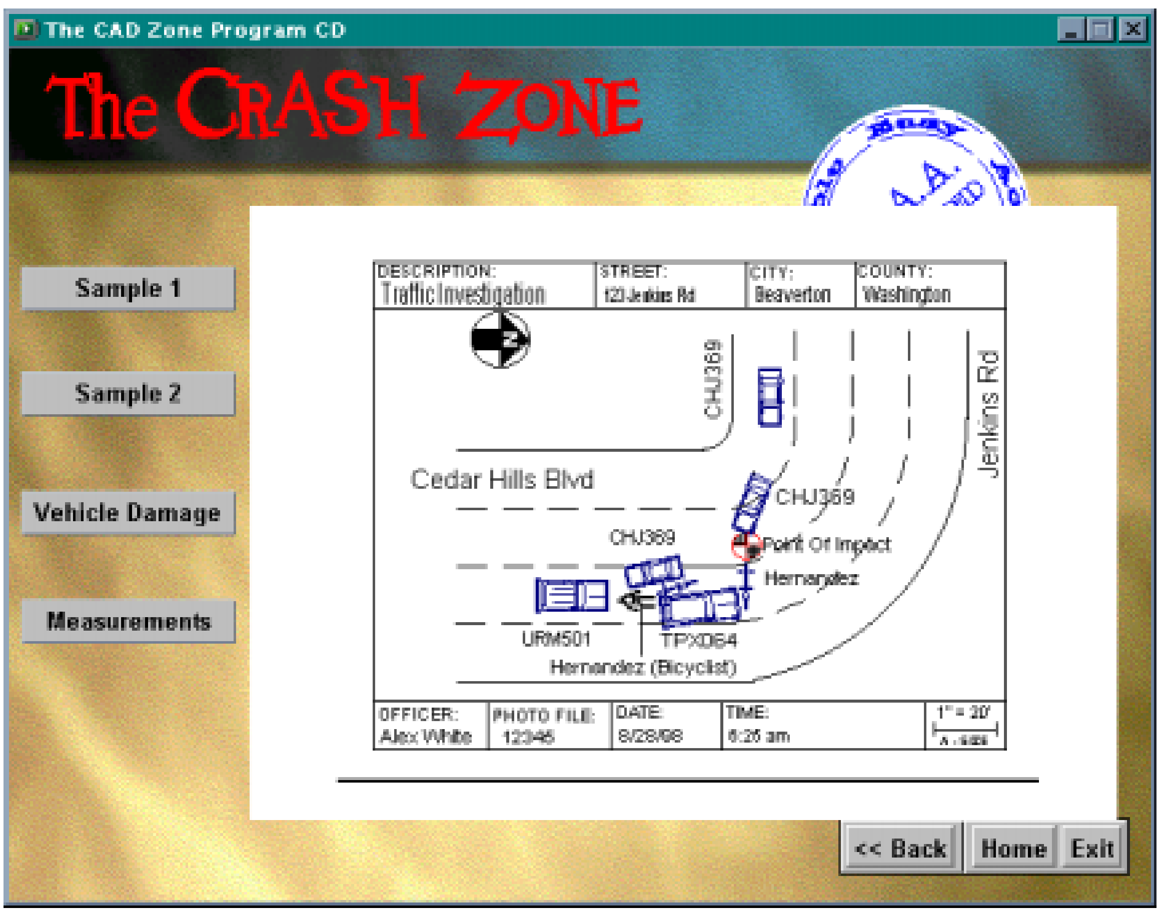
Draw any accident scene quickly, easily and accurately.

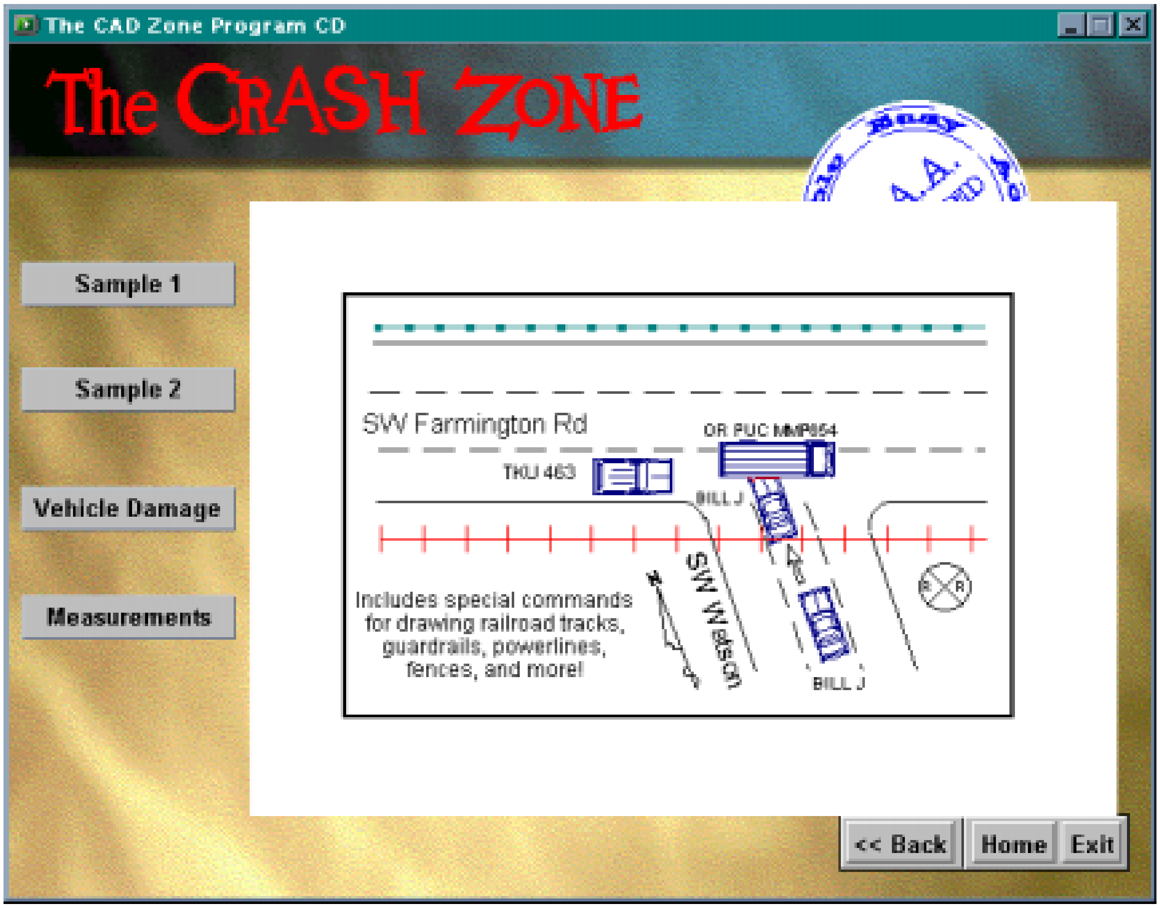
Team up with the Crash Zone drawing software and quickly create accurate diagrams for accident reports - right from your laptop or desktop computer. Save valuable time and document every scene with precision and clarity. We developed the Crash Zone by consulting accident reconstructionists and law-enforcement professionals all over the world. The result is the simplest, most practical, most powerful tool of its kind on the market. Toss aside your pencil, eraser, and plastic templates. The Crash Zone is about to make a major impact on the way you work.

> *"As a traffic officer I don't have much time to do diagrams. The CRASH ZONE gives me the results that I need - faster and more accurately than I can draw by hand." - Officer Kevin Stich, Beaverton, OR, PD.*

Draw three to four times faster than by hand.
The Crash Zone not only enables you to draw faster, but also draw more accurately than ever before. Many common drawing tasks are already programmed into the software. What's more, you don't need any computer drawing experience. You'll be fully productive with the software in a very short time.



