AASHTOWare Bridge Management

5.2.2 Deterioration

2015 BrMUG

Overview

- Tuning Deterioration Rates
- Weibull vs Markovian
- Examples
- Protective Systems
- Agency Deterioration Models

Tuning Deterioration Rates

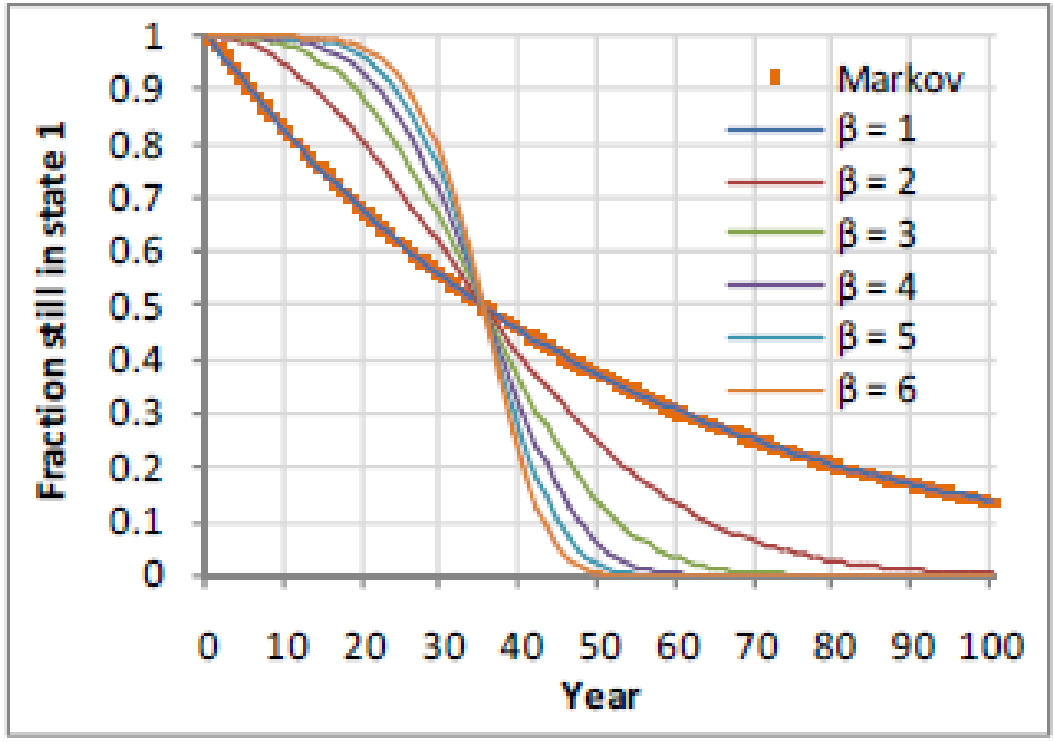
- 5.2.2 introduces Weibull model as an enhancement to Markovian deterioration model
  - The goal is to manage known shortcomings of the Markovian model
- Dependent upon:
  - The effect that the parameter configurations have on the deterioration forecasted by the combined model
  - How an agency can tune the parameters to best meet their needs

What did 4.x do?

- 4.x was Markovian based
  - Condition based model
  - Faster deterioration rates in the early stage
  - Effect of protective systems not considered

