**11th National Conference on Transportation Asset Management**

# *Improving Bridge Risk and Deterioration Modeling*

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# Background

Agency's questions:

**How our bridges deteriorate?**

**What factors influence our bridge deterioration?**

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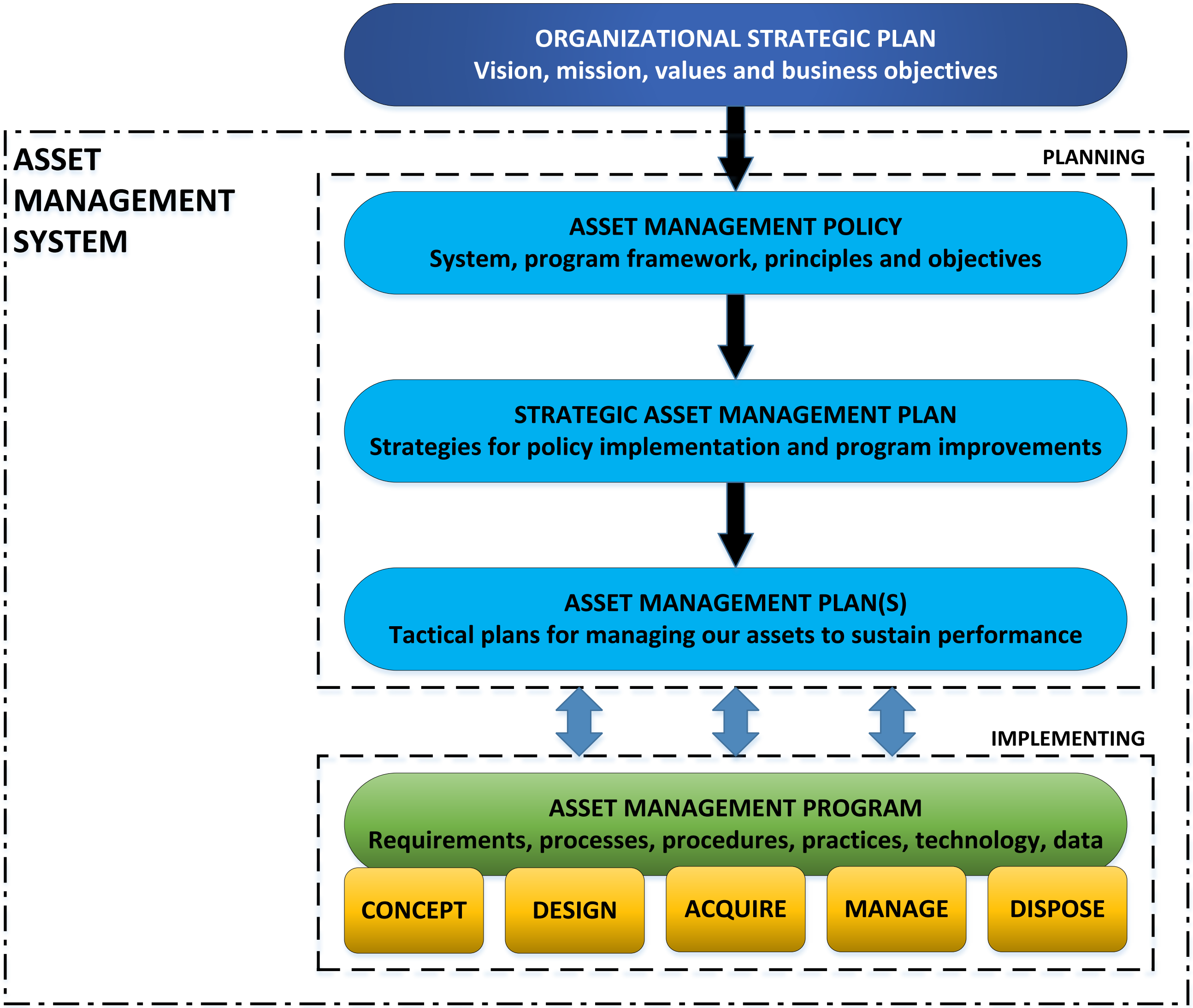
# Importance

