Accident Data Availability

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Disclaimer

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List of Acronyms

AIMS	Accident Information Management System
CARS	Central Accident Reporting System
FHWA	Federal Highway Administration
GIS	Geographical Information System
ITE	Institute of Transportation Engineers
LAN	Local Area Network
LATM	Local Area Traffic Management
LUTS	Land Use Transportation System
PC	Personal Computer
SAS	Statistical Application Software
SELATM	Safety Evaluation Method for Local Area Traffic Management
T&S	Traffic and Safety
UDOT	Utah Department of Transportation

EXECUTIVE SUMMARY

Accident information is valuable for identifying problem areas or locations of interest. This is true not only to the Traffic and Safety section, but also to many UDOT departments that would benefit from improved access to accident information. The data is not readily available and its current format is a summary spreadsheet format using codes and mileposts to denote location, type and severity of accidents. With little graphical interface, the usefulness of the accident information by most not familiar with the codes and software is questionable.

This project investigates alternate forms of dissemination for the accident information. Costs, capabilities, and compatibility are reviewed for integration of the accident database with a GIS format to allow a graphical and spatial interface. The issues being addressed by this research focus on information circulation. Two specific issues have been identified as key elements in the research.

1. Making accident information more readily available.
2. Incorporating a GIS graphical interface with the accident information to allow for query searches on various accident attributes.

A review of available management systems revealed three commercially available systems in addition to the current CARS management system used by UDOT. BETA's "MARS," JMW Engineering's "AIMS," and Exor's "Highways" are reviewed. Final recommendation is reserved for demonstrations of each system by the vendors, which will be coordinated for a TAC presentation. Preliminary results indicate the AIMS software is best suited to meet the needs of the state while also providing the most cost effective method of service.

CHAPTER 1. INTRODUCTION

Traffic accident information is important in many planning and design decisions. The Utah Department of Transportation (UDOT) is comprised of many departments that benefit from accident information. Currently, not all departments and divisions benefit fully from the large amount of available accident information. This research seeks to determine some of the causes of this lack of use and explore some possible options to help overcome it.

Currently, user access to the accident information is provided by a program developed specifically for the UDOT accident database system. This client program is called the Central Accident Reporting System (CARS).

In the recent past, all accident information was input, controlled, and disseminated by the Traffic and Safety Studies Section of the Traffic and Safety Division. For this reason, the section is proficient in all aspects of the accident data management. Since the beginning of this research project, the section has begun to provide access to the accident database through the UDOT local area network (LAN).

There are several possible reasons the accident data is not used more by those outside of the Traffic and Safety division. Some of these reasons are explored with some suggested solutions and an overview of the practice of other public transportation organizations around the country.

CHAPTER 2. UDOT ORGANIZATIONAL CONTEXT

The Utah Department of Transportation consists of 11 divisions and four regions. The *Traffic and Safety Division* maintains, controls and disseminates accident information. This information is used to monitor safety performance of the highway system in Utah.

The *Traffic and Safety Studies* section of the Traffic and Safety Division does most accident data management. This section is comprised of the Traffic Studies Unit, the Safety Studies Unit, the Railroad Safety Unit, and the Roadside Safety Devices Unit.

An Informix© database system stores the accident data provided by police reports. A custom client application called Central Accident Reporting System (CARS) is used for data entry, query building, and reporting. Figure 1 illustrates the way data is retrieved and distributed by the Traffic and Safety Section.

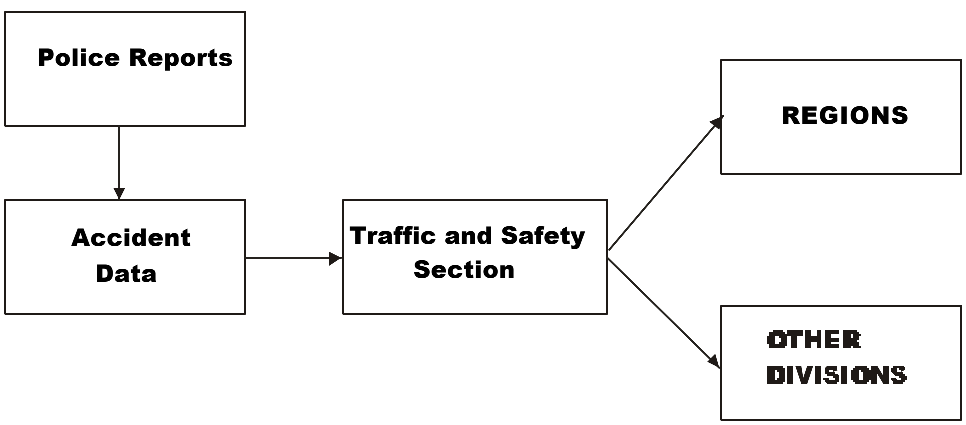


Figure 1. Accident Data Delivery Process

The problem statement provided by UDOT to this research is that many are not using the available accident data to its full potential because it is difficult to obtain the information. Many people also do not use the data because of one or more of the following reasons:

1. The location capabilities required users to have an extensive knowledge of mile marker location to refer to a particular intersection or a road segment. Milepost locations have

changed in the past. Many inquiries come in the form of coordinates where the requesting party does not know or want to bother with the Milepost location lookup.

2. The use of the client application CARS requires medium to advance knowledge on Structured Querying Language (SQL).
3. The system cannot produce graphical output.
4. Users outside the Traffic and Safety Division describe CARS as confusing and difficult to use.
5. Users outside the Traffic and Safety Division frequently don't know what kind of data is available.
6. Data interpretation is not simple or clear enough for the occasional user to make an accurate interpretation.
7. CARS does not have a user's manual.

If an easy-to-use graphical interface were incorporated, occasional users outside Traffic and Safety could access the data and create custom reports on demand, relieving the processing burden from the Traffic and Safety section.

At the time this research began, anyone outside of Traffic and Safety that wanted to obtain accident data information needed to call or deliver a petition to the Traffic and Safety group. This practice is now changing. Currently, Regions 4 and 1 have access to CARS according to the database administrator for the Traffic and Safety division. The training for Region 3 is expected to be done sometime during June or July 2000. Region 2 is scheduled for training in the next couple of months, according to the same source. CARS is scheduled for the intranet/Internet in the long range plans. This will occur once the standard issues for intranet/Internet are settled within the appropriate committees in UDOT.

CHAPTER 3. ACCIDENT DATABASE AND GIS HISTORY

Geographical Information System (GIS) permits users to display database information geographically. It also can provide a common link between two or more previously unrelated databases. The most useful aspect of GIS as a management tool is its ability to associate spatial objects (e.g. street names, milepost, route number, etc.) with attribute information (e.g. accidents, cause, etc.).

Most of the documents reviewed consider the use of geographic information systems in transportation under either one of the following two categories. First, for general data maintenance, primarily inventory of transportation-related incidents, and second, simple data analysis. In practice, appropriate data storage methods are important to facilitation of analytic activities.

Several studies describe how GIS help the integration of many transportation elements. Meyer and Sarasua (1996) envisioned a common and coordinated database system that will serve all aspects of transportation management such as congestion, pavement, bridges, safety, inter-modal activities, and public transportation. Martin (1993) did a similar study, in which he proves that incorporating GIS in a pavement management program improves the reporting and analysis of data of traditional database management systems through the production of maps and graphic displays. Added to the mapped representation of traditional analytic results, a GIS allows the user to view the conditions on an entire region while combining data from other management programs, such as bridges or highway safety.

GIS also has been proven to work well in addressing transportation problems related to safety. Affum and Taylor (1996) describe the development of a Safety Evaluation Method for a Local Area Traffic Management (SELATM), which is a GIS-based program for analyzing accident patterns over time and the evaluation of the safety benefits of Land Area Traffic Management schemes. This is another example of versatility in transportation of GIS and how beneficial it can be for a department or agency in charge of transportation striving to develop tools for making more conscious and safe decisions. GIS software has the capability of displaying historical accident information pertaining to a particular site, this aspect would be helpful to the planner or designer in studying the impact of a particular roadway design with respect to safety. By providing direct access to planners and designers, the obstacles whether perceived or real, currently in place are greatly reduced making the assessing of safety issues information more readily available.

GIS can be implemented in determining roadway and surface conditions. This was proven by Gharaibeh et. al. (1994) when they proposed to use GIS to obtain statistical and spatial analyses of roadway characteristics such as safety, congestion level and pavement conditions. The main role of GIS in the study conducted by Gharaibeh et. al. (1994) was to be an analysis tool for the spatially distributed roadway data.

In a separate study by Johnson and Demetsky (1994), the capabilities of GIS in providing a framework for a management system was proven once again. It highlighted the fact that many transportation analysts reap benefits from improved access to data. Establishment of the geographic referencing scheme is the major contributor in making data more readily available.

There also have been studies that aimed at showing how GIS can be applied in accident management systems. Faghri and Raman (1995) developed a GIS-based traffic accident information system for Kent County, Delaware. Their system included knowledge about the occurrence of crashes, such as conditions of incident site, and frequency of incidents at any given location (mile-point) on a roadway. This type of tailor-made graphic information is useful to a transportation planner in identifying potentially dangerous (accident prone) locations when planning for development of new infrastructure, and also aids designers in choosing among different design alternatives.

Since the early stages of GIS, it was noticed that a vision of information technology outside the traditional transportation data analysis and even outside GIS was needed to implement this technology (Lewis, 1990). What is certain is that a GIS-based traffic accident system can be a tremendous help in efficiently managing database information.

CHAPTER 4. SYNOPSIS OF ACCIDENT DATA AVAILABILITY

Other DOTs Data Management Systems

To gain insight on software being used by transportation authorities throughout the U.S., they were questioned regarding accident data management, current front and back-end applications, the way this was developed and by whom. Also included in the survey were questions related to the availability of GIS or plans to incorporate this software into their system.