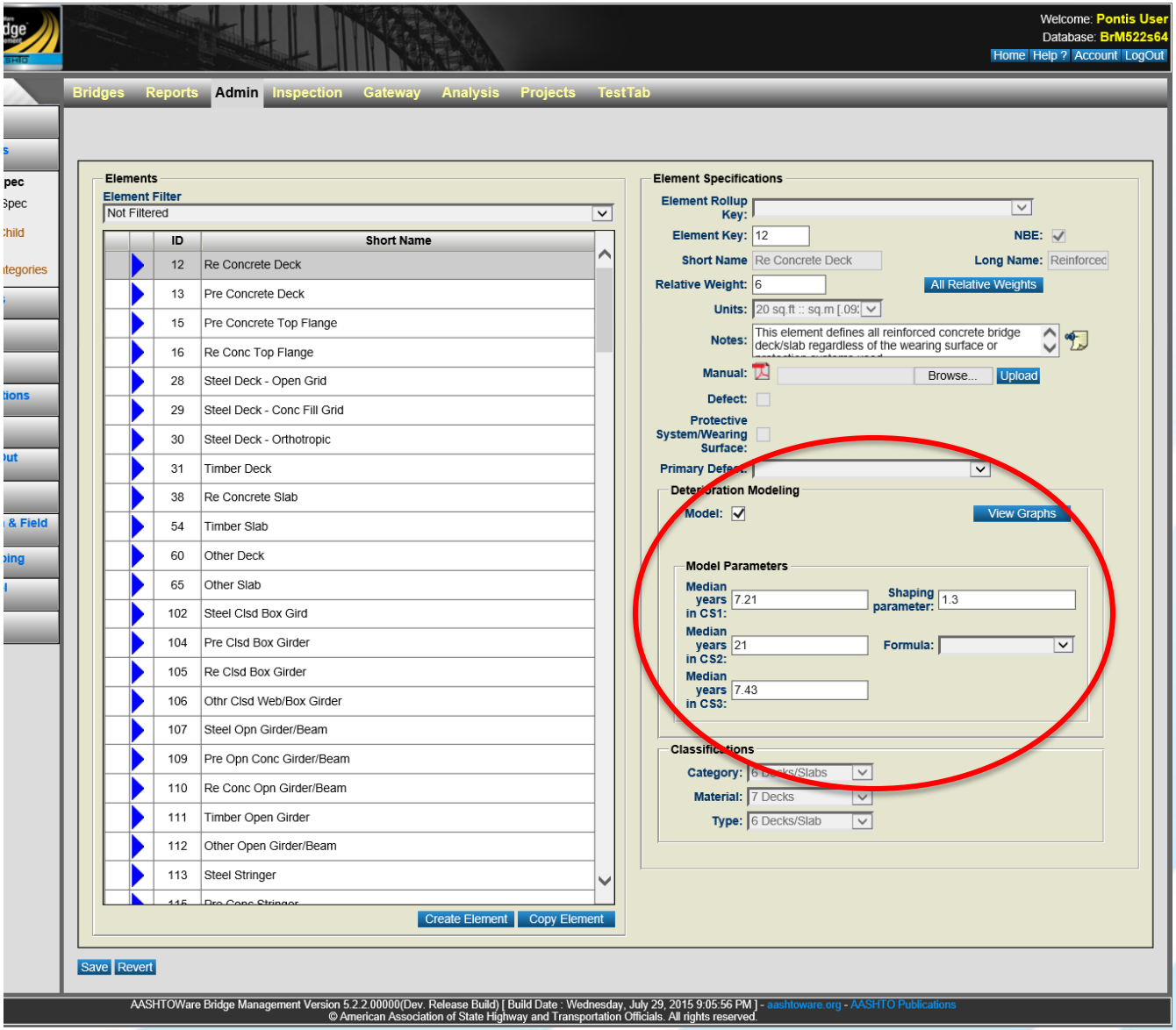
Weibull and Markovian Models

- Weibull and Markovian
  - Transition Times
- Weibull
  - CS1 to CS2
  - Shaping Parameter β



Example 1: #330 Metal Bridge Railing

- T1 : 29 years
- T2: 13 years
- T3: 9 years
- β: 1.8



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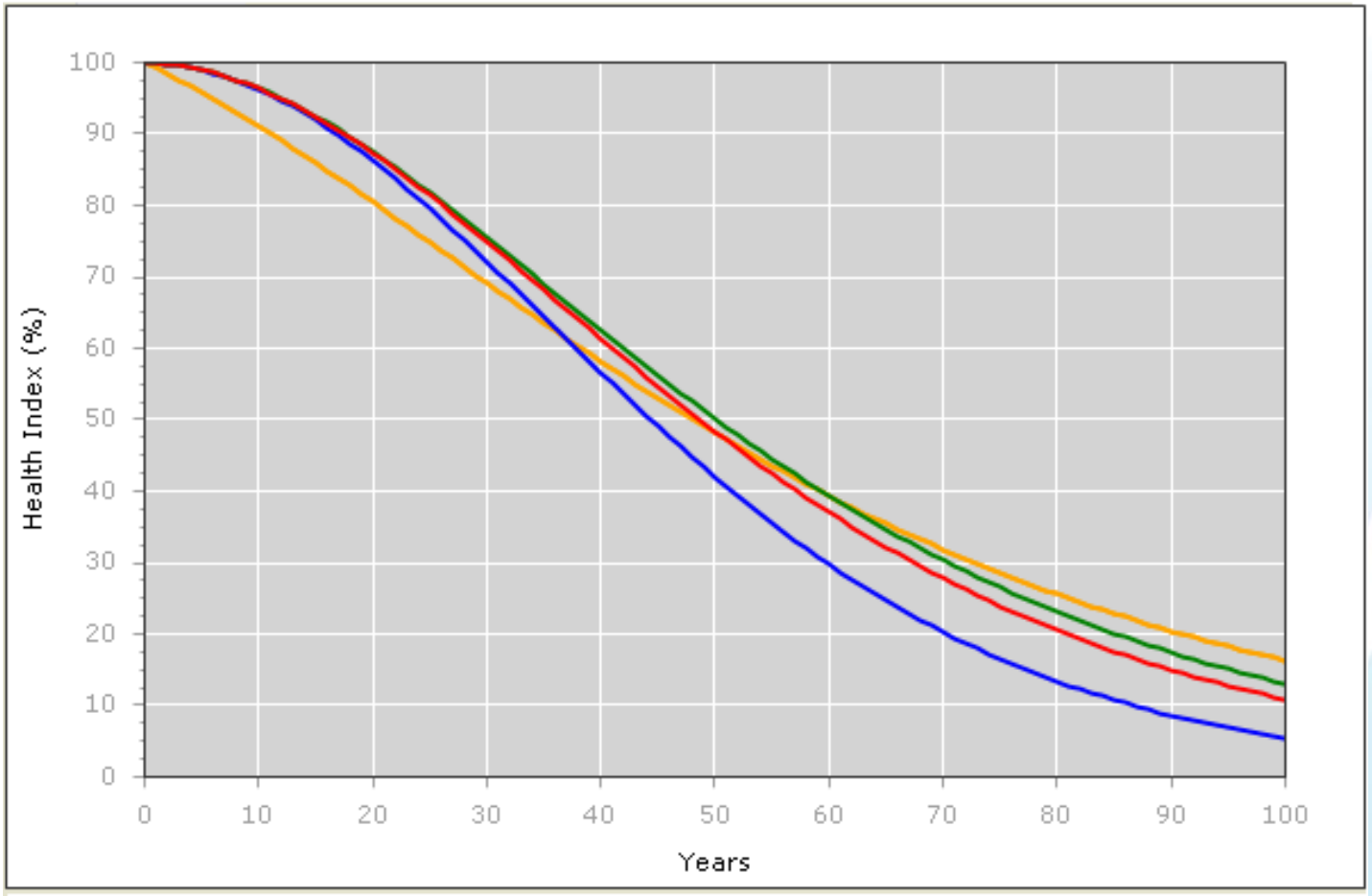
Example 1: #330 Metal Bridge Railing

