

You're designing a new work zone on the busy 6-lane (2x3) highway north of town that involves lane shifts and one lane closure, which will move over the course of the project.

The governor's office has just called your boss, saying,



“Don't let it become like the last disaster.  
Remember?”

Your manager passed this on to you before running off to another meeting. You're wondering if there is something new you could try, such as using V2I technology.

Section divider

# Vehicle-to-infrastructure (V2I) Benefits Framework:

## Stakeholder Workshop

March 27, 2018

*Project sponsor:* USDOT's Intelligent Transportation Systems  
Joint Program Office (ITS JPO)  
*Represented by:* Federal Highway Administration (FHWA)  
Office of Research, Development & Technology



U.S. Department of Transportation  
**Volpe Center**

# Objectives of the V2I Benefits Framework (1/2)

- Determine the **key elements and relationships** to be included in an eventual tool that will allow **infrastructure owner-operators (IOOs)** to perform **benefit-cost analysis (BCA)** on **potential V2I deployments**, in order to provide **confidence to deploy** where appropriate

# Objectives of the V2I Benefits Framework (2/2)

- Describes a **decision-making tool for IOOs**, not an assessment of overall societal benefits
- Not (at this phase) a functioning model that performs calculations

# Key results from 2017 stakeholder engagement

- Interest in a tool that helps **select applications based on agency needs**, rather than a tool that calculates benefits and costs for a known set of applications
- Formal BCA is not necessary – need basic benefit and cost information to **build the internal business case**
- Significant interest in modeling **phase-in / fleet penetration** and how this affects benefits
- Cost information is important but not as cut-and-dried as it might seem.  
**Consider ranges.**

# Objectives today

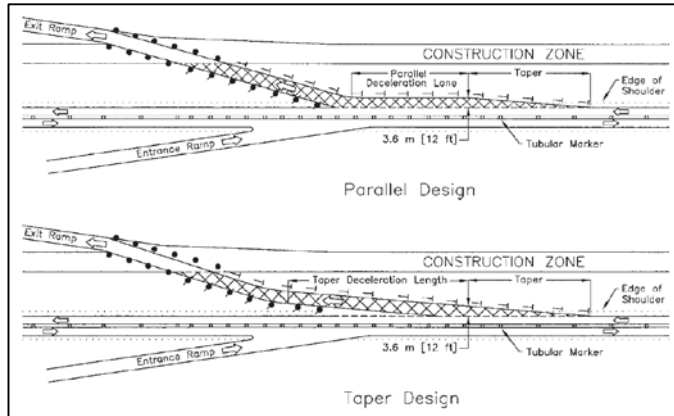
- Get your feedback on our approach to the framework and decision-support tool:
  - How do you select mitigations for work zones now?
  - In what ways could a tool following this framework be useful?
  - How could our work be more useful?

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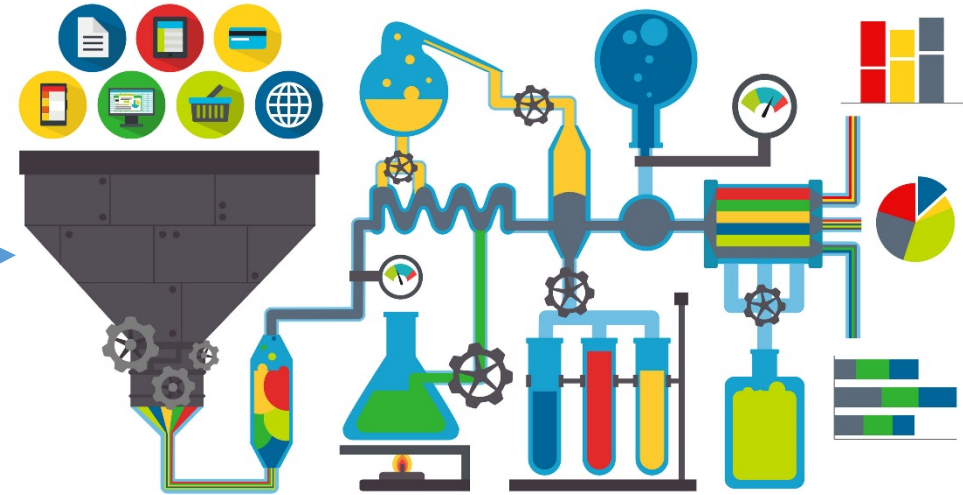
# So you need to plan WZ mitigations...