Many state agencies are developing GIS software packages to address safety-related issues in transportation. For example, Kentucky currently is migrating from a mainframe-based accident reporting system to a client/server imaging (FileNet w/Oracle)-based system. The system is under control of the Kentucky State Police (KSP). This system will house the accident report information and some of the operational elements needed by KSP. Sufficient data also is being stored to permit retrieval of the information from GIS applications. In a similar way, Delaware DOT is in the process of migrating all VAX-based applications into a client server environment. Delaware's current GIS viewing is obtained from the data that's ported from VAX into an ORACLE database. Delaware GIS efforts started as a demonstration project developed to provide accident-related information for a roadway network in Kent County. Delaware's accident information system, when extended to the entire state, will serve as a cost-effective alternative to the current operations in the area of accident safety and analysis in addition to offering expanded capabilities.

Several states currently are revising their management systems to make them more effective. The incorporation of GIS as a data retrieval and spatial analysis tool seems to be the trend most DOTs are following. Among those currently developing a GIS interface are the DOTs in Nevada, Illinois, Vermont, Nebraska, Kentucky, Wisconsin and Connecticut.

A notable revision of accident data management currently taking place is the case of the Idaho Transportation Resources. Their new system, called Crash Information Retrieval, Collection, & Analysis (CIRCA), was created in the client-sever environment. Historical data was transferred from the mainframe into the new system. The CIRCA system was created in visual basic with section 402 grant funds. These grant funds are allocated by the National Highway Traffic Safety Administration (NHTSA) and typically are administered by the state Highway (or Public) Safety Office. The system contains links to drivers' files and Milepost and Coded Segment/Road Segment System (MACS/ROSE) files on the mainframe. MACS/ROSE is the linear referencing system. Collision data managed by this system is stored in a SQL Sever database on the Idaho Transportation Department's (ITD) enterprise network.

The CIRCA system has three subsystems: data entry, inquiry, and reporting. Data entry was one of the main driving forces in creating the new system. The Idaho Vehicle Collision Report (IVCR) was revised in 1996. The data entry screens were never updated to match the new report. This caused a slowdown in the data entry process — shuffling pages to locate the information for entry. Their reporting system, called Crash Analysis Reporting System, currently is not accessing the CIRCA database. The reporting system currently is a graphical user interface to the Statistical Applications software (SAS). The CIRCA database is converted into SAS data sets (by year) for analysis purposes.

The current project integrates the electronic version of the IVCR (called IMPACT) and CIRCA so local law enforcement agencies will have the ability to collect, store, and access the collision reports completely electronically. The main purpose of this project for Idaho Transportation Resources is the facilitation of electronic data transfer. While the data still must be coded for location and edited for accuracy and completeness, it eliminates much of the time consuming manual data entry process.

While many DOTs are going to management databases with graphical interfaces, there still also are agencies with paper collection and handling methods, such is the case of the Ohio Department of Public Safety. For their paper reporting, an outside vendor scans the forms and creates data files and images for the Ohio Office of Criminal Justice.

The majority of the survey replies reported that most development of their accident data management software is being done in-house as reflected in Table 1, which summarizes the replies obtained from our survey in reference to the agencies front-end application, GIS availability and database in use.

Table 1. DOT Survey Response

DOT	Front-End Application	Back-End Database	GIS Available?
Iowa	Imaging/Workflow	25 years old IMS on-line/batch	GIS: ArcView and Arc Info
	Developed in House		
Nevada	Visual Basic	Visual Basic / Oracle Discoverer	GIS: Geo Media by Intergraph
	Developed in House		
Wisconsin	Parts/Smalltalk	Parts/Smalltalk	No GIS Available
	Developed in House		
Florida	Access 2000 and ISQL	SQL Server 7.0	No GIS Available
	Developed in House Vbasic		
Puerto Rico	Microsoft Access	Microsoft Access	GIS: ArcView by ESRI
	Developed in House		
Vermont	MS Visual Basic 6.0	MS Access	No GIS Available
	Developed in House		
Connecticut		UNISYS ANSI COBOL	No GIS Available
Nebraska	IBM's QMF	DB2 Database	No GIS Available
	Developed in House		
Delaware	Algorith Compilation on VAX	VAX-based	Geomedia and MGE's Segment Manger
	Developed in House		
Kentucky TC		FileNet w/ Oracle	GIS in developing stages
	Unknown		
Idaho TransRes.	SQL Server	Visual Basic	MACS/ROSE
	Unknown		
Virginia	ADABASE	ADABASE	No GIS Available

GIS Applications and Techniques

Improve Organizational Integration via GIS

Many organizations that have implemented a GIS have found one of its main benefits to be improved management of their own organization and resources. Because GIS has the ability to link data sets together by geography, they facilitate interdepartmental information sharing and communication. By creating a shared database, one department can benefit from the work of another - data can be collected once and used many times. As communication increases among individuals and departments, redundancy is reduced, productivity is enhanced, and overall organizational efficiency is improved.

GIS Applications in Transportation

In recent years, there has been much discussion about GIS technology and various GIS applications across a wide variety of settings. Moreover, there have been many GIS-related developments in transportation planning and engineering (FHWA, 1993; Lewis, 1990; Kim and Levine, 1996).

The power of this technology is rooted in the fact that GIS allows inferences to be drawn about the spatial nature of the data. Examples of GIS applications in transportation include pavement management systems that work with road segments, optimal vehicle routing, Automated Mapping Facilities Management (AM/FM) used for infrastructure management, drainage design, traffic modeling and accident analysis, demographic analysis for funding justification, and the option of displaying any form of tabular data that has a spatial component. GIS technology also is being used as a powerful tool in concert with various management information systems as mandated by the Intermodal Surface Transportation Efficiency Act (ISTEA).

Spatial Relationships and Technology

When viewing a map, the map-reader must interpret a variety of points, lines, and other symbols to identify spatial relationships among the geographic entities represented. For example, you can use a map to find a route from one city to another, or to identify which county contains a feature of interest. The information required to perform these analyses is not explicit in the map; rather, the map-reader must interpret the required spatial relationships from mapped objects.

In a GIS database, the method by which spatial relationships are explicitly represented is termed topology. Topology is used to describe how linear objects connect, to define areas, and to identify the areas lying to either side of a linear object. Information about the spatial relationships is stored in a topological data structure and is essential to carrying out most GIS functions.

Specific Applications to the Accident Data Management Problem

A wide array of applications exist for GIS in transportation management. The applications for which GIS can be used in accident data management include:

- providing quick and easy access to intersections and roadway segments information through point and click techniques
- evaluating and monitoring the magnitude of accidents
- identifying safety improvement needs
- analyzing alternative solutions to the safety problem and assessing their effectiveness in solving them
- measuring the effectiveness of the implemented actions.
- retrieving accident information that satisfies the query criteria established by the user
- obtaining a diverse and user-friendly delivery format

The old adage "better information leads to better decisions" is as true for GIS as it is for other information systems. A GIS, however, is not an automated decision-making system, but a tool to query, analyze, and map data in support of the decision making process. The information can be presented succinctly and clearly in the form of a map and accompanying report, allowing decision makers to focus on the real issues rather than trying to understand the data. Because GIS products can be produced quickly, multiple scenarios can be evaluated efficiently and effectively.

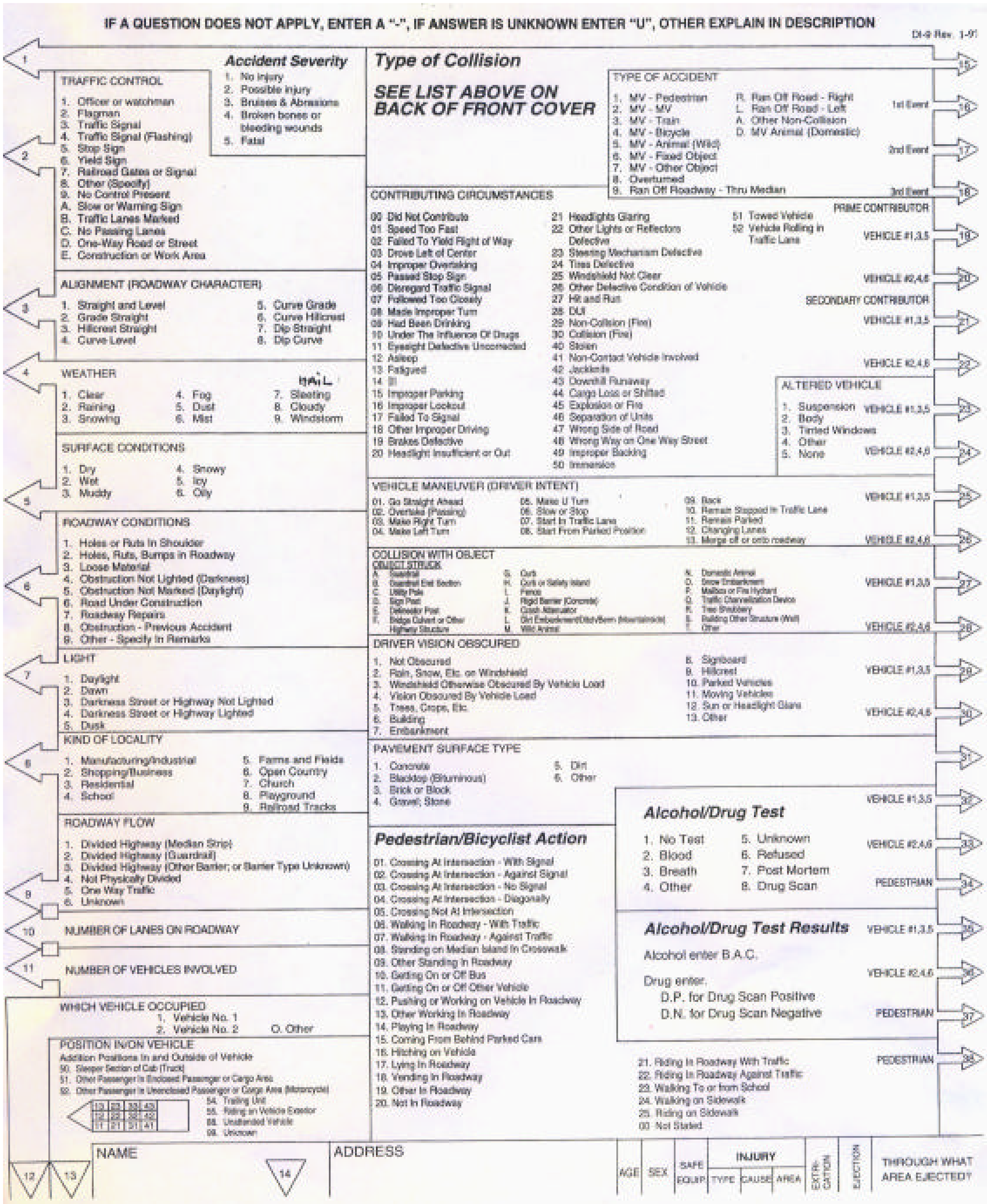
Current UDOT Accident Data Management System (CARS)

UDOT Traffic and Safety uses the Central Accident Reporting System (CARS) for their accident data management with input and output operations using this software program. A substantial investment already has been committed in the development of the CARS system and it should be noted that the users of the system in Traffic and Safety are satisfied with its functionality for their purposes.

