Reliability of Safety Management Methods Systemic Safety Programs

Presented by
Tim Harmon, PE

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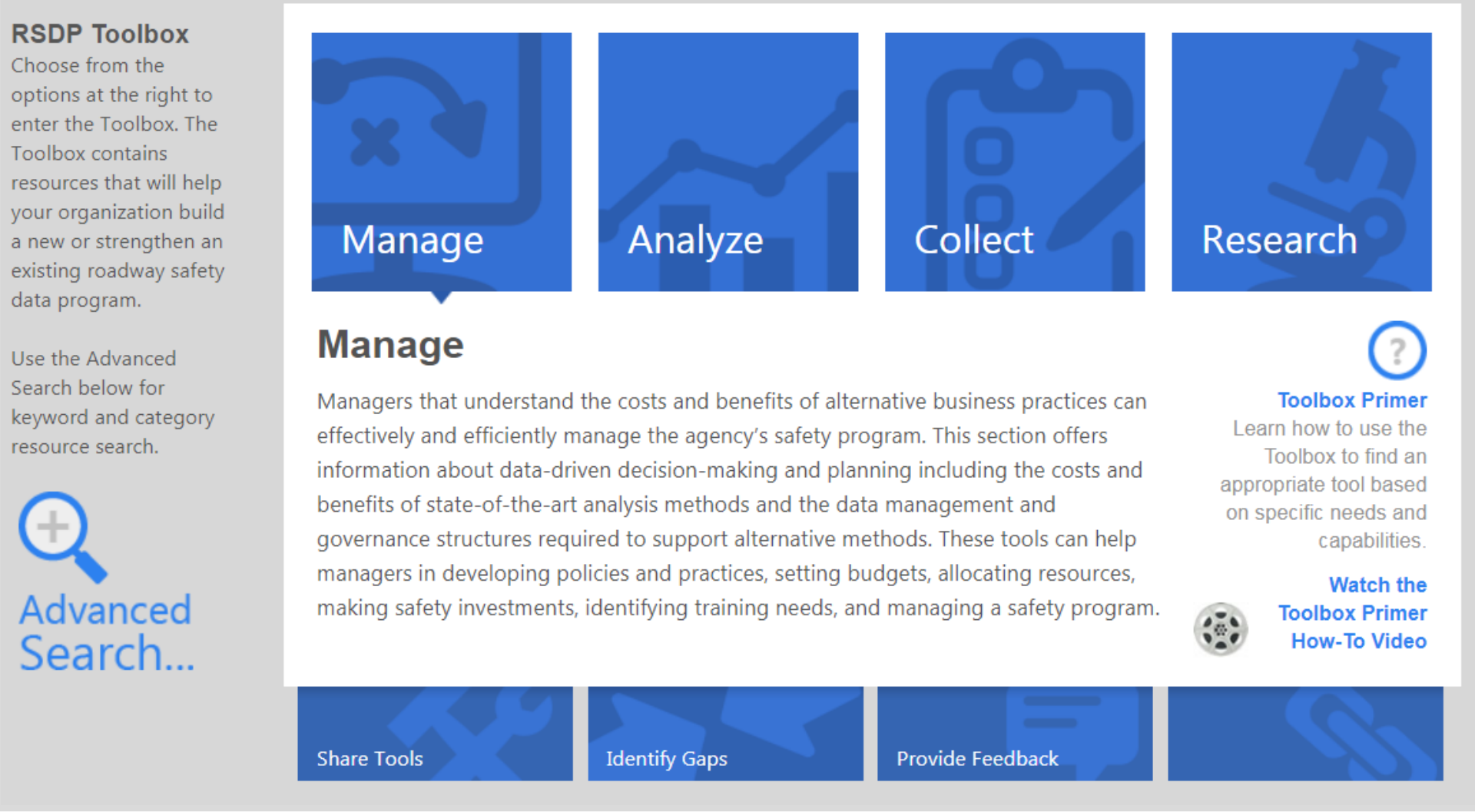
Outline

- Project Background
- Describe Problem
- Research Methods
- Interpreting Results
- Implications for Practice