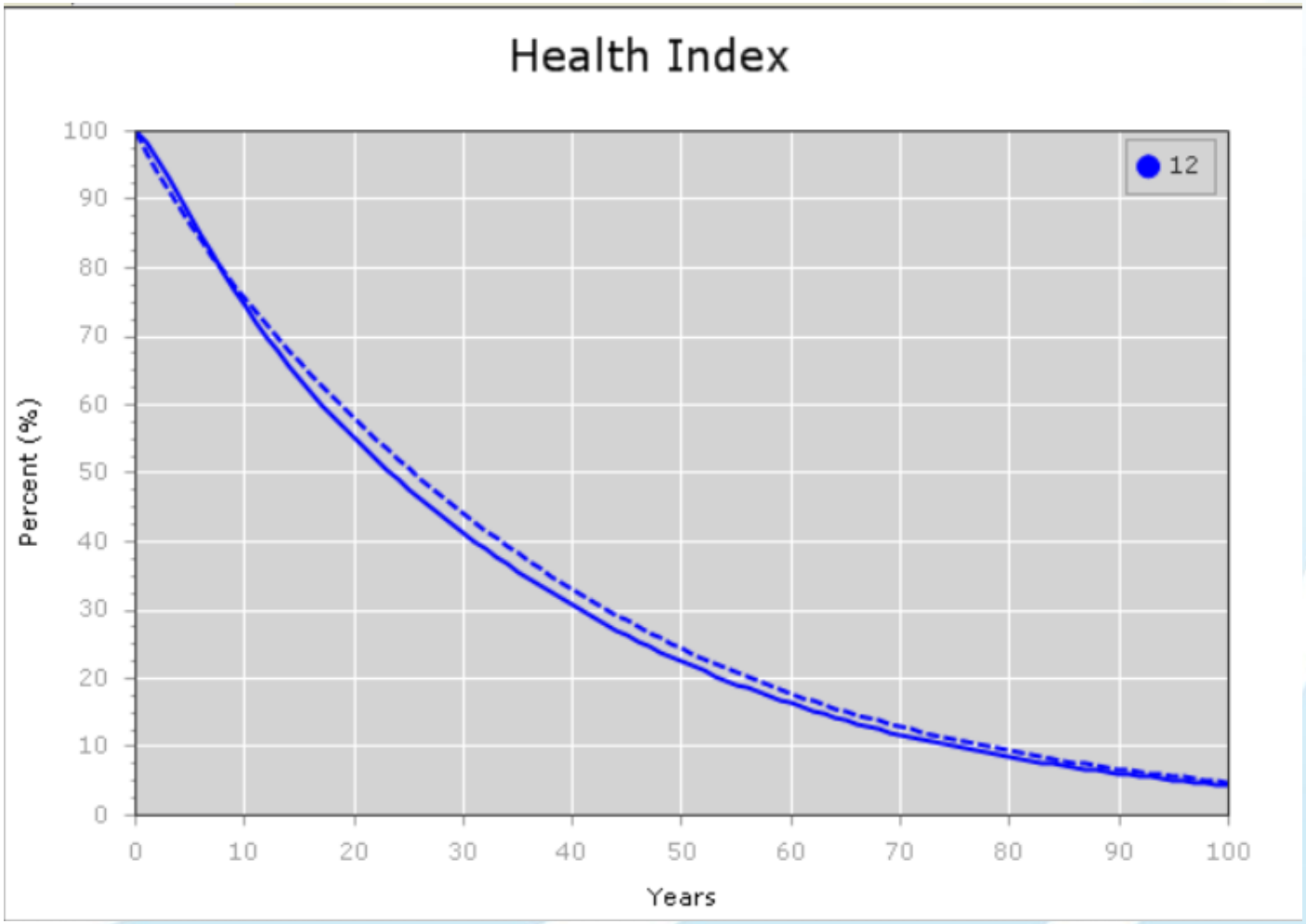


- Markovian model only (T1: 29, T2: 13, T3: 9, β: 1)
- Weibull + Markovian model (T1: 29, T2: 13, T3: 9, β: 1.8)
- Increasing T2 by 50% (T1: 29, T2: 20, T3: 9, β: 1.8)
- Increasing both T2 and T3 by 50% (T1: 29, T2: 20, T3: 14, β: 1.8)

