An Innovative Approach to Proactively Evaluate Safety Performance of Future Transportation Projects

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Presentation Outline

- ❑ Crash Facts
- ❑ Overview of Conventional Safety Analysis
- ❑ Emerging Techniques for Proactive Safety Analysis
- ❑ SSAM Case Study – revive 285 top end
- ❑ References / Useful Links

Crash Facts

➢ Motor vehicle crashes – Leading cause of death for 4-34 age group [1]

➢ Crash Contributors -

- ❖ Human
- ❖ Roadway / Environment
- ❖ Vehicle

[1] NHTSA Traffic Safety Facts, DOT HS 810 936, April 2008

Note: Economic Impact of U.S. Motor Vehicle Crashes Reaches $230.6 Billion, NHTSA Study

Conventional Safety Analysis

- ❑ Statistical analysis of historic crash data
- ❑ Review and analysis of police reported crash reports

<u>Limitations of Conventional Safety Analysis:</u>

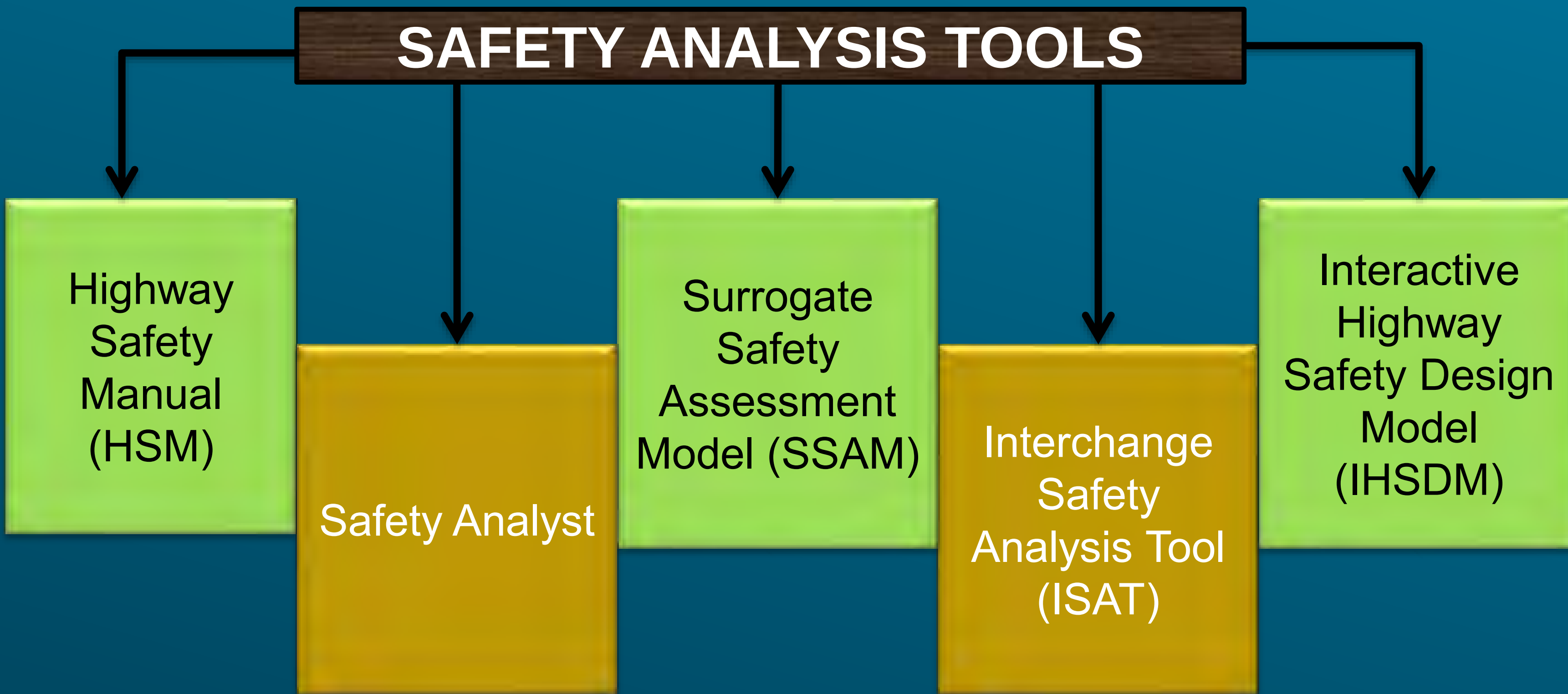
- ❑ A reactive approach
- ❑ Limitations in testing effectiveness of new design alternatives