## The situation



Generate options

## Evaluate and select



Implement ?

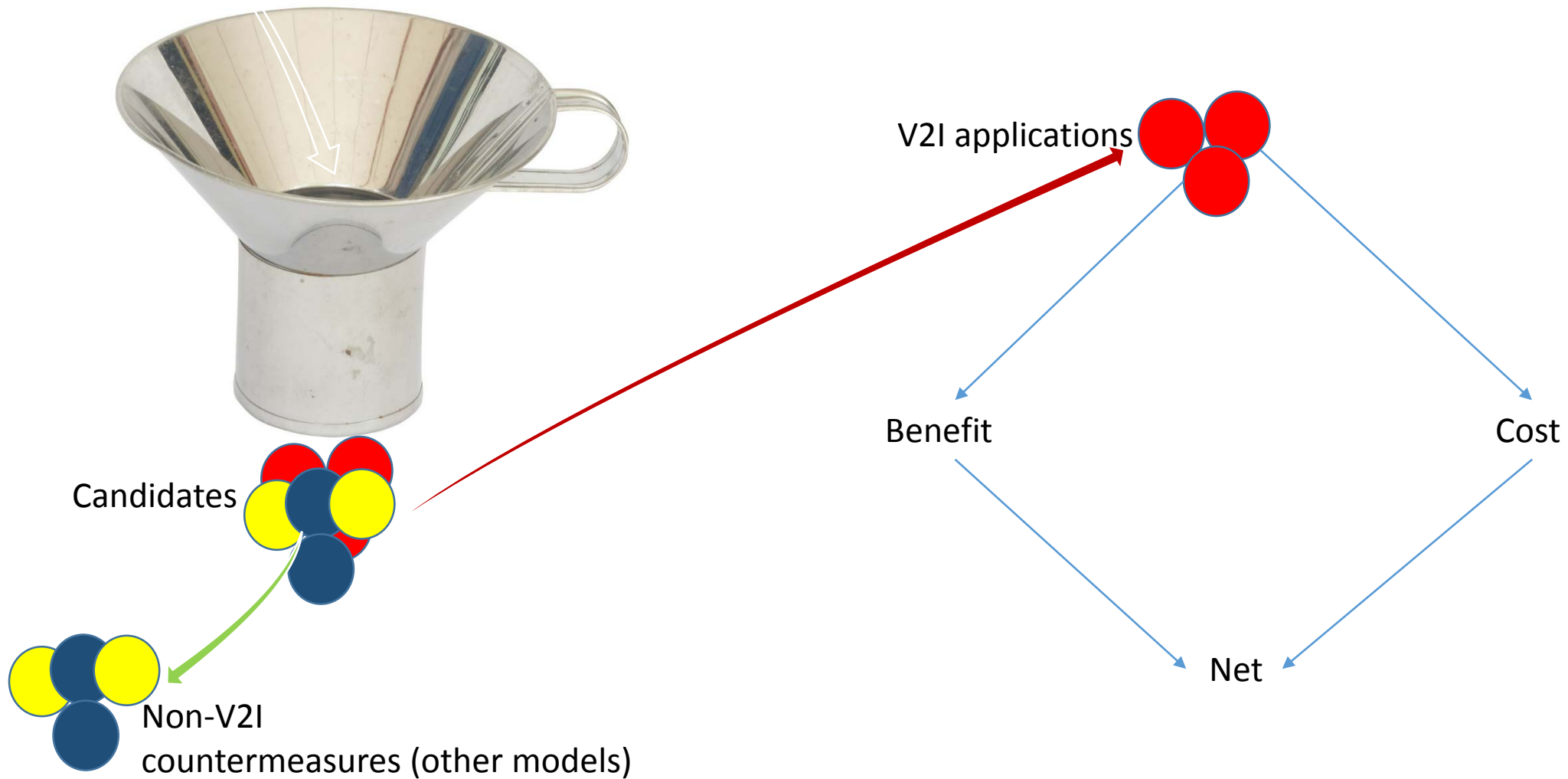


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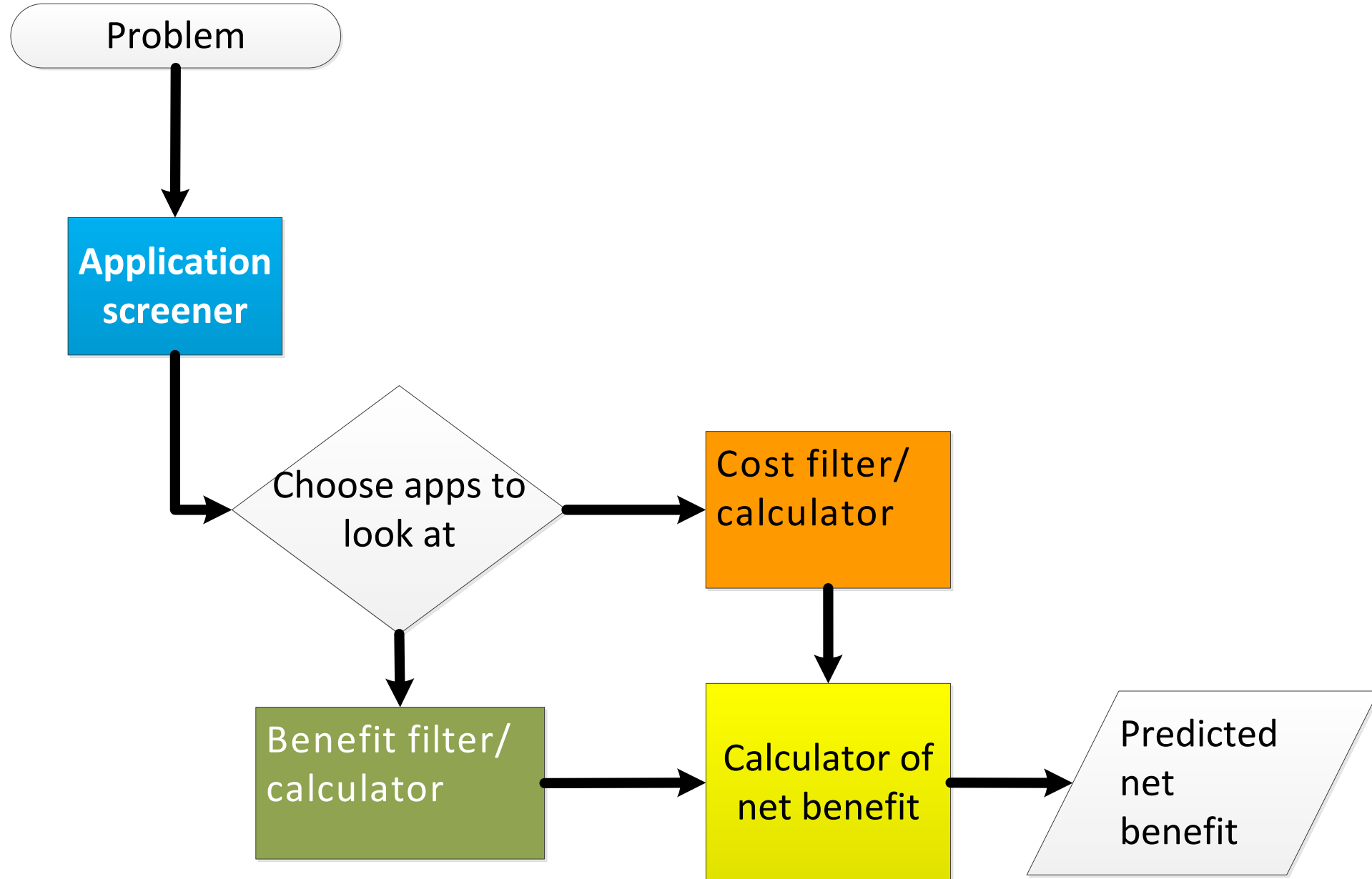
Ramp diagram: Mahoney, et al, 2007, *NCHRP Report 581: Design of Construction Work Zones on High-Speed Highways* • Congestion: stieberszabolcs via 123rf.com • Funnel: Le Moal Olivier via 123rf.com • Fabulous contraption: tereez via 123rf.com