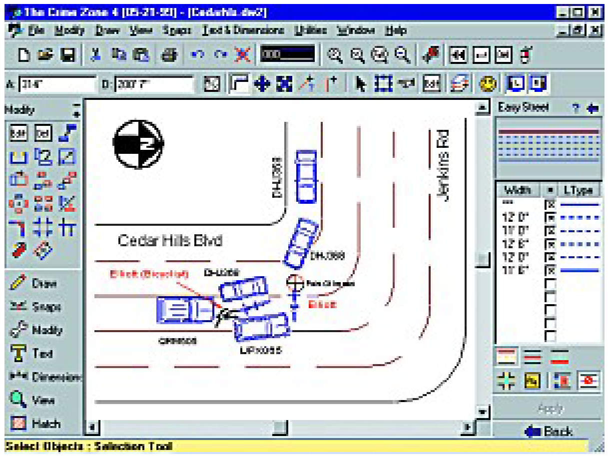




Draw everything to exact measurements based on the data you gather at the site. Import measurements from total station systems. Automatically scale your diagrams for printing or plotting on any size paper - create full color, large sized plots.

Easy Lines and Easy Streets.

Our Easy Lines toolbox lets you point and click to draw lines for buildings, parking lots, and more - all to precise measurements. And our Easy Streets feature allows you to quickly draw streets and intersections. Simply specify the number of lanes, lane width, and centerline data, then apply this data to any line, arc or curve to create a street. What's more, the Crash Zone is also an ideal partner for crime scene diagrams. The closer you investigate, the more you'll appreciate the many features and benefits of this dynamic software package. Whichever type of accident or crime scene you're re-creating, you can craft large, scaled plots in full color, sure to make a positive impact on any judge or jury.



Use the Easy Streets feature to draw any street or intersection automatically, then just drop symbols into position. Place vehicle symbols by locating points at their wheel centers, then stretch the symbol to exactly match the size of vehicles at the scene.

Fasten your seatbelt....

The Crash Zone is fast, accurate and affordable. Get set for a quick, smooth experience. No other software measures up to the Crash Zone. It's the ideal partner for any crash investigation. Take a look at just a few of the new Version 5.0 program features:

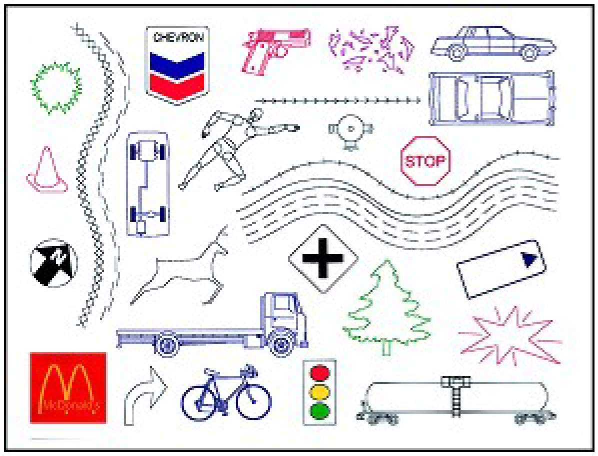
- ✓ **The Learning Center** - The Learning Center is designed to help you get started drawing faster than ever before! With shortcuts to your drawings, the electronic User's Manual, Training movies, and links to on-line technical support, the learning center will help you master the Diagram Program in no time!
- ✓ **AutoCAD 2000 Import/Export** - Now imports AutoCAD R14 and 2000 files in .DWG and .DXF formats. DXF import has been improved to retain all layer information.
- ✓ **Print Tiling** - Print tiling allows you to print out a drawing greater in size than on a single sheet of paper. If you don't have a large size plotter, print tiling gives you the ability to print on multiple pieces of paper that can be taped together.
- ✓ **Calculator** - Run the Windows Calculator program if you need to make a quick calculation.
- ✓ **File Run** - Use the Run command if you want to start a program outside of the diagram program.
- ✓ **Easy Intersection** - The Easy Intersection wizard allows you to create intersections by selecting options on a special toolbox to speed up the diagramming process.
- ✓ **Rotating Objects** (New Mouse Method) - Now it's now possible to rotate objects in a diagram using just a mouse technique without selecting the Rotate command. Once the desired objects are selected, simply click and drag rotation control points to rotate the object to any angle!
- ✓ **Window Stretch** - Use the Window Stretch command to quickly stretch objects to a new size or shape.

- ✓ **Skeleton body types** - You can now place poseable skeletal bodies in your drawings.
- ✓ **Arrow Line** - allows you to draw an arrow on the screen in any direction.
- ✓ **Cut-Out Box** - Use the Cut Out Box command to "cut out" a section of a drawing by placing a box around it. Then use other commands to erase, copy, move, or edit the section that was cut out.
- ✓ **Right Toolbox and Help Pull-Down Menu** - New links have been added to the Right Toolbox and the Help pull-down menu. You can now open up the Help Manual and Tutorials while in the program.
- ✓ **Laser Technology RAW files** -The Diagram program now imports LTI RAW files directly from Laser Technology's Quickmap program. Allows you to import the front (y,z), side (x,z), and top (x,y) views!
- ✓ **Image Export** - Selecting the Export Image (VB) feature on the File Menu brings up a list of different file formats that can be exported from the program. Use this command to export a diagram in Bitmap (.BMP), Windows Metafile (.WMF), and JPEG (.JPG) files formats.
- ✓ **Windows Metafile** (WMF) Import - Bitmap Import (BI) now imports windows metafiles (.WMF) also. Use this command to import .WMF files into a diagram. Once placed in a diagram these images can be viewed, printed, or moved.
- ✓ The User Interface has been improved to be the most modern interface available on any drawing program. Better and easier to use than DynaCop, AutoCAD®, AutoSketch®, or Visio®!
- ✓ Our latest version of the Crash Zone retains all of the features that you've come to rely on in the earlier software versions, but now they have been improved to be faster and better than ever! No conversion process is necessary, so there is nothing new to learn - just an easier and faster way to draw those all-important diagrams for your reports. Just check out these hot new improvements to your favorite tools!
- ✓ The User Interface has been improved to be the most modern interface available on any drawing program. Better than AutoCAD, AutoSketch, Visio, Dynacop, and 3D Eyewitness! *(Don't take our word for it, take a look at these expert opinions)*
- ✓ 32 Bit, OLE 2.0 Compatible, Windows 98, 2000, and NT compatible.
- ✓ Task-Aware Environment keeps track of what you are doing and uses the Right-Mouse button to open "pop-up smart menus" that allow you to finish your work faster than ever!
- ✓ More customizable - set the program up to work the way you want it to!
- ✓ New "Direction-Distance" drawing capability; just click, move your cursor in the direction you want the line to be drawn, type in the distance on the keyboard, and the program draws the line for you!
- ✓ A new "Autosnap" mode allows you to automatically snap or attach objects together without executing a single command.

- ✓ Directly load drawings created in AutoCAD, AutoCAD LT, Generic CADD, and Visual CADD. Load files from previous versions of The Fire Zone with no conversion process!
- ✓ Better mapping features! Use the new Easy Intersection and Roadbuilder toolboxes to create maps with just a few mouse clicks.
- ✓ More symbols, plus a whole new "symbol manager" for organizing and reviewing symbols. Improved symbol placement - see the full symbol detail as you are placing it!
- ✓ Improved editing features. See what the objects look like as they are being moved, copied, or rotated.
- ✓ New improved Hatching and Fill features - work on any type of area, no matter what shape it is! Now when you change an object the hatch or fill changes to fit it!
- ✓ New custom line types allow you to draw Railroad tracks, Fences, Flame Vectors (and more), in any shape! Even draws around arcs, curves, circles, and continuous line segments.
- ✓ New unlimited Undo/Redo! Undo any actions no matter how complicated!
- ✓ The Easy Lines feature has been updated to allow drawing in Standard, Baseline, and Triangulation modes!
- ✓ And so much more that we can’t write it all here!

Symbols included within the Crash Zone.
Crash Zone includes more than a thousand pre-drawn symbols to help you create accurate, professional diagrams for your crime scene and accident reports, including:

- ✓ Vehicles - Both civilian and emergency, such as cars, trucks, buses, semi-trucks and trailers, squad cars, motorcycles, and so on. Even "cut-away views" are included of common vehicles;
- ✓ Traffic symbols - signs, lane markers, traffic lights, fire hydrants, and more;
- ✓ Streets - pre-drawn streets and intersections are included which can easily be modified to re-create an exact scene;
- ✓ Commercial signs - signs for familiar landmarks like restaurants, and gas stations;
- ✓ Exterior symbols - trees, shrubs, swimming pools, property lines, fences, railroad tracks, and so on;
- ✓ Bodies - human body symbols are included in a variety of poses; common animal symbols are also included;
- ✓ The structure - doors, windows, stairs, fire escapes, elevators, and more;
- ✓ Interior symbols - furniture, appliances, and plumbing fixtures in both plan and elevation views;
- ✓ Weapons - Including firearms, knives, baseball bat, sticks, axe, broken bottle, and so on.