- Performance Forecasting
- Life Cycle Cost Analysis
- Financial Planning
- Risk Management

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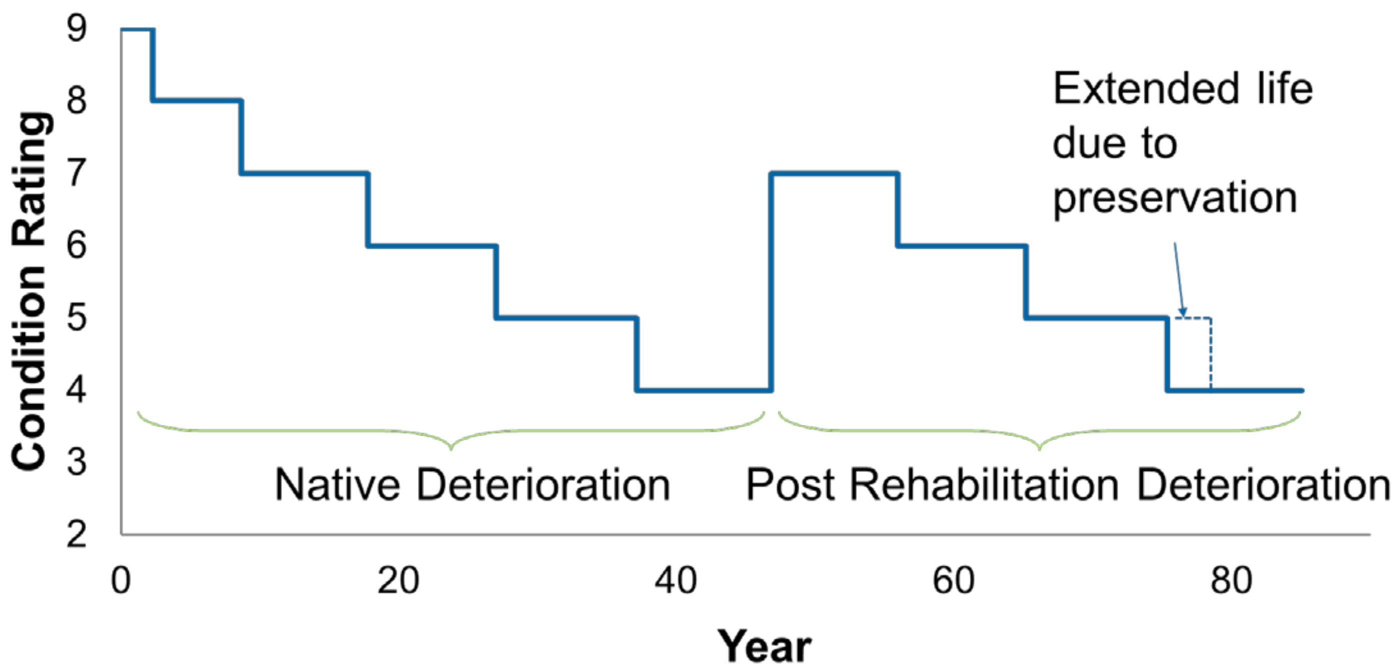
# Main Questions

- ✓ Native Deterioration (no preservation or rehabilitation)
- ✓ Post-rehabilitation Deterioration
- ✓ Impact of Preservation on Deterioration

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# Deterioration Analysis

Deterioration Modeling of:

- 16000 bridges (deck, superstructure, substructure, wearing surface)
- 6000 culverts

## Statistical Analysis of the Impact of the Following Factors on Bridge Deterioration:

- Material
- Traffic
- Truck Traffic
- Functional Classification
- Construction Year
- Freeze Thaw Rating
- Business Plan Network
- Bridge Length