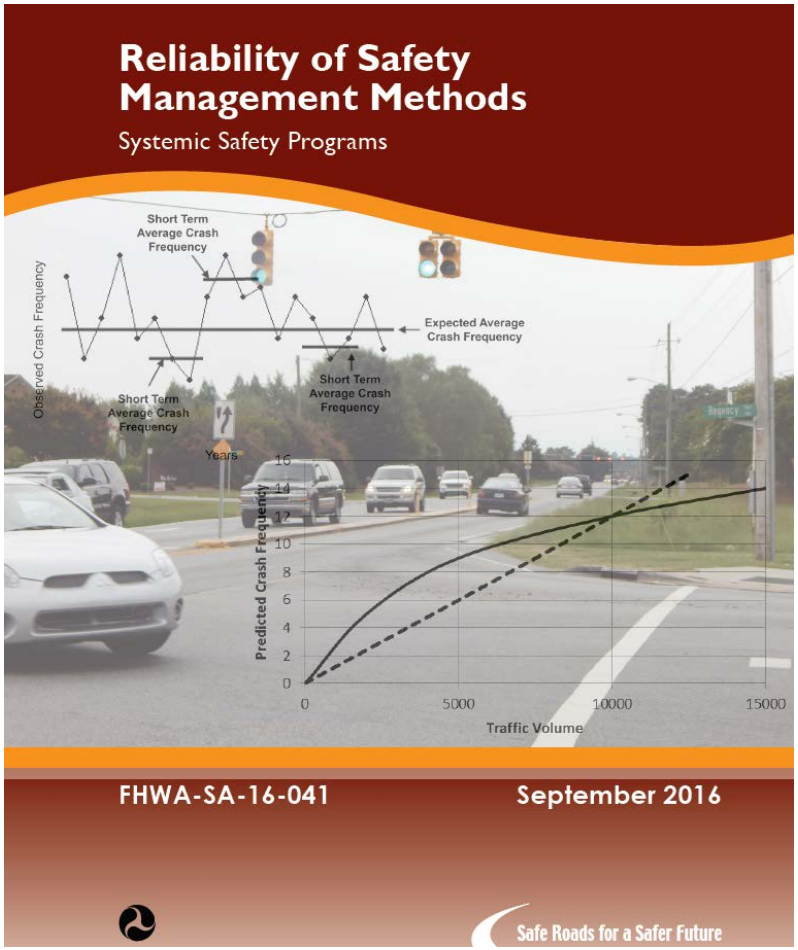
FHWA Roadway Safety Data and Analysis Toolbox

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

Reliability of Safety Management Methods

Series of Guides

- Network Screening
- Network Screening Measures
- Diagnosis
- Countermeasure Selection
- Safety Effectiveness Evaluation
- Systemic Safety Programs



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

Systemic Safety Programs Guide

- Define “crash-based” and “systemic” projects
- Characterize state-of-the-practice
- Demonstrate value of systemic approach
- Guidance for allocating funds

Crash-Based and Systemic Projects

Start with the Basics

- Crashes occur with frequency and severity
- Caused by driver, vehicle, roadway, or other
- Engineering-related improvements:
  - Fix geometric or traffic deficiencies
  - Reduce negative impacts of other factors
- Spectrum of project types

