

Seed-Project - Transportation Safety Resource

Development of an Enhanced Crash Data Analysis Tool: “A Plan for Safety”

FINAL REPORT

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Table Of Content

ABSTRACT	1
Development of an Enhanced Crash Data Analysis Tool: A Plan for Safety.....	2
A PLAN FOR SAFETY	2
TRANSPORTATION SAFETY RESOURCE CENTER	3
PLAN4SAFETY	3
Design and Implementation	5
Plan4Safety Environment	5
CONCLUSIONS.....	10
ACKNOWLEDGEMENTS	10
REFERENCES	10

ABSTRACT

According to a 2000 report by NHTSA, 42,000 people were killed and 3,200,000 people were injured on U.S. roadways, with a total economic cost exceeding \$230 billion. New Jersey has the highest population density in the country, and the highest numbers of drivers per miles of road. Naturally, traffic safety is top on the State's agenda for improving transportation and quality of life. Accurate reporting, processing and maintaining of crash data, has been a priority for NJDOT in its effort to develop effective solutions to traffic safety problems. In 2002, NJDOT engaged a nationally recognized team of safety experts to perform a Traffic Records Assessment of the New Jersey Traffic Data System. These evaluators made recommendations that included a revised crash data form which will improve data collected by police officers at the scene of an incident. The Transportation Safety Resource Center has partnered with the NJDOT Division of Traffic Engineering & Safety to develop crash data analysis applications for the NJDOT. Customized software (Plan4Safety) was developed to enable crash data analysis. Plan4Safety offers a powerful statistical analysis tool, which will be enhanced over the next few months to include predictive crash modeling and cost/benefit evaluation capabilities. The data to be analyzed is only as good as the data collected, as such, consistent and complete crash records are critical to a rigorous analysis. Plan4Safety, along with the new crash data form, will enable New Jersey to improve on crash data collection and subsequent analysis.

Development of an Enhanced Crash Data Analysis Tool: A Plan for Safety

A PLAN FOR SAFETY

According to a 2000 report by NHTSA, 42,000 people were killed and 3,200,000 people were injured on U.S. roadways. The total economic cost of such a volume of fatalities and injuries exceeds \$230 billion [1]. As a high volume Corridor State with one of the highest population densities in the nation, New Jersey works hard to improve transportation and traffic safety at all levels.

New Jersey has the highest population density in the country (about 14 times the national average), along with one of the highest numbers of drivers per miles of road (161, about 3 times the national average). Naturally, traffic safety is top on the State's agenda for improving transportation and quality of life. Accurate reporting, processing and maintaining of crash data, for example, has been a priority for NJDOT in its effort to develop effective solutions to traffic safety problems.

In 2002, the New Jersey Department of Transportation (NJDOT) engaged a nationally recognized team of safety experts to perform a Traffic Records Assessment of the New Jersey Traffic Data System. These evaluators made sixteen recommendations that included restructuring the former Accident Records System Advisory Committee (ARSAC) into a Statewide Traffic Records Coordinating Committee (STRCC) with representatives from the several federal, state, county, and local agencies. The outcome of this effort is a revised crash data form which will improve data collected by police officers at the scene of an incident.

To effectively implement the federal and NJDOT safety programs all the 21 counties and municipalities of the State need to be involved and partnered with at all levels. For the NJDOT Crash Data System to evolve, it was important to identify how to efficiently provide optimal data to user groups that can directly affect the reduction of fatalities on the state's roadways. Training and technical assistance to user groups can reduce turn-around time in responding to acute local needs and thus lead to a more efficient interaction between NJDOT decision makers and local users.

As an example of a partnership between a state agency and local stakeholders for promotion and implementation of safety programs at local levels, the Federal Highway Administration (FHWA) recently designated the Iowa Data Collection System as a national model for statewide data collection. This partnership includes the Iowa DOT and the Department of Public Safety that work together on integrated data collection, management, and communications of safety information. The AASHTO Traffic Safety Information Management System (TSIMS) Project will be incorporated into this National Model once it is developed. In New Jersey, a partnership between the FHWA, NJDOT and Rutgers University is embodied in the Transportation Safety Resource Center.