The Solution…

To develop / adopt sound procedures to evaluate / predict safety performance measures for

- ❑ New roadway designs
- ❑ Operational strategies

Safety Tool Box



Highway Safety Manual (HSM) – Roadway Safety Management Process (RSMP)[2]

[2] Highway Safety Manual

Predictive Safety Evaluation (HSM)

Application Scenarios

- ❖Existing conditions
- ❖Alternative designs
- ❖New roadway designs
- ❖Countermeasure effectiveness

Applicable Roadway Facility

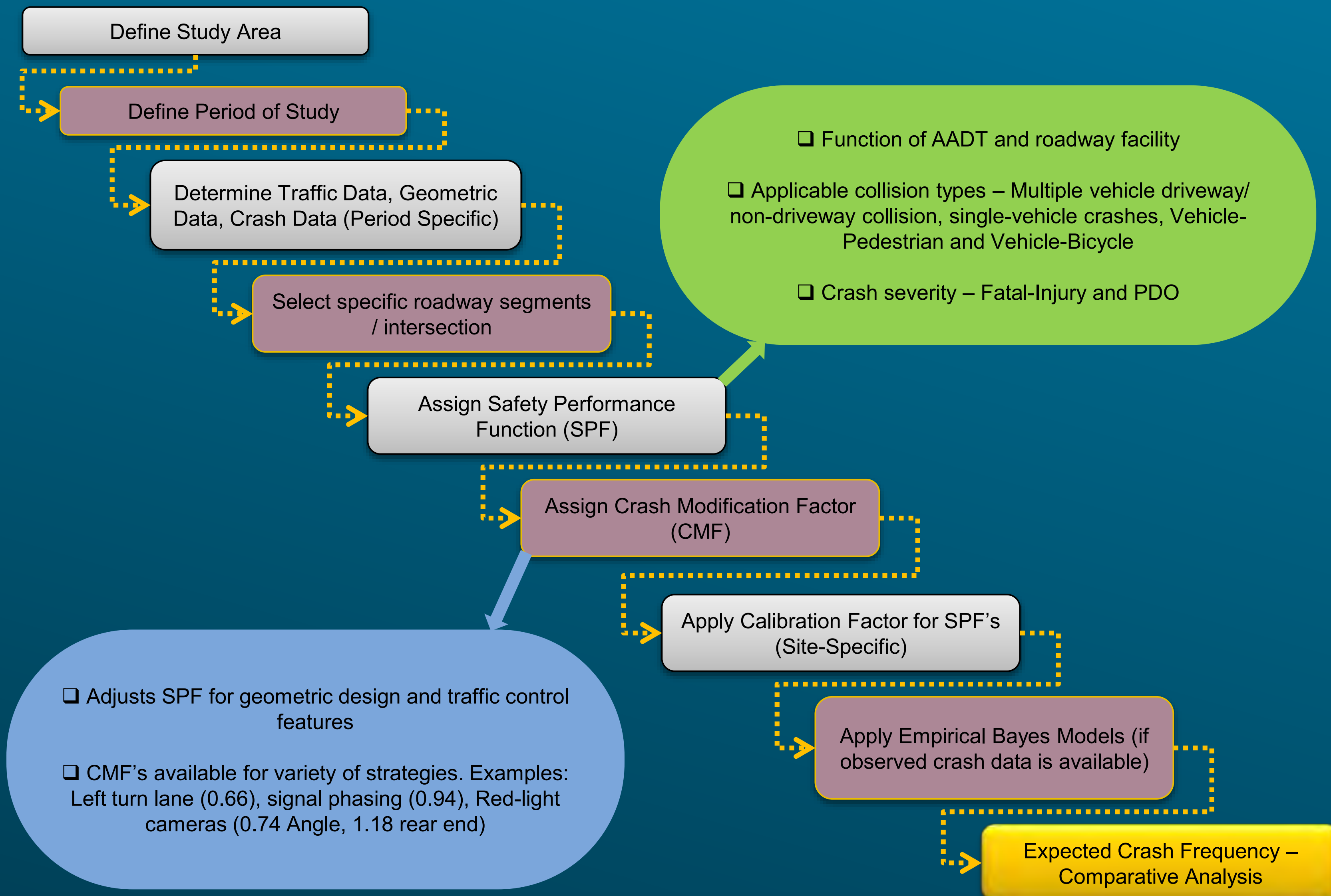
- ❖Two lane rural roadways (two-way)
- ❖ Multi-lane rural roadways
- ❖ Urban and sub-urban arterials

