TECHNICAL MEMORANDUM

MAG Regional Transportation Safety Information Management System
Evaluation of Available Crash Analysis Software

By

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This memorandum summarizes the evaluation of several software programs conducted by Kittelson & Associates, Inc. (KAI). The evaluation determined the applicability of each software to the unique crash analysis needs of the Maricopa Association of Governments (MAG). KAI considered four software packages as part of this evaluation, shown in Table 1 below.

Table 1 Evaluated Software Packages

Software	Full Name	Developer
CARE	Critical Analysis Reporting Environment	University of Alabama Computer Science Department
Intersection Magic	Intersection Magic	Pd' Programming
AZLGSP	Arizona Local Government Safety Project Analysis Model Version 2.0	Arizona State University Civil and Environmental Engineering
CDART	Crash Data Analysis and Retrieval Tool	Pennsylvania Department of Transportation

Each software package was evaluated with respect to the intended purpose of the software, functionality related to MAG's system requirements, user interface, graphical and reporting capability, configurability, and cost. Table 2 provides a summary of the evaluation results.

Table 2 Summary of Evaluation Results

Evaluation Category	CARE	Intersection Magic	AZLGSP	CDART
Intended Purpose	Summarize and analyze crashes on a state-wide level.	Produce crash diagrams, and perform limited filtering and crash analysis.	Allow local jurisdictions to produce crash diagrams, and identify high-crash intersections.	Allow DOT planners and engineers to access, analyze, and map crash data.
Reporting Capability	Needs preprocessing of data to generate any reports	Generates some MAG reports.	Generates some MAG reports.	Generates all segment-related reports, but does not perform intersection analysis.
User Interface	Web- or desktop-based. Easy-to use features, poor Help menu.	Web- or desktop-based. Confusing user interface, difficult to create complex filters.	Desktop-based. Straightforward, and easy-to-use. Provides step-by-step guidance for user.	Web-based only. Very straightforward, and easy-to-use. Provides step-by-step guidance for user.
Graphical Capability	Wide variety of custom charts and graphs available for all reports. Integrated with ArcView GIS.	Limited variety of custom charts and graphs available for reports. Partially integrated with GIS.	Reports are text-only, with no charts or graphs. No integration with GIS-mapping.	Reports are text-only, with no charts or graphs. Full integration with GIS-mapping.
Configurability	Proprietary. However, CARE representatives indicated willingness to work with clients to customize CARE and create new reports.	Proprietary, limited opportunity to customize.	Microsoft Access application, relatively simple to customize using VBA.	Requires significant customization before being used outside of Pennsylvania.
Platform/ Technology	Microsoft .NET 2.0, ASP.NET, SQL Server	Unknown	Microsoft Access 2000 & 2003, Visual Basic for Applications	Microsoft .NET 2.0, Crystal Reports, GeoMedia Web Map, Oracle 9i
Cost	$0 for software, $100,000-$250,000 cost to create CARE dataset	>$6,500	$0	Unknown

The results of the evaluation show that only one of the software packages, CARE, is able to create all MAG reports but it is a tedious task to translate MAG ALISS data into the CARE datasets. CARE also integrates well with ArcView GIS software, allowing crash data to be mapped but again the data needs to be preprocessed to certain proprietary format. These aspects of CARE may make it unsuitable to MAG's long-term needs. CARE is proprietary, which limits the ability to modify and expand it as MAG continues to expand its crash analysis program. Additionally, the total cost to create a CARE dataset from MAG's crash data is high, potentially ranging from $100,000 - $250,000.

Several of the other evaluated software packages have features that may be valuable to MAG. Specifically, CDART provides a framework for integrating crash data with GIS, and provides easy-to-use and comprehensive reporting features for segment crashes. CDART is not currently configured to analyze intersection crashes, however. Additionally, CDART runs on an Oracle platform and uses GeoMedia Web Map as its GIS application. MAG currently possesses neither Oracle nor GeoMedia, presenting cost and technical difficulties to adapting CDART for MAG's use. However, CDART's architecture, and PennDOT's experience developing CDART, may provide useful guidance, if MAG decides to develop crash analysis software in-house.