CARS Overview

CARS possesses the ability to run several types of reports and accident data analyses. The traffic lab was introduced to reports that the Traffic and Safety Section considers most valuable or useful. The capabilities of CARS are found in the type of reports it can provide — *Report Types* (the user can reach them from the pull down menu "Reports")

The different circumstances are input using the description code provided by UDOT. Using the same description code the user can interpret the output data. Figure 2 shows the description codes.



IF A QUESTION DOES NOT APPLY, ENTER A "-", IF ANSWER IS UNKNOWN ENTER "U", OTHER EXPLAIN IN DESCRIPTION

DI-9 Rev. 1-97

1 — *Accident Severity*
1. No injury
2. Possible injury
3. Bruises & Abrasions
4. Broken bones or bleeding wounds
5. Fatal

2 — TRAFFIC CONTROL
1. Officer or watchman
2. Flagman
3. Traffic Signal
4. Traffic Signal (Flashing)
5. Stop Sign
6. Yield Sign
7. Railroad Gates or Signal
8. Other (Specify)
9. No Control Present
A. Slow or Warning Sign
B. Traffic Lanes Marked
C. No Passing Lanes
D. One-Way Road or Street
E. Construction or Work Area

3 — ALIGNMENT (ROADWAY CHARACTER)
1. Straight and Level
2. Grade Straight
3. Hillcrest Straight
4. Curve Level
5. Curve Grade
6. Curve Hillcrest
7. Dip Straight
8. Dip Curve

4 — WEATHER
1. Clear
2. Raining
3. Snowing
4. Fog
5. Dust
6. Mist
7. Sleeting (HAIL)
8. Cloudy
9. Windstorm

SURFACE CONDITIONS
1. Dry
2. Wet
3. Muddy
4. Snowy
5. Icy
6. Oily

5 — ROADWAY CONDITIONS
1. Holes or Ruts In Shoulder
2. Holes, Ruts, Bumps in Roadway
3. Loose Material
4. Obstruction Not Lighted (Darkness)
5. Obstruction Not Marked (Daylight)
6. Road Under Construction
7. Roadway Repairs
8. Obstruction - Previous Accident
9. Other - Specify In Remarks

6 / **7** — LIGHT
1. Daylight
2. Dawn
3. Darkness Street or Highway Not Lighted
4. Darkness Street or Highway Lighted
5. Dusk

8 — KIND OF LOCALITY
1. Manufacturing/Industrial
2. Shopping/Business
3. Residential
4. School
5. Farms and Fields
6. Open Country
7. Church
8. Playground
9. Railroad Tracks

9 — ROADWAY FLOW
1. Divided Highway (Median Strip)
2. Divided Highway (Guardrail)
3. Divided Highway (Other Barrier; or Barrier Type Unknown)
4. Not Physically Divided
5. One Way Traffic
6. Unknown

10 — NUMBER OF LANES ON ROADWAY

11 — NUMBER OF VEHICLES INVOLVED

WHICH VEHICLE OCCUPIED
1. Vehicle No. 1
2. Vehicle No. 2
O. Other

POSITION IN/ON VEHICLE
Addition Positions In and Outside of Vehicle
50. Sleeper Section of Cab (Truck)
51. Other Passenger In Enclosed Passenger or Cargo Area
52. Other Passenger In Unenclosed Passenger or Cargo Area (Motorcycle)
54. Trailing Unit
55. Riding on Vehicle Exterior
88. Unattended Vehicle
99. Unknown

13	23	33	43
12	22	32	42
11	21	31	41

Type of Collision (15)

SEE LIST ABOVE ON BACK OF FRONT COVER

TYPE OF ACCIDENT — 1st Event (16), 2nd Event (17), 3rd Event (18)
1. MV - Pedestrian
2. MV - MV
3. MV - Train
4. MV - Bicycle
5. MV - Animal (Wild)
6. MV - Fixed Object
7. MV - Other Object
8. Overturned
9. Ran Off Roadway - Thru Median
R. Ran Off Road - Right
L. Ran Off Road - Left
A. Other Non-Collision
D. MV Animal (Domestic)

CONTRIBUTING CIRCUMSTANCES — PRIME CONTRIBUTOR: VEHICLE #1,3,5 (19), VEHICLE #2,4,6 (20); SECONDARY CONTRIBUTOR: VEHICLE #1,3,5 (21), VEHICLE #2,4,6 (22)

00 Did Not Contribute
01 Speed Too Fast
02 Failed To Yield Right of Way
03 Drove Left of Center
04 Improper Overtaking
05 Passed Stop Sign
06 Disregard Traffic Signal
07 Followed Too Closely
08 Made Improper Turn
09 Had Been Drinking
10 Under The Influence Of Drugs
11 Eyesight Defective Uncorrected
12 Asleep
13 Fatigued
14 Ill
15 Improper Parking
16 Improper Lookout
17 Failed To Signal
18 Other Improper Driving
19 Brakes Defective
20 Headlight Insufficient or Out
21 Headlights Glaring
22 Other Lights or Reflectors Defective
23 Steering Mechanism Defective
24 Tires Defective
25 Windshield Not Clear
26 Other Defective Condition of Vehicle
27 Hit and Run
28 DUI
29 Non-Collision (Fire)
30 Collision (Fire)
40 Stolen
41 Non-Contact Vehicle Involved
42 Jackknife
43 Downhill Runaway
44 Cargo Loss or Shifted
45 Explosion or Fire
46 Separation of Units
47 Wrong Side of Road
48 Wrong Way on One Way Street
49 Improper Backing
50 Immersion
51 Towed Vehicle
52 Vehicle Rolling in Traffic Lane

ALTERED VEHICLE — VEHICLE #1,3,5 (23), VEHICLE #2,4,6 (24)
1. Suspension
2. Body
3. Tinted Windows
4. Other
5. None

VEHICLE MANEUVER (DRIVER INTENT) — VEHICLE #1,3,5 (25), VEHICLE #2,4,6 (26)
01. Go Straight Ahead
02. Overtake (Passing)
03. Make Right Turn
04. Make Left Turn
05. Make U Turn
06. Slow or Stop
07. Start In Traffic Lane
08. Start From Parked Position
09. Back
10. Remain Stopped In Traffic Lane
11. Remain Parked
12. Changing Lanes
13. Merge off or onto roadway

COLLISION WITH OBJECT — VEHICLE #1,3,5 (27), VEHICLE #2,4,6 (28)
OBJECT STRUCK
A. Guardrail
B. Guardrail End Section
C. Utility Pole
D. Sign Post
E. Delineator Post
F. Bridge Culvert or Other Highway Structure
G. Curb
H. Curb or Safety Island
I. Fence
J. Rigid Barrier (Concrete)
K. Crash Attenuator
L. Dirt Embankment/Ditch/Berm (Mountainside)
M. Wild Animal
N. Domestic Animal
O. Snow Embankment
P. Mailbox or Fire Hydrant
Q. Traffic Channelization Device
R. Tree Shrubbery
S. Building Other Structure (Wall)
T. Other

DRIVER VISION OBSCURED — VEHICLE #1,3,5 (29), VEHICLE #2,4,6 (30)
1. Not Obscured
2. Rain, Snow, Etc. on Windshield
3. Windshield Otherwise Obscured By Vehicle Load
4. Vision Obscured By Vehicle Load
5. Trees, Crops, Etc.
6. Building
7. Embankment
8. Signboard
9. Hillcrest
10. Parked Vehicles
11. Moving Vehicles
12. Sun or Headlight Glare
13. Other

PAVEMENT SURFACE TYPE (31)
1. Concrete
2. Blacktop (Bituminous)
3. Brick or Block
4. Gravel; Stone
5. Dirt
6. Other

Alcohol/Drug Test — VEHICLE #1,3,5 (32), VEHICLE #2,4,6 (33), PEDESTRIAN (34)
1. No Test
2. Blood
3. Breath
4. Other
5. Unknown
6. Refused
7. Post Mortem
8. Drug Scan

Alcohol/Drug Test Results — VEHICLE #1,3,5 (35), VEHICLE #2,4,6 (36), PEDESTRIAN (37)

Alcohol enter B.A.C.

Drug enter.
D.P. for Drug Scan Positive
D.N. for Drug Scan Negative

Pedestrian/Bicyclist Action — PEDESTRIAN (38)
01. Crossing At Intersection - With Signal
02. Crossing At Intersection - Against Signal
03. Crossing At Intersection - No Signal
04. Crossing At Intersection - Diagonally
05. Crossing Not At Intersection
06. Walking In Roadway - With Traffic
07. Walking In Roadway - Against Traffic
08. Standing on Median Island In Crosswalk
09. Other Standing In Roadway
10. Getting On or Off Bus
11. Getting On or Off Other Vehicle
12. Pushing or Working on Vehicle In Roadway
13. Other Working In Roadway
14. Playing In Roadway
15. Coming From Behind Parked Cars
16. Hitching on Vehicle
17. Lying In Roadway
18. Vending In Roadway
19. Other In Roadway
20. Not In Roadway
21. Riding In Roadway With Traffic
22. Riding In Roadway Against Traffic
23. Walking To or from School
24. Walking on Sidewalk
25. Riding on Sidewalk
00. Not Stated

12	13	NAME (14)	ADDRESS	AGE	SEX	SAFE EQUIP.	INJURY TYPE	INJURY CAUSE	INJURY AREA	EXTRI-CATION	EJECTION	THROUGH WHAT AREA EJECTED?