TRANSPORTATION SAFETY RESOURCE CENTER

Roadway safety has been identified as an important concern for most municipalities, but it is often overlooked as a funding priority. At the same time, many local organizations lack the resources that are required for maintaining safe roadways in their communities. The TSRC provides resources such as technical assistance and training on how to obtain funding for safety projects, and enable communities to improve the safety for their residents through reduction of roadway crashes and fatalities.

Once fully operational, the TSRC will be a one-stop resource center with a major focus on traffic safety concerns of local governments in New Jersey. The TSRC provides technical support and training services to local agencies to help them achieve the goal of reducing crashes and fatalities on New Jersey roadways. Some of the objectives include:

- Provide technical support and training services to MPOs to enable them to prioritize safety projects that will be funded through the Local Aid Program.
- Develop basic statistical crash analysis software upon which subsequent phases will be built.
- Provide engineering support services to select local agencies through a pilot program, in order to develop a statewide program model.
- Develop a dynamic decision support framework for the cost/benefit evaluation of safety projects.
- Provide support for the development of a statewide strategic safety management system.

The TSRC has partnered with the NJDOT Division of Traffic Engineering & Safety to develop crash data analysis applications for the DOT. The tools developed may also be made available to local users. The existing system lacked data mining functionality for analysis of crash data and elements of appropriate decision support systems. Customized software was developed to provide statistical analysis of crash data. A layer of functionality will be added to the statistical tool to enable the evaluation of alternative decisions based on cost/benefit analyses.

PLAN4SAFETY

This application is exclusively designed for the statistical analysis of the crash data for the State of New Jersey and is to be used by the New Jersey Department of Transportation (NJDOT) traffic engineers and planners. Plan4Safety provides a user friendly environment for analyzing the crash records and presenting them as charts, tables or on maps. Plan4Safety combines and integrates data from 5 separate NJDOT crash data [2] files (accident, driver, occupant, pedestrian and vehicle) that contain data related to a single crash record. The 'accident' file contains general variables related to the crash such as weather, light, or pavement conditions, number of persons killed or injured, crash location etc. The 'driver', 'occupant', and 'pedestrian' files contain information such as age and sex of driver, occupant or pedestrian. In addition, the 'driver' and 'pedestrian' files contain information on whether or not a sobriety test was performed and the results of the test. Finally, the 'vehicle' file contains information about the vehicles involved in the crash such as make, age, color etc. Note that a single record in the accident file may be related to several entries in the other four files; for example, if several vehicles with

multiple occupants each were involved in one crash that also involved more than one pedestrian. As such, the relationship between the ‘accident’ file and the other four files is typically one-to-many. The five files are currently stored in Access format, where the relationships have been specified as shown in Figure 1 below.