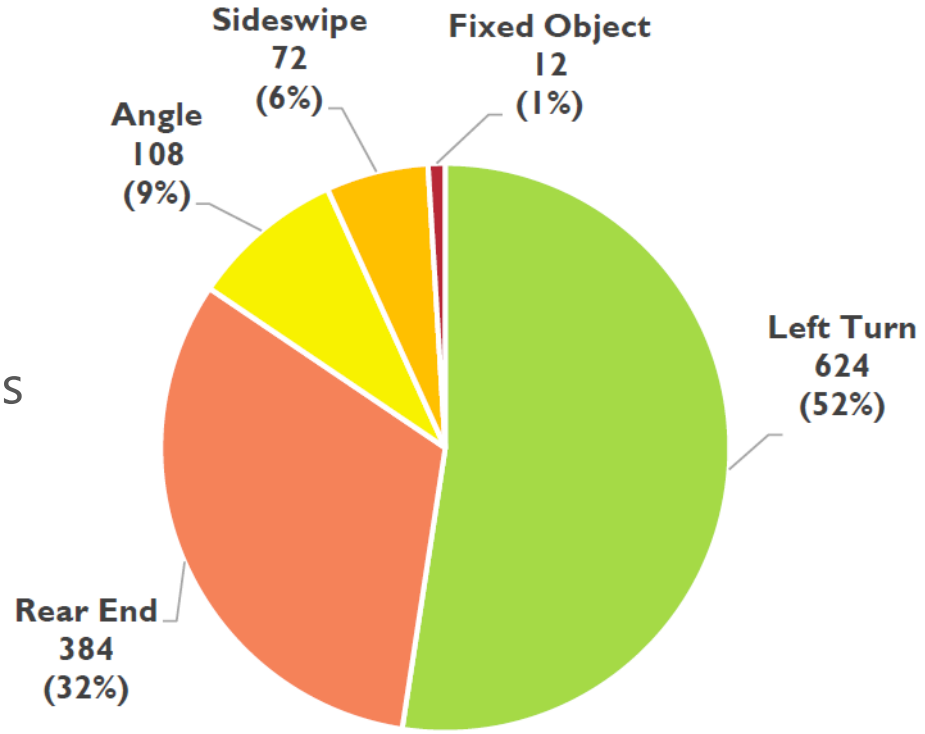
Crash-Based Projects

- Sites have unique crash experience
- **Address sites with high PSI**
- One project per site
- **Diagnose every location**
- Unique countermeasures
- Higher effectiveness
- Lower efficiency

- Example: Roundabout

Systemic Projects

- Many sites have similar experience
- System-level diagnosis
- **Target specific concern**
- **Many sites per project**
- Predetermined countermeasures
- Lower effectiveness
- Higher efficiency



- Example: Flashing Yellows

Difference is in the Diagnosis

Crash-Based (Hotspot)

- Select and treat sites based on **site-specific** safety concerns

Systemic

- Select and treat sites based on **network-wide** safety concerns

Both methods can have:

- High or low cost treatments
- Basic to advanced methods
- High or low treatment effectiveness

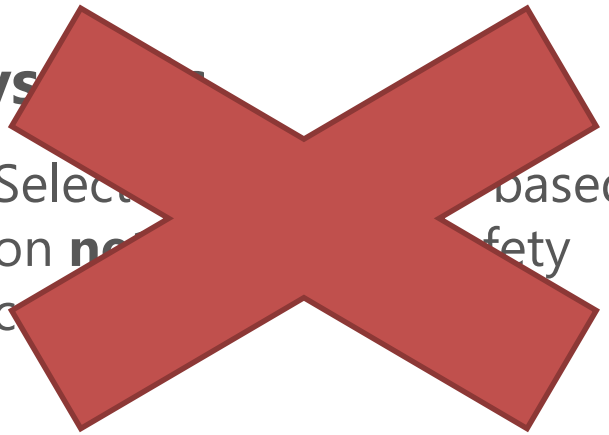
How to Compare Effectiveness?

- **Many interpretations of systemic in practice**
- **No information about systemic approach**
- Difficult to identify systemic projects
- Minimal data about pretreatment frequency
- Wide range of potential costs
- Wide range of CMFs

How to Compare Effectiveness?

Cr[illegible]ased ([illegible]ot)

- Selec[illegible]s based on **s**[illegible]ty



Sys[illegible]

- Selec[illegible]based on **no**[illegible]fety c[illegible]

Typical Implementations….

Crash-Based

- Higher unit cost
- Higher effectiveness

Systemic

- Lower unit cost
- Lower effectiveness

Value of Systemic Projects

General Method

- Select crash-based and systemic countermeasures
- Analyze countermeasure data
- Consider hypothetical implementations
- Compare effectiveness

Characterize Typical Projects

- Select treatments for study
- Collect implemented project data
  - 2014 HSIP reports
  - FHWA research
  - State databases
- Some simple before-after evaluation data

Crash-Based Countermeasures

- Add left turn lane
- High friction surface
- Reconfigure intersection
- Reduce skew and add LTL
- Road diet w/o resurface
- Road diet with reconstruction
- Roundabout

Systemic Countermeasures

- Cable median barrier
- Rumble strips
- Horizontal curve warning signs
- Ramp curve warning signs
- Various signal improvements
- Various stop improvements