Calling all cars...

> "It's phenomenal! I've tried Autosketch and all of the other drawing programs. There's just no comparison to Crash Zone." - Jerry Jones, Brevard County (FL.) Sheriff
>
> "The compatibility with our Total Station system is a huge benefit. We survey the scene then import the files. We can quickly create final diagrams ready for court and no one can argue with the accuracy." - Mike Bann of Accident Measurement Mapping, Yuma, AZ.
>
> "I taught Crash Zone to officers and within just 2 hours they were creating finished diagrams! I could have never accomplished that with any other program, and I've tried them all." - Doug Jordan, Eugene P.D., OR.

Enter the Zone for just $399!

Everything you need to create professional looking crash and crime scene diagrams is included in one low price. Discounts are available on purchases of multiple copies. Crash Zone features the complete software program, comprehensive user's manual with illustrated tutorials, and free telephone technical support. The software also comes with a 30-day money back guarantee, ensuring that you have absolutely nothing to lose.

Click here to order your FREE evaluation copy,
or call: 800-641-9077

System Requirements: Pentium computer with Windows 98, 2000, or NT 4.0, 64 Mb RAM, available hard disk space of at least 80 Mb, CD ROM drive.

Currently, SD DOT OAR does not recreate the handwritten accident diagrams. Creighton uses the diagram to modify items on the accident form such as direction of travel. Data from PS-01 is then fed into Intersection Magic. However, if there is an easy solution such as a pen-type laser device that can be used to add value to the handwritten diagram, then we'd like to know about it.

Interview with Crash Zone
Brian 800-641-9077

Does this product compete with Intersection Magic? I.e. does it produce the cluster diagrams? They have never heard of it IM and CZ does not do the cluster (analysis) diagrams.

Is CZ typically used for all accidents or just reconstruction of serious accidents? Used for all accidents. The Crime Zone software is the same exact product with a different name and you do not have to license both products. Therefore, LE agencies use the product for both crash diagrams AND crime scene diagrams – getting more bang for the buck

Tell us about the Laser measuring device. CZ works with Laser Technologies Inc. They sell a DataPack system. LTI generates and saves data points (such as the coordinates for each car tire) into a proprietary format called a .RAW file on a PC. These data points are imported into CZ. Other laser systems' data can be imported into Crash Zone via the standard DXF file format (generic AutoCad file extension). ClickMap is LTI's program that saves the RAW file.

Discounts are available for multiple copies. 2-4 = $249 each, 5 copies = $199 each. Larger quantity discounts are negotiable. Upgrades are purchased as opposed to paying maintenance. They are typically $99 per copy.

MapScenes

http://www.mapscenes.com/mapscenes_4.htm

Crash and Crime Scene Mapping
MicroSurvey's *MapScenes*™ software package is a single product solution for the serious problems addressed by the Accident Reconstructionist or Crime Scene Diagrammer. *MapScenes* provides a powerful array of Forensic tools, symbols, and calculation programs to assist in the investigation. Take a feature tour!

MapScenes includes :

- Full CAD Power - modern interface with AutoCAD®, LT, & AutoSketch® compatibility
- Direct Serial Interface with a broad range of Total Stations and Data Collectors
- Reads "raw" and coordinate files from Geodimeter, Leica, Nikon, SMI, Sokkia, Topcon, TDS and others.
- Processes SDRMAP™ and AIMS™ coding into linework and shapes
- Includes traditional Baseline / Offset and Triangulation Methods

- Automatically builds streets, roads, buildings and other features from site measurements
- Includes more than 3,000 accurately drawn symbols in Metric or Feet - includes the complete dataSketch library plus many more!
- Perform many different types of Accident Reconstruction calculations with complete reporting of all calculations
- Works in Feet or Meters
- Insert Digital Photographs in the drawing, plus reference digital files on your computer for fast review
- Street, roads, & intersections generator to create custom scenes for your drawings
- Designed for Windows 95, 98, NT4.0 or Windows 2000 Professional
- Prints drawings to scale on Windows printers
- Includes 3 hours of FREE computer-based training movies that demonstrate many different aspects of the program
- Saves time, money, and is easy to learn
- CALL MicroSurvey at 1-800-668-3312 to Order ***MapScenes*** Now.
- For more details, continue here.

This is a fairly heavy-duty accident and crime scene analysis and reconstruction diagramming tool. It accepts measurement data input from several measuring devices on the market including Sokkia's TotalStation (see Sokkia review in this document). It can generate the basic diagram based solely on measurement/coordinate data entered into the product or captured via one of the measuring device products. It is a fairly complex tool that does not appear to be well-suited to the day-to-day accident diagramming function. They list their competitors as AIMS and SDRMAP.

EDCAD

http://www.edccorp.com/about/press-edcad.html

The Best Tool for Accident Investigation Since the Tape Measure
by Joseph E. Badger

First a quick definition — CAD: Computer-Aided Drafting. Or Computer Assisted Drawing. Even Colossal Accident Diagram. Call it what you will, even the police investigator, with minimal drawing ability, one who can't draw a straight line without a ruler, can create great scale drawings with a CAD program and a computer. CAD systems are to the draftsmen and diagrammers as the word processor is to the writer. Granted, many individual officers can't rush out and buy a personal computer, color monitor and CAD program just to draw accident diagrams. However, most police departments already have a computer, color monitor, and printer. Many agencies have more than one and, in some cases, they've even relegated an old IBM to a store room someplace and it's just sitting there collecting dust.

As far as price, CAD programs run anywhere from $30,000 and up for vast, complicated, multi-faceted programs that only major industry or the federal government can afford. And there are those developed for architectural and complex engineering disciplines down to simple "paint" programs. The hardware can be quite expensive also, depending on the peripheral devices (mice, plotters, and printers), screen resolution, and sophistication of the processor (primarily speed and size).

Probably the best known CAD software is AutoCAD by Autodesk, Inc., of Sausalito, CA. It costs "around" $3,000. Others frequently considered are Drafix CAD Ultra ($395) by Foresight Resources, Kansas City, MO; GenericCADD ($300) by Generic Software, Bothell, WA; DesignCAD ($299 to $399) by American Small Business Computer, Inc., Pryor, OK; or VersaCAD/386 ($3,495), by Versacad Corp., Huntington Beach, CA. However, to my knowledge, there is only one CAD program designed specifically for motor vehicle accident investigators. The backbone of an accident reconstruction is a scale diagram of the accident site. In my opinion, the best program available today for police officers and those involved with accident investigation and reconstruction is EDCAD ($750), developed by Engineering Dynamics Corp. (EDC), of Beaverton, Oregon.

Why? For one reason, it's easy to use, "User Friendly," as they say. I mastered the program without any special training and if I, the original computer illiterate, can produce scale drawings with it, anybody can. It can take the drudgery and travail out of doing scale drawings.

Unfortunately, many police agencies don't put a lot of time or effort into accident investigation. The brass may not want you spending a lot of time on accident investigation; some of the old timers feel it's just a job they do for the insurance companies. However, most of the progressive police departments have specially trained units or teams of specialists whose primary function is to investigate and/or reconstruct fatality or serious injury accidents. It is to those agencies and officers that this article is directed.

Basically, CAD programs let the user draw lines and arcs in different colors and line widths. Many have symbol libraries that come with the program or that are optional extras. Most allow you to copy or move something from one place to another on the screen and automatically erase the last entity created. They also have an "Oops" option, a single key stroke, should you accidentally erase something. A quality CAD program will permit the operator to zoom in on a drawing for fine detail work and to zoom out for a bird's eye view of the entire drawing.

EDCAD does all that and more. But the point I must stress is that it was designed for the accident investigator. It can take the drudgery and travail out of doing scale drawings.

First, the EDCAD developers have included an accident site template with several generic roadways and intersections with typical lane widths. There are two-, three- and four-lane roads plus intersection combinations. For instance, Figure 1 represents a two-lane road intersection of four-lane undivided highway.

