Roadway Safety Data Program

ALABAMA'S SAFETY PLANNING TOOLS FOR MPOs

ROADWAY SAFETY DATA AND ANALYSIS

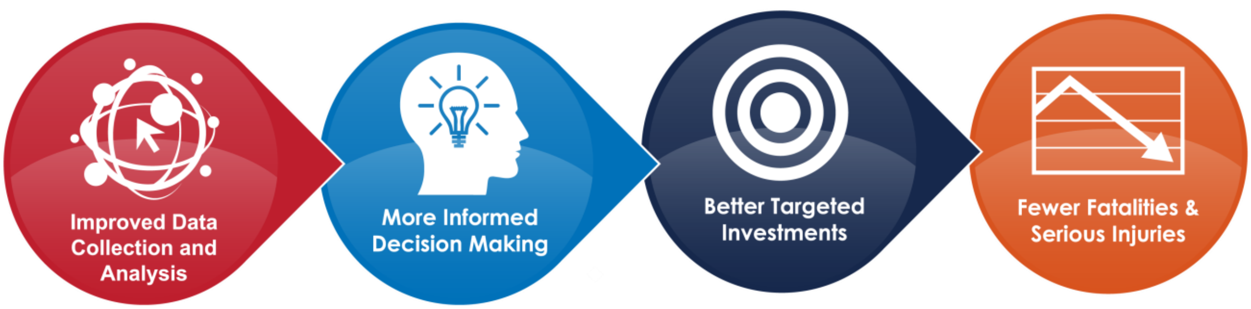
CASE STUDY

FHWA-SA-17-015

Federal Highway Administration Office of Safety

Roadway Safety Data Program

http://safety.fhwa.dot.gov/rsdp/



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U.S. Department of Transportation
Federal Highway Administration

Safe Roads for a Safer Future
Investment in roadway safety saves lives
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Notice

Quality Assurance Statement

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The Alabama Department of Transportation (ALDOT) led the effort to develop ALSAFE, a spreadsheet-based safety tool that can be used for short- and long-range transportation safety planning. ALDOT developed ALSAFE to serve as a safety planning tool for Metropolitan Planning Organizations (MPOs). The short-range planning process allows MPOs to develop benchmarks and performance measures, evaluate crash trends and patterns, and identify potential countermeasures for further evaluation. The long-range planning component of ALSAFE provides predictive equations to estimate changes in crash frequency or severity influenced by area-wide planning characteristics.</td></tr>
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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		NOTE: volumes greater than 1000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
°C	Celsius	1.8C+32	Fahrenheit	°F
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.
(Revised March 2003)

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ACRONYMS

AADT	Average Annual Daily Traffic
ALDOT	Alabama Department of Transportation
CARE	Critical Analysis Reporting Environment
FAST	Fixing America's Surface Transportation Act
GIS	Geographic Information System
HPMS	Highway Performance Monitoring System
HSIP	Highway Safety Improvement Program
MAP-21	Moving Ahead for Progress in the 21st Century Act
MPO	Metropolitan Planning Organization
NCHRP	National Cooperative Highway Research Program
RPO	Regional Planning Organization
SPF	Safety Performance Function
TAZ	Traffic Analysis Zone
VMT	Vehicle-Miles Traveled

EXECUTIVE SUMMARY

The Alabama Department of Transportation (ALDOT) led the effort to develop ALSAFE, a spreadsheet-based safety tool that can be used for short- and long-range transportation safety planning. ALDOT developed ALSAFE to serve as a safety planning tool for Metropolitan Planning Organizations (MPOs). The short-range planning process allows MPOs to develop benchmarks and performance measures, evaluate crash trends and patterns, and identify potential countermeasures for further evaluation. The long-range planning component of ALSAFE provides predictive equations to estimate changes in crash frequency or severity influenced by area-wide planning characteristics. ALDOT is currently conducting Phase II of the ALSAFE project, where ALDOT will replicate the ALSAFE tool and process for three more MPOs.

INTRODUCTION

The Alabama Department of Transportation (ALDOT) teamed with the University of Alabama in Huntsville and an engineering consulting firm (Cambridge Systematics) to develop ALSAFE, a spreadsheet-based safety tool that can be used for short- and long-range transportation safety planning. ALDOT developed ALSAFE to serve as a safety planning tool for Metropolitan Planning Organizations (MPOs). Using data from the Huntsville MPO, the project team compiled, organized, and analyzed the data to develop ALSAFE. Following testing, ALDOT made the tool available to all potential users in the state.

BACKGROUND

Prior to ALSAFE, the State did not have a formal process to analyze safety in project planning. ALDOT wanted a process to make logical, data-driven decisions and incorporate safety into new projects. ALDOT first considered using the planning software PLANSAFE, which the National Cooperative Highway Research Program (NCHRP) released in NCHRP CRP-CD-78 *PLANSAFE: Forecasting the Safety Impacts of Socio-Demographic Changes and Safety Countermeasures*. After further examination, ALDOT decided that PLANSAFE did not fit the exact needs of the State; however, ALDOT still desired to create a tool modeled after the concept and functionality of PLANSAFE.