Safety Performance Measures

- ❖ Expected average crash frequency
- ❖ Crash severity
- ❖ Crash type

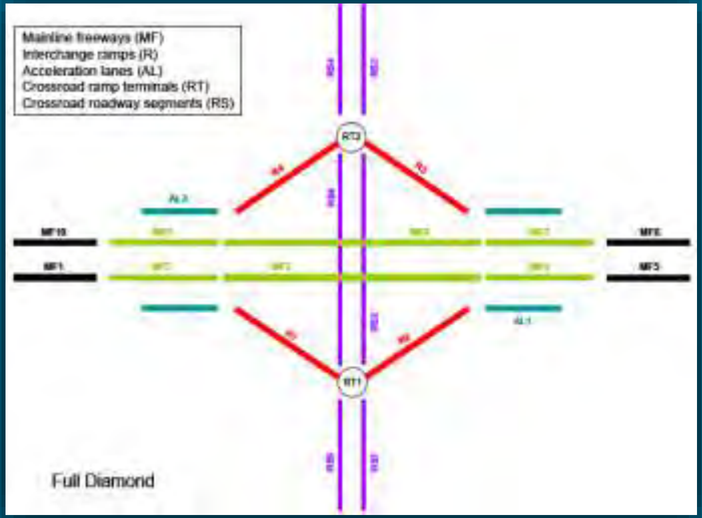
Predictive Safety Evaluation (HSM) [2]

[2] Highway Safety Manual



Interchange Safety Analysis Tool (ISAT)

- ❑ Evaluates safety impacts of geometric design and traffic control features
- ❑ Spreadsheet tool
- ❑ Evaluates freeway system and service interchanges, Isolated and series of interchanges
- ❑ Safety performance functions (SPF) built-in to the tool
- ❑ Historic crash data (up to 10 years) can be input, if available
- ❑ Combines crash data and predicted crashes using Empirical Bayes methodology
- ❑ Outputs
    - Predicted crashes by interchange element (ramp, intersections, arterial and freeway)
    - Predicted crashes by type
    - Predicted crashes by year



ISAT Interchange Roadway Segments Definition
(Source: ISAT User Manual)

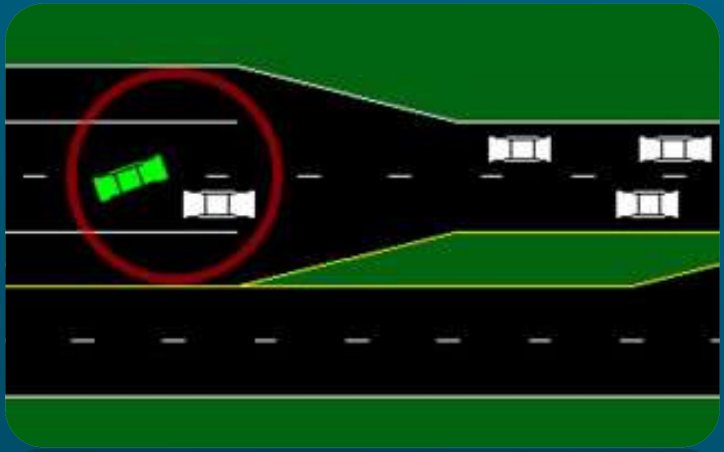
Surrogate Safety Assessment Model (SSAM)