Example 2: #12 Re Conc Deck

- T1 : 7 years
- T2: 21 years
- T3: 7 years
- β: 1.3

Example 2: #12 Re Conc Deck



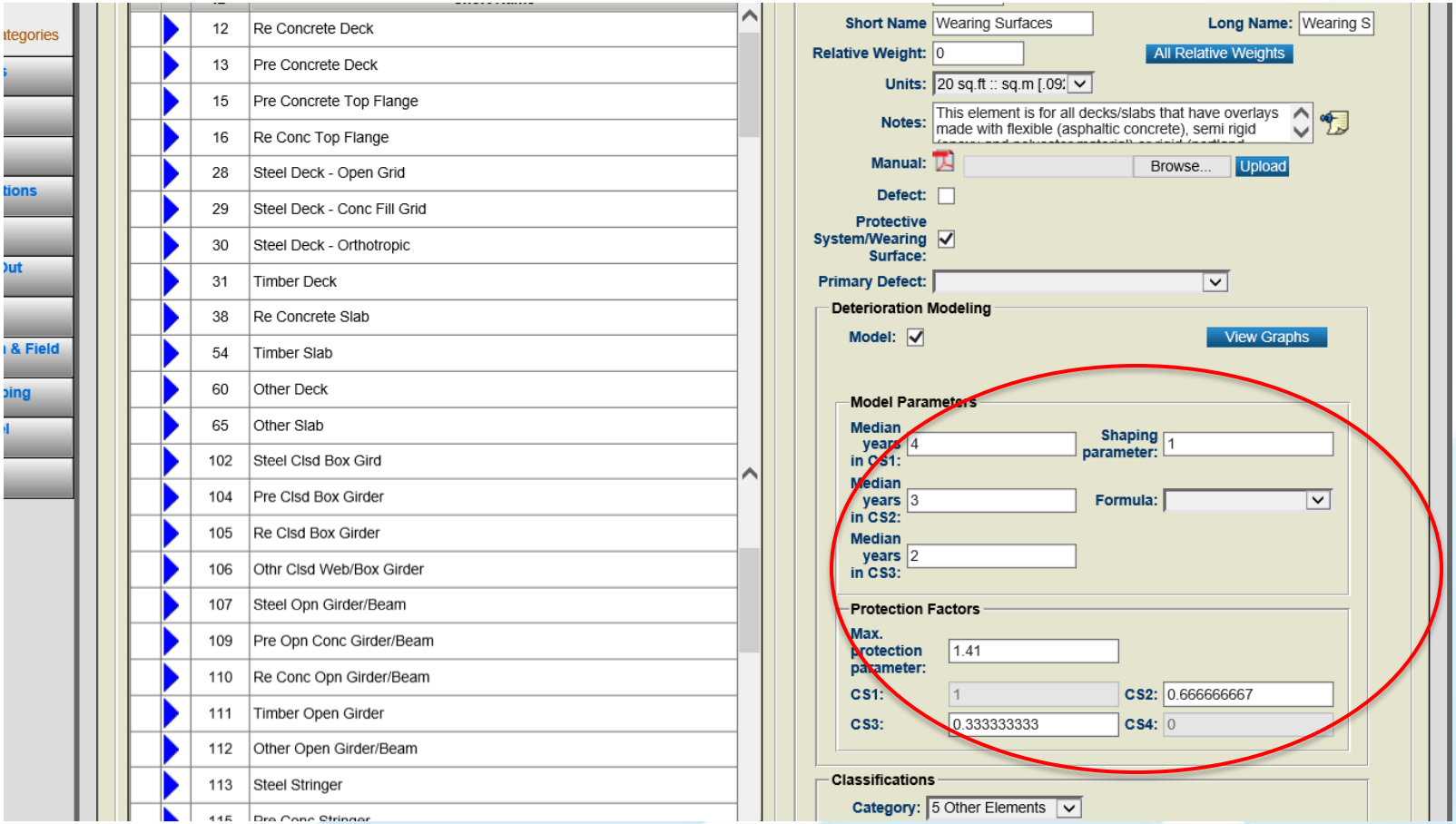
Protective Systems

- 5.2.2 includes the effects of protective systems
  - Designed to slow element deterioration
  - An element may contain several protective systems
  - Effectiveness is based on condition state of protective system

Protective Systems

- Effectiveness
  - CS1 is always 100% effective
  - CS2 and CS3 can be edited by user
  - CS4 is always 0% effective
- Maximum protection factor
  - Defines how much protection is offered

Protective Systems



Agency Deterioration Models

- Copying an element will also copy the Transition Time and Shaping Parameter
- Agency can then edit or accept depending on the situation

Questions?

Interested in joining Reports TAG?

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5.2.3 Deterioration Use Case Discussion