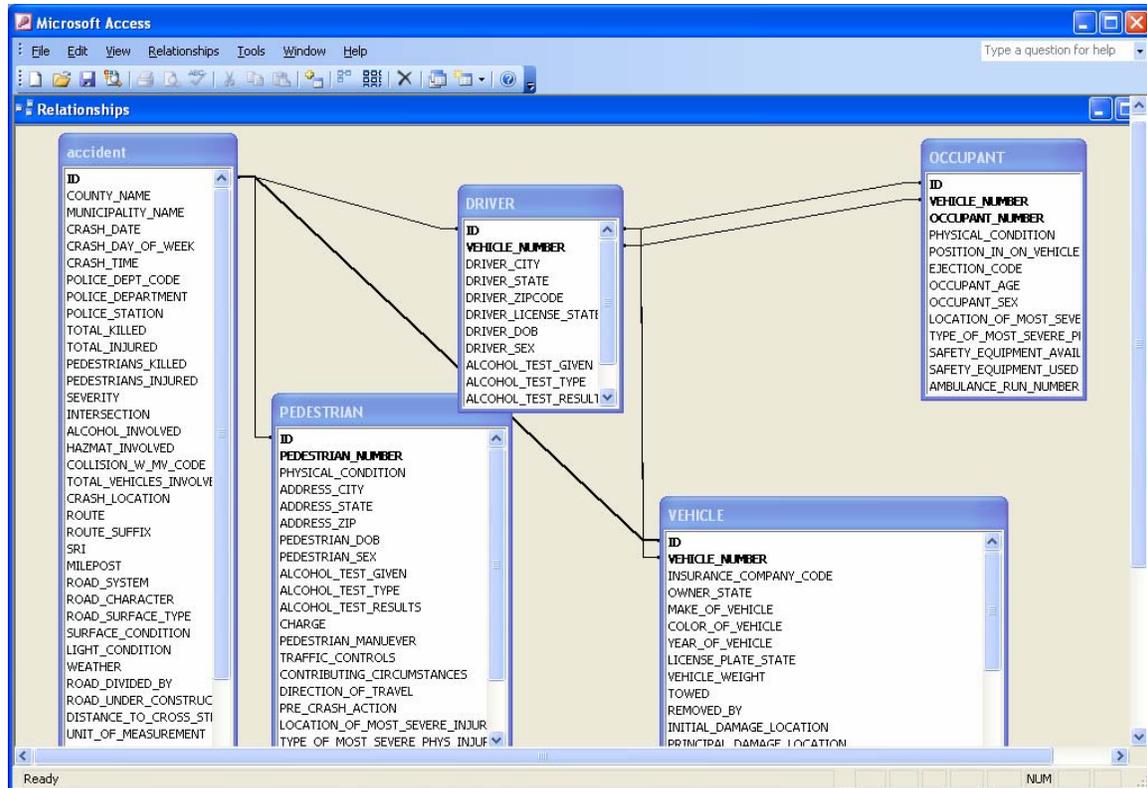


Figure 1: Data relationships

In Plan4Safety you can easily create filters to generate subsets of the whole data set. The filters can include variables from 1 or all 5 tables. Using appropriate tools available in the application, you can create the filters and extract a part of the subset for analysis and presentation. The generated subset of data can be statistically analyzed in detail, using record, frequency, cross-tabulation, or GIS (Geographical Information Systems) view tools. The software allows the user to print charts, tables or lists of data.

Design and Implementation

Even though there are several useful packages that have been designed for crash analysis, such as CAS [3], PBCAT [4], or CARE [5, 6] (to name a few), the special structure of the data set and particular needs of NJDOT motivated the Center to design and implement Plan4Safety. The following are some of the reasons:

- The structure of the database and tables of the crash data of New Jersey makes the use of existing crash data analysis tools almost impossible.
- The domain of the available tools is mostly restricted to categorical data, represented by nominal or ordinal values [6]. Plan4Safety, on the other hand, is designed in a way that even non-categorical data can be represented in datasheets (or in maps). This helps engineers and planners to easily find the information about specific types of crashes. For instance, users are able to easily search for crashes that occurred at a particular intersection in a specific county, which can include all types of vehicles.
- Most of the time, planners need to analyze the data based on the attributes of a crash - for example number of occupants or pedestrians involved.
- Users in Plan4Safety are able to have a cross-tabulation of more than two variables at the same time. Cross-tabulation in Plan4Safety provides a tool for frequency and relationship analysis between two or more variables.
- Having geo-coded data in hand, the application provides a mapping tool which locates crashes on the map of New Jersey. A set of individual crashes can be selected on the map to create a filter based on crash locations.

Plan4Safety Environment

Figure 2 shows the record view in Plan4Safety. Once the user has created a filter, individual records can be seen on this page. Optional variables can be selected for this screen to be shown. Figure 3 shows a more detailed view of a desired record.

Figure 4 is the frequency view environment. Basic statistics and histograms can be seen on this page. Cumulative frequencies and percentages are part of the basic information of any desired variable, which can be accessed using the frequency view tool. A chart at the bottom of the page will present the results in graphs.

You can use cross-tabulation queries to calculate and restructure data for easier analysis of the data. When you summarize data using a cross-tabulation query, you select values from specified fields or expressions as column headings so you can view data in a more compact format than with a select query. Figure 5 shows the cross-tab view in Plan4Safety.

Figure 6 shows all the accidents that have occurred on every Saturday of year 2003 Mercer County, New Jersey. The user is able to zoom into the map and select an individual accident or a group of accidents at the same time and get the related information in a spreadsheet, as it can be seen in Figure 7. The user is able to select a set of crashes in a region on the map. The map will also give the information about individual roads on the map; items like road type, road length, name, starting and ending mileposts, etc.