Figure 2. Accident Description Codes

A. Dynamic Quick Listing

In the dynamic quick listing, users can find more frequent types of query searches.

A.1 Types of quick list

A.1.1 Summary Data

A.1.2 Light Condition

Provides light conditions under which the accident occurred: daylight, dawn, dusk, darkness street, highway not lighted or highway lighted.

A.1.3 Surface Condition

Allows the user to query for the surface conditions present in the accident site. Six choices are available: dry, wet, muddy, snowy, icy and oily.

A.1.4 Accident Type

Allows the user to query for a specific type of accident. The type of accidents available are: Moving Vehicle(MV) – Pedestrian, MV-MV, MV-Train, MV-Bicycle, MV-Animal (wild), MV – Fixed object, MV-Other Object, Overturned, and Ran Off Road.

A.1.5 Accident Severity

Allows the user to query for the physical conditions of the people involve in an accident. It's divided into a 1-5 rating encompassing: no injuries, possible injury, bruises and abrasions, broken bones or bleeding wounds and fatal.

A.2 Search Criteria

The second component of the quick listing is defining structural query language parameters.

A.2.1 Route

The route ID can be found in the reference system manual and it input is required for specific queries on state or county routes.

A.2.2 Year (specify the year for which information is needed)

A.2.3 Number of Years (for a group of years)

A.2.4 Beginning Mile Post

A.2.1 Ending Mile Post

By specifying the beginning and ending mile post the user selects a particular road segment to be queried.

B. Intersection Report

To obtain accident information on a particular intersection the user must identify all four legs of the intersection using the Mile Posts. Inputting the MP located 150 ft. from the center on each direction from the intersection does the querying.

B.1 Types of Intersection Report

B.1.1 Accident and Average Daily Traffic (ADT)

The ADTs are given by block number and accidents are usually attributed to the major street when in an intersection. To obtain a block number the user must refer to UDOT records.

B.1.2 Summary of collision type on intersection is shown in Figure 3.

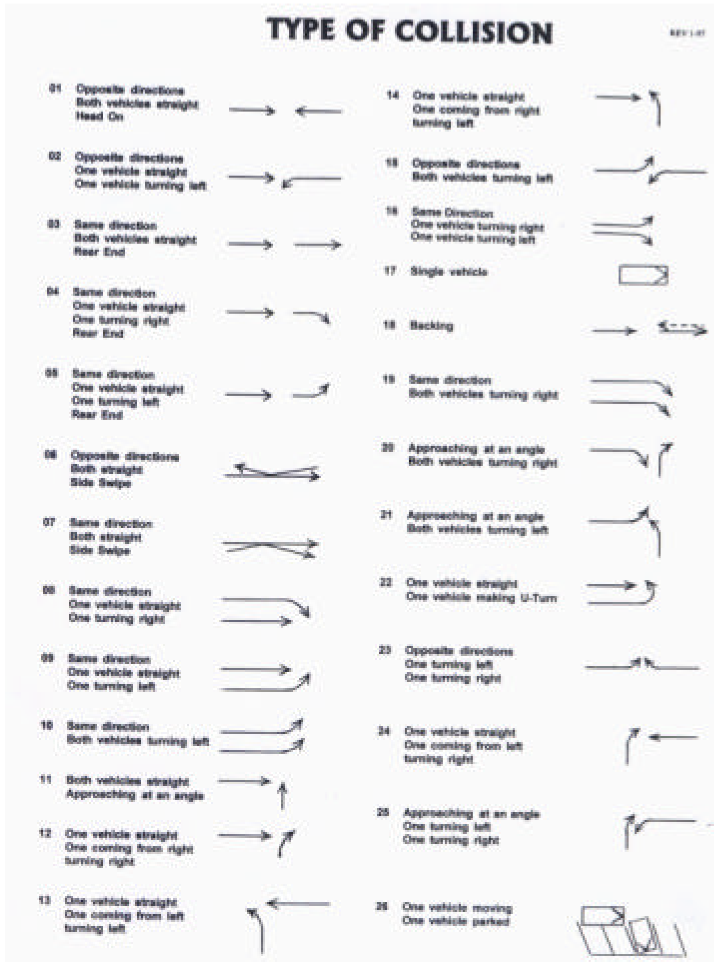


Figure 3. Collision Types

B.1.3 Summary of road conditions

Similar to the road conditions from the dynamic quick listing with the difference that the accident location is an intersection, it allows users to query for the surface conditions present at the moment of the accident. Six choices are available: dry, wet, muddy, snowy, icy and oily.

B.1.4 Summary of accident type

Allows the user to query for a specific type of accident in the intersection.

B.1.5 Summary of light conditions

Gives the user information concerning the type of lighting in the intersection.

C. Fatal Count Report

This report includes the feature that enables the user to obtain a fatal count on a particular intersection, road segment or the entire road network for the state of Utah. Because of administrative reasons, this report can be run only once per logging session.

D. Correctable Site Report

This mainly is an administrative "in house" report. The Traffic and Safety Division generates this report to use in the hazard elimination program, which is a once-a-year report to the FHWA for national statistics purposes. It takes a significant amount of time and usually is done overnight and only once a year. This report is disabled for users with a low hierarchy in the system.

E. Summary Report

This report allows the user to query under different criteria.

- can potentially be a huge report
- actual report has no header making it difficult to interpret (e.g. grand total, total)
- lists by 0.01 MP
- can export most reports to SS format (this is not the case of OSR)

F. Expected Value Report

This report gives a summary of the accident rates, taking into account all the elements involved in the accident. The report is readily available to region offices.

G. Milepost Report

This report enables users to run an internal accuracy check for date entry (this feature may or may not be used). The user also can check MP limits vs. accident specific range. As an additional note, when run in the demonstration the system crash trying to do this report.

CAR Uses

As mentioned previously, CARS is an accident data analysis tool with a "point and click" environment based on pull-down menus. CARS is used for the preparation of Operational Safety Reports (OSR) available upon request to anyone in UDOT doing roadway design or other construction. The OSR includes the relevant accident and safety information to a particular segment of road or intersection. All types of accident analysis can be done with the accident information gathered from CARS.

Data Dissemination with CARS

In the past, the Traffic and Safety Division were the only ones with access to cars. Currently, Regions 4 and 1 have access to CARS. Region 2 is scheduled for testing in the next couple of months, and Region 3 will be trained most likely sometime during July 2000. At the moment, the dissemination is accomplished using a Citrix server and through the Novell LAN Server/Replication Services. This means that the Replication services server hosts the complex programs and the Regions can "call" and bring down any changes. At Region 4 they do this and then they use an "AT" program to copy to the Citrix server. Simply said, the access to CARS by the regions is performed through the UDOT LAN.

Summary

CARS is the accident data software used by UDOTs Traffic and Safety Division to analyze all accident information. It's run mainly with pull down menus and SQL based queries. The report capabilities range from simple surface condition dynamic quick listing reports to the correctable site report for hazard elimination. The pull-down environment, the SQL queries, the lack of graphical outputs, in addition to the lack of a user manual, makes it perceived as non-user friendly software. The data obtained from CARS has great value for accident analysis to individuals that are familiar and frequently use the system. However, to the occasional user, the CARS spreadsheet format often is too cumbersome to be considered useful. With the current training of the system and distribution to the regions, increased access to accident information will be available. The data obtained from CARS may lead to misinterpretation by the occasional user. Improving the output, informing of available capabilities and training occasional users will help in user-friendliness and data interpretation. The addition of a graphical interface will improve users' perception on CARS.

CHAPTER 5. CLIENT SOFTWARES

The following client application is intended for an evaluation in possible regional use only for enhanced read-only capabilities. These are not intended as a replacement for CARS by the traffic and safety division.

Accident Information Management System (AIMS)

The following information is provided by JMW Engineering, the vendor for AIMS. AIMS is an accident software with GIS and 3-D mapping that allows the user to:

- manage millions of accident records. AIMS contains a database system for data management.
- display accidents on map in three dimensions. AIMS contains a GIS system for mapping.
- retrieve data by clicking area(s) on map or by querying/sorting.
- analyze intersection and 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.

The following features are the main ones pointed out by the manufactured in order to state its uniqueness:

A. 3-Dimension Mapping

A.1 AIMS is a specifically designed GIS accident software that plots accident locations on map in three-dimension. 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 three-dimension rapidly.