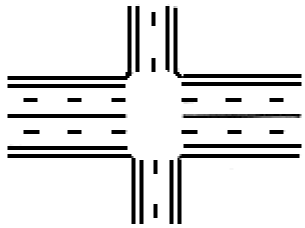


Figure 1: Example of an EDCAD pre-drawn site. The computer filename is 2-4.SIT, signifying a two-lane road intersecting a four-lane road.

Pre-Drawn Shapes

Also included in the program is a library of 29 symbols. Figure 2 shows a partial list including a car, pickup truck, van, north arrow, semi-tractor / trailer, bush, and railroad warning sign. Each symbol may be enlarged or reduced in size, rotated at an angle, and positioned anywhere on the screen.

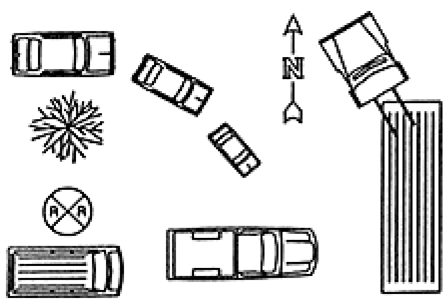


Figure 2: Examples of shapes or symbols included with EDCAD. Each shape may be enlarged, reduced or rotated to any angle.

Once you become accustomed to EDCAD, you'll want to create your own shapes to expand the program's capabilities. In Figure 3, you'll see some of my own shapes from a Dodge Daytona T-top to a VW bug. I've also created a couple of motor cycles, with or without riders (Figure 4).

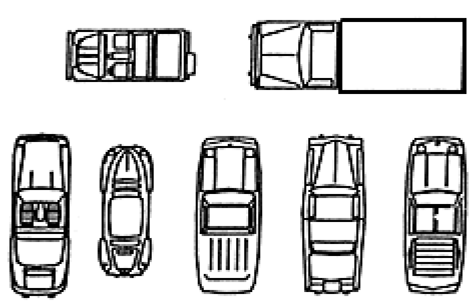


Figure 3: The user may wish to create shapes. These were created by the author.

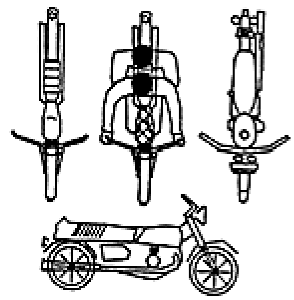


Figure 4: More examples of the author's shapes. Your library of symbols and shapes is limited only by your imagination.

After-accident situation maps or diagrams can be as detailed as you choose to make them. Figure 5 depicts a parking lot in Anytown, USA. As you can see, a car comes into the lot a bit on the fast side, squalls around a corner, and clips the back of a parked car.

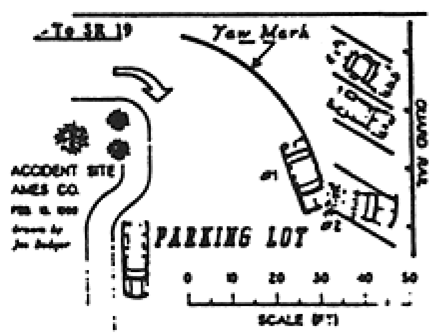


Figure 5: Sample after-accident situation diagram. The scale drawing may be as detailed as you wish.

There is an on-line HELP file that gives detailed information about EDCAD commands, options, data entry formats, and errors. An OPTIONS menu lets you choose from among eight fonts for text (including the normal and italicized Roman, Ivy, Script, and the more traditional Helvetica), sixteen colors, seven line types, and an infinite number of line widths.

Another benefit of EDCAD is its ability to show and print diagrams at different scales. You can create one drawing and print it to the common scales of 1" = 10" or 1" = 20" or virtually any scale that fits your needs.

Eight layers of overlays within EDCAD allow the user to draw a site (with roadways, sidewalks, trees, and shrubs) on one layer, the pre-collision position of vehicles on another, and the final rest position on yet another level. All layers can then be printed as one drawing or as separate facets. If you're working with a color plotter, you can place items of like colors on its own layer.

There is a DISTANCE feature that has several applications. One is checking distances between objects. You merely place the cursor on the first object, then on the second, and a message at the bottom of the screen will display the exact distance between the two points, accurate within one hundredth of a foot.

Frequent Accident Locations

If your jurisdiction is characteristic of most, there are certain locations where accidents are prevalent. Each time an officer works an accident at one of those frequent accident locations, a new drawing must be made for the accident report. An attorney might be able to call the accuracy of a particular drawing into question if it was compared to other diagrams of the same location. However, with a CAD program, the location of frequent accidents, usually an intersection, can be drawn once, then saved within the program.

As accidents occur, all the officer need do is recall the location diagram, put the physical evidence in place (tire marks, debris, vehicles, etc.), and print out the completed scene in minutes. The investigator may then save that new drawing in its own file and the original site diagram is still available for the next accident.

Why a Scale Drawing Anyway?

Often, the quality of a traffic accident investigation is in direct proportion to the seriousness of the event. "Fender benders" usually get a quick going-over and fatality accidents customarily dictate more attention to detail. However, the investigator cannot always know when a specific accident will end up in civil court, often years after the occurrence. I recommend treating almost all traffic accidents as though a lawsuit will be filed.

The officer at the scene may feel, at the time, that the accident scenario is cut and dried, and even a couple eyeball witnesses will testify to what happened, the location of vehicles and so on. The accident report is completed quickly so the road can be cleared and he or she can get on to the next assignment.

From there, you can almost take it to the bank. Two years down the road, you're called in to testify. The photographs were either lost, or they didn't turn out, the witnesses cannot be found, and an issue comes up, such as speed of one of the vehicles. An element of the accident must be reconstructed.

While you're at an accident scene, and the vehicles are at final rest and the road is blocked, take sufficient measurements, especially of tire marks, gouges, concentration of debris, and location of vehicles. Keep in mind the drawing will later be done with a CAD program and start with a reference point. This could be the apex intercept of two roadways or some fixed object, such as a utility pole or concrete abutment. Measure not only the length of skid marks, but where they start and stop in relation to the reference point. Then, once the scale drawing has been completed, a reconstruction can possibly be conducted two or three years later.

At any time during the creation of a diagram, the on-line HELP file "contains the equivalent of nearly 100 typewritten pages of information about EDCAD commands, options, data entry formats, and errors," according to the EDCAD manual. For quality accident diagrams, you no longer have to use the little rubber stamp cars and traffic templates, nor will you need to use the edge of your campaign hat or an LP record to draw curves. Use a CAD program and let the computer do the work.

Collision Diagramming Software Review

Note – for purposes of the SD 2000-14 project, we use the term “accident diagramming” to indicate the process of drawing an individual accident at the accident scene. This varies from “collision diagramming” or “multiple accident diagramming” which is an analysis function performed at the state level and usually involves multiple accidents.

Intersection Magic (Software Currently Used by SD DOT)

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.

Intersection Magic's support for node based systems, milepost systems, intersections, and corridors make it the only software package designed with the needs of State DOTs, Counties and Local agencies in mind.