❖ “Conflict Analysis” based safety evaluation technique

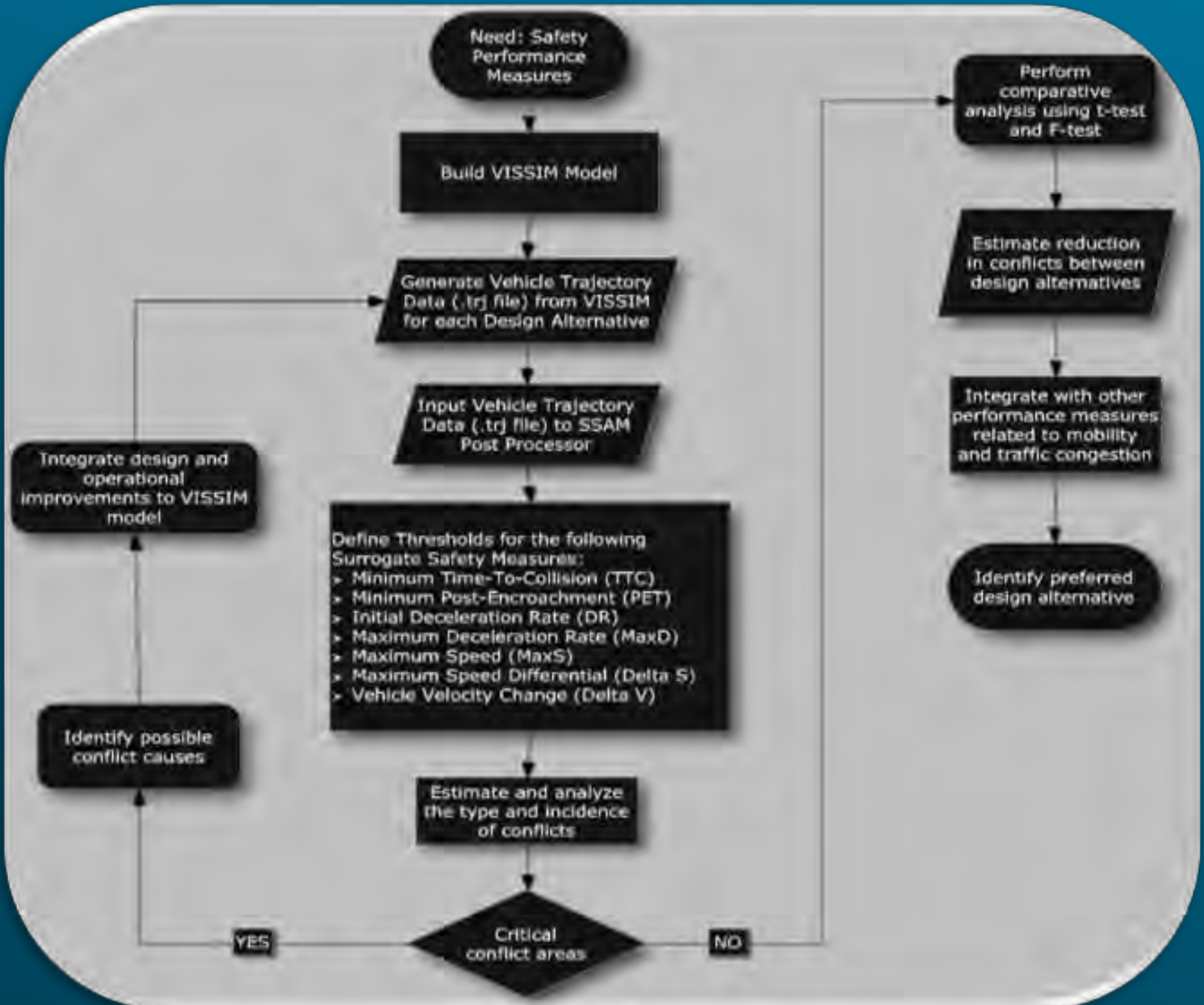
❖ A conflict is defined as an observable situation in which two or more road users approach each other in time and space to such an extent that there is risk of collision if their movements remain unchanged.