The two other software packages, Intersection Magic and AZLGSP, produce only a small portion of the crash reports that MAG requires, and do not represent solutions to MAG's needs. These programs provide the ability to create crash diagrams, though MAG's system requirements do not include the need to create crash diagrams. Having such a tool available may be beneficial for local jurisdictions trying to identify possible safety mitigations, however. Both software packages import standard database files, and could be included as a supplement to the crash analysis system MAG ultimately adopts.

The remainder of this memorandum discusses each of the software packages in more detail.

Software Overview

Each of the evaluated software packages serves somewhat different purposes. Even though the primary focus of each is on crash analysis, some are designed primarily to analyze crashes at individual locations and produce crash diagrams, while others filter and summarize crashes at a multi-jurisdiction or statewide level.

CARE – Critical Analysis Reporting Environment (CARE) was created by the University of Alabama, Department of Computer Science, and is designed for the analysis and summary of any database information. While CARE is typically used for crash analysis, none of its features are specific to crash analysis, and CARE could also be applied to other applications (e.g., medical records or aviation safety data). The CARE website states that "CARE software is applicable to any database and can be adapted for use in virtually any commercial or governmental field". The primary features of CARE are the ability to create custom database filters, and generate a variety of reports and graphics from these filters.

Intersection Magic – Intersection Magic is a crash analysis program produced by Pd' Programming. Its primary focus is the production of crash diagrams, and not on generating reports, graphics, and crash analysis at a region-wide level. However, Intersection Magic does have limited filter tools that allow users to analyze and summarize crashes in report or graphic formats. Intersection Magic is capable of analyzing both intersection and segment crashes.

AZLGSP – The Arizona Local Government Safety Project, Version 2.0 (AZLGSP) is a Microsoft Access application created by Arizona State University. The intended purpose is to support safety analysis for local jurisdictions, and help these jurisdictions meet eligibility requirements for statewide safety improvement funding. It may be used to identify intersections where safety deficiencies exist based on either crash frequency or crash rate. Ten different filters are available for the screening (e.g., intersection type, alcohol-related).

AZLGSP then uses crash diagrams to assist in determining appropriate safety mitigations for such locations. AZLGSP does primarily intersection-based analysis, locating high-crash intersections and creating crash diagrams for those intersections. It also provides the ability to assess the economic costs associated with high-crash locations.

CDART – Crash Data Analysis and Retrieval Tool (CDART) is a product developed by Pennsylvania DOT (PennDOT) for internal use. CDART is a web-based program, and is notable for its integration with other PennDOT data. For instance, CDART allows users to seamlessly access original police reports associated with individual crashes, or access GIS data associated with a particular high-crash roadway segment. CDART is integrated with PennDOTs GIS, allowing users to plot crash data on maps.

Reporting Capability

As part of the background materials for this review, MAG provided KAI with a list of crash reports that would be required by the system developed for MAG. These report requirements relate to reporting freeway segment, arterial segment and intersection crashes, and include creating custom charts and graphs. This section considers the ability of each of the software packages to meet these requirements without any modifications.

CARE – CARE has the capability to create all of the reports listed in the MAG system requirements. It is straightforward to create all of the summary reports relating to total crashes by type (e.g. freeway crashes by day of week), and there are a wide variety of options for creating custom graphs from the generated reports. CARE is also able to produce the location related reports (e.g. top 10 intersections). However, there is no ability to calculate the crash severity index indicated in MAG's system requirements within CARE; calculation of any crash severity index would occur outside of CARE, and then be imported into CARE as an additional field.