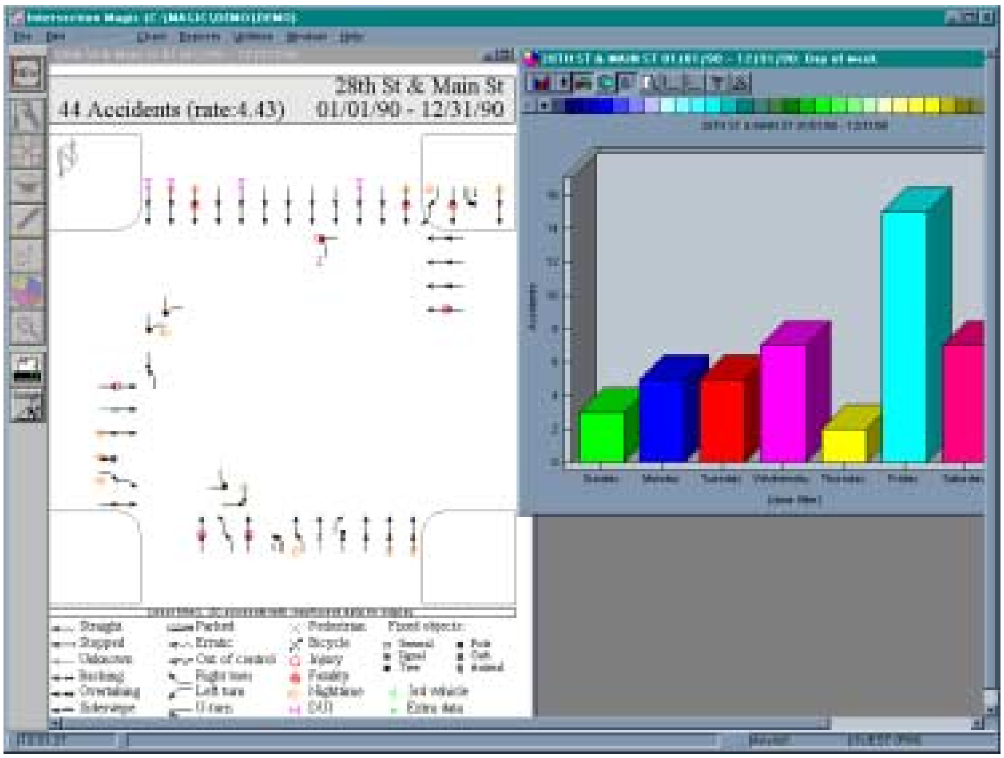
Intersection Magic provides analysis at the macro or micro level. It provides access to data from individual crashes all the way to jurisdiction-wide pin maps. Intersection Magic is a fantastic tool for transportation planners, traffic engineers and others involved in crash records analysis and safety planning.

By linking Intersection Magic to ESRI's ArcView GIS, Pd' Programming has expanded Intersection Magic's capabilities while preserving software standards already in use.

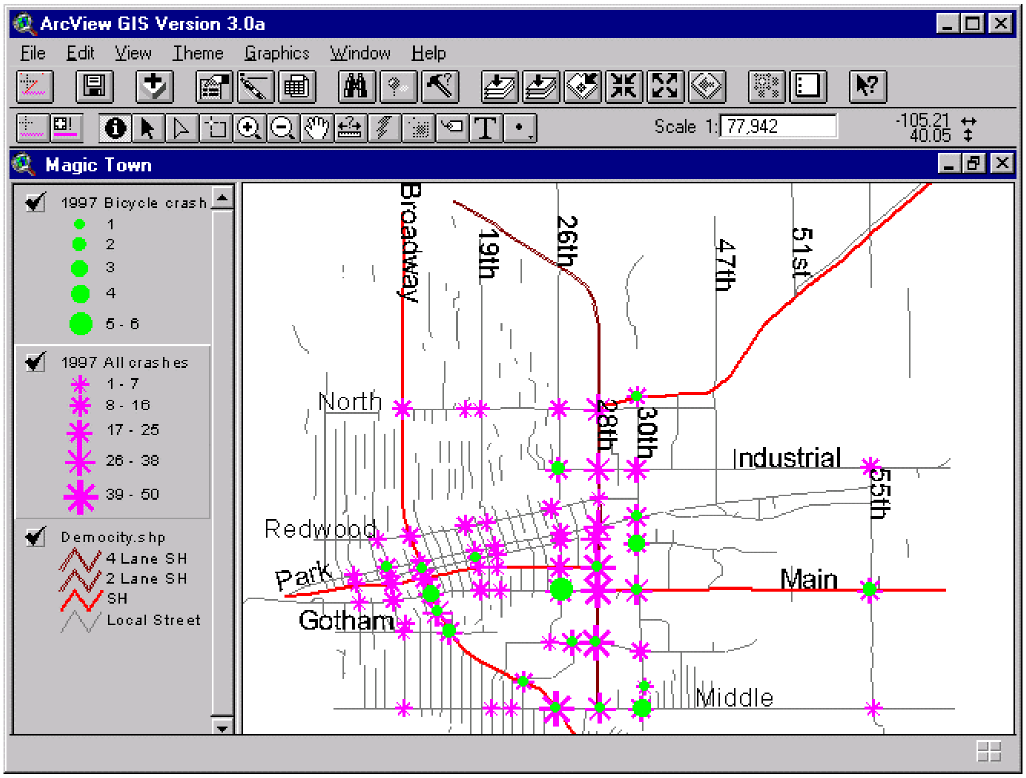
This product diagrams and gives reports and graphics on groups of accidents by intersection, day of week, etc. This software is currently being used by SD DOT as well as 13 other state DOT’s plus many cities and counties. Annual maintenance is $750. MapMagic is the GIS integration piece. It costs an additional $1,000. Pd Programming is an ArcView reseller, so you can deal with just the one vendor for both products.

Pd' Programming's Intersection Magic for Windows pricing is for a site license. This means that it may be installed on as many computers as desired, within one physical building. It may also be installed on a local area network. In order to make the software available to jurisdictions of all sizes, the cost is discounted based on the population of the purchasing jurisdiction. The largest one mentioned was 300K population at $6,500. State licenses are negotiated.

A demo version of this software is available from the web site. We loaded it onto my laptop and was able to create the screen shot below. Example – the left diagram shows the locations of the 44 accidents reported at the intersection selected. The right diagram plots the accidents by day of week.



Has integration with ArcView's GIS product.



Interview with Pd Programming (Intersection Magic Vendor)

Pete d'Oronzio – President and Founder
303-666-7896
pete@pdmagic.com

- IM can access location in a number of ways - via primary street and cross-street, primary street and mile post reference, address, node (unique id for each intersection). They recently added a range (corridor) to the primary/secondary location.
- Pete is very familiar with all of his clients. Of all of them, SD is unique in terms of their accident location data. SD has divided the state into a grid system. Each county has a 0,0 grid coordinate in upper NW corner and then a grid is developed from there. This means the crash location is based on an x,y coordinate on the grid. The grid resolution varies by density of street (i.e. one county might use a 1/4 mile scale and another might use 1 mile per grid square). IM has a scripting language. IM built a script for SD that asks them for the left side, right side, etc. coordinates that builds a filter for use with the ad hoc query. This is unique to SD.
- SD's grid system script in IM was written 6-8 years ago and probably needs to be re-analyzed to see if we can resolve SD's problems. IM is willing to make changes to accommodate SD's needs.

- Valerie (the GIS consultant) indicated that SD would be changing how the location is stored. She grouped accidents manually and sent that group to IM. IM built this interface to make this work in IM. No longer have to look at grid system.
- IM does not customize the software for clients with the exception of the data dictionary – which is handled by IM. So, all upgrades that are requested are built centrally and are provided to all customers. Data dictionary includes an interpretation of the data. IM keeps a copy of each client's data dictionary. SD has not provided an update in a long time. IM would like a copy of their data to help them analyze SD's needs.
- Filtering/sorting requirement – once a location is specified, and the diagram of the location is produced, you can filter by various criteria. This has been in the product since 4.0 version. Query functionality is very robust. The answer set is referred to as a diagram. IM can be used to find the problematic locations, not just diagram the chosen intersection. If you want to see all rear-end type accidents across the state, you still create a diagram, but it is presented as a summary. You can sort, filter, export, create diagrams, etc. Therefore, Pete did not understand what functionality SD believes they cannot get with respect to filtering/sorting with their product, unless it has to do with the way location is stored, which is unique to SD. Pete would like to discuss SD's needs further and try and resolve any issues. If a script is needed, he can develop that. If new functionality is needed, he is open to building that for all customers to benefit from.
- Radial analysis/display requirement– if there is no means to identify a crash location besides the grid, then, this functionality, while existing in IM won't work for SD because IM doesn't know the distance that one grid unit equals. It may be 1/4 of a mile, 1 mile, or any other scale. So, IM cannot determine what you want if you ask for a "5-mile radius". If SD can specify the number of grid units desired for the radial analysis (rather than just specifying a distance), then IM can do the radius diagram. IM can build a script that will translate the desired distance into grid units, if desired. But, the script will have to be maintained as the grid units are modified.
- Linear segment analysis/display requirement – In IM, you can say "I want from mile marker x to mile marker y" and you will receive that length/segment of roadway on the diagram. Another feature called the sliding spot feature provides you the ability to specify a segment that includes an intersection. Without this feature, when a specified segment includes an intersection, the diagram gets divided into two halves (separate sides of the road) so you don't get an accurate accident count. Therefore, IM built a feature that slides the diagrammed segment by smaller increments so that the intersection falls into several diagrams/windows, so this fixes the problem. This sliding feature works with address locations or mile marker locations or intersection name locations.
- Latitude/longitude vs. x,y coordinates – x,y coordinates are relative to each state or locale. This will likely be the standard, primary form for storing accident locations in the future. IM will support this as soon as one of their

customers has fully implemented their use. Latitude/longitude is a standard x,y coordinate across the world. GPS gives latitude/longitude and can convert to the state-specific x,y coordinates. Tuolunne County, CA is developing this and will be the first customer for IM to build this functionality for.