❖ Federal Highway Administration (FHWA) tool for comparative safety evaluation

❖ A post processor that combines microscopic simulation and automated conflict analysis



Surrogate Safety Assessment Model – Work Flow



SSAM Case Study - revive285

- Rated in top 35 most travelled roadways in the US [3]
- Project length – 17 Miles
- Key project need – "Provide safer travel conditions along I-285"

[3] http://www.fhwa.dot.gov/policyinformation/tables/02.cfm

SSAM Case Study - revive285

Why SSAM for safety evaluation?

- ❑ Complex nature of traffic operations
- ❑ Shockwave effect due to operational impacts from adjacent interchanges
- ❑ An approach to capture safety impacts of dynamic nature of traffic operations
- ❑ Ability to capture temporal variation of traffic on safety
- ❑ Ability to indirectly capture impacts of heavy vehicles on safety

SSAM Case Study - revive285

Define crash to conflict relationship

1

- ❑ Crash Data Sieving
- ❑ Estimate conflict rate for existing conditions
- ❑ Preliminary statistical analysis

Segment	Number Of Crashes			Percent Vehicle Only Crashes	Crash Rate Per 100 Million VMT			Conflict Rate Per 100 Million VMT
	All Crashes	Vehicle Only Crashes	Non-Vehicle Crashes		All Crashes	Vehicle Only Crashes	Non-Vehicle Crashes	
I-285 Eastbound from Cobb Pkwy to I-75	52	41	11	79%	259.41	204.54	54.88	904,145
I-285 Eastbound from I-75 to Northside Pkwy	127	101	26	80%	184.06	146.38	37.68	469,888
I-285 Eastbound from Northside Pkwy to Riverside Dr	77	64	13	83%	126.68	105.29	21.39	923,704
I-285 Eastbound from Riverside Dr to Roswell Rd	141	122	19	87%	243.42	210.62	32.80	346,041
I-285 Eastbound from Roswell Rd to SR 400	144	131	13	91%	307.43	279.68	27.75	38,610,350
I-285 Eastbound from SR 400 to Ashford Dunwoody Rd	129	114	15	88%	254.91	225.27	29.64	1,042,893
I-285 Eastbound from Ashford Dunwoody Rd to Chamblee Dunwoody Rd	109	100	9	92%	175.89	161.37	14.52	277,819
I-285 Eastbound from Chamblee Dunwoody Rd to Peachtree Industrial Blvd	267	251	16	94%	334.28	314.25	20.03	21,539,802
I-285 Eastbound from Peachtree Industrial Blvd to Buford Hwy	169	162	7	96%	401.36	384.73	16.62	26,811,549
I-285 Eastbound from Buford Hwy to I-85	188	171	17	91%	337.60	307.08	30.53	31,601,893
I-285 Eastbound from I-85 to Chamblee Tucker Rd	96	78	18	81%	202.61	164.62	37.99	203,426
I-285 Westbound from Cobb Pkwy to I-75	39	33	6	85%	194.56	164.63	29.93	1,289,302
I-285 Westbound from I-75 to Northside Pkwy	170	155	15	91%	246.38	224.64	21.74	16,032,053
I-285 Westbound from Northside Pkwy to Riverside Dr	138	125	13	91%	227.03	205.65	21.39	8,354,024
I-285 Westbound from Riverside Dr to Roswell Rd	87	74	13	85%	150.20	127.75	22.44	5,052,337
I-285 Westbound from Roswell Rd to SR 400	101	91	10	90%	215.63	194.28	21.35	2,715,847
I-285 Westbound from SR 400 to Ashford Dunwoody Rd	104	100	4	96%	205.51	197.60	7.90	2,083,453
I-285 Westbound from Ashford Dunwoody Rd to Chamblee Dunwoody Rd	96	82	14	85%	154.91	132.32	22.59	11,196,472
I-285 Westbound from Chamblee Dunwoody Rd to Peachtree Industrial Blvd	161	148	13	92%	201.57	185.29	16.28	19,266,335
I-285 Westbound from Peachtree Industrial Blvd to Buford Hwy	141	137	4	97%	334.86	325.36	9.50	12,803,070
I-285 Westbound from Buford Hwy to I-85	122	98	24	80%	219.08	175.98	43.10	7,237,808
I-285 Westbound from I-85 to Chamblee Tucker Rd	81	61	20	75%	170.95	128.74	42.21	5,988,265
Average	124	111	13	88%	233	207	26	9,761,385
Standard Deviation	47	47	5	6%	68	71	11	11,065,208
Minimum	39	33	4	75%	127	105	8	203,426
Maximum	267	251	26	97%	401	385	55	38,610,350
Correlation					0.70			