ID	COUNTY_NAME	MUNICIPALITY_NAME	CRASH_DATE	CRASH_TIME	CRASH_TIME_OF_DAY	POLICE_DEPARTMENT	POLICE_STATION	T	I	P	SEV
2004010204-0976	ATLANTIC	ATLANTIC CITY	4/30/2004	Friday	5:31:00 AM	01 ATLANTIC CITY	ACAIU	1	0	1	Fatal
2004010204-2032	ATLANTIC	ATLANTIC CITY	8/12/2004	Thursday	12:11:00 AM	01 ATLANTIC CITY	?	1	0	1	Fatal
2004010804-051698	ATLANTIC	EGG HARBOR TWP	9/1/2004	Wednesday	12:55:00 PM	01 EGG HARBOR TWP	HQ	1	0	1	Fatal
2004010804-43330	ATLANTIC	EGG HARBOR TWP	7/23/2004	Friday	2:42:00 AM	01 EGG HARBOR TWP	HQ	2	2	2	Fatal
2004011204-10217	ATLANTIC	HAMILTON TWP	3/8/2004	Monday	9:25:00 PM	1 TWP OF HAMILTON		1	0	1	Fatal
2004011204-45057	ATLANTIC	HAMILTON TWP	10/28/2004	Thursday	10:05:00 PM	1 TWP OF HAMILTON	MAYS LANDING	1	0	1	Fatal
2004011204-47128	ATLANTIC	HAMILTON TWP	11/11/2004	Thursday	5:16:00 PM	1 TWP OF HAMILTON	MAYS LANDING	1	0	1	Fatal
20040114204-11944	ATLANTIC	LINWOOD CITY	11/16/2004	Tuesday	9:09:00 PM	01 LINWOOD	HQ	1	0	1	Fatal
200401192004-10236	ATLANTIC	PLEASANTVILLE CITY	4/30/2004	Friday	4:56:00 PM	1 PLEASANTVILLE		1	1	1	Fatal
200401212004-9714	ATLANTIC	SOMERS POINT CITY	10/20/2004	Wednesday	6:54:00 PM	1 SOMERS POINT		1	0	1	Fatal
200402012004-080	BERGEN	ALLENDALE BORO	6/25/2004	Friday	9:58:00 AM	01 ALLENDALE	ALLENDALE	1	0	1	Fatal
200402048060-2004-02044A	BERGEN	BOGOTA BORO	8/1/2004	Sunday	3:21:00 AM	2 STATE POLICE	TOTOWA SUBSTAT?	1	2	1	Fatal
2004021704-5570	BERGEN	FAIR LAWN BORO	3/26/2004	Friday	2:06:00 AM	01 FAIR LAWN	3001	1	0	1	Fatal
200402192004-43247	BERGEN	FORTLEE BORO	11/17/2004	Wednesday	11:08:00 AM	1 FORT LEE	TRAFFIC AIU	1	0	1	Fatal
2004022304-02870	BERGEN	HACKENSACK CITY	1/31/2004	Saturday	10:46:00 AM	01 HACKENSACK	PATROL	1	0	1	Fatal
2004022304-08076	BERGEN	HACKENSACK CITY	3/30/2004	Tuesday	6:55:00 PM	01 HACKENSACK	PATROL	1	0	1	Fatal
2004022304-26566	BERGEN	HACKENSACK CITY	10/15/2004	Friday	8:42:00 PM	1 HACKENSACK	PATROL	1	0	1	Fatal
2004022304-32022	BERGEN	HACKENSACK CITY	12/18/2004	Saturday	3:08:00 PM	01 HACKENSACK	PATROL	1	0	1	Fatal
200402318060-2004-02503A	BERGEN	LODI BORO	9/17/2004	Friday	11:49:00 PM	2 STATE POLICE	TOTOWA-SUB	1	0	1	Fatal