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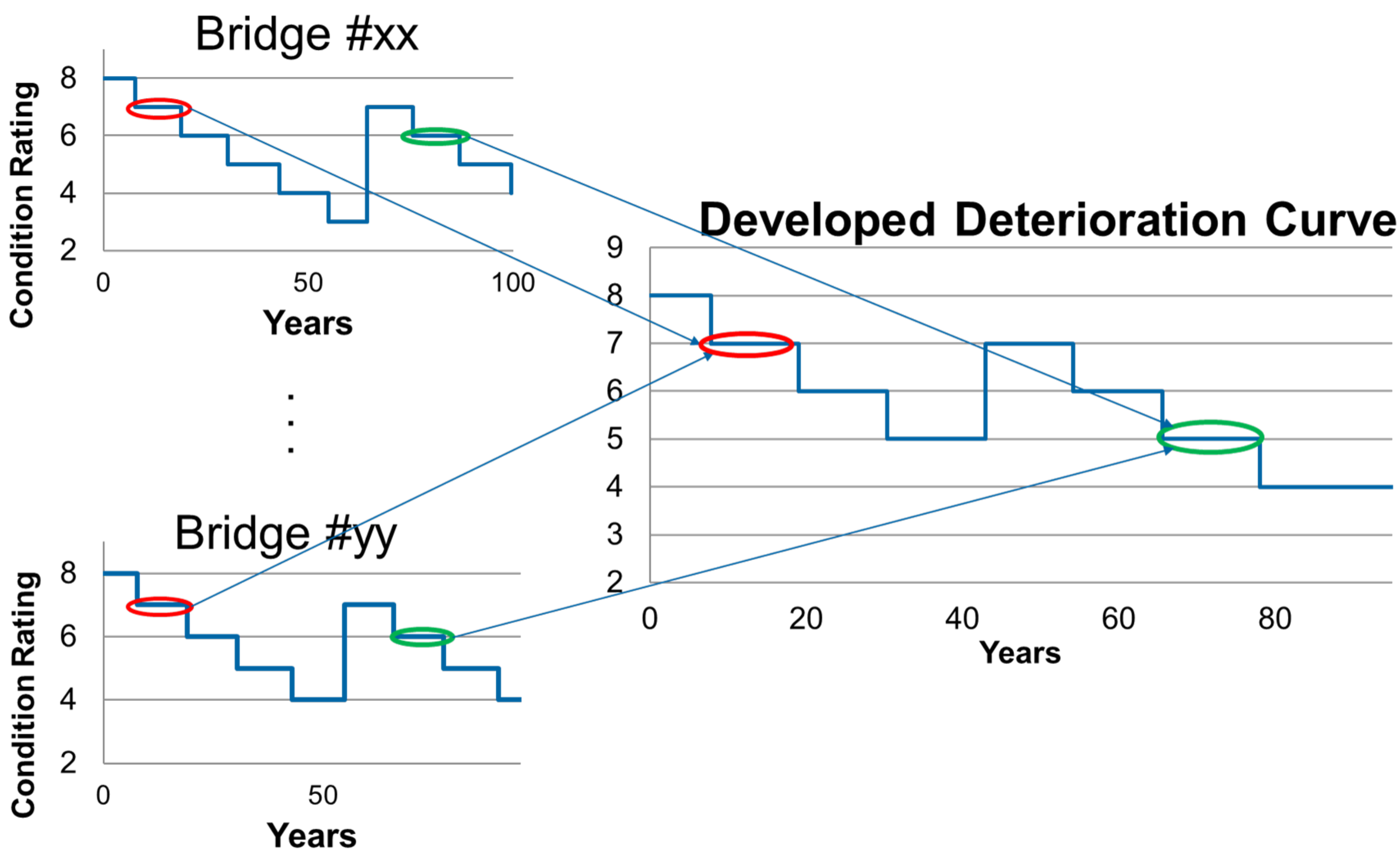
# Method: Condition State Duration Prediction