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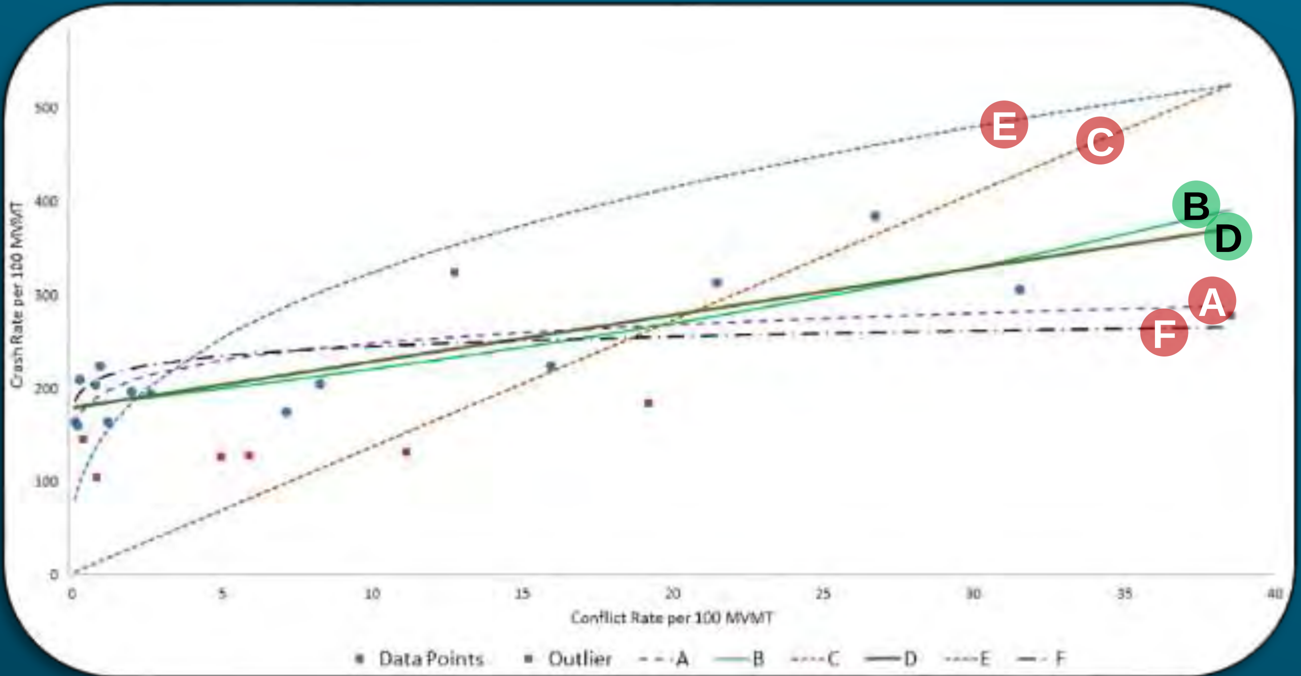
SSAM Case Study - revive285