200402338060-2004-01729A	BERGEN	MAHWAH TWP	7/3/2004	Saturday	11:14:00 AM	2 STATE POLICE	TOTOWA-SUB STA?	3	0	1	Fatal
2004024504-8771	BERGEN	PALISADES PARK BORO	2/17/2004	Tuesday	11:35:00 PM	01 PALISADES PARK		1	0	1	Prope
2004025004-15580	BERGEN	RIDGEFIELD PARK VILLAGE	10/20/2004	Wednesday	7:36:00 PM	01 RIDGEFIELD PARK	H.Q.	1	0	1	Fatal
2004025604-012695	BERGEN	RUTHERFORD BORO	12/21/2004	Tuesday	5:35:00 PM	01 RUTHERFORD		1	0	1	Fatal
2004025704-4983	BERGEN	SADDLE BROOK TWP	7/10/2004	Saturday	3:36:00 AM	01 SADDLE BROOK		1	0	1	Fatal
2004025704-8625	BERGEN	SADDLE BROOK TWP	12/14/2004	Tuesday	5:07:00 PM	01 SADDLE BROOK		1	0	1	Fatal
2004026004-042898	BERGEN	TEANECK TWP	5/19/2004	Wednesday	11:16:00 PM	01 TEANECK	TEANECK	1	0	1	Fatal
2004026000-0302004-2940A	BERGEN	TEANECK TWP	8/31/2004	Tuesday	8:34:00 PM	2 STATE POLICE	NEWARK	1	0	1	Fatal
200402642004-2487	BERGEN	WALDWICK BORO	7/15/2004	Thursday	4:23:00 PM	01 WALDWICK		1	0	1	Fatal
200403042004-31512A	BURLINGTON	BORDENTOWN TWP	12/18/2004	Saturday	2:14:00 AM	01 BORDENTOWN TWP		1	0	1	Fatal
20040304020-2004-00839A	BURLINGTON	BORDENTOWN TWP	9/10/2004	Friday	2:26:00 PM	02 STATE POLICE	BORDENTOWN	1	0	1	Fatal
200403062004-15038	BURLINGTON	BURLINGTON TWP	9/9/2004	Thursday	7:53:00 PM	01 BURLINGTON TWP	MUNICIPAL	1	0	1	Fatal
200403062004-9493	BURLINGTON	BURLINGTON TWP	6/12/2004	Saturday	9:25:00 PM	01 BURLINGTON TWP	MUNICIPAL	1	0	1	Fatal
2004031705-1158-04	BURLINGTON	LUMBERTON TWP	5/16/2004	Sunday	11:16:00 PM	01 LUMBERTON TWP	130	1	0	1	Fatal
2004031710-1301-04	BURLINGTON	LUMBERTON TWP	10/3/2004	Sunday	11:45:00 AM	01 LUMBERTON TWP		1	0	1	Fatal
200403232004-13491	BURLINGTON	PEMBERTON TWP	7/3/2004	Saturday	11:45:00 AM	01 PEMBERTON TWP		1	0	1	Fatal
2004040604-261	CAMDEN	BERLIN TWP	7/5/2004	Monday	1:53:00 AM	1 BERLIN TWP		1	0	1	Fatal
2004040804-03-11-271	CAMDEN	CAMDEN CITY	3/11/2004	Thursday	7:49:00 PM	01 CAMDEN PD	TRAFFIC HDQTS	1	1	1	Fatal
2004040804-0530-064	CAMDEN	CAMDEN CITY	5/30/2004	Sunday	5:11:00 AM	01 CAMDEN	TRAFFIC DIV.	1	0	1	Fatal