- Current version (6.6) of IM is ISAM-based. Index of all accidents is loaded into memory and then the query is run off of that. This causes performance problems with bandwidth in a wireless or remote operation. The way the SD grid system works, exacerbates the problem – you get the whole database loaded for every query. With and SQL-based system, you can directly access the data records needed.
- Next version – will be a new product (rewrite). They are re-developing IM as a component system for two reasons 1) a number of agencies are just wanting certain functions (standalone) and not the whole system - diagrams, browsing, queries, etc. 2) The Traffic Records Forum (chaired by Creighton Miller for several years) of ASSHTO has an initiative that IM is participating in. Litton PRC was contracted by AASHTO to create a front-end to any legacy dataset that will create a standard analysis API. For example, this will permit you to retrieve data in feet even if you only have mile marker references. TX, UT, WA, NE, LA, MISS, GA, VG, etc. have signed on to be a part of this pilot project. The project will result in a federal standard for crash analysis, exporting, etc. The project will start with crash and EMS records. IM was asked by Litton to provide the analysis engine for this project. Another requirement is to be web-enabled (in addition to supporting a Windows client). IM will also act as a hosted server application provider for the web-enabled solution. The beta version of this new IM version will be shown at the Institute of Transportation Engineers (ITE - www.ITE.org) conference in New Orleans in late July. They may be ready to show the system at the ITE Conference in Albuquerque 1st week of July. IM is currently written in Delphi. Initial components of the new version will be written in ActiveX in Delphi due to time constraints. It may be re-written in Java later. This is confidential information.
- He has also worked with state of CO – the state patrol has state-of-the-art systems and will be using IM. CDOT is not going to standardize on the highway patrol system and is not as technologically advanced as other states or their highway patrol division.
- He is also working closely with Iowa – They have an analysis system called ALAS that is DOS-based. CTRE is the division in Iowa that writes all of Iowa's software (including TraCS and ALAS). ALAS has been upgraded and now includes Access-ALAS and GIS-ALAS versions. Michael Pawlovich (not "Mike" – need to let him know Pete referred him) is the original author of ALAS systems. He is now at the DOT (formerly in CTRE) – He is a crash analysis engineer – 515-239-1428. Michael.pawlovich@dot.state.ia.us.
- IM's competitors – there are only two: 1) AIMS – don't have many clients and have not been around long. 2) Cross Roads software – they charge about 3 times IM's price, they are very integrated with ArcView GIS and are not an open product. IM tries to stay generic/standalone.

- IM has about 200 government agency customers with about 500 users. Thirteen state DOT's use IM.
- New feature in 6.6 – link to ODBC data source for supplemental data. IM can only bring in 40 data fields for analysis. If you have a database that has all of the characteristics about an intersection, this data is not stored in IM but you may want to use it for analysis. By accessing the database through ODBC connectivity, you can request analysis for say, signalized intersections only.
- Calculation of accident rates by traffic volume is available in IM. Rates are entered by intersection or virtual location (combines types of locations).

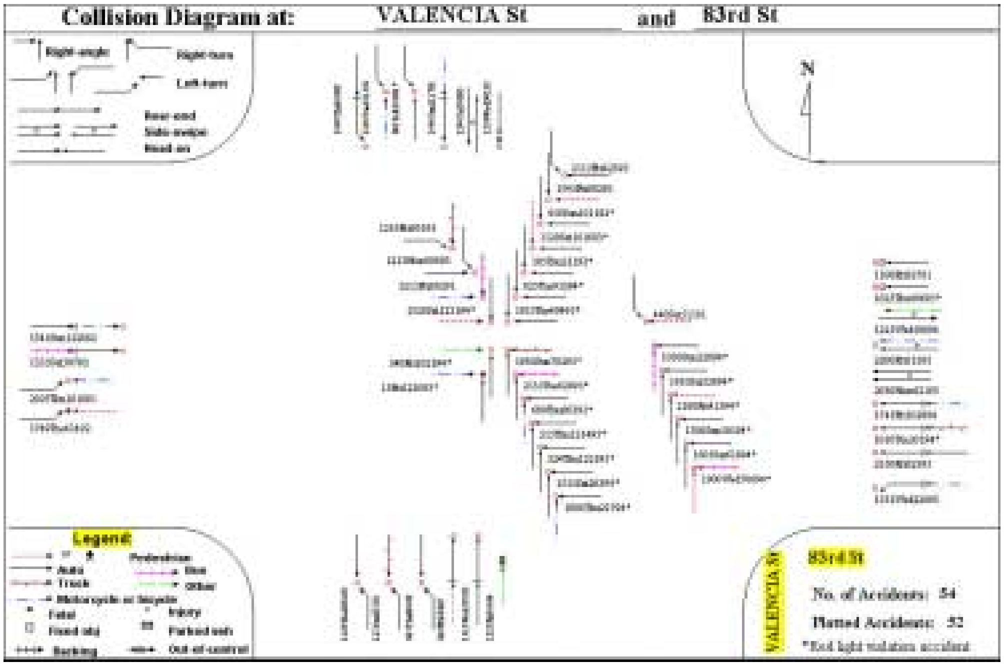
AIMS

http://www.jmwengineering.com/

About AIMS Collision Diagram:
Collision Diagram was originally an option of AIMS. Now, it can be a software by itself, or it can be AIMS option.
Collision Diagram Features:- You can:

- Plot collision diagram by:
  - Clicking an intersection on map.
  - Typing street names of an intersection.
- Query any field in your record, and plot only those collisions which satisfy your query. For example, you can plot collisions which involved pedestrians in 1996 only.
- Add texts, symbols, and/or drawings (line, circle, rectangle, etc.) to the diagram.
- List all the accident records of the intersection.
- List those records from which collision cannot be plotted (good for checking coding error).
- Produce summaries: collision types, causes, number of injuries and fatalities, etc.
- Print or save the diagram, lists, or summaries as files in various formats to be used by other software.
- If one page is not enough to draw all collisions, it will go the next page (up to 6 pages).

Sample output from collision diagramming:



Cross Roads Software

www.crossroadssoftware.com

Crossroads Software has more than one hundred clients in California, in addition to clients in Washington, Arizona, and New Jersey.

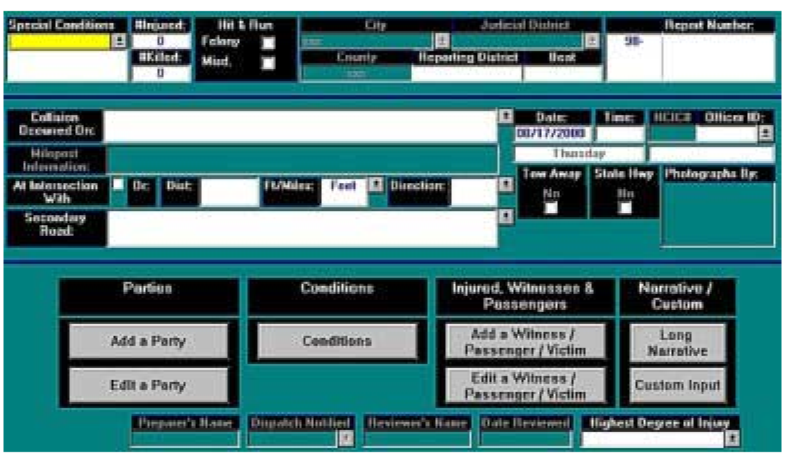
Crossroads Software's Traffic Collision Database is a powerful yet simple, solid yet flexible program for data input and management, queries and reports, and data analysis for traffic collisions, citations, and DUIs. Used by cities and counties throughout California, as well as in Washington, Arizona, 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 product 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.

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.

The Traffic Collision Database works in the familiar Windows environment and is easy to use with is drop-down menus, clickable buttons, and "auto-match" and "limit-to-list" features. It also has complete editing capabilities, customization for data entry, and functions for reading to and from external databases.