***Estimates the expected years that a bridge remains in each condition state***

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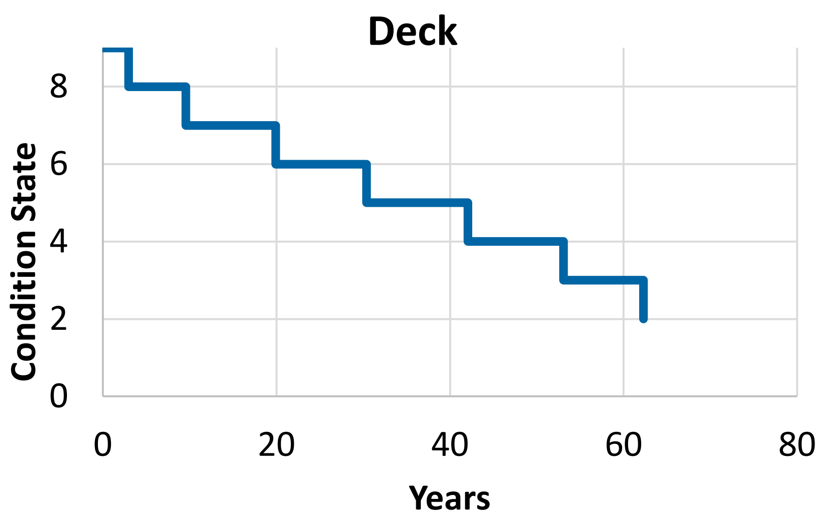
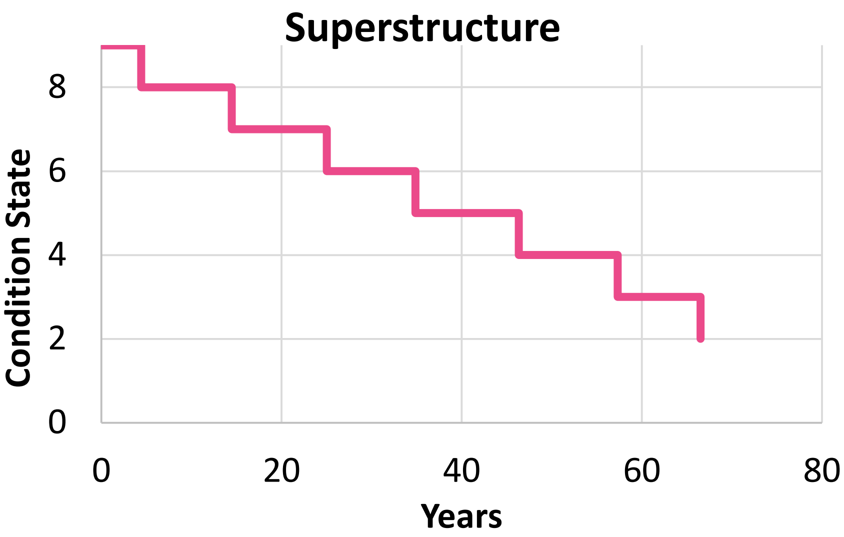
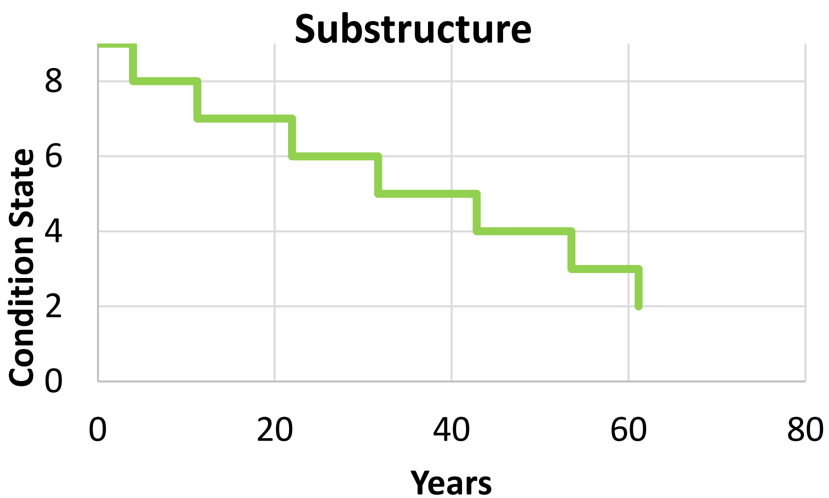
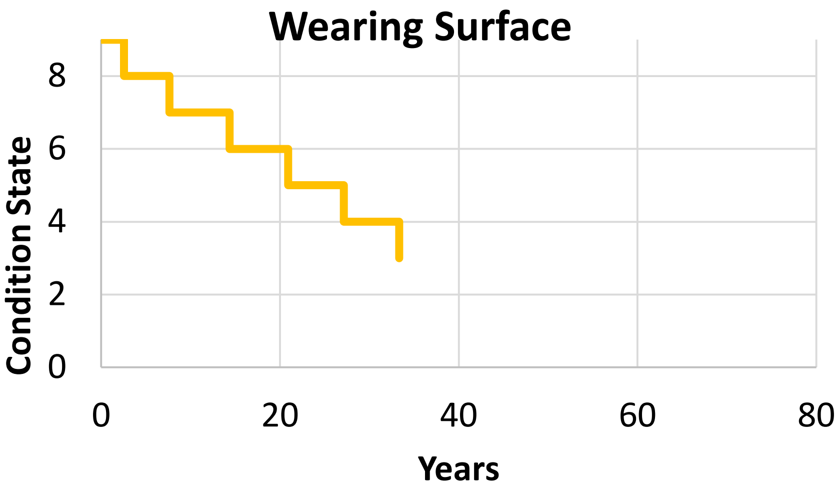
# Native Curves