Methodology

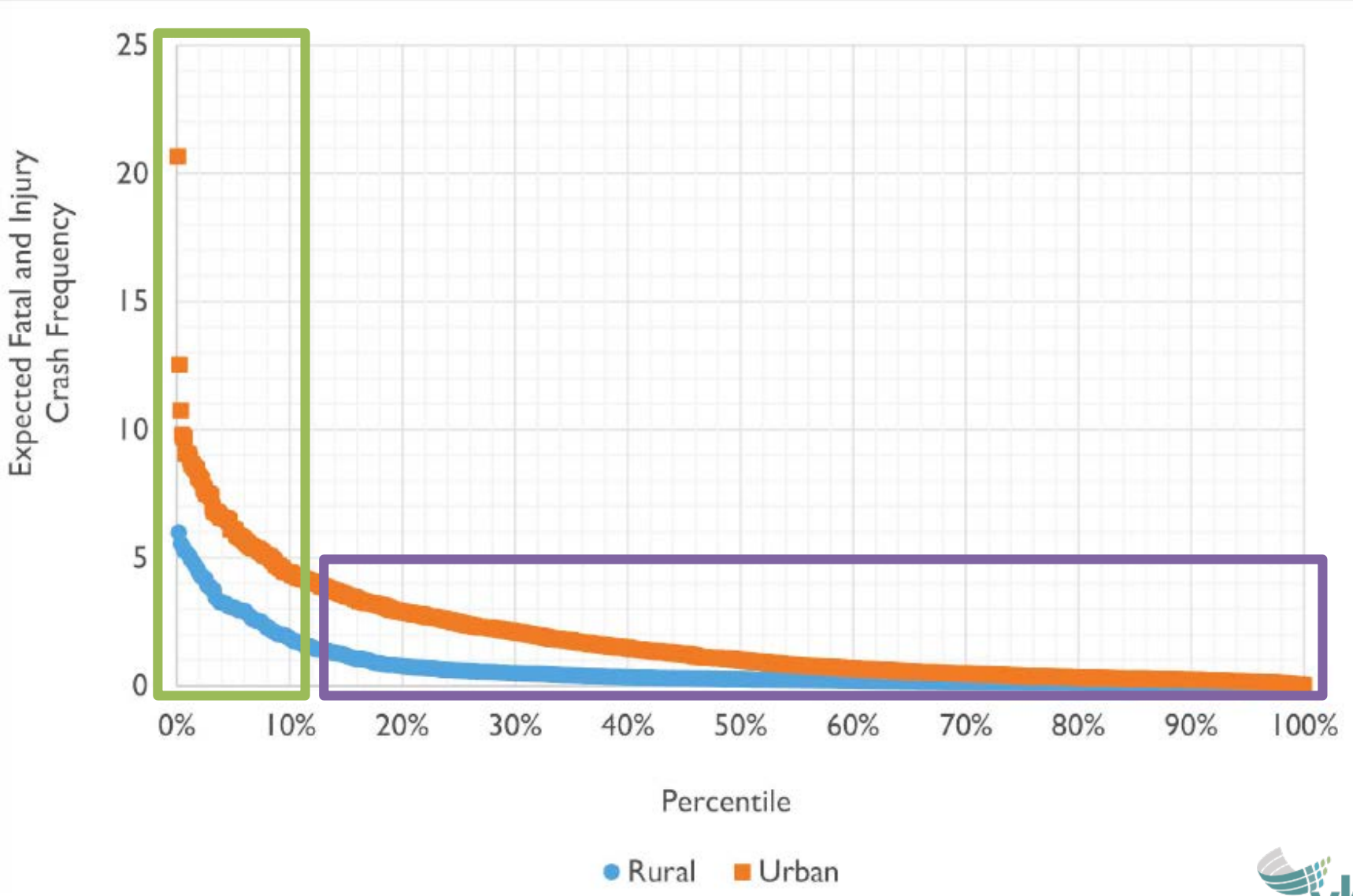
- $10,000,000 of each countermeasure
- Average cost per site
- Average CMF
- Average frequency before treatment