OBJECTIVE

As a short-range safety planning tool, MPOs can use ALSAFE to:

- Develop benchmarks.
- Evaluate crash trends and characteristics.
- Identify and evaluate focus crash types.
- Identify countermeasures.

As a long-range safety planning tool, MPOs can use a set of built-in equations to evaluate and understand the impacts of long-term demographic changes, land uses changes, and planning decisions on transportation safety.

AUDIENCE

This case study may be of interest to the following audiences:

- State Department of Transportation: Safety Engineering, Design, Planning, and Geographic Information System (GIS) units.

- Local and Regional: City and County Public Works/Engineering/Transportation Departments, MPOs, and Regional Planning Commissions.
- Local Technical Assistance Programs.
- Consultants and private industries involved in safety.
- Universities and academia

PROGRAM APPLICATION

DEVELOPMENT OF ALSAFE

The project team chose the Huntsville MPO to conduct the first phase of the ALSAFE project. The Huntsville MPO had a comprehensive data set, which included crash data and roadway inventory data. The consultant used this data to develop a test version of the spreadsheet tool. The project team also integrated other data sets, such as land use, demographics, Vehicle-Miles Traveled (VMT), and population density. ALDOT sponsored workshops attended by various MPO and Regional Planning Organization (RPO) planners throughout the State. The project team trained the planners on the basics of safety planning, (e.g., network screening). The MPO/RPO planners supported the tool and agreed that they would find the long-range planning tool useful in their jurisdictions.

The project team developed ALSAFE knowing that MPOs are often faced with challenges such as limited staff resources and the lack of personnel with a technical background in transportation safety or planning. ALSAFE is a tool that can provide advanced analyses using multiple data sets and provide output that is understandable and supports MPOs' decision making.

MPOs can use the equations in the long-range safety planning process to evaluate the safety impacts of various future scenarios (e.g., land use changes, demographic shifts). The modelers developed Safety Performance Functions (SPFs) specific to Huntsville using negative binomial regression techniques and data from Huntsville. The models from the long-range planning process rely on data from the Critical Analysis Reporting Environment (CARE), the MPO travel demand model, signal inventory files, the Highway Performance Monitoring System (HPMS), the U.S. Census TIGER/Line roadway network, and the American Community Survey.

APPLICATIONS OF THE SHORT-RANGE PLANNING PROCESS

ALSAFE provides ALDOT and MPOs with two processes for integrating quantitative safety into transportation planning practices, which are a short-range and a long-range planning process. The short-range planning process allows MPOs to develop benchmarks and performance measures, evaluate crash trends and patterns, characterize existing safety concerns at a regional and sub-regional level, and identify potential countermeasures for further evaluation.

Develop Benchmarks and Performance Measures

With the use of ALSAFE, MPOs can compare their own regional safety performance with other MPOs in the State or elsewhere. The Moving Ahead for Progress in the 21st Century Act (MAP-21) and the current legislation Fixing America's Surface Transportation (FAST Act) continues to require MPOs to report on five performance measures in order to receive federal funding. ALSAFE includes the four safety performance measures required by MAP-21 and Phase II of the ALSAFE project will seek to incorporate the fifth performance measure required by the FAST Act (pedestrian and bicyclist fatalities and serious injuries). ALSAFE also allows the agencies to add their own measures as needed.

Evaluate Crash Trends

ALSAFE analyzes various crash variables to identify trends or patterns that are occurring in a specified area, for specified sub-populations, and for roadway types. These variables include:

- Driver age and gender.
- Number of vehicles involved.
- Type of vehicles involved.
- Crash distribution by Traffic Analysis Zone (TAZ), Urban/Rural classification, route type, or intersections.
- Time of day (e.g., year, month, day of week, hour).
- Behavioral and environmental factors.

Evaluate Crash Types

ALSAFE also analyzes the crash data to identify trends for specific crash types:

- Crash type (e.g., rear-end, run-off-road, angle, sideswipe, head-on, pedestrian, bicycle).
- Geographic distribution of crash type.
- Evaluation of risk factors.

Identify and Investigate Countermeasures

The decision to implement a specific countermeasure in a particular location or area requires consideration of existing conditions and crash trends. For locations experiencing a high frequency of crashes, the safety engineer may need to review crash narratives, traffic volumes, and turning movements. Although ALSAFE cannot select or recommend countermeasures, the program uses various national sources for engineering staff to investigate countermeasures in more detail. Staff can conduct "what if" analyses based on documented Crash Modification Factors (CMFs) from the CMF Clearinghouse.

APPLICATIONS OF THE LONG-RANGE PLANNING PROCESS

The long-range planning component of ALSAFE provides predictive equations to estimate changes in crash frequency or severity influenced by area-wide planning characteristics such as changing demographics, land use changes, technological innovation, and mode shifts. The equations produce estimates of total crashes, fatal crashes, serious injury crashes, and property damage only crashes for future scenarios. These equations allow planners to proactively identify and prepare for such trends and to modify planning activities to possibly reduce future safety problems. The analyst can apply ALDOT annual crash costs to estimate the financial implications of safety decision-making.