# Basic flow of the framework...

Countermeasures in the model



# Four modules



# Output

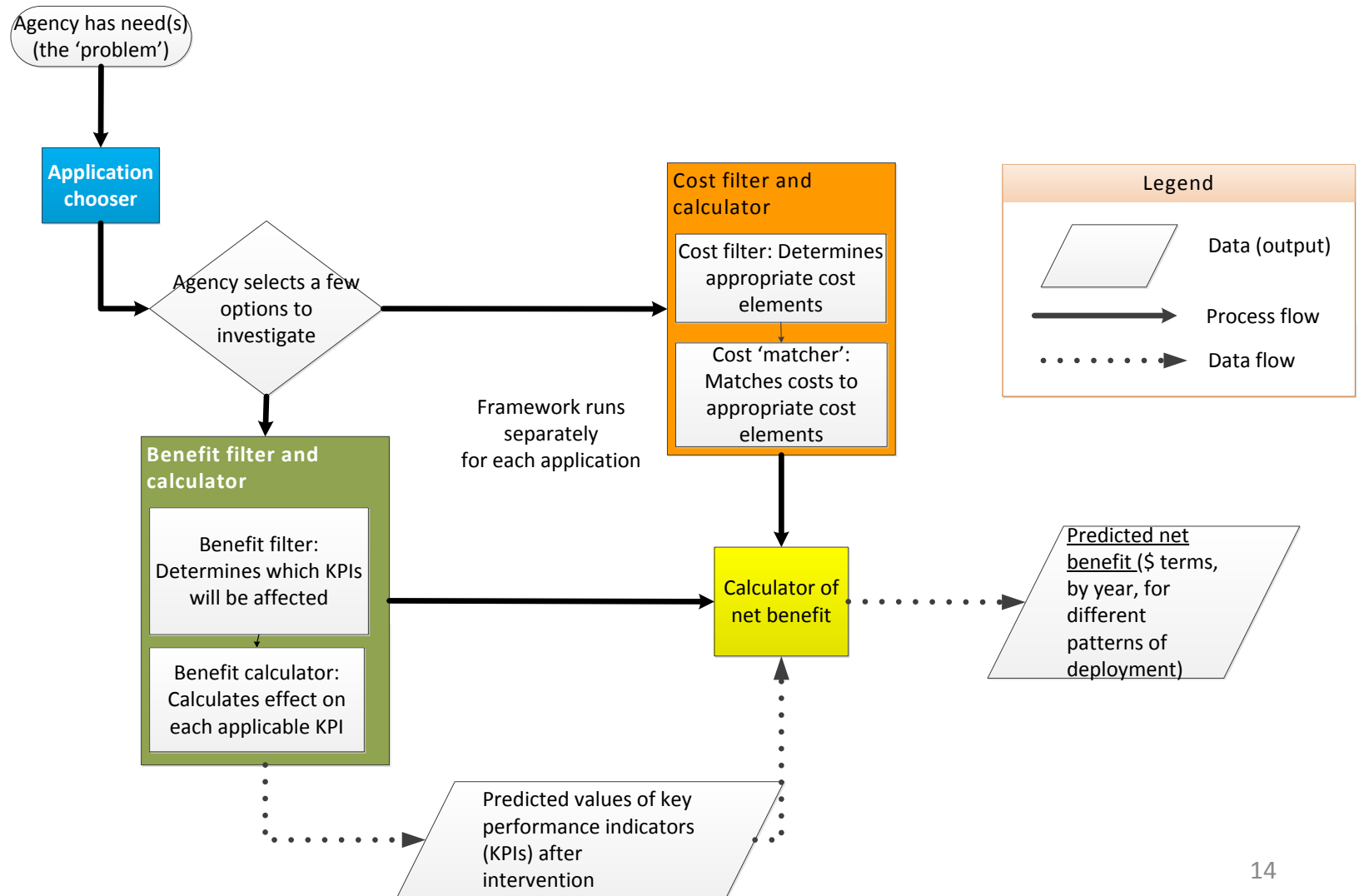
*Table 3: Sketch of envisioned form of output from application chooser module (indicative example for Eco-Approach and Departure from Signalized Intersection)*