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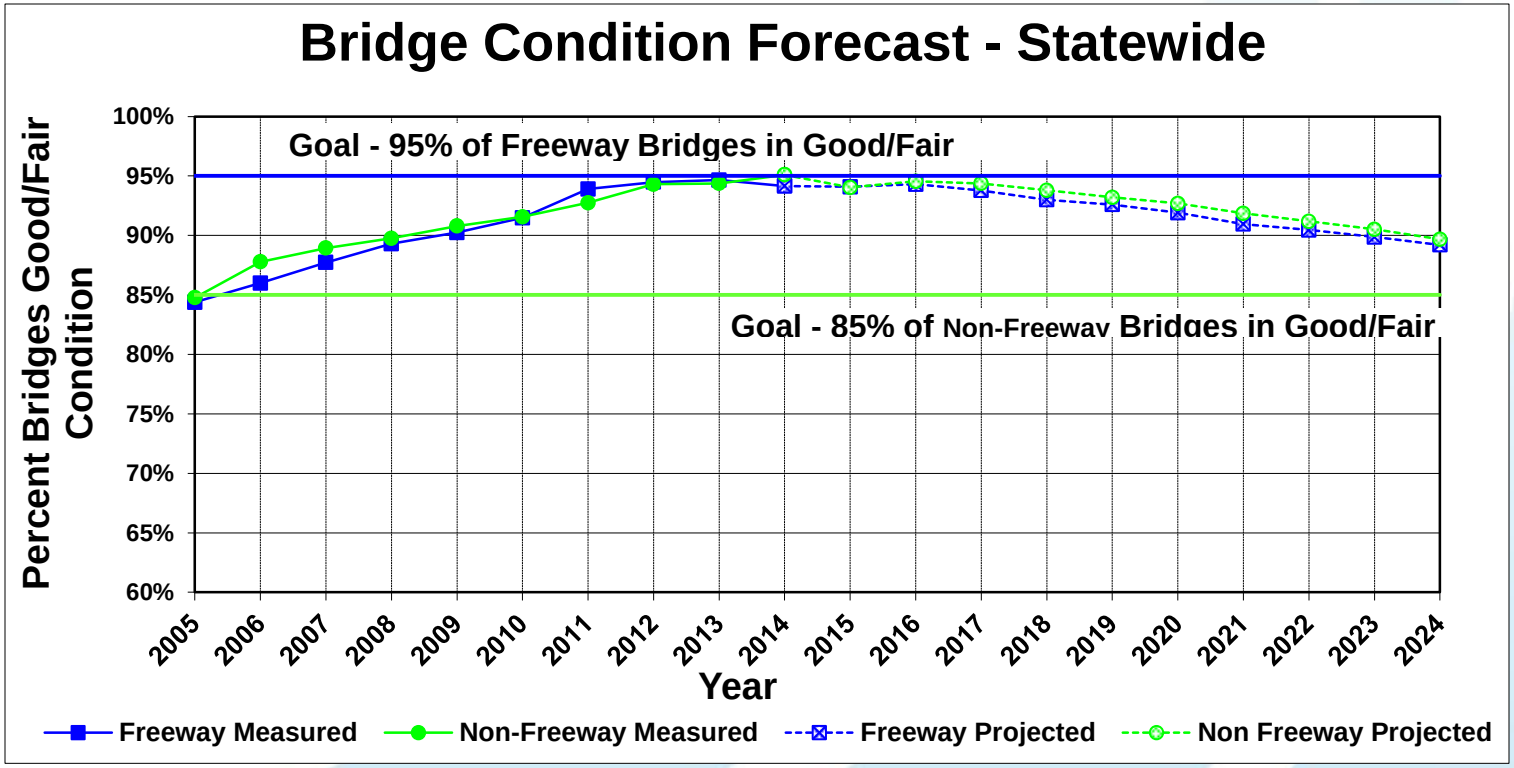
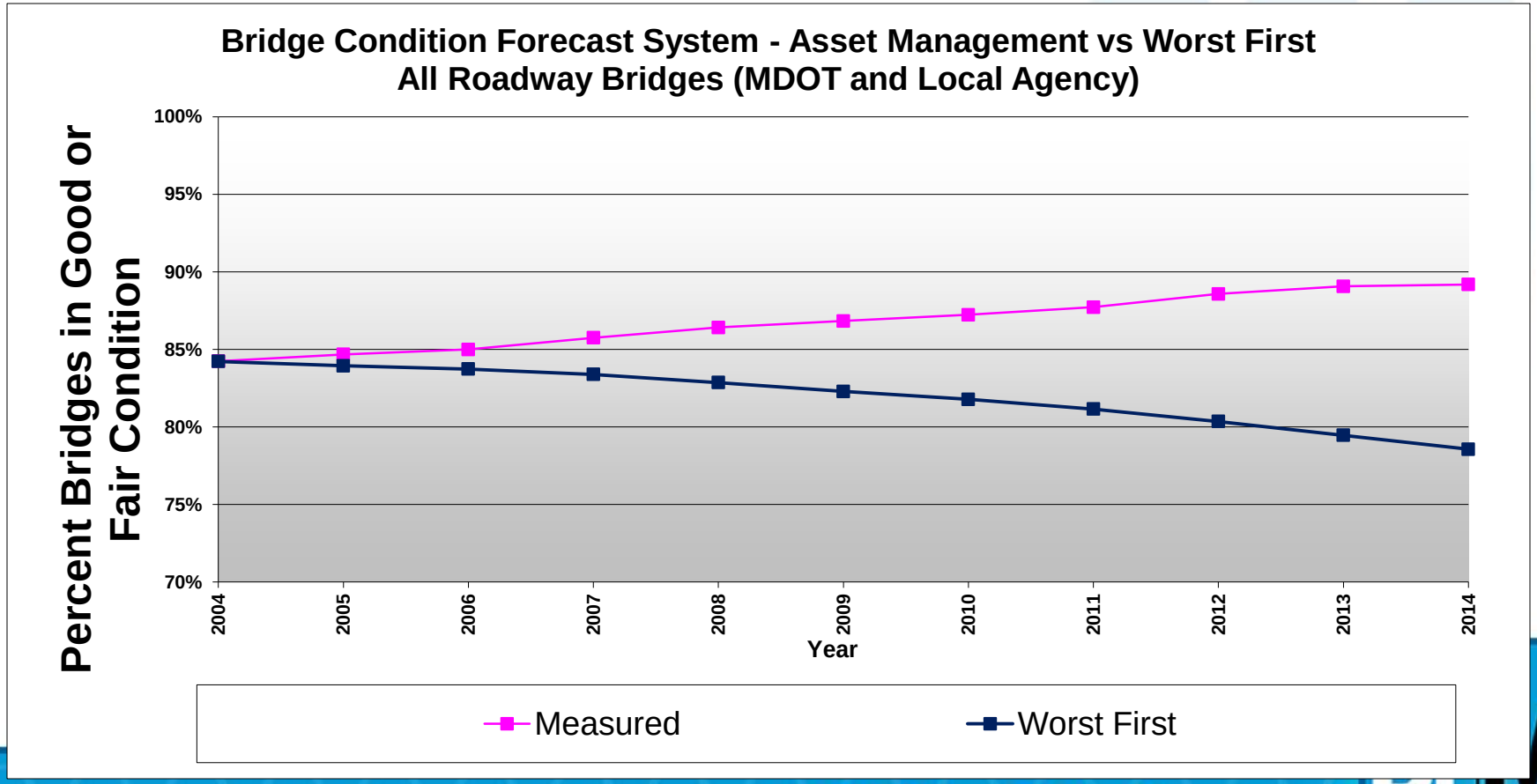
Forecast Bridge Conditions