Intersection Magic – As stated above, the primary purpose of Intersection Magic appears to be the fast and easy production of crash diagrams. However, MAG's system requirements primarily relate to summarizing and reporting crashes at multiple locations rather than crash diagramming individual intersections. Intersection Magic's filtering and reporting tools are somewhat limited, but do allow it to do many of the tasks required by MAG. For instance, the crash frequency reports on freeway and regional arterial crashes are possible to create in Intersection Magic. There is no way to calculate per-mile crash frequency, or to calculate a crash severity index, however.

Finally, Intersection Magic is limited to only 40 fields in the crash database. Because of the large number of fields typically represented in crash databases, and the large number of variables that MAG wishes to analyze, this limitation may prevent Intersection Magic from creating all of the reports MAG requires.

AZLGSP – Because AZLGSP is designed to identify and mitigate specific intersection safety problems, its configuration is not well-suited to provide most of the reports that MAG desires. AZLGSP does not produce any reports related to segment (i.e., freeway or arterial) crashes. Moreover, AZLGSP's reporting options for intersections are limited to only a few variables, and do not provide a straightforward method of tabulating totals (e.g., Crashes by Day of Week). Rather, all of its reports are lists of individual intersections ranked based on user-specified criteria. AZLGSP also does not currently have the capability to create charts from the reports that it generates.

CDART – CDART has the capability to produce many, but not all, of the reports in the MAG system requirements. Because it was developed for a state agency maintaining primarily rural highways, the focus of CDART is on segment, rather than intersection crashes. Therefore, CDART is able to create all of the reports related to freeway and segment crashes; however, it is not designed to produce any of the intersection crash reports that require lists of specific intersections. Finally, all CDART reports are in table or map format, with no way within CDART to create charts from the reports that it generates.

Cost of Each Software Package

CARE – CARE is available to download for free from the CARE Research and Development Laboratory website. However, CARE datasets are specific to CARE; CARE does not import standard database files. Therefore, MAG would need to work with the University of Alabama to modify MAG's data to fit CARE. Based on conversations with CARE staff, the estimated cost to create a CARE dataset is between $100,000 and $250,000.

Intersection Magic – According to the Pd' Programming website, the price of Intersection Magic varies by the size of the jurisdiction purchasing it. For cities with populations greater than 300,000, the cost of the program is $6,500. However, County and State DOT's are not provided with a quote, and are instructed to call. Given the size of MAG, it is unlikely that the cost of Intersection Magic would be less than $6,500, and could be considerably more.

AZLGSP – AZLGSP is available to download for free from the Arizona DOT .ftp site.

CDART – CDART is not currently distributed outside of PennDOT, and there is no protocol for doing so. Because development of CDART was funded federally, it may be possible for MAG to receive CDART for free.

Other Considerations

CARE – Meets the MAG's reporting requirements but needs preprocessing of MAG ALISS data into CARE datasets, CARE also integrates with Intersection Magic, allowing the user to easily create collision if Intersection Magic is available. Additionally, CARE includes mapping tools to visually display crash data on maps, and is integrated with ArcView GIS. However, there are also several limitations to CARE as an analysis tool. CARE does not permit the calculation of new variables or addition of new crash records within the CARE platform; these changes would need to be made in a separate database and then imported to CARE. Because of the unique nature of CARE datasets, the ease with which new fields/variables could be imported is unknown.

Overall, the CARE user interface is well-designed, and straightforward to use. However, the Help menu does not provide a lot of guidance. One benefit of CARE is that it provides the ability for users to create complex, custom filters incorporating multiple variables, in addition to pre-defined filters.

Finally, CARE is proprietary software owned by the University of Alabama. Consequently, MAG would not have access to source code in order to modify CARE to suit their unique purposes. However, CARE representatives indicated that they have worked with clients in the past to create new reports or other features, and showed a willingness to do so again in the future.

Intersection Magic – Intersection Magic's user interface is simple, with only a few icons and menus. However, the interface is not particularly user-friendly, and is difficult to comprehend. In particular, the tool to create filters is confusing and makes the creation of multi-variable filters difficult. Intersection Magic has the ability to create several different types of charts and graphs to summarize reports; however, the options are more limited than for CARE.