Figure 2: Plan4Safety Record view

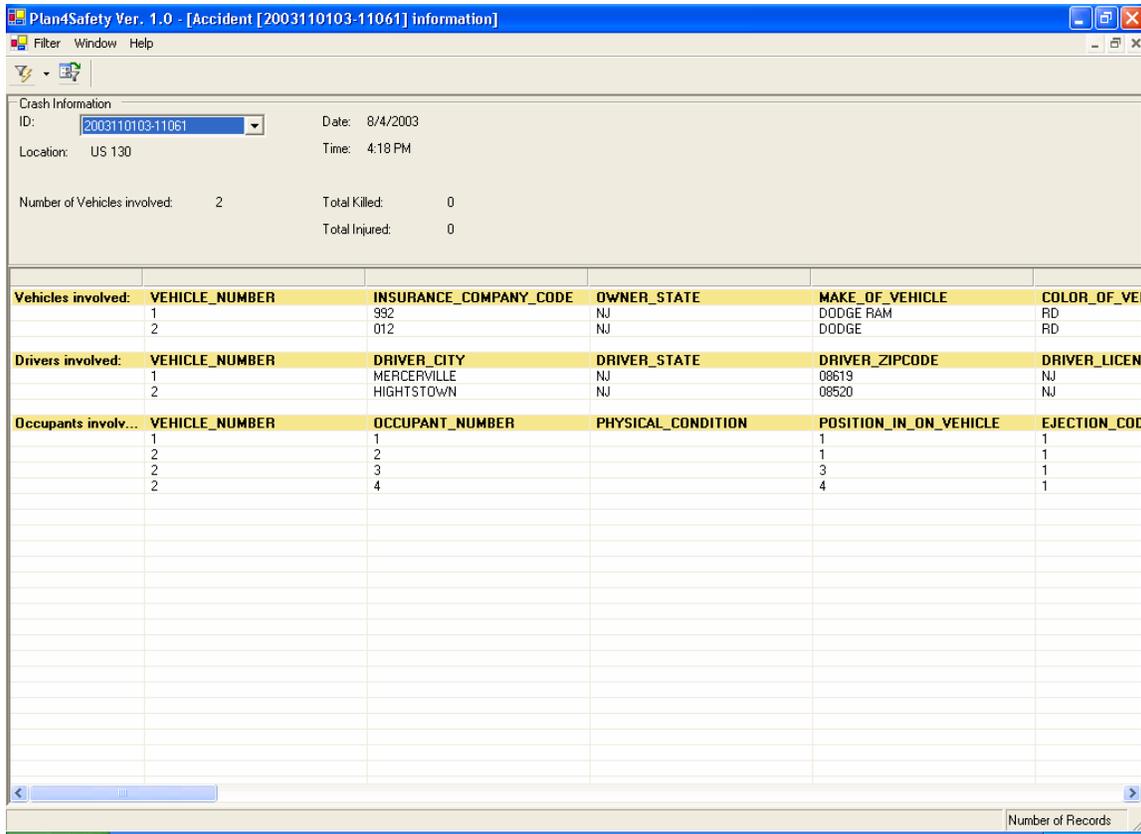


Figure 3: Plan4Safety Record view – Detailed view

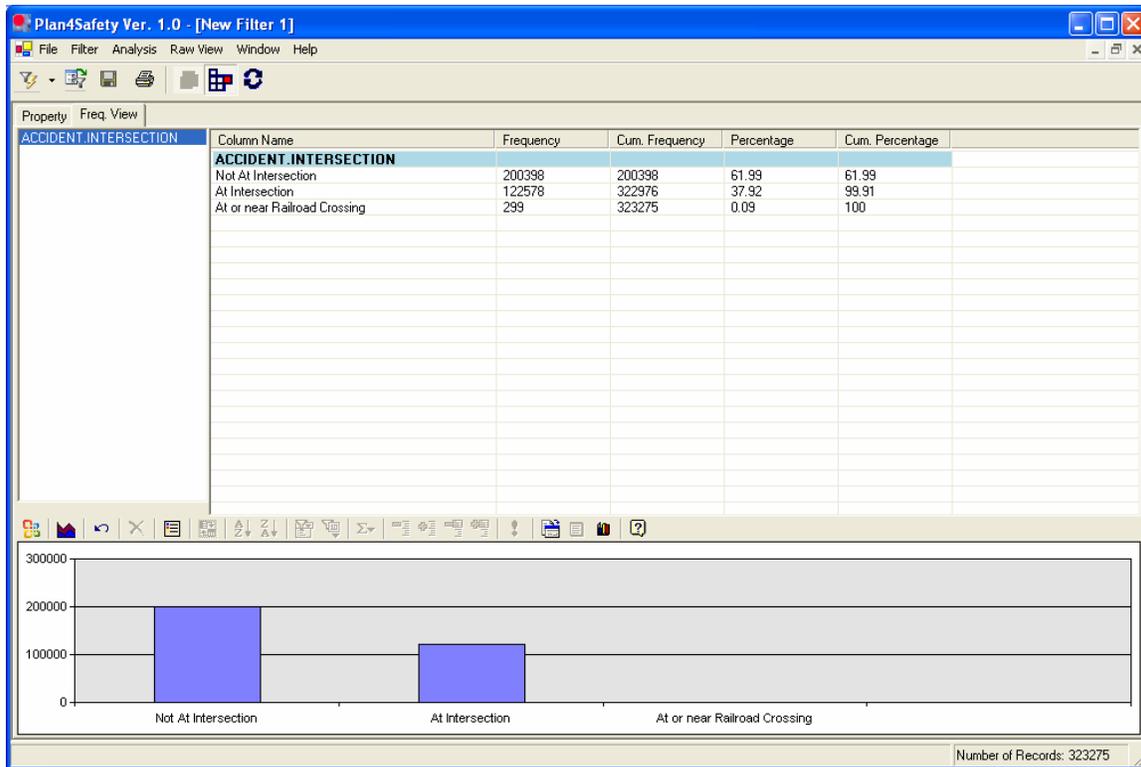


Figure 4: Frequency view

Plan4Safety Ver. 1.0 - [Filter III]

File Filter Analysis Raw View Window Help

Property | Freq. View | Crosstab View

ACCIDENT.ROAD_SYSTEM	CRASH_DAY_OF...	REMOVED_BY	Interstate	State Highway	State/Interstate...	State Park or Inst	County	Co. Auth. Park o...	Mur
ACCIDENT_CRASH_DAY_OF_WEEK	Saturday	NULL	8	68	15	0	96	0	326
ACCIDENT_TOTAL_INJURED			0.21%	1.79%	0.39%	0%	2.53%	0%	8.5%
VEHICLE_REMOVED_BY	Saturday	Owner	30	238	69	1	231	1	457
DRIVER.DRIVER_SEX			0.79%	6.27%	1.82%	0.03%	6.08%	0.03%	12.1%
	Saturday	Driver	31	285	63	1	268	0	416
			0.82%	7.5%	1.66%	0.03%	7.06%	0%	10.1%
	Saturday	Police	28	165	26	4	170	0	250
			0.74%	4.34%	0.68%	0.11%	4.48%	0%	6.5%
	Total		97	756	173	6	765	1	144
			2.55%	19.91%	4.56%	0.16%	20.14%	0.03%	38.1%