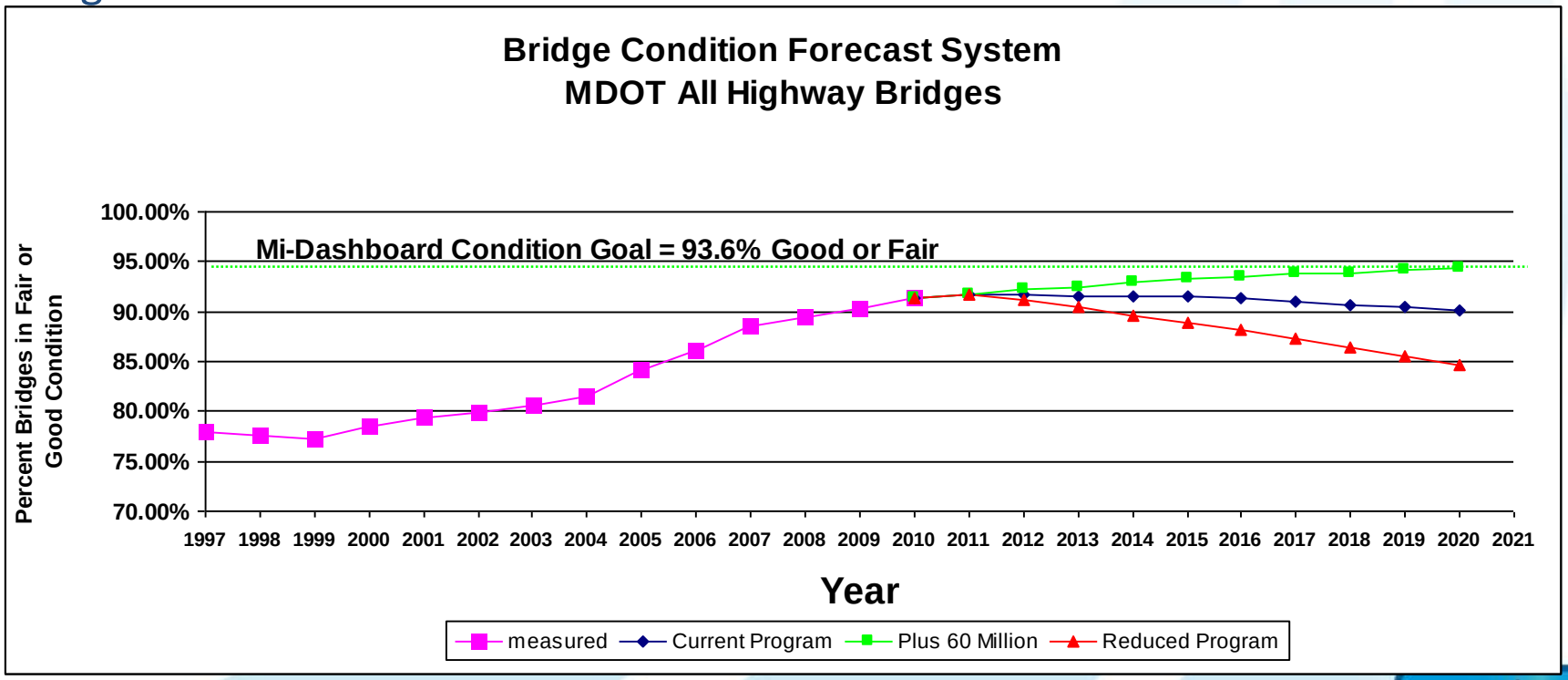
Value of Network Modeling

- What is the value of Bridge Preservation? What is the ideal mix of fixes?