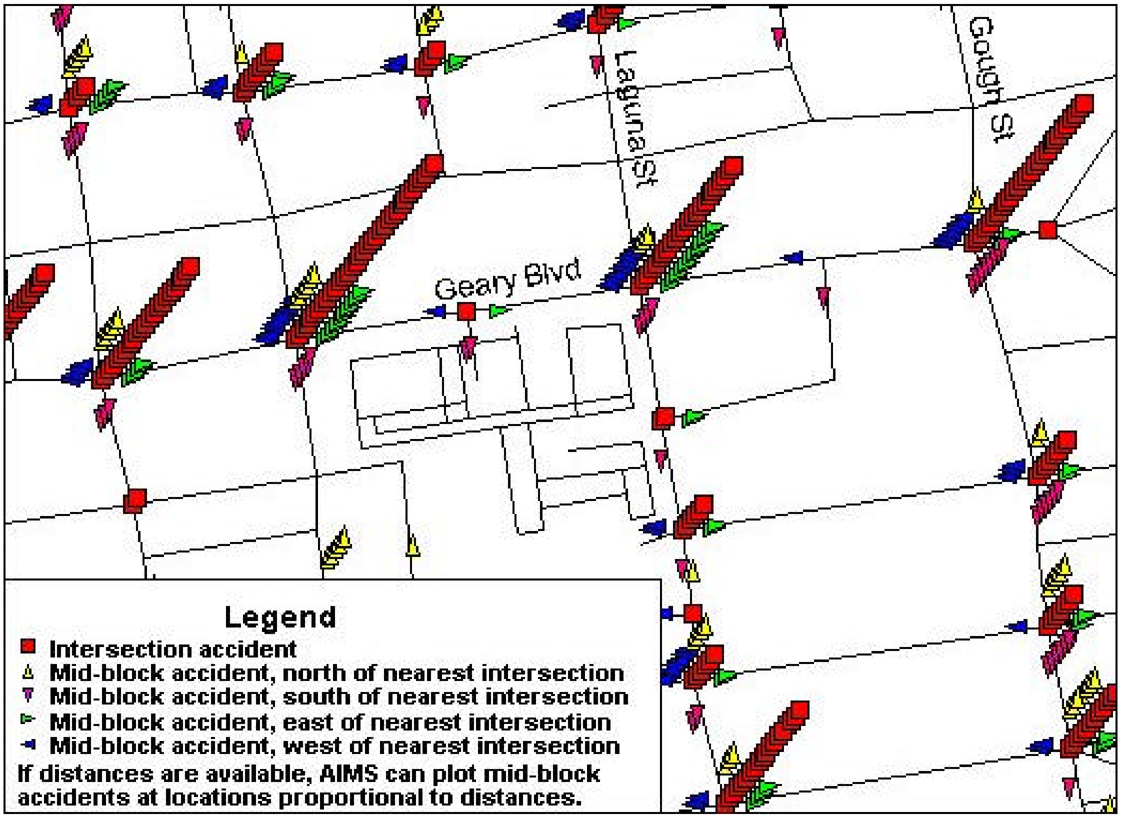


Figure 4. AIMS 3-D Pin Plot Map

About AIMS 3-Dimensional Plot

- AIMS plots accidents on map with 3-dimensional symbols. Higher stack of symbols means more accidents.
- Suppose you want to analyze accidents downtown. You can click one or more areas in downtown from the map, AIMS will retrieve accidents for the area you clicked and will plot the accident locations with 3-dimensional symbols (see Figure 4 above).
- AIMS queries will retrieve accidents to satisfy your query and plot the accident locations on map with 3-dimensional symbols.

- **Additional Features:**

Users can:

- Choose size, shape, and color of symbols.
- Assign number of accidents per symbol.
- Filter unwanted accidents, for instance, plot locations where there are 10 or more accidents (locations with less than 10 will be filtered out).
- Add texts and drawings (line, circle, rectangle, etc.).
- Print and/or save the plot in various formats to be used by other software.

B. No Change in Database

B.1 AIMS is customized to use and interpret your existing data. Whatever data structure, JMW engineering 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.

C. Users don't have to know GIS to run AIMS

C.1 AIMS is complete, executable software with extensive, user-friendly interfaces. It is designed for people to use without GIS knowledge. The users can obtain results via click-and-pick operation. As far as training, it is possible to learn how to plot accidents on map and how to create collision diagrams in a few minutes.

D. No other software is needed to run AIMS (No ArcView, No AutoCAD, etc.)

D.1 Except Windows and a GIS map of your jurisdiction. AIMS has a stand-alone version, which includes GIS capabilities. A GIS map for the state of Utah can be obtained from UDOTs Planning Department GIS group.

E. Multiple GIS platforms

E.1 AIMS can use data and map from ARC/INFO®, ArcView®, Atlas GIS®, AutoCAD®, MapInfo Professional®, or Intergraph/MicroStation®. ArcView and MapInfo Versions of AIMS also are available.

F. Powerful Accident Data Management and Analysis Tool

F.1 AIMS produces many standard reports to meet day to day needs. It also generates unlimited number of reports and statistics through its powerful query and re-query capabilities, to satisfy the user special needs. AIMS can be used for many accident analyses, including high accident location identification, scenario analysis, surface and weather conditions spot/intersection analysis, strip analysis, cluster analysis, corridor analysis, etc.

G. AIMS Maintenance

G.1 You can add, delete or modify data by clicking a few buttons or typing a few letters should the Traffic and Safety division find input using AIMS easier. For regional areas, the system would be configured for a read-only setting.

H. Expansion to include other traffic data

H.1 AIMS is modular structured to add other traffic data (traffic volumes, signs, signals, etc.) to the system at any time.

AIMS is available in the following versions:

1. 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.

2. MapInfo Version

AIMS interfaces with MapInfo Professional® 4.1 or later. It can use data and the map from MapInfo. User can send outputs to be used by MapInfo, or switch back and forth between AIMS and MapInfo.

3. 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® 3.x, 9x or NT.

b. For other GIS users — It can use map and data from ARC/INFO®, ArcView®, Atlas GIS®, AutoCAD®, Intergraph/MicroStation® or Mapinfo®.

4. Collision Diagram (new software)

a. Non-GIS Version — Plot collision diagrams with JMW Engineering customized system it to use and interpret your existing data. It runs on Windows® 3.x, 9x or NT.

b. GIS Version — This is for GIS users of ARC/INFO®, ArcView®, Atlas GIS®, AutoCAD®, Intergraph/MicroStation® or Mapinfo® who want to add collision diagram capability to their system. JMW Engineering customizes it to use and interpret your GIS map and data.

AIMS Capabilities

Some of the AIMS capabilities are summarized below.

Data Display on Map

AIMS plot symbols on map to represent locations of the data. The symbols can be stacked to provide a 3-dimensional view. A higher stack means more accidents.

The user is allowed to choose different shape, size and color of symbol to be plotted. You can assign the number of occurrence per symbol. The addition of texts, labels, symbols, and/or drawings to the plot also is possible. Plots can be saved in various formats to be used by other software.

This function applies to other options. If you choose Traffic Volume Data option, the symbols plotted on the map will represent locations of traffic volume locations. If a Sign Data option is requested, the symbols plotted on the map will represent locations of signs, and so on. Figure 5 gives an example of a query plot with Figure 6 showing a collision diagram.