		Relevant KPI			Geographic scope of applicability
		crossing-traffic crashes at signalized intersection	secondary collisions at signalized intersection	delay at intersection	R: regional C: corridor I: intersection
	<b>description--&gt;</b>				
	<b>sample unit--&gt;</b>	#/year	#/year	-daily average minutes	
				-average maximum delay over 24h period	
				-etc	
<b>Possible Countermeasure</b>					
signal optimization along corridor (e.g. signals timed to 30 mph)					C
glidepath					C
roundabout				?	I
four-way stop (if traffic volumes permit)					I
traffic calming					C?
dynamic speed limits					R

Section divider

# Overall view of the framework

- Initial version summer 2017, based on stakeholder expressed priorities
- Revised in accordance with stakeholder feedback December 2017
- Need to make sure the tool can be modular in order to expand functionality in the future



# Framework modules, dimensions and their functions

Module	Dimensions used	Main function
Application chooser	Dimensionless	The user indicates the KPIs of interest; the module suggests applications with potential applicability.
Benefit filter and calculator	<i>Filter:</i> Dimensionless	Predicts which KPI would likely see a benefit based on agency starting point and input regarding benefits observed or modeled elsewhere
	<i>Calculator:</i> Units of each applicable KPI	Models benefit in terms of the change in each KPI of interest, in two ways: <ul style="list-style-type: none"> <li>• Units of that KPI at various penetration rates</li> <li>• Units of that KPI over time</li> </ul>
Cost filter and calculator	<i>Filter:</i> Dimensionless	Predicts necessary cost elements based on agency starting point.
	<i>Calculator:</i> Money	Puts cost on each element, expressed either in net present value (NPV) or over time.
Calculator of net benefit	Money	Monetizes the benefit over all KPIs affected, and nets out the cost. Results expressed either in NPV or over time.

Hannah Rakoff

[hannah.rakoff@dot.gov](mailto:hannah.rakoff@dot.gov)

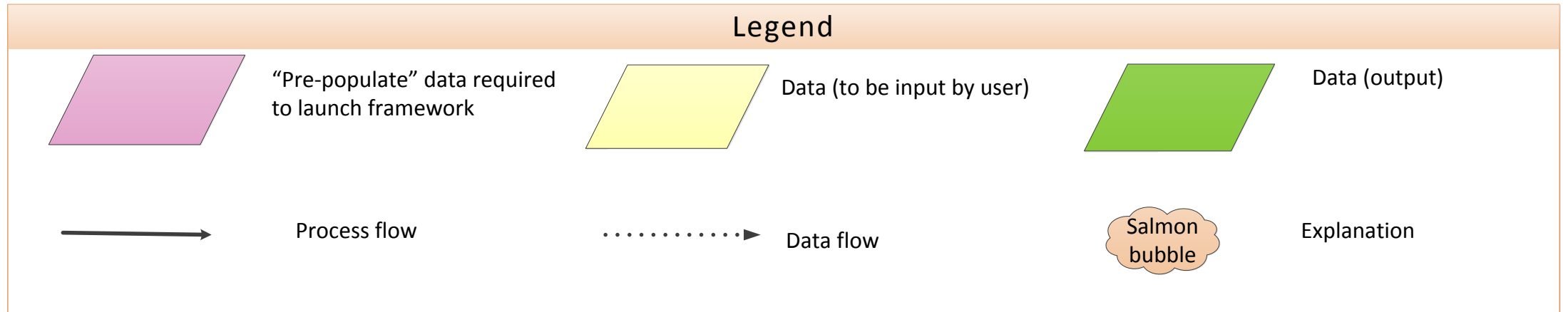
Jonathan Badgley

[jonathan.badgley@dot.gov](mailto:jonathan.badgley@dot.gov)



# Back-pocket slides

# Legend for the module diagrams



# Application screener module

Agency has need(s)  
(the 'problem')

List of possible countermeasures for all applications in tool's scope

- Traditional countermeasures
- V2I applications

Agency starting point: Details about the problem

- Current statistic(s) for relevant KPIs
- Scale
- Situation
- Agency approach (baseline for comparison)

**Application chooser**

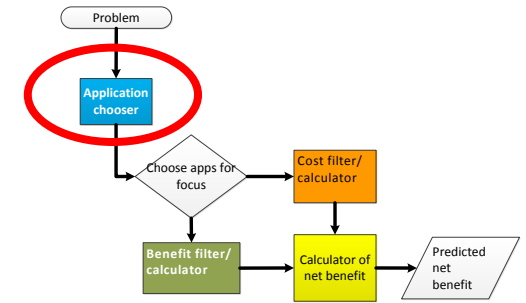
Table of options filtered based on starting point