Hypothetical Implementations

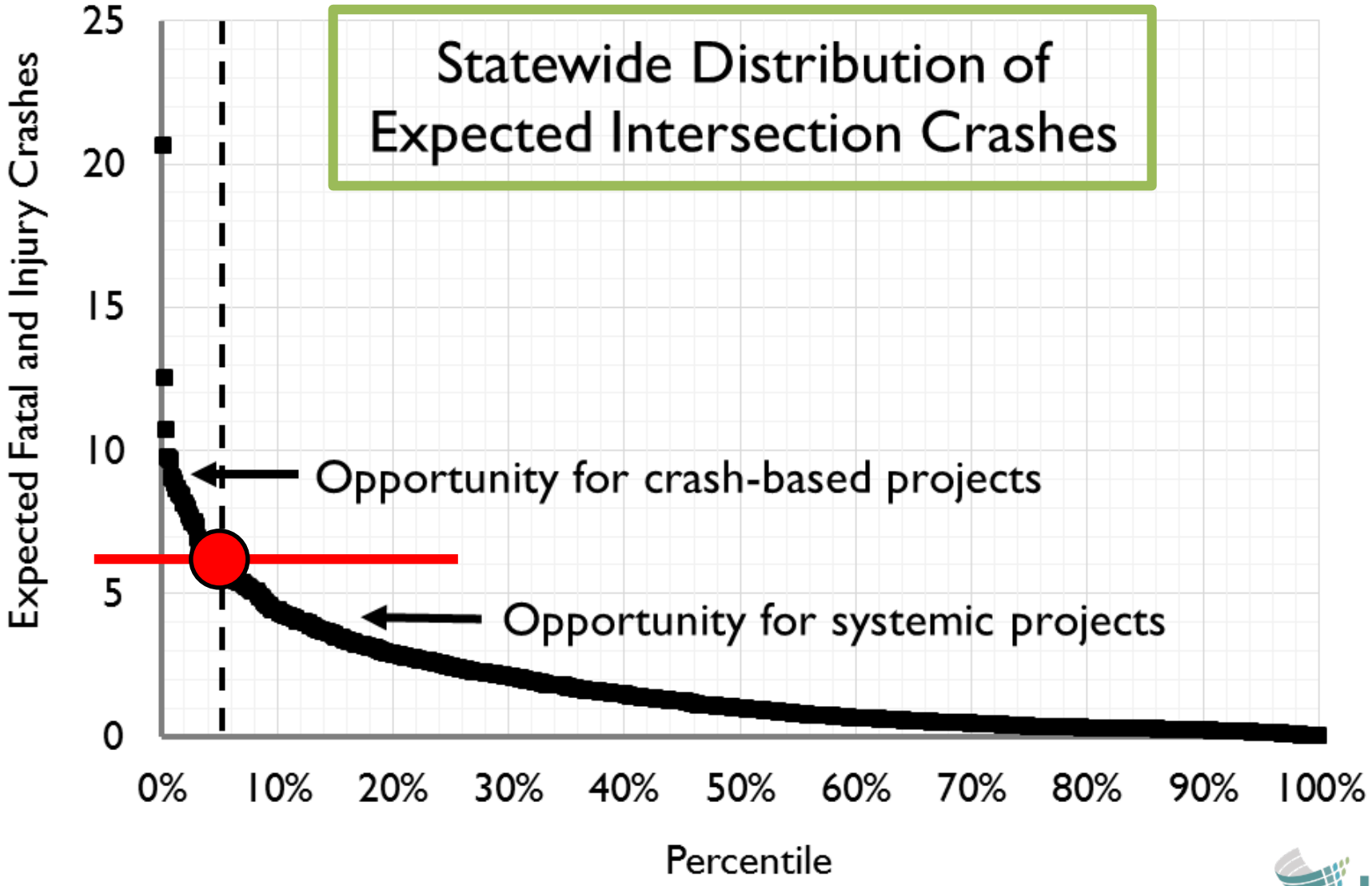
Economic Measure	Crash-Based	Systemic
Average Cost	$9,901,286	$9,998,000
Average Benefit	$226,519,265	$700,219,396
Overall Benefit-Cost Ratio	23.0	70.0