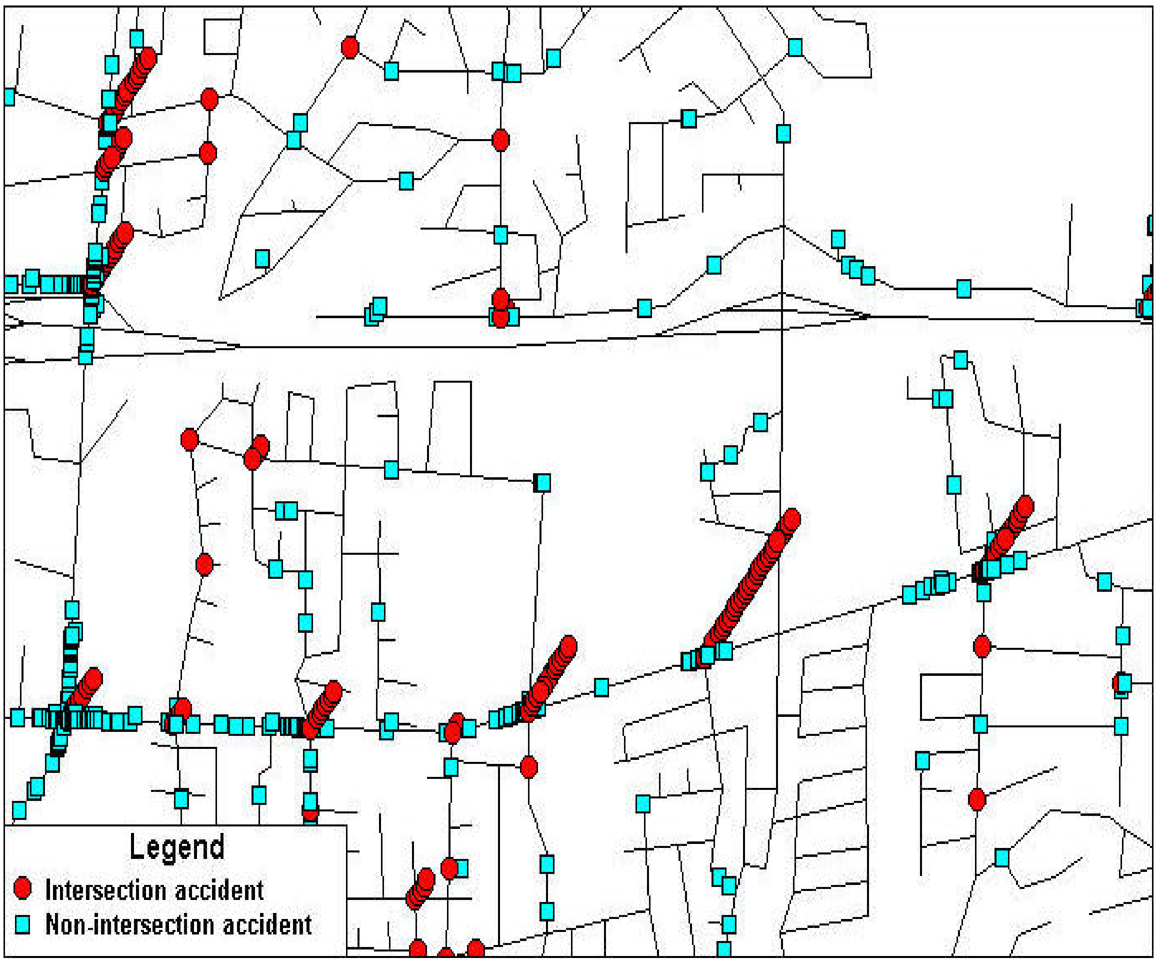


Figure 5. Example AIMS Output

AIMS Collision Diagram

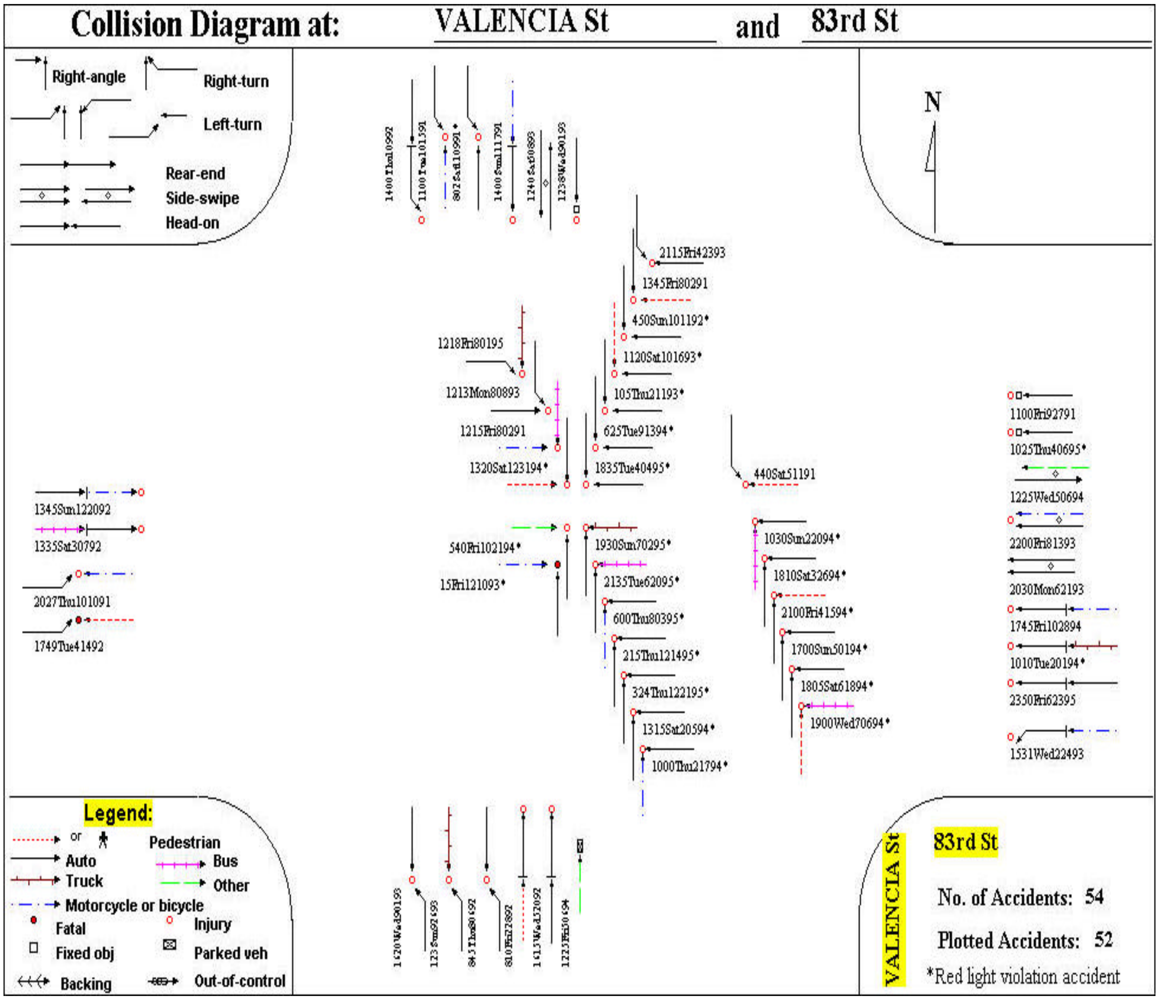


Figure 6. AIMS Collision Diagram

About AIMS Collision Diagram:

Collision Diagram originally was an option of AIMS but it also is available as a stand-alone software.

Collision Diagram Features:

Users 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 that satisfy your query. For example, you can plot collisions that 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 six pages).

Collision Diagram is available in the following forms:

Collision Diagram (Non-GIS Version):

It has all features as listed above, except you cannot click an intersection on the map. JMW Engineering customizes it to use and interpret your existing data (no change in your data).

Collision Diagram (GIS Version):

It has all features as listed above and is customized to use and interpret UDOT data and the map. It can use the map and/or data from ARC/INFO, ArcView, Atlas GIS, AutoCAD, Intergraph/MicroStation or MapInfo.

Traffic Data as AIMS Option:

In addition to accident information, traffic information can be managed by the AIMS software. Figure 7 shows a Traffic Volume Data Graphic.

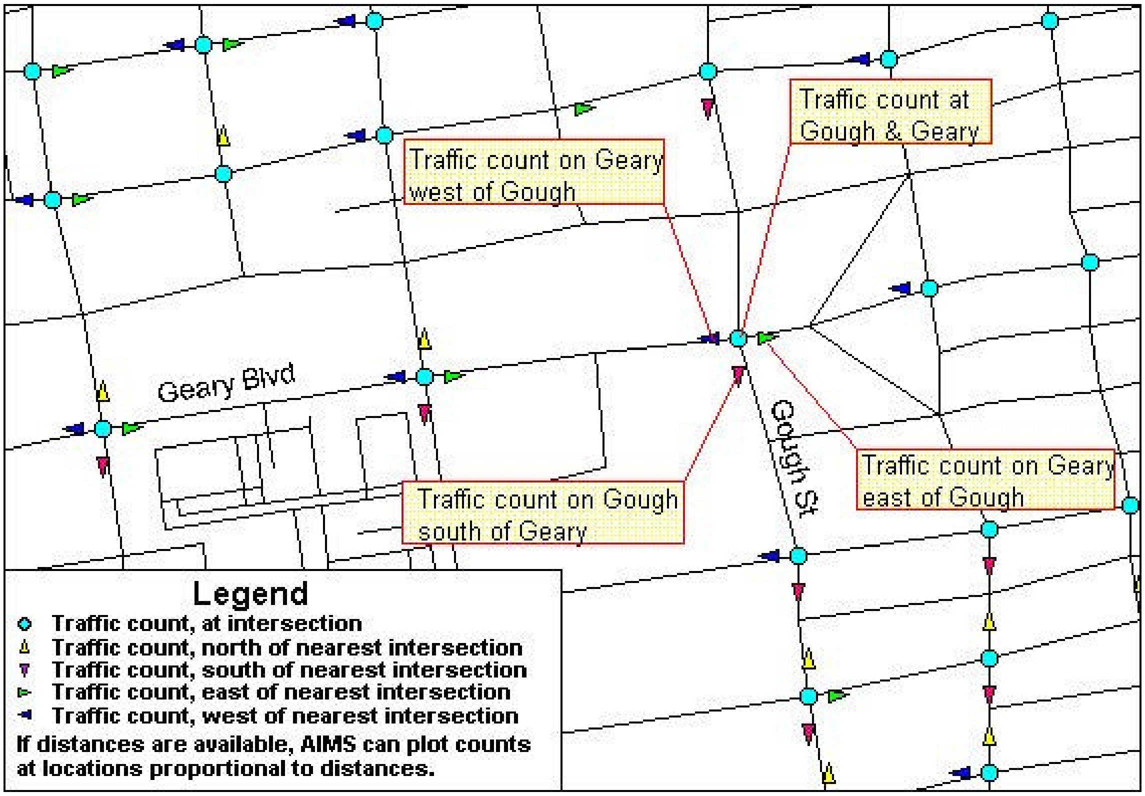


Figure 7. AIMS Traffic Volume Data Graphic

About Traffic Volume Data Option

AIMS can handle several types of traffic volume data: 24-hour, turning movement, vehicle classification, pedestrian, intersection, mid-block, etc. Using a database to manage traffic volume data, AIMS is customized to interpret existing data, hence no need to change system data format. The system automatically will read and input data into the system. The data may be saved as a file in any of the following formats: ASCII (TXT), DBF (dBase), WKS (Lotus123), XLS (Excel) or MDB (Access). The existing system or AIMS can be used to maintain/update your data. If the volume data is not in electronic form, JMW Engineering can develop a database and data input system. Once the volume data is in the system, it is managed the same way as the accident data, with capabilities to:

- display locations of traffic volumes on map
- retrieve data by clicking one or more areas on map
- perform query or sorting on the data
- generate reports and summaries
- display results in bar, pie, line, area or x-y graph
- customize results by adding texts, symbols, lines, curves, etc.
- save the outputs/results in various formats to be used by other software
- print the outputs/results on printer or plotter

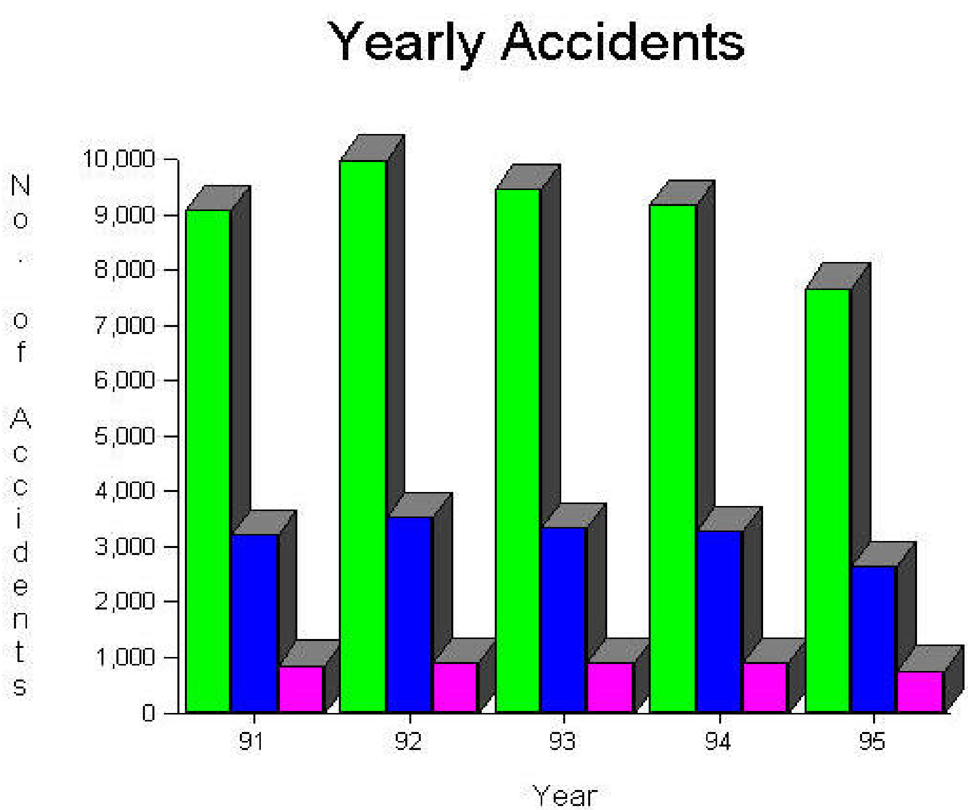


Figure 8. AIMS Graphing Capability

About AIMS Graphing Capability

AIMS can display data or query results in graphs. In creating graphs, choose between bar, line, pie, area, and x-y graphs with different color, 3-dimensional, etc., similar to the graphing capabilities found in spreadsheet software. This capability also applies to Traffic Volume Data option, Sign Data option, Signal Data option, and so on.