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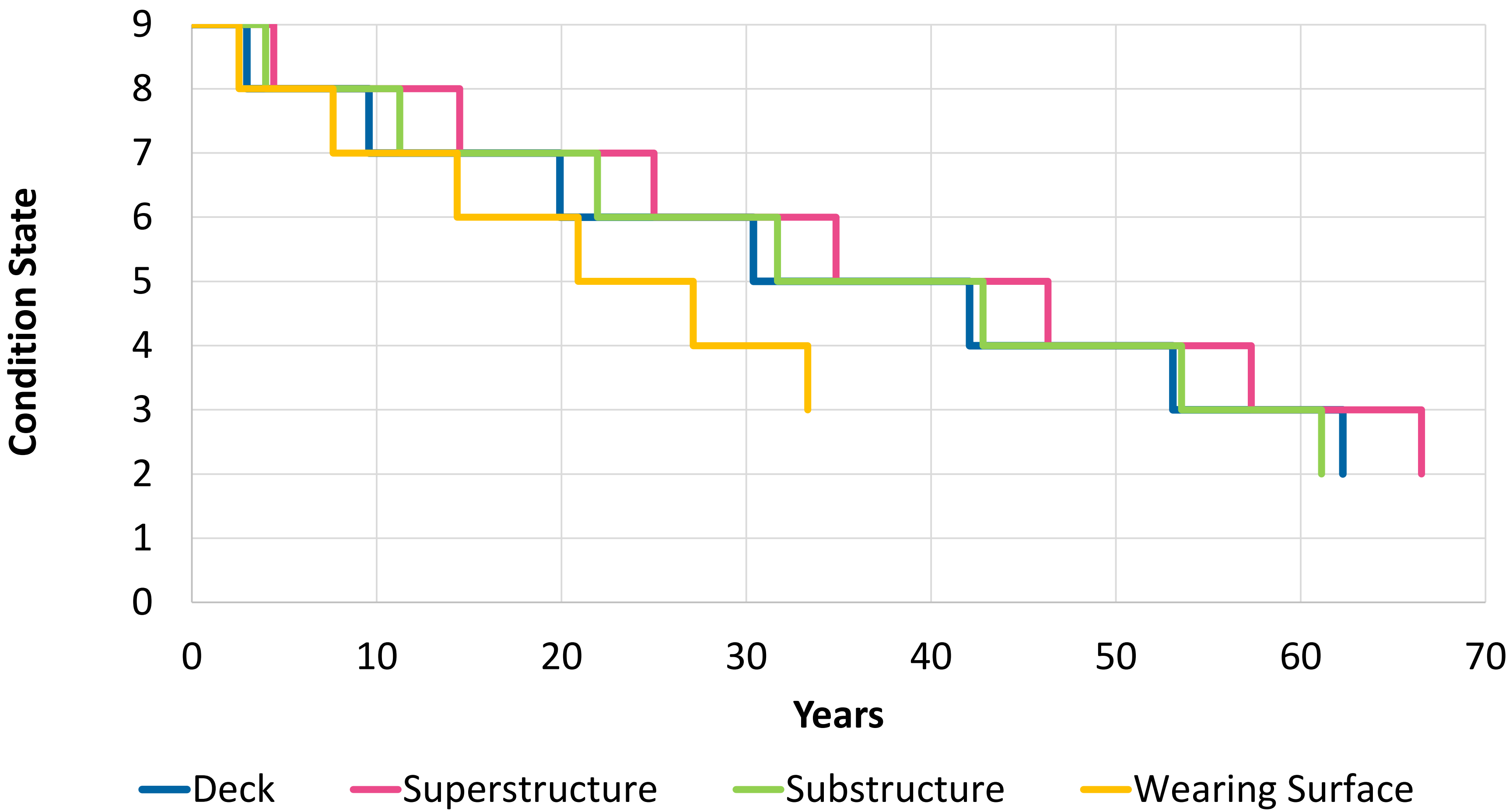
# Native Curves