- V2I applications
- Traditional countermeasures

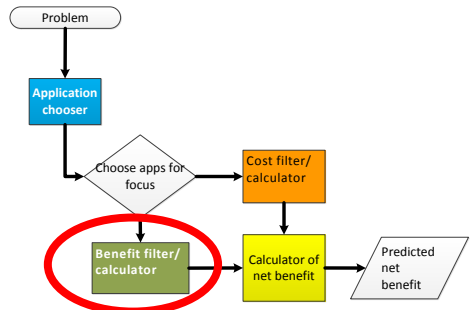
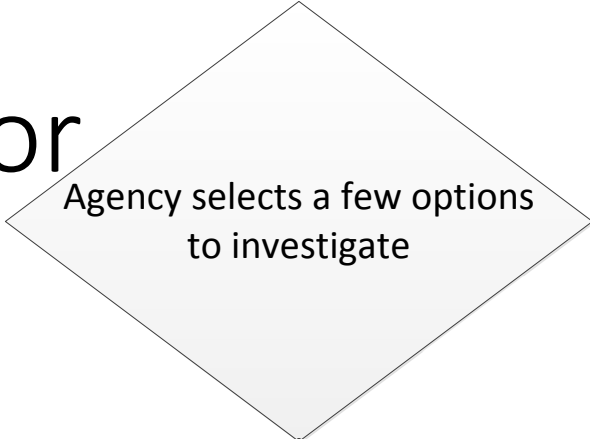
Sources of data regarding KPIs affected; magnitude of benefit for each; and relationship of benefit to market penetration

- CV Pilots
- International field operational tests (FOTs)
- Modeling (e.g. at TFHRC, CAMP, JPO, Volpe)
- Others (TBD)

Agency selects a few options to investigate



# Benefit filter and calculator



Sources of data regarding KPIs affected; magnitude of benefit for each; and relationship of benefit to market penetration