AIMS Pricing

Table 2 provides the pricing information for AIMS provided by its developer, JMW Engineering.

Table 2. AIMS Pricing Guide

Description	**Price***		
	1 User	5 Users	10 Users
AIMS	$1,790 (up to 6,000 records)	-	-
	$2,790 (up to 100,000 records)	$7,990	$14,990
	$3,790 (over 100,000 records)	$9,990	$18,990
Collision Diagram	$1,790 (up to 6,000 records)	-	-
	$2,790 (up to 100,000 records)	$7,990	$14,990
	$3,790 (over 100,000 records)	$9,990	$18,990
Accident Rate	$495	$1,390	$2,590
Technical Support	$750/yr	$750/yr	$990/yr
On-Site Installation	$2,000	$2,000	$2,000
On-Site Training	$2,000	$2,000	$2,000

*Add 10% if data consist of 2 tables, add 30% if data consist of 3 tables, add 40% if data consist of 4 or more tables.

Price Includes:

- Customizing the software to use existing data. Hence no data structure, format or coding definition will be needed.
- Customizing the software to user with clients GIS map.
- Free support for 60 days. If the Technical Support is ordered, 14 months of technical support will be provided.

The Traffic Laboratory has asked the following questions to JMW to obtain a detailed pricing guideline.

1. What would be the difference in cost between having a live connection to the database, or having a CD burned and downloading information periodically?

   The cost for a live connection to the database will be $5,000 - $10,000, in addition to the prices found in the price chart. If having a CD burned and downloading information periodically, the cost will be the same as the price found in the price chart.

2. Is there a workstation-related cost?

   Suppose the software will be installed in a network with one server and five workstations. It will require purchasing six user licenses or six copies (each server or each workstation counts as one user).

3. What's your setting up cost?

   The setting up cost is $2,000. This includes air ticket and all travel expenses for on-site installation. Do you provide technical support? Is that included in your price?

   JMW will provide free technical support for 60 days. After this period, the price is $750 to $990 per year. Technical support means JMW provides help to users through telephone, e-mail, fax or mail.

AIMS Extra Features

- AIMS can perform an unlimited number of queries and generate an unlimited number of reports.
- Query files can be saved so the user can implement it at any time. However, the creation of a complex query requires knowledge and experience on Structural Query Language (SQL). If the user has technical support, he or she can call JMW, inform them what sorting criteria is wanted, and JMW will create the query, save it in a file, and email it back to the user. The user can then load the query file into AIMS for use.

Information Needed by the Developer to Customize AIMS

1. Sample Accident Data

   One hundred or more records must be provided. The saved data must be provided in one of the following formats: ASCII (TXT), dBASE (DBF), Access (MDB), Excel (XLS) or 1-2-3 (WKS or WKx). JMW prefers Access or dBase format, because it tells more about your data structure. For ASCII, please use ","(comma) as delimiter.

2. List of field names, data type, and data length of each field.

   The purpose of this is to be able to understand the data structure. For relational databases, it is necessary to provide the field name for each table, the data type and length for each field, and each table's key field for linking the tables.

3. Coding definitions

   This is to interpret the data. A blank police accident report form that contains the codes and meanings should be sufficient.

4. GIS map file(s) for the jurisdiction

If using existing GIS map, provide the following information:

a. What is the projection or coordination system? e.g. longitude/latitude, U.S. State Plane Coordinate System (1983, feet), etc.

b. What is the coordinate unit? e.g. degree, mile, meter, feet, etc.

c. What is the distance unit? e.g. feet, mile, meter, kilometer, etc.

If you do not have a GIS map, JMW will obtain one for a cost of $1,995 to $3,995 per state in the U.S.

AIMS Summary

The Utah Traffic Lab has worked with a demonstration version of the AIMS software. AIMS is a pull down menu, SQL querying and GIS mapping environment. The pull down menu contains options that allow user to query (e.g. yearly summaries, intersection and non-intersection accidents) that plot the results directly into a map providing for a graphic evaluation. The SQL knowledge required ranges from simple to complex. If a query is complex and technical support was ordered at purchase time, there always is the option of requesting the query directly from JMW Engineering. Once a query is created it can be saved for future use without the need of creating the same query over and over. The saving capability can be of great use for occasional users who request the same information. Also, accident characteristics can be selected directly from the map. Accidents can be plotted for a defined area in the map according to users specifications. Accident information output can be obtained in plots, graphics or charts. For accident densities, creating 3-D plots make the recognition of higher areas easier. Full analysis potential can be reached when the customization specifications are provided to JMW Engineering.

AIMS Contact Information

Contact Mr. Ying Wong, the president of JMW Engineering Inc, regarding any AIMS questions. Mr. Wong's address and contact information is:

Mr. Ying Wong,
JMW Engineering Inc.
5562 Caithness Court
Fairfax, Virginia 22032-3834
Telephone (703) 503-3219, Fax (703) 503-0876
e-mail: wong@jmwengineering.com

Highways

By Exor

Exor provided the following descriptions on "Highways," their accident management software. The Utah Traffic Laboratory has not been able to evaluate a demo version of this product since one was not provided. Instead, Exor prefers a demonstration by a member of Exor during a schedule TAC meeting.

Highways by Exor consists of a core module, network manager, which manages all highway network information and its associated data in a single shared database. Modular applications, working with this single database, are then available, which satisfy the operational requirements of a modern highways organization. These include:

- Network Manager
- Maintenance Manager
- Street Lightning Manager
- Spatial Data Manager
- Public Enquiry Manager
- Accident Manager
- Document Manager
- Street Works Manager
- Structure Manager
- Map Capture

The Product Highways is a road management information system. According to its developer, it represents a significant upgrading of the successful Oracle*Highways product and is designed to address the needs of all highways departments and all aspects of highways management.

Highways provides benefits to an organization as an effective tool in operational applications, but also as an integrated solution for a single database. This approach ensures up-to-date and accurate information is available both to management and operational staff without the need for data duplication and the complex management procedures required to control it. Senior management is then better able to make informed long-term strategic decisions, and policies can be more effic iently translated into operational programs.

Highways originally was developed for engineers based on logical designs controlled by highway authorities world-wide. As a result, a key feature is its data-driven flexibility that allows users to implement their own data model and represent their own organizational structure and business practices. In addition, the system can be easily changed over time to reflect changes in data requirements, organizational structures, working practices and legislative requirements. This provides users with sound long-term investments.

The product set is developed exclusively in the Oracle relational database management system, which provides state-of-the-art open, and commercially supportable database technology. This gives a long-term solution, which is portable, flexible, and scaleable. UDOT's accident information currently is in an Informix database. It will take a gateway between Informix and Oracle for it to be retrieved. Exor can provide this gateway according to the UTL's contact with Exor (Mr. William Nally).

Highways also is capable of interfacing with other systems (such as Geographic Information Systems, office, specialist engineering, and financial systems) to form part of an integrated management information system.

Network Manager Overview

Network manager provides a single core database in which to manage multiple linear networks and their associated attributes. This core module contains the underlying data on which Highways application modules are based.

The provision of a single database in which all networks are modeled benefits an organization because all operational data can be integrated. This allows different operational divisions to share data, and provides management and operational staff with a common view of the most up-to-date information. Such integration recognizes that information is a corporate resource and is valuable, promotes better awareness, improves operational efficiency, and allows for improved decision making.

Network manager provides all the necessary tools to model linear networks, with full network maintenance functions, which date stamp changes to allow for a full history to be maintained. The concept of user-definable groups of network links, and partial links, allows for multiple user-defined views and network referencing systems to be established to reflect individual organizational structures and working practices. This allows the user, for example, to create a database of street and road names as a means of referencing the network elements in a user-friendly way.

Associated information may be stored directly against network elements or may be defined relative to the network with distance or offset measures. This information is defined in a data-driven manner by the user and can then be set up to record and manage an inventory of network characteristics. Users are free to implement their own data model and, more importantly, can change the system over time.

Network Manager provides all necessary routines for fast, efficient data loading with full automatic validation. These routines automatically register new inventory as it is defined by the user. Therefore, it allows loading of existing datasets without the need for costly localized customization. Routines also are available to export data for use in external systems with software for two-way transfer via hand-held data capture devices.

Network Manager has a user-friendly reporting tool, allowing users to query and report on the data without any programming knowledge. This ensures that all information is available to all levels of user. These tools respond automatically to user changes to the underlying data model, making the system truly flexible. In addition, Network Manager can be integrated with Geographic Information Systems to provide graphic access to network information and query results.

Accidents Manager

Accidents Manager is an application module in the Highways product set, which allows for storage, management, and analysis of traffic accident information and provides the foundation for a full safety management system.

Accidents Manager provides tools that allow the user to load and record details of accidents received from a police or agent authority in an efficient manner, with rule-based validation to ensure integrity of data. The user is free to define information to be stored and this can easily be changed over time, making the system flexible and easily adaptable to an individual organization's needs. Integration with Document Manager allows for the storage of associated scanned accident forms, site photographs and remedial scheme plans.