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# Results

| Expected Life to Structural Deficiency without Major Rehabilitation/Reconstruction (yrs) – Numbers are Illustrative | | | | |
|---|---|---|---|---|
| **Category** | **Deck** | **Superstructure** | **Substructure** | **Wearing Surface** |
| **Overall** | 36 | 39 | 36 | 23 |
| **Concrete** | 41 | 41 | 39 | 23 |
| **Steel** | 32 | 36 | 33 | 22 |
| **P/S** | 32 | 37 | 36 | 24 |
| **Rural** | 36 | 40 | 37 | 23 |
| **Urban** | 34 | 39 | 36 | 24 |
| **BPN 1** | 30 | 34 | 32 | 22 |
| **BPN 2** | 33 | 38 | 36 | 22 |
| **BPN 3** | 36 | 41 | 37 | 23 |
| **BPN 4** | 36 | 40 | 37 | 24 |
| **ADT < 1000** | 37 | 40 | 37 | 24 |
| **1000 < ADT < 5000** | 37 | 42 | 38 | 22 |
| **5000 < ADT < 15000** | 35 | 39 | 36 | 23 |
| **ADT > 15000** | 31 | 36 | 33 | 23 |
| **Pre 1919** | 37 | 42 | 36 | 23 |
| **1918 - 1931** | 38 | 40 | 35 | 22 |
| **1931 - 1944** | 37 | 37 | 33 | 22 |
| **1947 - 1979** | 32 | 35 | 35 | 22 |
| **1983 - 2000** | 37 | 36 | 36 | 29 |
| **Span Length < 40** | 39 | 41 | 38 | 23 |
| **40 < Span Length < 80** | 33 | 38 | 36 | 23 |
| **80 < Span Length < 100** | 32 | 36 | 35 | 23 |
| **100 < Span Length < 150** | 30 | 34 | 32 | 23 |
| **Span Length > 150** | 33 | 36 | 32 | 23 |