Although Intersection Magic does not meet several of the MAG requirements, its ability to produce high-quality crash diagrams makes it an intriguing product. While it would not suffice as a stand-alone product, it may be possible to incorporate Intersection Magic with another product (e.g., CARE) to create crash diagrams. However, because of the cost of Intersection Magic, it may not make sense to use to it for only this limited purpose.

Intersection Magic is a proprietary software created by Pd' Programming. Therefore, purchasers of Intersection Magic do not have access to the source code, and would be unable to make modifications to the software. It is unknown whether Pd' Programming would consider working with MAG to customize Intersection Magic.

AZLGSP – AZLGSP is a Microsoft Access application, with custom forms that guide the user to create the applicable reports and crash diagrams. The design of the forms is very straightforward, and guides the user step-by-step through the analysis process, making AZLGSP very easy to use. AZLGSP only produces reports in text-format, and does not currently create any graphs. However, because it is a Microsoft Access application, it would be relatively straightforward to add additional reporting features.

While AZLGSP does not meet most of the MAG requirements, its ability to produce high-quality crash diagrams makes it an intriguing product. While it would not suffice as a stand-alone product, it may be possible to incorporate AZLGSP with another product to create crash diagrams. Because AZLGSP is free, it may make sense to use to it rather than Intersection Magic for this purpose. However, it should be noted that the time to create a crash diagram with AZLGSP is considerably longer than for Intersection Magic because of the Microsoft Access platform.

Finally, AZLGSP also allows the user to modify the underlying crash database to add crash data, either manually or by importing database files.

CDART – CDART is a web-based program for use by PennDOT employees for crash analysis and mapping. CDART's primary purpose is segment analysis, and it provides a high-quality interface that guides the user through the analysis process. CDART is most notable for its integration with GIS, which allow crash data to be easily mapped and overlaid with other GIS layers (e.g., number of travel lanes, topography). It also integrates with PennDOT's digital video log, allowing users to access digital photos of crash locations.

Because CDART was designed specifically for PennDOT, and not for commercial purposes, it would not be possible for MAG to simply start using CDART. Rather, CDART would need to be reconfigured significantly to allow it to integrate with MAG's data. Additionally, CDART uses Oracle 9i as its platform, and GeoMedia Web Map for its GIS applications. However, MAG currently uses SQL Server for databases, and ArcView for its GIS. Migrating to Oracle for safety analysis would thus come with large costs and technical difficulties, which makes it unlikely that CDART could provide the basis for MAG's crash analysis system.

Conclusions and Recommendations

Overall, this evaluation shows that there are several existing crash analysis software packages that satisfy some of MAG's crash analysis needs; only CARE, however, has the potential to serve of MAG's primary crash analysis system. Of the four programs, CARE is the only program able to generate all of the crash reports currently identified by MAG. In addition, CARE is fully integrated with GIS, which increases its functionality.

While CARE may meet current needs, there may be drawbacks to relying on CARE for crash analysis over the long-term. CARE is a proprietary software application, which limits the ability to customize it. As safety research methods evolve, and more sophisticated crash-analysis tools become accepted, it will be important for MAG's crash analysis tools to be able to adapt. CARE staff indicated a willingness to work with clients to customize CARE, but even under this scenario MAG staff would not have the ability to customize CARE. It is recommended that CARE be considered in more detail with respect to these issues to determine whether it fully meets MAG's needs.

For the reasons stated above, a jurisdiction-developed and fully-customizable crash analysis tool, may be the preferred long-term solution. Such a tool would allow MAG to develop and conduct the type of crash analysis desired for the region, and if developed appropriately would allow the tool to evolve as the MAG program evolves. While CDART itself is not a solution for MAG, for reasons stated above, it offers a good example of how an in-house software system can provide an agency with a customized solution to its crash analysis needs.