

A Holistic Approach to Mitigate Rural Roadway Departure Crashes

ITE Western District Annual Meeting
Phoenix, Arizona
July 15, 2013

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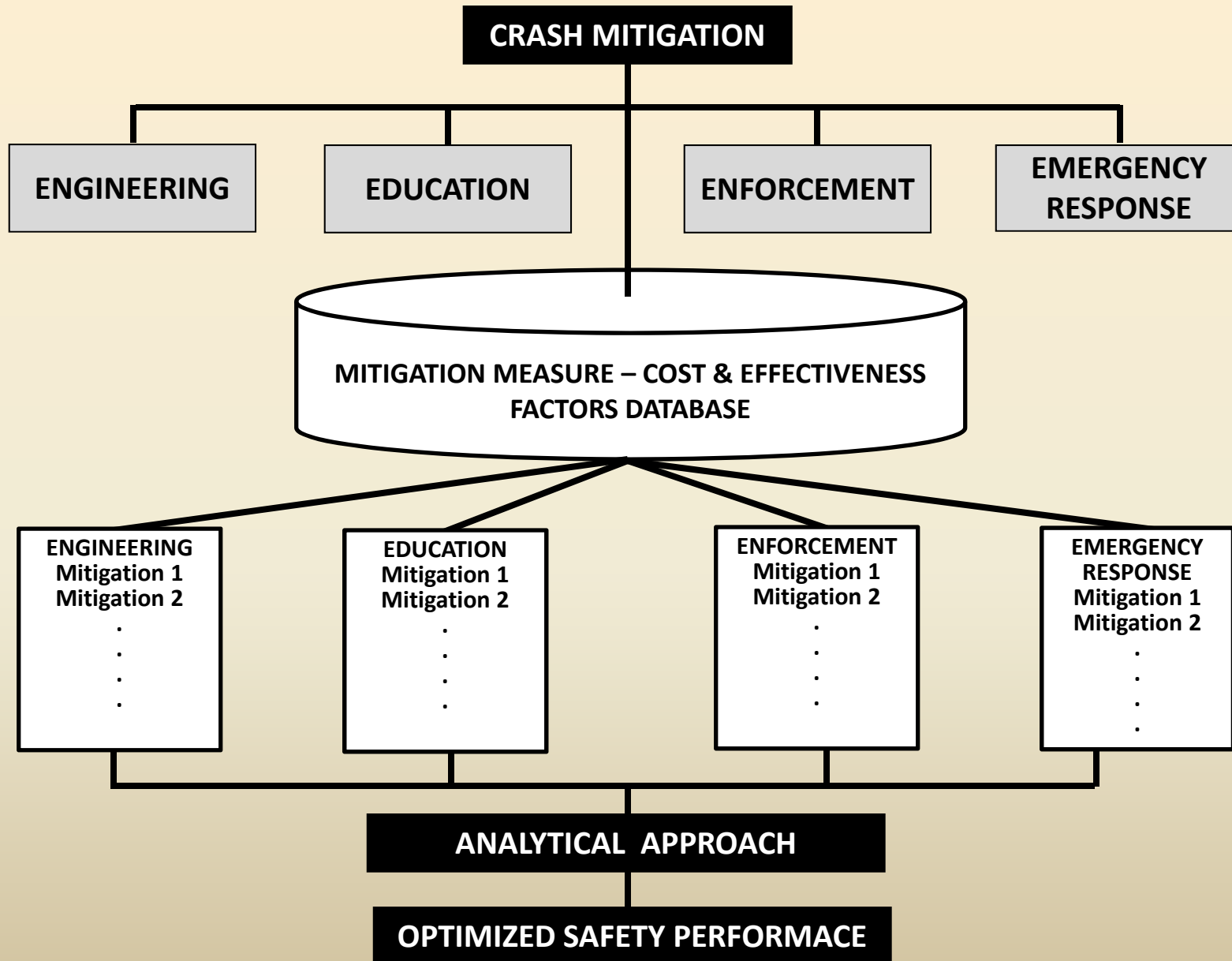
Proposed Holistic Approach

- Optimize allocation of 4E resources at a program level
- Optimize a combination of 4E mitigation measures at the project level
- Foster the use of 4Es
- Ascertain CMF research needs

Optimization Models

- Non-linear programming
- Dynamic programming
- Linear programming

Optimization Process



Simple Constraint Method

$$X_i = \begin{cases} 1 & \text{if a mitigation measure is selected} \\ 0 & \text{if a mitigation measure is not selected} \end{cases}$$

Minimize cost, Z_1

$$Z_1 = \sum_{i=1}^n X_i * C_{i1} \quad \text{.....(i)}$$

Where C_{i1} is the CMF of mitigation measure i and n is the number of mitigation measures

$$\sum_{i=1}^n X_i = 1 \quad \text{..... (ii)}$$

Where n is the number of mitigation measures

$$CMF_{\min} \leq CMF \leq CMF_{\max} \quad \text{.....(iii)}$$

4E Allocation Process Issues

- 4E CMF values and costs
- Interagency coordination
- Funding limitations

Rural Roadway Crashes

- Rural roadway crashes lead to fatal (K) and serious injury (A) crashes
- Roadway departure crashes result in KA type crashes

Effective 4E Improvements

- Roadway design
- Vehicle design
- Motor vehicle laws
- EMS (reduced response times and transport times)

Roadway Design Improvements

- Breakaway supports
- Safety edge
- Guard rail end treatments
- Roadside recovery
- Rumble strips (ELRS & CLRS)

Vehicle Design Improvements

- Electronic Stability Control
- Occupant Restraints, Air bags
- Door latches
- Steering columns
- Head restraints

Motor Vehicle Laws

- Seat belt laws
- DUI laws
- Licensing laws
- Helmet laws

First Responder Improvements

- Notification & Communication systems
- Locating crash site: e911, GPS, AACN, milepost signs
- Transport methods
- EMS training and equipment

Common Mitigation Measures

Before Crash

- Allow the vehicle/driver to stay on the roadway
- Provide an opportunity to recover

During Crash

- Minimize the severity of the crash if it occurs

After Crash

- Improve emergency response

Study Findings

- Agencies refer to *Countermeasures That Work* and *NCHRP Report 622* for driver behavior mitigation measures
- Agencies refer to *CMF Clearinghouse* for engineering mitigation measures
- Agencies cite lack of *interagency coordination* as an impediment to education, enforcement, and emergency response mitigations

Lessons Learned

- 4E resources can be allocated objectively
- Reliable CMFs ➡➡ Reliable 4E optimization
- Lack of non-infrastructure CMF is a limitation
- Interagency coordination, communication and partnership is essential
- Other factors – project deliverability, predicted/expected crash frequency, project life cycle cost

Future Study Needs

- Development of CMFs for education, enforcement and emergency response mitigation
- Further robust studies to refine the existing CMFs

What is Next?

- What are the synergistic effects of combined CMFs with multiple Es?
- Would “before crash” mitigations be more cost effective than “during crash” and “after crash” mitigations?
- Should highway safety professionals promote research to fill the CMF gaps?

Thank You!

Questions?

Comments?

Disclaimer: The views and opinions contained herein are those of the presenters and may not necessarily represent the views of the Arizona Department of Transportation.

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