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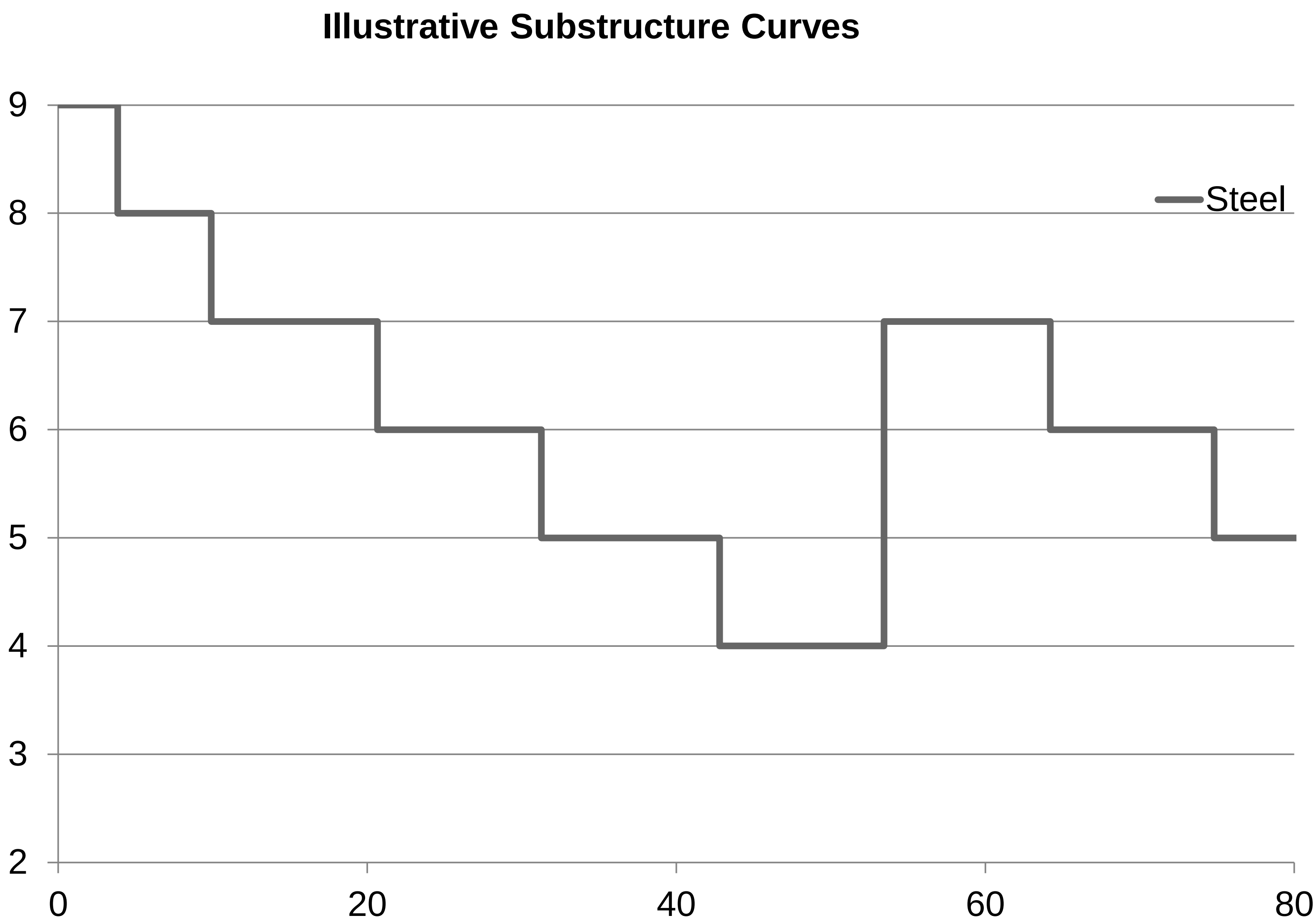
Illustrative Substructure Curves
9
8
7
6
5
4
3
2
0
20
40
60
80
Steel