There are standardized input forms for collisions, citations, and DUIs, as well as an option for Custom Input Forms--those forms that are custom-made by Crossroads Software for specific cities.

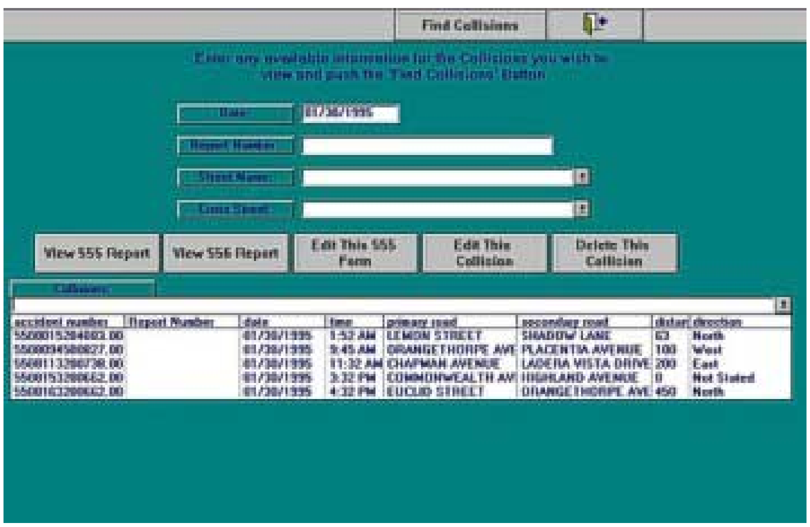


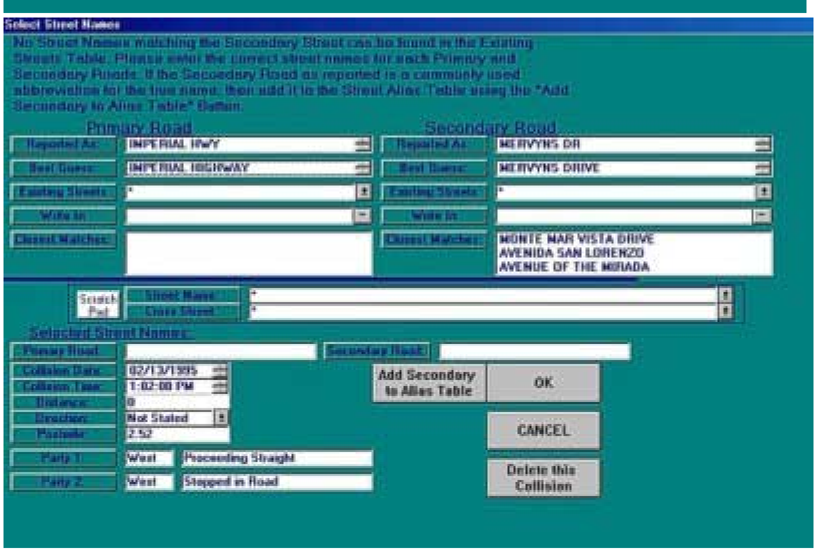
The Collision Input Form is characteristic of the entire Traffic Collision Database. Navigation is easy with the click of a mouse or a push of the Tab key. The active field is yellow, and many of the fields are "fixed-length," meaning that when the maximum number of spaces is reached, the cursor automatically jumps to the next field. There are also drop-down menus from which the user can select and entry (as shown in the detail image at bottom left).

The form itself contains all of the standard fields, including, among others, special conditions, number injured and killed, city, reporting and judicial districts, collision location, and date and time.

Buttons at the top of the screen allow for additional features, whether they are for parties, conditions, injured/witnesses/passengers, or long narratives.

Editing records is just as straightforward. Search the database for existing records by entering data, report number, street name, cross street, or any combination thereof, and then hit "Find Collisions." The Database brings up all matching records in a list, from which the user can select a specific record and then edit it.





Street Name Verification is one of the most important steps in data input and analysis, for it ensures that all (or almost all) reported street names match the formal names in the Street Layout Table. Verification is necessary in order for all queries and reports to be accurately.

Fortunately, the Street Name Verification process is quite easy to learn, employing buttons and drop-down menus and having the software do most of the hard work (matching entered names against official names in the Street Layout Table).

The process involves "soft" and "hard" verification--soft to make sure that the street names conform to the Street Layout Table; hard to verify one-by-one those locations that could not be verified through regular soft verification.

Once the collision record is "cleaned up," it is ready to be queried and searched.

The Queries and Reports section is the heart and soul of the Traffic Collision Database. It represents the most substantial features of the product and fully display the Database's power.

Using the general query option, users can query along one or more parameters, everything from street name, direction, primary collision factor, and city name to date, time, reporting district, and number injured. Querying can also include party, victim, and condition information.

The reports are where the analysis truly comes into play. Available reports include intersection historical, intersection high incidence, midblock historical, midblock high incidence, reports by officer, collision reports, queries by the month, citations reports, and many more.

Report data can be sorted by primary collision factor, time of collision, distance and direction, and other parameters, while the Collision Diagram's colors can be customized to suit the user's needs (sample Collision Diagram at top left).

The Collision Diagram focuses on a specific intersection and displays all collisions within a specified distance, the time they occurred, the degree of injury, the direction of travel, and collision types.

While the Collision Diagram offers analysis of a particular intersection, the Intersection High Incidence Report (second image at left) ranks the intersections with the highest number of collisions over a specified period of time. The user can specify how many locations are included in the report.

Other reports include Collision Severity Summary, Collision Type Summary, Midblock Historical, Midblock High Incidence, Reports by Officer, Citations by Officer, Officer Activity Report, DUIs, and Collisions by Day and Week.

The Graphs and Charts section of the Traffic Collision Database provides informative and effective visual layouts for collision data and records. By specifying a location and a range of dates, the user can produce graphs and charts for highest degree of injury & primary collision factor, collision type & involved with, weather & lighting conditions, degree of injury, and more.

The query parameters can be limited further according to hit and run, collision type, lighting, day of the week, and other options.

Each graph and chart can be easily printed or saved.

One of the most useful and impressive features of the Traffic Collision Database is the ability to produce detailed, color-coded GIS maps for a number of collision categories. After running a General Query or queries for Intersection High Incidence, Midblock Historical, and Midblock High Incidence, corresponding GIs maps are automatically updated in ESRI's ArcView™ which is included with the Collision Database. (A screen shot of a map in ArcView™ is shown at the top left. The layout, color coding, and the type of information to be viewed are all customizable.)

The query results are displayed on a citywide GIs map, and you can show individual locations as well as highlighted intersections and midblock segments. You can run, for example, a query to show all collisions involving school-age pedestrians on a specific day of the week and have the collision locations appear on the map. Even midblock collisions are located along the streets automatically. Clicking on an individual location yields the relevant information for that collision record.

Queries can be run to highlight the top ten intersection locations or midblock segments (or any number you prefer), ranking them by collision rate or number of collisions. Full color layouts are easily printed with maps, graphics, compasses, legends, and additional text and graphics. This ability to map collision records can help cities and departments understand collision patterns better and help them work towards preventing collisions.

555 Report for the Palm Pilot

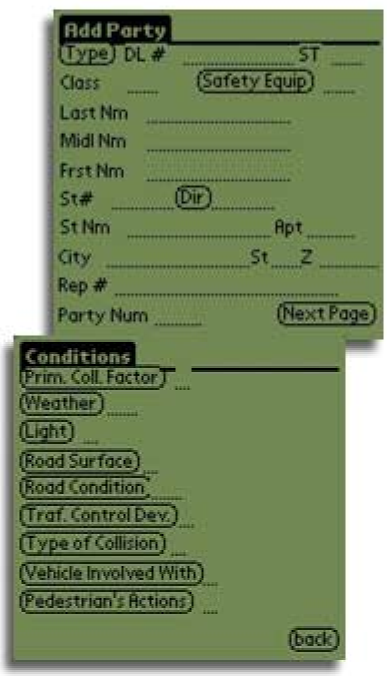
Over the past several years, the need for small, mobile digital computing has been met with the development of personal digital assistants (or PDA’s), those handheld, versatile instruments that do much more than hold your address book. Beginning with 3Com's revolutionary Palm™ Pilot, PDA’s have evolved into powerful tools for running applications, managing information, and accessing the web.