RESULTS

Users of ALSAFE can produce tables, graphs, and maps identifying locations, crash patterns, and crash types. For example, Figure 1 shows the over-representation of severe crashes among selected crash types. In this case, single vehicle roadway departure crashes account for only 14 percent of total crashes, but represent 29 percent of all severe crashes. This type of information can help the analyst prioritize improvement locations; in this case, for example, locations with a history roadway departure crashes or locations with similar risk factors as sites with high crash frequencies.

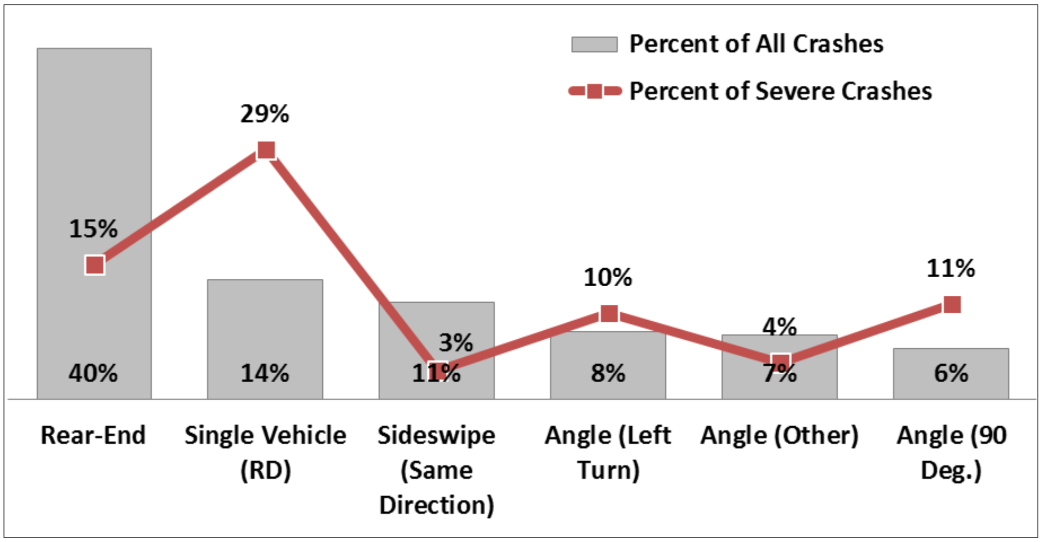

Figure 1. Sample output of the short range planning tool.

FUNDING

ALDOT used the Highway Safety Improvement Program (HSIP) to fund the development and implementation of ALSAFE.

BENEFITS

Alabama identified the following benefits for MPOs implementing ALSAFE in safety analyses:

- Evaluate current system performance (how does an individual MPO compare to other MPOs within the state, or to the state as a whole?).
- Understand current crash trends with regard to the temporal component of crashes (hour, day, month, year), the number and types of users involved (single vehicle, multiple vehicle, motorcycles, etc.), and behavioral and environmental contributing factors (alcohol use, speeding, weather, etc.).
- Use GIS software to visualize crash data on a map of TAZs (e.g., from running a query on roadway departure crashes as a percent of all crashes, an analyst can see that rural areas have more roadway departure crashes).
- Identify potential countermeasures for implementation on a regional or sub-regional scale, based on the most prevalent crash type.

BARRIERS AND HOW THEY WERE OVERCOME

The project team noted that it was a difficult task to gather, process, and clean the raw data from the Huntsville MPO to fit into ALSAFE. This time-consuming process is repeating with other MPOs as Phase II of the ALSAFE project continues. Some efficiency will be gained in future years as the process is refined and data transfer and translation routines are worked out.

LESSONS LEARNED

The creators of ALSAFE noted the importance of identifying the target users of a tool when in the development process. MPO personnel, some without technical expertise, would be using the tool, so the safety planning process should be easy to understand. The developers desired MPOs to follow along the safety planning process and therefore made a product with robust capabilities and easy to learn and use.

NEXT STEPS

ALDOT is currently conducting Phase II of the ALSAFE project. ALDOT is replicating the ALSAFE tool and process for three more MPOs. The project team is interested to see how ALSAFE will transfer from the Huntsville MPO experience to these new data sets.

ALDOT also noted that data is constantly improving. The University of Alabama in Huntsville is working on a methodology for accurately estimating Average Annual Daily Traffic (AADT), which will help improve the models for both short-range and long-range processes.

Lastly, ALDOT desires ALSAFE to be a web-based tool in future iterations, where MPOs can access data from any computer with internet access. It is currently a software application that is limited to individual computers.

REFERENCES

The following resources were consulted in development of this case study:

1. Tim Barnett (ALDOT), Beth Wemple (Cambridge Systematics), Alexander Maistros (Cambridge Systematics). Telephone Interview. November 17, 2016.
2. Cambridge Systematics. *ALSAFE: Quantitative Safety Planning Tools for Alabama MPOs, Progress Update*. 2015.

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