Accidents Manager allows the user to adjust coordinates and positioning of accident details in line with accompanying text descriptions. When combined with Network Manager, accidents may accurately be located on the road network and thus, integrated fully with other highway related data.

Accidents Manager provides a number of tools to analyze accident data and to identify potential accident sites. Thresholds for analysis may be defined and modified and traffic data may be incorporated. Sites can be identified by clustering at junctions or along network sections (moving cursor), by analyzing pre-defined routes, or by area analysis. Analysis may be refined by user-defined criteria (e.g. only consider accidents at weekends, for the last month, that are drink-related). Once sites have been identified, the user can then examine common causes or related factors by producing factor grids for the site. The most cost effective remedial solution can then be determined and Accidents Manager allows for the effectiveness of completed remedial schemes to be monitored.

User-friendly query and reporting tools allow easy access to accident information with reporting possible on individual accidents and groups of accidents defined as sites. Integration with Geographic Information Systems and Statistical Reporting Packages also is possible, which allows for graphic display, spatial processing, and complex statistical analysis of data.

Maintenance Manager

Maintenance Manager is an application module used in conjunction with Network Manager to manage the maintenance functions for a transportation network and its associated attributes.

Maintenance Manager provides complete control over the management and operation of routine, cyclic, and structural maintenance and allows the user to maintain financial control of maintenance contracts and budgets. It aids in the implementation of policy standards and provides facilities for monitoring performance against these standards. This ensures effective work management. In addition, Maintenance Manager allows for implementation of inspection regimes and so provides a legal framework for defending liability claims.

Tools are available within Maintenance Manager to record and manage, in a user-defined manner, information concerning:

- Inspections: planned, reactive, ad-hoc, and quality. Planning of surveys, performance reporting, and integration with mobile Data Collection Devices (DCD) are key features.
- Defects: with definable priority codes and status and an inventory change indicator. Full on-line reporting allows managers to readily assess maintenance needs.
- Treatments: treatment models translate defect treatments into sets of pre-defined Bill Of Quantity (BOQ) items, which allow engineers to easily translate defects into work packages.

- Contracts: holding estimates, actuals and retentions for any pre-defined work type. Managers can have direct access to up-to-date budget positions at any time.
- Works orders: defect, cyclic, and scheme works orders. Automatic costing for multiple contracts and multiple budget codes, allowing for variations and interim payments. Work can be grouped based on location, pricing, budget code, defect priority, and BOQ item. Using these tools, engineers can benefit by comparing scenarios to plan cost-effective and timely work solutions.
- Resources: such as contractors, schedule of rates, and budgets. Budgets may be set for any area, financial period or type of work and can continually be monitored and trends examined. They may be integrated with Corporate Financial Systems or linked to standard office tools, such as desktop spreadsheets for budget profiling. In addition, the on-line assessment of contractor and labour availability is a clear benefit. Maintenance Manager also interfaces into contractor-based systems, which manage the labour, plant and materials primitives that make up the higher level BOQ.

Maintenance Manager includes a wide range of standard reports, which enable performance to be monitored against pre-determined standards. These measures include how quickly defects of given priorities are repaired and can be used to monitor inspectors, contracts and budgets.

Street Works Manager

Street Works Manager, formerly known as SWIMS, is a comprehensive street works information management system designed to enable agencies to manage, coordinate, and schedule utility company work occurring on the road network. Street Works Manager is an application module within the highways product set.

Street Works Manager manages all aspects of the process of utility street works from the initial promotion of works, inspection generation, and sampling through to eventual reinstatement. Key features include optimized sample inspection generation algorithms and the automatic generation of work and reinstatement notices. In addition Street Works Manager provides the opportunity to store street works information in a central database and includes an interface into the UK Street Works Register (SWR). Street Works Manager conforms fully to the UK 1991 New Road and Street Works Act (NRSWA).

Street Works Manager has been designed to be fully flexible, allowing users to define information to meet individual needs and for the system to change over time. In addition there has been extensive collaboration with users to ensure that operational requirements associated with the NRSWA are met.

A comprehensive reporting suite is provided with user-friendly management reporting capabilities. This allows the data to be accessed across an organization in a true multi-user environment. Based on the Oracle advanced open database technology Street Works Manager provides a long-term solution, which is portable, scaleable and easily integrated with other information systems.

Spatial Data Manager

Spatial Manager is an application module in the Highways product set. It is used in conjunction with network manager. The combined modules provide for full graphical display of highway network attributes and, when used with other applications in the Highways product set, allow full GIS functionality in a surface transportation information system.

Spatial Manager provides tools, which allow the user to build and maintain any number of disparate transportation networks. All functions of network manager can be managed graphically in one common Oracle database. Users of this products can have the relevant spatial tools they require provided as part of the overall engineering business application in a user-friendly intuitive manner, and without the need to become GIS “experts”.

All data is stored in the Oracle database, allowing it to be open to other users in the organization including specialist GIS departments. This also means that previous problems of keeping map-based data in a proprietary database in step with the road network data in Oracle are eliminated.

Spatial Manager is embedded in the interface in the same client-server manner as the rest of the product set. By purchasing this option, users are able to freely switch between map-display and textual display at any time, and can use the power of GIS to perform spatial-based analysis and queries. Spatial Manager can be used in conjunction with all the modules in the Highways product set, thus providing users with a fully "spatially-enabled" business application.

Spatial Manager has a user-friendly graphical reporting tool allowing users to query and report on data without any programming knowledge. This ensures all information is available to all levels of user. Many users have used GIS technology as a means of providing a map-based view of the Highways database, for carrying out spatial processing and queries, and for integrating with other spatial datasets. Highways has been linked to all leading GIS systems over the years to facilitate this and, where desired, customers can continue interfacing in this way. Spatial manager, however, provides for a fully-integrated spatially-enabled product set without the need for any data duplication or sire specific interface programs.

Highways Pricing

The pricing information for Highways and its different modules can be found in Table 3. Note that the prices include an Oracle run-time license for Oracle Workgroup Server. The price also includes, where appropriate, run-time ESRI licenses for ArcView client and Spatial Data Engine Server. Exor can provide Spatial Data Manager without ESRI licenses for a reduction of $1,600 per named user.

Table 3. Highways Prices

Product Name	*Price Per User*		*Product Name*	*Price Per User*
Network Manager	$3,444		**Document Manager**	$3,024
Spatial Data Manager	$5,964		**Structures Manager**	$3,528
Maintenance Manager	$5,712		**Structural Projects Mgr**	$3,528
Pavement Manager	$5,544		**Map Capture Manager**	$2,268
Street Works Manager	$5,544		**Accidents Manager**	$3,528
Street Lighting Manager	$5,544		**Pub Inquiry Manager**	$3,024

Fully discounted upgrades to Oracle licenses are:

Workgroup Server:

Upgrade to Full Oracle License	$75 per named user

Enterprise Server:

Upgrade to run-time license -	$300 per named user
Upgrade to Application Specific License	$425 per named user
Upgrade to Full License	$625 per named user

Support and Maintenance is 20 percent of license price per annum, payable in advance.

Highways Contact Information

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Accident INFORMATION Reporting Systems

By BETA Information Systems Organization

BETA is presently designing, developing, and implementing statewide accident data management systems for the states of Vermont, Rhode Island and Maine.

In Rhode Island they are implementing a statewide Electronic Accident Reporting System (EARS). This system includes the Mobile Accident Reporting System (RIMARS), which is in use by police agencies to collect and transfer accident data to the State via Rhode Island Law Enforcement Telecommunications System (RILETS) network directly from the accident location.

In Maine, their Mobile Accident Information Reporting System is already in use by the Maine State Police, allowing them to collect consistent, validated electronic crash data. The system also includes a drawing feature that allows the officer to easily create accident diagrams. In Phase II of this project, BETA will design a law enforcement agency system that will receive data from the mobile and desktop units and allow the for transmission of the validated and approved accident data to the Maine Department of Public Safety.

The work that BETA has done for the state of Vermont is basically the conversion of two mainframe systems (ARS and AMS) to a PC-based client/server environment. Phase I is the conversion process and is not really relevant to our study. Phase II it's the one that has not being carried out yet but will include the design, analysis and implementation of a statewide accident reporting system.

Pricing

Rhode Island approximated cost: $120,000, this was their first product. Maine approximate cost: $80,000. They used part of the already developed system for Rhode Island. For UDOT the price is most likely to be closer to the $80,000 mark paid by the Maine DOT.

CHAPTER 6. CONCLUSION

The review of various management systems provided potential systems in UDOT's CARS, Beta's MARS, JMW's AIMS, and Excor's Highways. The CARS, MARS and Highways systems are query based SQL methodology that operate very similar to one another. AIMS is the only true accident management system designed specifically with a "point-and-click" nature. As with CARS, MARS and Highways vendors state that the management system can be incorporated into GIS for an additional cost. But these are viewed as so similar to CARS that the value of incorporating a new system is not clear.

Based on the UTL review, CARS should remain the primary input/output management system for the Traffic and Safety Division. There is a possibility to incorporate ESRI's Arcview GIS system with CARS for approximately $10,000 according to Mr. Rick Julio. This should be encouraged as expanding the availability to those familiar with GIS. The distribution of CARS to the regions should be supported by a comprehensive training program. Several planned modifications to CARS by Traffic and Safety should enhance the ability of CARS to query.

For maximum availability to the accident information, AIMS is recommended as a read-only software for occasional regional users. Its user-friendly, stand-alone, point-and-click setup makes it ideal for allowing non-technical individuals access to accident information. Besides easy query capabilities and saving newly created customized queries for recurring use, the collision diagram that AIMS provides is similar to the "Intersection Magic" software output that Traffic and Safety have utilized in the past.

According to the vendor, the AIMS system could be installed for $15,000 on five machines, which includes customizing the system to the UDOT database and providing a training seminar. It is encouraged that UDOT use a static database to each region in the form of an annual database to minimize costs. A live-link connection to the database can be made but at an additional cost of $5,000 to $10,000 since the UDOT Informix database would need to be translated into AIMS each time the system was accessed.

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