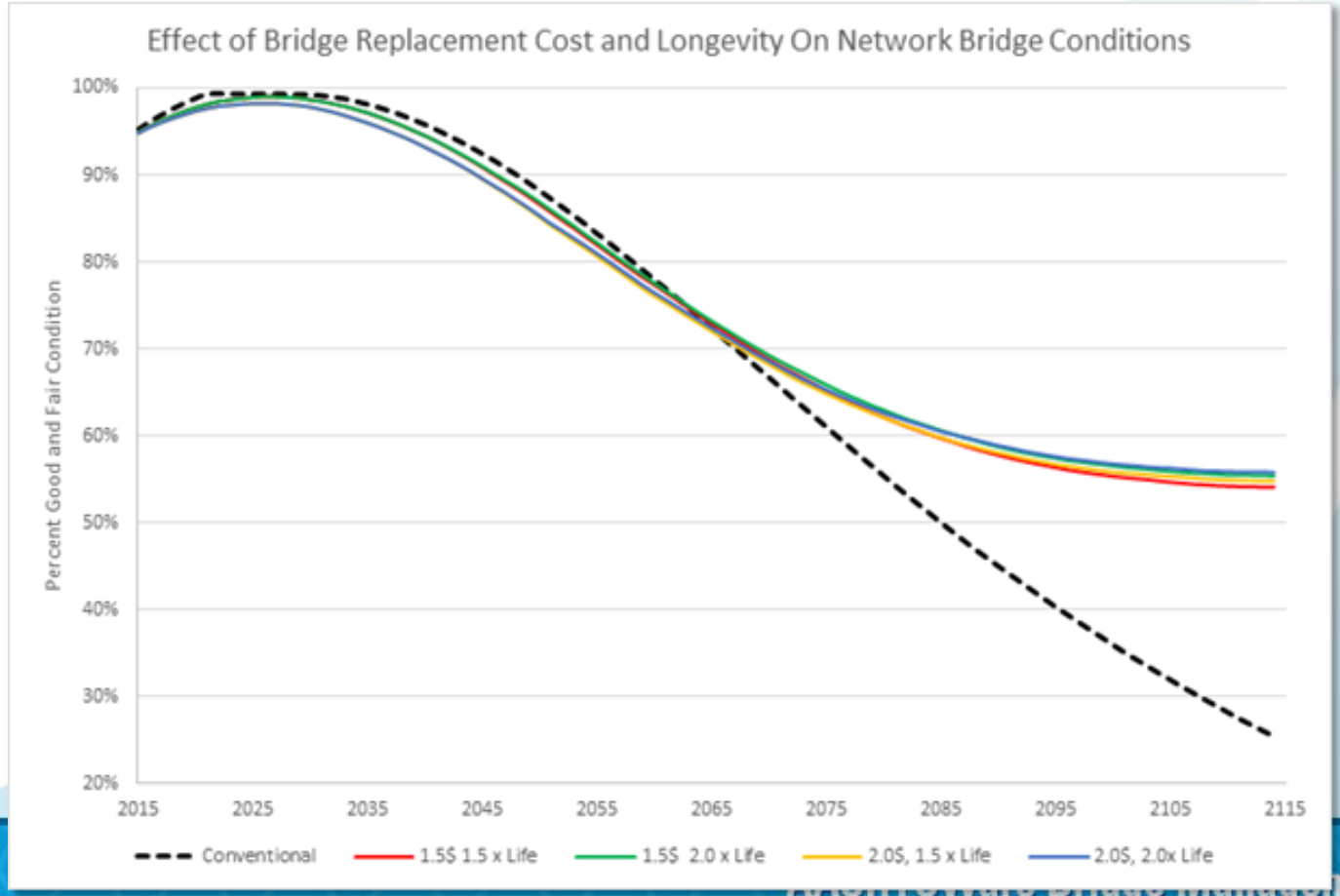
Value of Network Modeling

- What is the impact of revised budgets? What is the funding need to meet goals?



Value of Network Modeling

- What is the value of innovative materials?



Value of Network Modeling

- Develop preservation guidelines

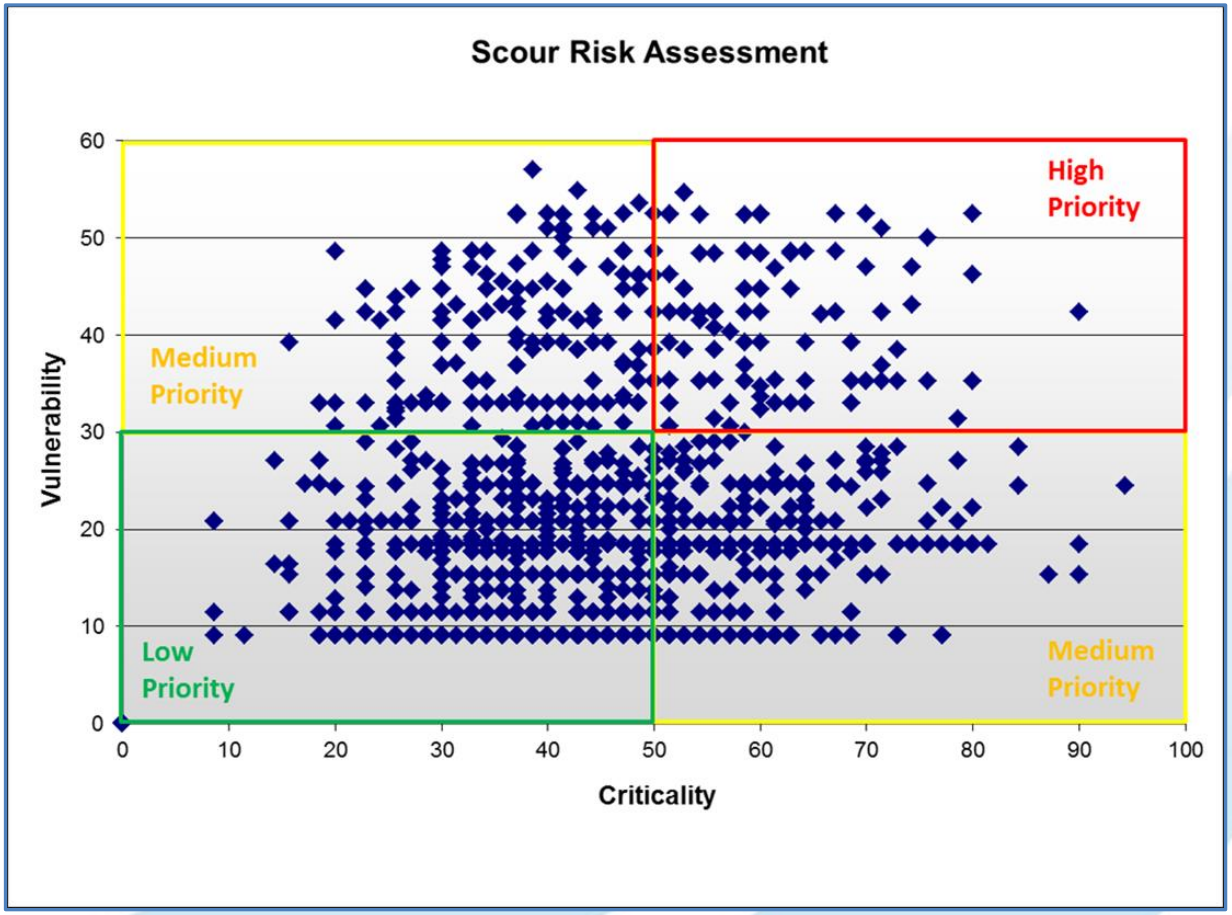
BRIDGE DECK PRESERVATION MATRIX – DECKS WITH EPOXY COATED REBAR (ECR)