Allocating Funding

Typical Network Screening



When to Apply Each Approach



Project Breakeven Equation

$$ACF = \frac{AVC_C - AVC_S}{CC * (CMF_S - CMF_C)}$$

ACF = breakeven average crash frequency

AVC = annualized project costs

CC = average crash cost

CMF = crash modification factor

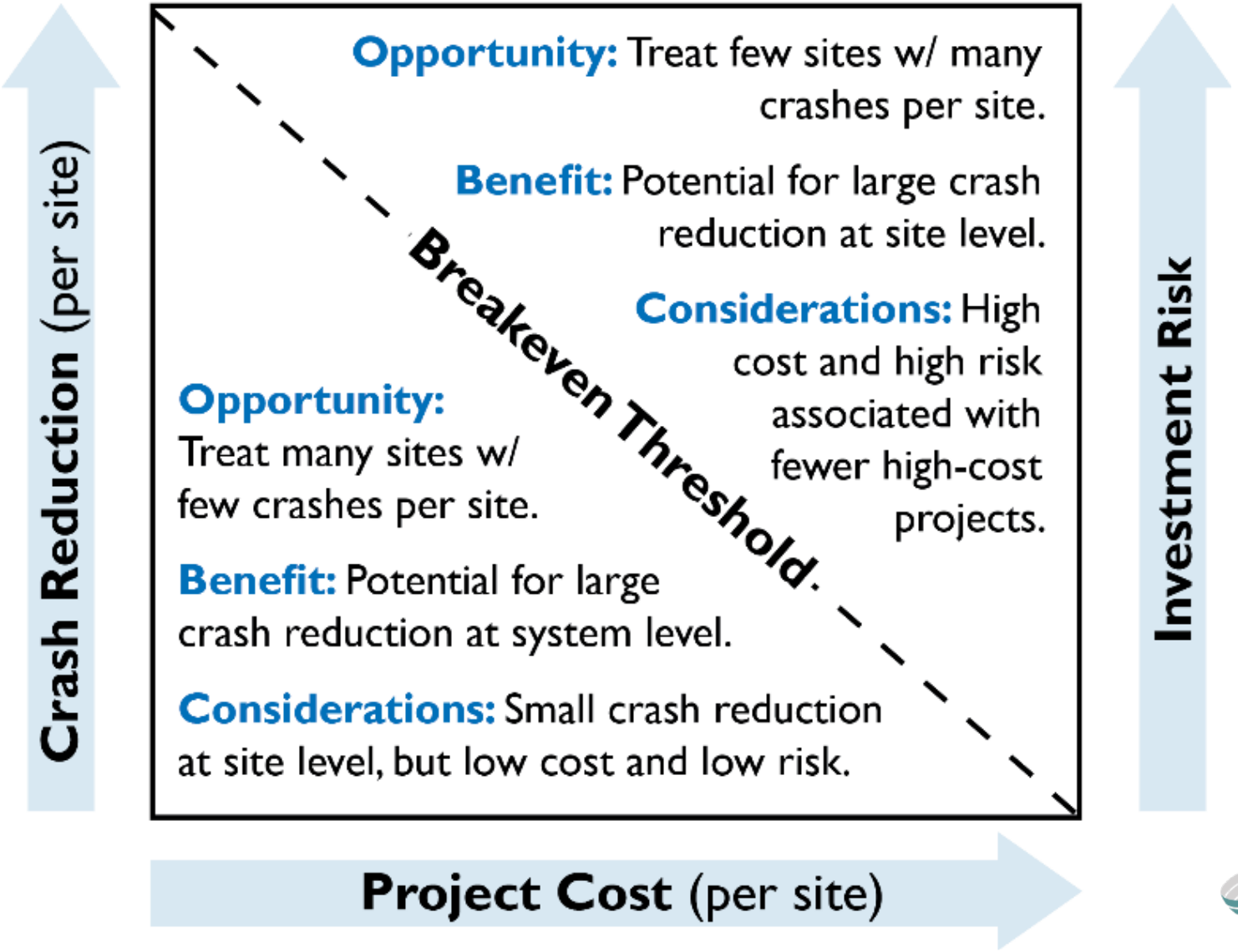
Applying the Breakeven Equation

- Determine sites that warrant higher investment
- Use for average project costs and CMFs
- Use for site-specific alternatives

- When $CMF_C > CMF_S$ and $AVC_C > AVC_S$ (or vice versa), choice is obvious

Comprehensive Safety Programs

When to Use Each Approach?