Define crash to conflict relationship

2

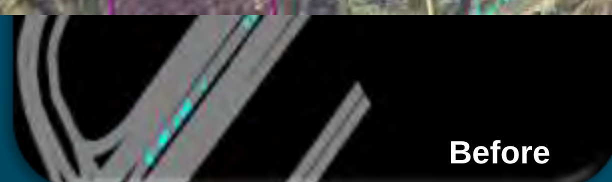
ID	Regression Equation	R Square
A	$\text{Crash rate} = 41.21(\text{Conflict rate})^{0.1116}$	0.55
B	$\text{Crash rate} = 180.67\, e^{(2E-8 \times \text{Conflict rate})}$	0.75
C	$\text{Crash rate} = 1.36E-5 \times \text{Conflict rate}$	0.63
D	$\text{Crash rate} = 5E-6 \times \text{Conflict rate} + 178.52$	0.758
E	$\text{Crash rate} = (\text{Conflict rate})^{0.3586}$	0.99
F	$\text{Crash rate} = 15.222 \times \ln(\text{Conflict rate})$	0.96

- Regression Analysis
- Fitted curve analysis



SSAM Case Study - revive285

based on regression equation “B” or “D”



SAFETY FIRST

SSAM Case Study - revive285 top end

Comparative Analysis

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- ❑ Segment level crash rate comparison

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SSAM Case Study - revive285

Operations Vs. Safety – Side by Side Comparison

SSAM Case Study - revive285

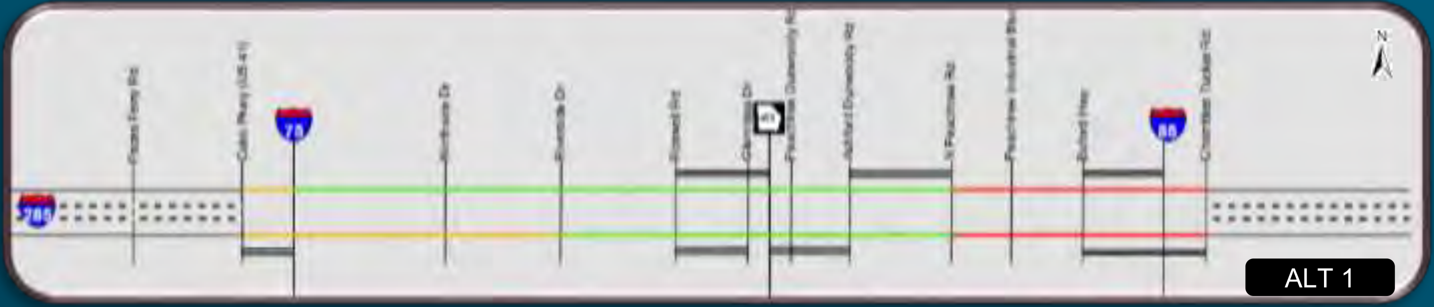
Operations Vs. Safety – Side by Side Comparison

AM Peak LOS

PM Peak LOS

LOS A-C
LOS D
LOS E
LOS F

Predicted Crash Rate



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Conclusions…

- Be Proactive and not reactive - Include safety evaluation as part of project development process
- Tool selection from Safety Tool Box should align with your project needs and complexity
- Tools are just tools, use your engineering judgment to obtain meaningful, reasonable and defendable outputs

References / Useful Links

- US Department of Transportation (2007), Interchange Safety Analysis Tool (ISAT): User Manual, Publication No. FHWA-HRT-07-045
- US Department of Transportation (2008), Surrogate Safety Assessment Model (SSAM): Tech Brief, Publication No. FHWA-HRT-08-049
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- US Department of Transportation (2007), Safety Assessment of Interchange Spacing on Urban Freeways, Publication No. FHWA-HRT-07-031
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- http://safety.fhwa.dot.gov/
- Highway Safety Manual

Imagine the result

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