Assumptions regarding in-vehicle equipment

- Market penetration vs. time
- Expected benefit at high penetration

Optional: User can vary these assumptions

**Benefit filter and calculator**

Benefit filter:  
Determines which KPIs will be affected

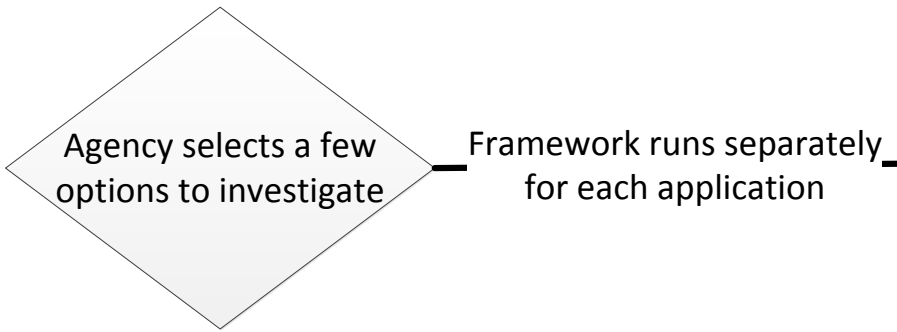
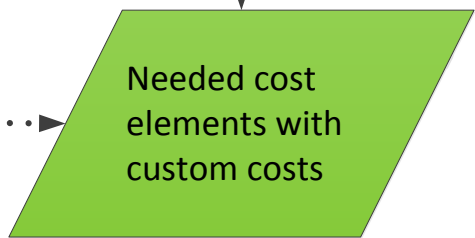
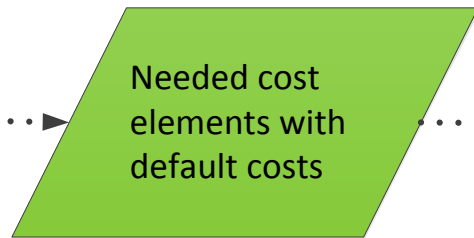
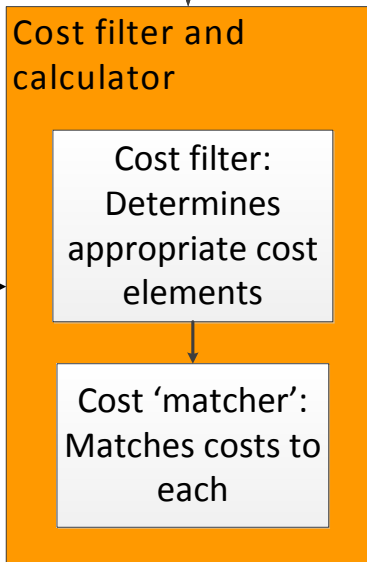
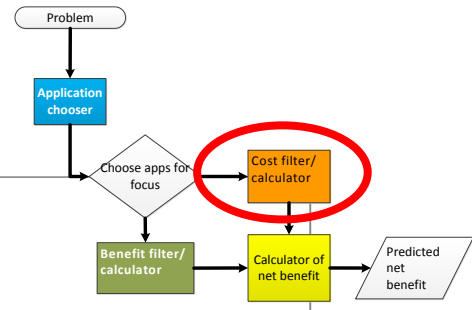
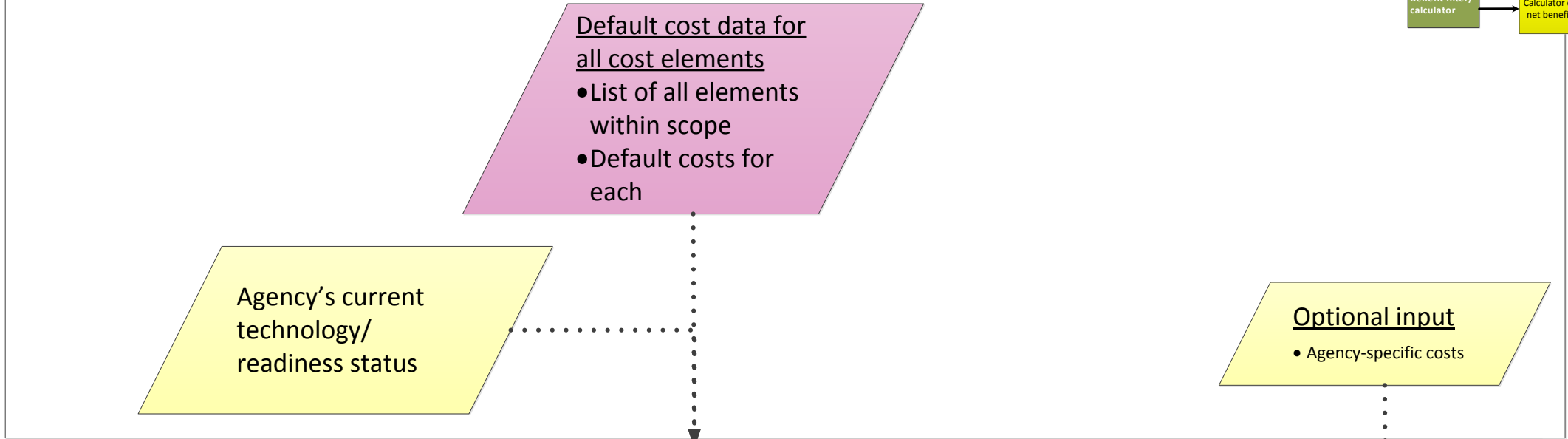
Benefit calculator:  
Calculates effect on each applicable KPI

Predicted values of KPIs after intervention **assuming default penetration rate (e.g. 25%), with sensitivity analysis**