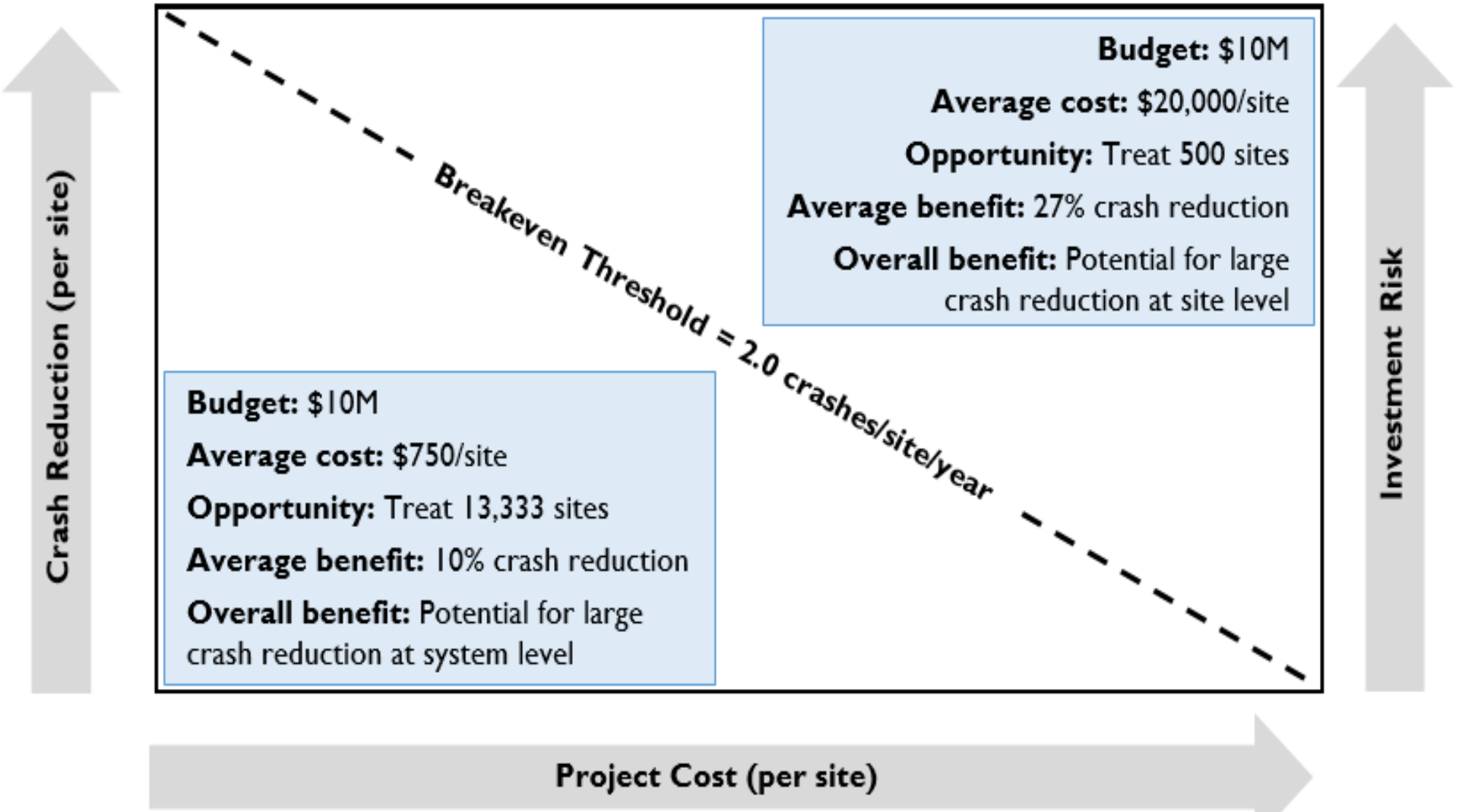


Example Calculation with Average Data

Data	Crash-Based	Systemic
Average CMF	0.73	0.90
Average cost per site	$20,000	$750
Average crash cost	$55,900	$55,900

$$ACF = \frac{\$20{,}000 - \$750}{\$55{,}900 \times (0.90 - 0.73)} = 2.0$$

Optimization Example



Comprehensive Safety Programs

- Cannot solely address site-specific concerns
- Cannot solely address network-wide concerns
- ~75% of HSIP to crash-based projects

Considerations

Strengths and limitations

Objectives (policy, goals, other)

SHSP and performance targets

Data requirements

Jurisdiction and agency

Considerations (cont'd)

Future research needs

Tracking systemic projects

- Prepare for evaluations
- Specific locations, not corridors
- Site-specific/typical countermeasure data
- Project type

Summary

- "Crash-based" and "Systemic"
- Hypothetical implementations
- Breakeven equation
- Consider objectives

Acknowledgements

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