DECK CONDITION STATE				REPAIR OPTIONS	POTENTIAL RESULT TO DECK BSIR		ANTICIPATED FIX LIFE
Top Surface		Bottom Surface			Top Surface BSIR #58a	Bottom Surface BSIR #58b	
BSIR #58a	Deficiencies % (a)	BSIR #58b	Deficiencies % (b)				
≥ 5	N/A	N/A	N/A	Hold (c) Seal Cracks/Healer Sealer (d)	No Change	No Change	1 to 4 years
	≤ 5%	> 5	≤ 2%	Epoxy Overlay	8, 9	No Change	10 to 15 years
	≤ 10%	≥ 4(k)	≤ 25%(k)	Deck Patch (e)	Up by 1 pt.	No Change	3 to 10 years
4(k) or 5	10% to 25%(k)	4(k)	10% to 25%(k)	Shallow Concrete Overlay (h, i)	8, 9	No Change	20 to 25 years
				HMA Overlay with water-proofing membrane (f, h, i)	8, 9	No Change	8 to 10 years
		2 or 3(k)	> 25%(k)	HMA Cap (g, h, i)	8, 9	No Change	2 to 4 years
≤ 3(k)	>25%(k)	4(k) or 5	2% to 25%(k)	Shallow Concrete Overlay (h, i)	8, 9	No Change	10 years
				HMA Overlay with water-proofing membrane (f, h, i)	8, 9	No Change	5 to 7 years
		2 or 3(k)	>25%(k)	HMA Cap (g, h, i)	8, 9	No Change	1 to 3 years
				Replacement with Epoxy Coated Rebar (ECR) Deck	9	9	60+ years

(a) Percent of deck surface area that is spalled, delaminated, or patched with temporary patch material.
(b) Percent of deck underside area that is spalled, delaminated or map cracked.
(c) The "Hold" option implies that there is on-going maintenance of filling potholes with cold patch and sealing of incident spalls.
(d) Seal cracks when cracks are easily visible and minimal map cracking. Apply healer sealer when crack density is too great to seal individually by hand. Sustains the current condition longer.
(e) Crack sealing can also be used to seal the perimeter of deck patches.
(f) Hot Mix Asphalt overlay with waterproofing membrane. Deck patching required prior to placement of waterproofing membrane.
(g) Hot Mix Asphalt cap without waterproofing membrane for ride quality improvement. Deck should be scheduled for replacement in the 5 year plan.
(h) If bridge crosses over traveled lanes and the deck contains slag aggregate, do deck replacement.
(i) When deck bottom surface is rated poor (or worse) and may have loose or delaminated concrete over traveled lanes, an in-depth inspection should be scheduled. Any loose or delaminated concrete should be scaled off and false decking should be placed over traveled lanes where there is potential for additional concrete to become loose.
(k) Contact C&T's Bridge Operations section if a deck with epoxy coated rebar in poor condition is identified.

Bridge Deck Preservation Matrix – Decks with Epoxy Coated Rebar June 8, 2011 Rev.

Multi-Objective Network Modeling



Scour Vulnerability Factors	
Factor	Relative Weight
Scour (Item 113)	8.0
# of Sub Units	3.0
Footing Type	2.5
Skew Angle	5.0
Channel Protection	5.0
Soil Type	2.5
Scour Mitigation	2.0
Presence of Scour	6.0
Total Weight	**34.0**

Scour Criticality Factors	
Factor	Relative Weight
Highway Classification	1.0
Traffic Volume	2.0
Detour Length	3.0
Cost of Replacement	3.0
Economic Impact	5.0
Total Weight	**14.0**

Suggestions?