Number of Records: 2037

Figure 5: Cross-tab view

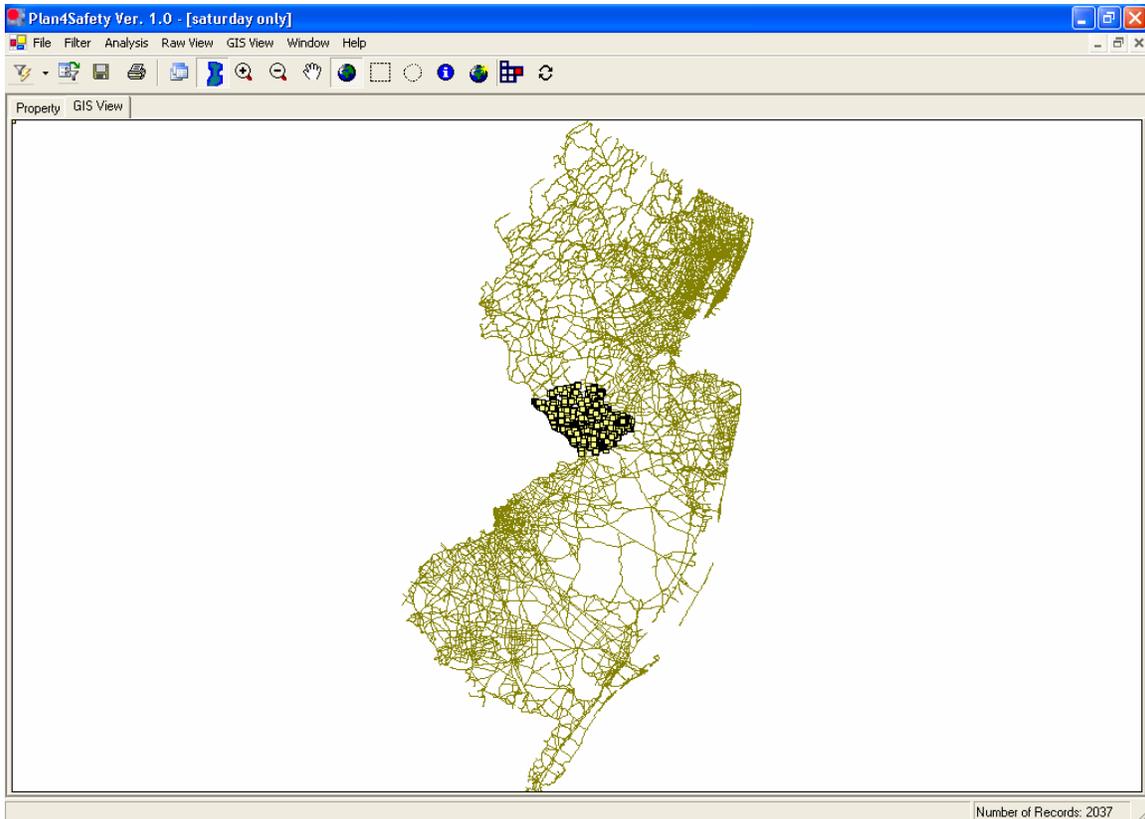


Figure 6: GIS view

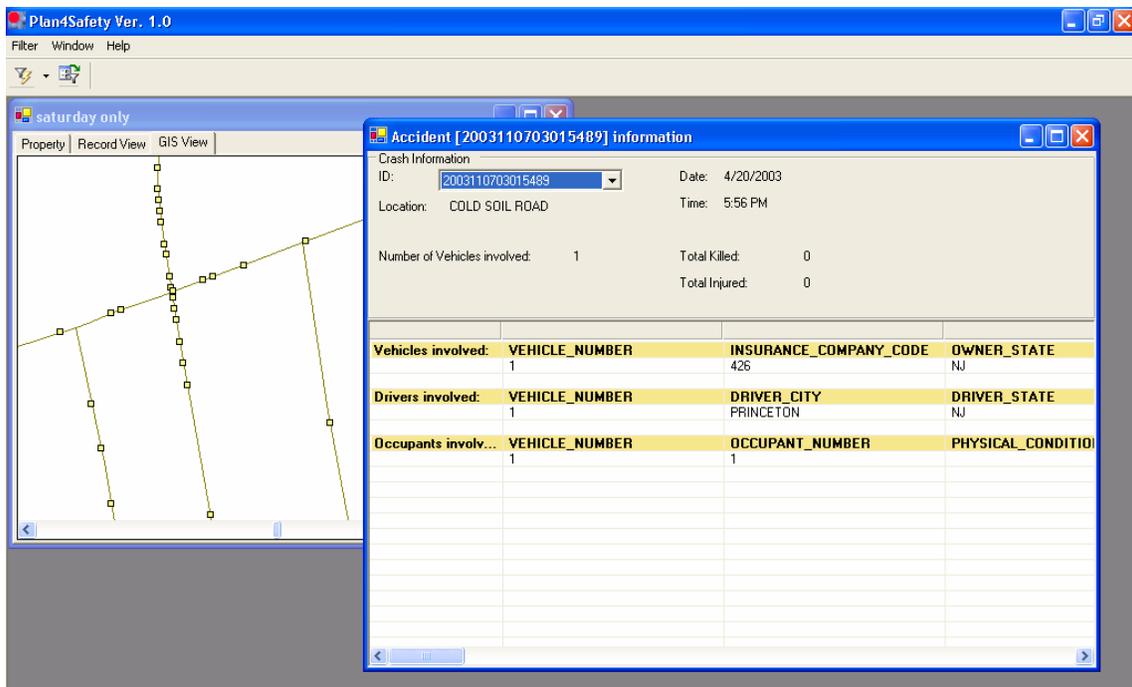


Figure 7: GIS view – Zoom in – Crash Information

CONCLUSIONS

This presents preliminary work conducted by the Center in its first phases of development. Plan4Safety offers a powerful statistical analysis tool, which will be enhanced over the next few months to include predictive crash modeling and cost/benefit evaluation capabilities. The data to be analyzed is only as good as the data collected, as such, consistent and complete crash records are critical to a rigorous analysis. As part of its mandate, the Center is offering training courses to police agencies statewide. Along with the new crash data form, New Jersey will improve on crash data collection and subsequent analysis. The Center will be in a better position to study the circumstances under which crashes are caused and underlying user behavior that cause these crashes. The Center is currently conducting behavioral analysis using existing data – this analysis will be revisited once sufficient data has been collected incorporating new technologies and additional fields of data.

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