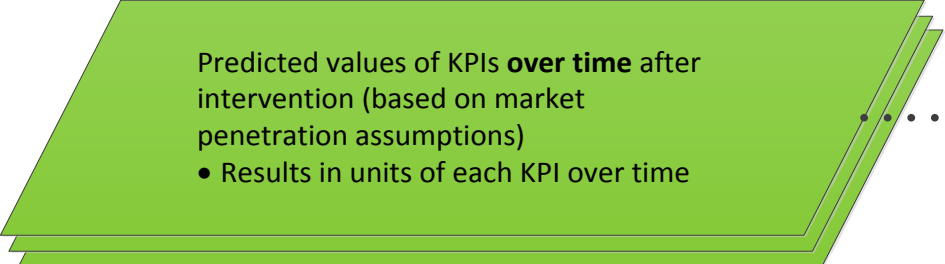
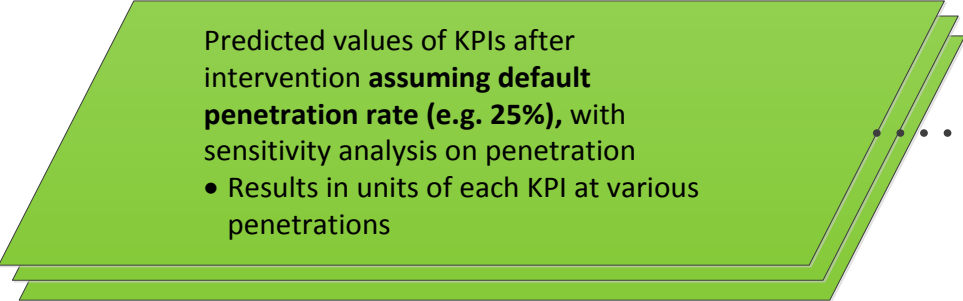
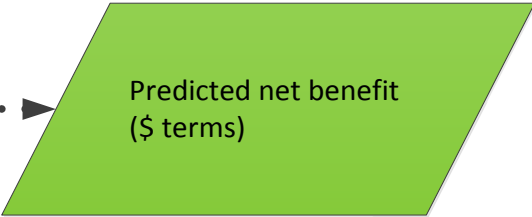
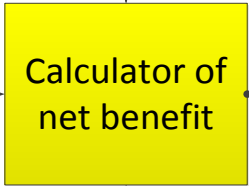
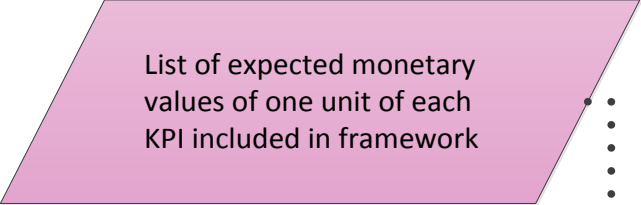
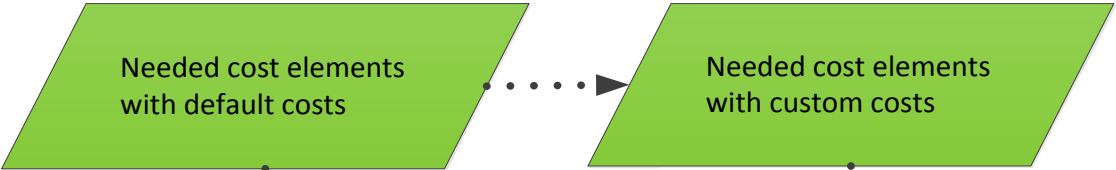
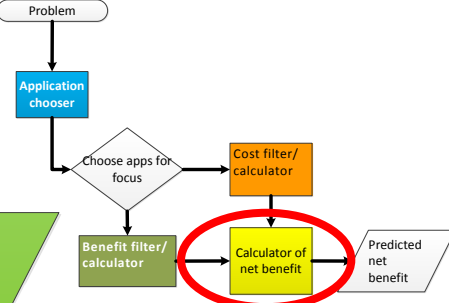
Predicted values of KPIs **over time** after intervention (based on penetration assumptions)

# Cost filter and calculator

Agency starting point: Items that affect cost



# Calculator of net benefit



# Draft outline for memo on WZ baseline

- Introduction

- Project context
- Choice of RSZW/LC
- Need to document baseline in order to accurately attribute benefit and cost

- Baselines

- For WZ interventions

- Process for decision-making at strategic level (e.g., when to work, overall traffic management plan)
- Interventions currently used (including work scheduling; lane configurations/operations; and ITS/public information)
- Selection of ITS investments to aid in work zone management (inc. what costs and benefits are counted)

- For crashes and delay




- How they are measured; tracked; classified (metrics)
- Current numbers

- For costs [case study here]

- Qualitative; identification of cost elements for WZ mgt.
- Current status for telecoms, mapping, staffing etc., as feasible
- Identification of primary gaps, as feasible

- Discussion and recommendations for revising the framework

# Timeline

-  Period of performance
-  Target date for deliverable
-  Multi-agency site visit to TxDOT