How can this technology assist police departments? Police officers filling out collision reports can do so by hand while in the field and then go back to the department and type the data into a desktop computer. Sooner or later, however, that will become a thing of the past. PDA's, especially the 3Com® Palm™ Pilot and the Handspring™ Visor, are relatively powerful, efficient, and, most of all, amazingly portable, fitting perfectly into the palm of your hand.

As the leading developer of traffic collision databases, we realized the need to develop collision reporting software for additional platforms, especially mobile ones; and so we developed a 555 Report Program for the Palm Operating System (any PDA that runs the Palm OS® can also run the 555 Report). Users can enter collision data straight into the 555 Report in the Palm™ Pilot, Visor, or other PDA and then later link the PDA to a computer and transfer all reports to the main Traffic Collision Database in a matter of seconds.

One of the reasons, among many, why Crossroads Software decided to write a program for the Palm OS® is the amazing simplicity of PDA's. The basic, understandable interface and "user-friendliness" make it the best platform available. In addition, PDA's, unlike laptop computers, turn on and off automatically and require no "boot up" time; they have exceptionally long battery life; they fit in your palm and your pocket; and they are relatively inexpensive (roughly $150 to $400, compared to several thousand for a laptop).

The 555 Report Program for the Palm OS® contains the complete 555 Traffic Collision Report Form (the standard form issued by the State of California). Because PDA's such as the Palm™ Pilot and the Visor are small devices, it was not possible to create an electronic version of the report form that could fit in a single screen image. Instead, Crossroads Software's programmers developed an easily navigable program that presents the form in sections and that contains all of the fields of the original, standard, hard-copy form.



Inputting New Collision Reports

Users can create and store numerous 555 reports. A header section contains information for city and county names, judicial district, report number, and hit and run type, as well as a Special Conditions section (which include Private Property, City Property, School Bus, Radar, and more). A location section allows input of street name, direction, distance, date, photo information, among other fields. Users can also describe the extent of property damage, in addition to weather, lighting, and road conditions.

Inputting Party Information

The 555 Report Program includes an extensive section for party information, including driver's license number, address, name, report number, party type, height, weight, date of birth, hair color, eye color, vehicle make and model, vehicle damage, and much more. A number of these fields contain pre-configured data tables that help save time; for example, instead of writing in eye color, the user can select a color from a list by tapping the screen with the stylus. Instead of writing in a road condition, the officer can tap through a list and make a selection. In addition, there's even a damage sketch figure for depicting the area of a vehicle damaged in a collision.

Injured/Witnesses/Passengers

Finally, the 555 Report has a complete section for injured parties, witnesses, and passengers. Users can input the extent of injury, age, sex, safety equipment (which includes a full list of equipment types), name, address, phone number, and more.

Once an officer has completed a new 555 report, the report can be saved in the PDA (to be synced with the full Traffic Collision Database later) and then new reports can be filled out and saved.

As Easy as 1-2-3

The Seat Position diagram at the top left is a good example of the 555 Report's simplicity. With a single tap of the stylus, the user can specify the position in the vehicle occupied by the party; the information is then automatically entered into the report, and the user continues entering remaining party information. A number of the fields in the program operate this way; others require writing in data with the stylus (and the Palm OS® has a very easy-to-learn "graffiti" script).

Full Editing Capabilities

Existing reports in the 555 Report Program can be accessed within the PDA and any and all data can be edited or, if need be, deleted. Selection screens allow the user to find the specific record to be edited or deleted. Once the record has been brought up, an officer can edit or remove data in any of the report's sections (header, party, injured/witness/passenger, etc.); also, the entire record itself can be deleted from the PDA if necessary.

Clearing Data

At the end of the day, after collision reports have been entered in the 555 Report Program and transferred to the full Traffic Collision Database on a desktop PC, the data in the 555 Report Program can be cleared, thus making additional memory space for a new set of records. With the push of a few buttons, the user can clear all existing collision reports. Crossroads Software built this feature in the software because there's no need to keep collision records in the PDA once those records have been synced to a desktop PC and imported into the full Traffic Collision Database.

Syncing with a Desktop PC and the Traffic Collision Database System

The 555 Report for the Palm™ Operating System was designed to work in conjunction with Crossroads Software's Traffic Collision Database System. The Collision Database actually has a feature called "Read Palm™ Pilot File" that takes the 555 Report Program file and transfers all of the records into the Collision Database. The collision report data is automatically placed in the appropriate fields of the collision reports built into the Collision Database. These reports can then be viewed, edited, and printed, and users can run queries and reports on these collision records, just as they can do with all other records in the Collision Database.

Syncing a PDA with a desktop PC is a standard process with all PDA devices. Palm™ Pilots and Visors, for example, come equipped with desktop software that allow for synchronization of data between the PDA and the desktop with a single touch of a button.

Without integration with the Traffic Collision Database, the 555 Report Program would not be as useful as it needs to be. The ability to import records on the PDA to the full Collision Database means that police departments can use the data not only to report and investigate specific collisions, but also to run historical and high incidence reports, map collision patterns, analyze collision types, produce collision diagrams, and much, much more.

Analysis – Offers much more than just collision diagramming. Also offers reporting, GIS, accident report data entry system and back-end accident records database. Also includes an accident data entry "system" for the Palm Pilot. Would likely require heavy customization.

Interview with Crossroads

Barry Dee
714-990-6433, CA
bdee@crossroadssoftware.com

CA has had a lot of funding for enhanced accident records systems. Crossroads has 170 users in four states (primarily counties and cities – ex: San Bernadino County). They have not done a state system, but are working with the state of Utah to provide the back-end system for analysis and GIS. UT has written their own front-end collection system. LADOT, City of Oakland are using CR. Las Vegas police department is also looking at CR. Most states want to develop their own systems so they won't get tied into one contractor. State of WA is in a mess after working for 2-3 years on a new system.

Standard GIS mapping requires capturing GPS coordinates or address geocoding (but nobody does the latter). So, CR wrote software that uses primary road, secondary road, distance and direction, which is traditionally how accidents are located. Can resolve directional nuances, street name nuances, intersection anomalies, etc. Also provides data scrubbing capabilities. Delivers 96% location accuracy or above on ability to show accident locations on the GIS map given the traditional location criteria..

Analysis capabilities – 400-500 reports can be generated. Ex: Intersection high incidents – top 10 report. Also stores traffic volume info and uses that in reporting. Can create parameter driven queries from pre-defined (delivered queries). Can build your own SQL queries if you need additional capability.

Database support – MS Access or SQL Server back-end with Access front-end.

Front-end data collection via Palm Pilot or laptop creates MS Access files. Customized via modifying the screen look, the drop-down list choices, etc. Don't have to modify the source code/logic. Written in MS Access, which generates VB. Typically takes 3-4 months to customize. Have two sets of input forms – one that emulates the crash report form and one that is optimized for data entry.

Back-end system – To consolidate the accident data at the state level, the agencies would execute the export function which would send the data to the state via an import function at the state, assuming they are using Cross Roads. Or, you can export from agencies to a file format that the state can use with their system.

Data Model – Is MMUCC-compliant and FARS-compliant, he didn't know about SAFETYNET but they are definitely collecting a lot of data about commercial vehicles. They have yet to run into a state (out of 4) that needs any data fields that they do not already store. They provide 30 unused data fields. CA has 255 data fields that they capture.

Analysis – GIS – uses ArcView – supports milepost references, also. Generates shape file out of the CR SQL database.

Accident diagramming – CA uses 2 types of diagrams 1) collision sketch (very basic). CR provides this sketching tool. 2) Factual diagram – to scale – done in about 2-3% of the collisions for major injuries and fatalities (i.e. reconstruction diagram) – CR does not provide this tool. Most users use Visio, AutoCad Light, AutoDesk Atrix. These diagrams are electronically attached to the accident report.

Collision diagramming – provided with CR. More flexible than Intersection Magic. Don't have to pre-define accidents as "intersection-related". You can do radial analysis from intersection by defining what you consider an intersection on the fly.

Data Translation – can access historical accident records.

Pricing/Modules – Creating street centerline model is a major portion. $250,000 – $750,000 implementation cost including some level of customization. Could include historical data translation. Don't do seat licensing – software is sold as a site license only.