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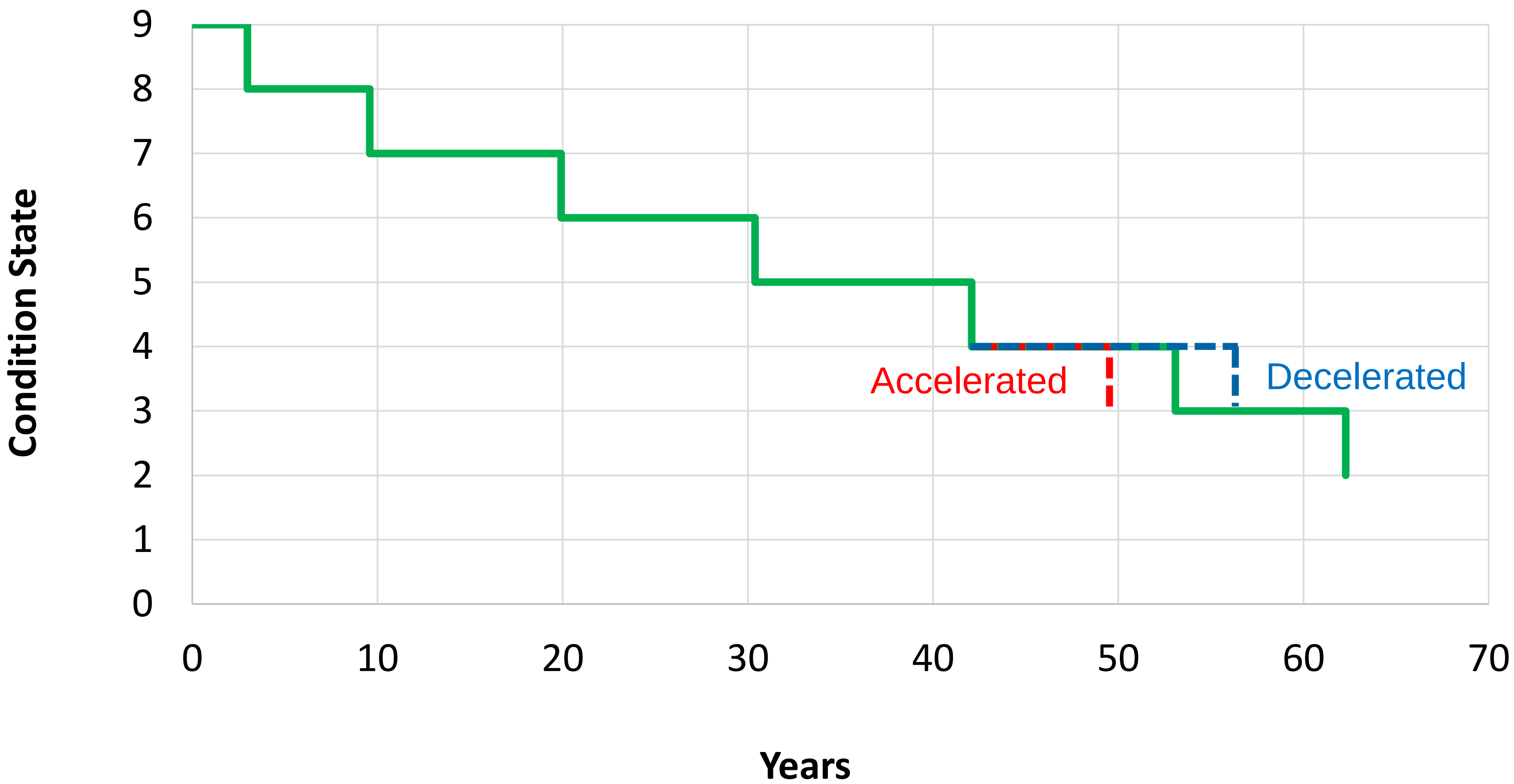
# Incorporating Risk…

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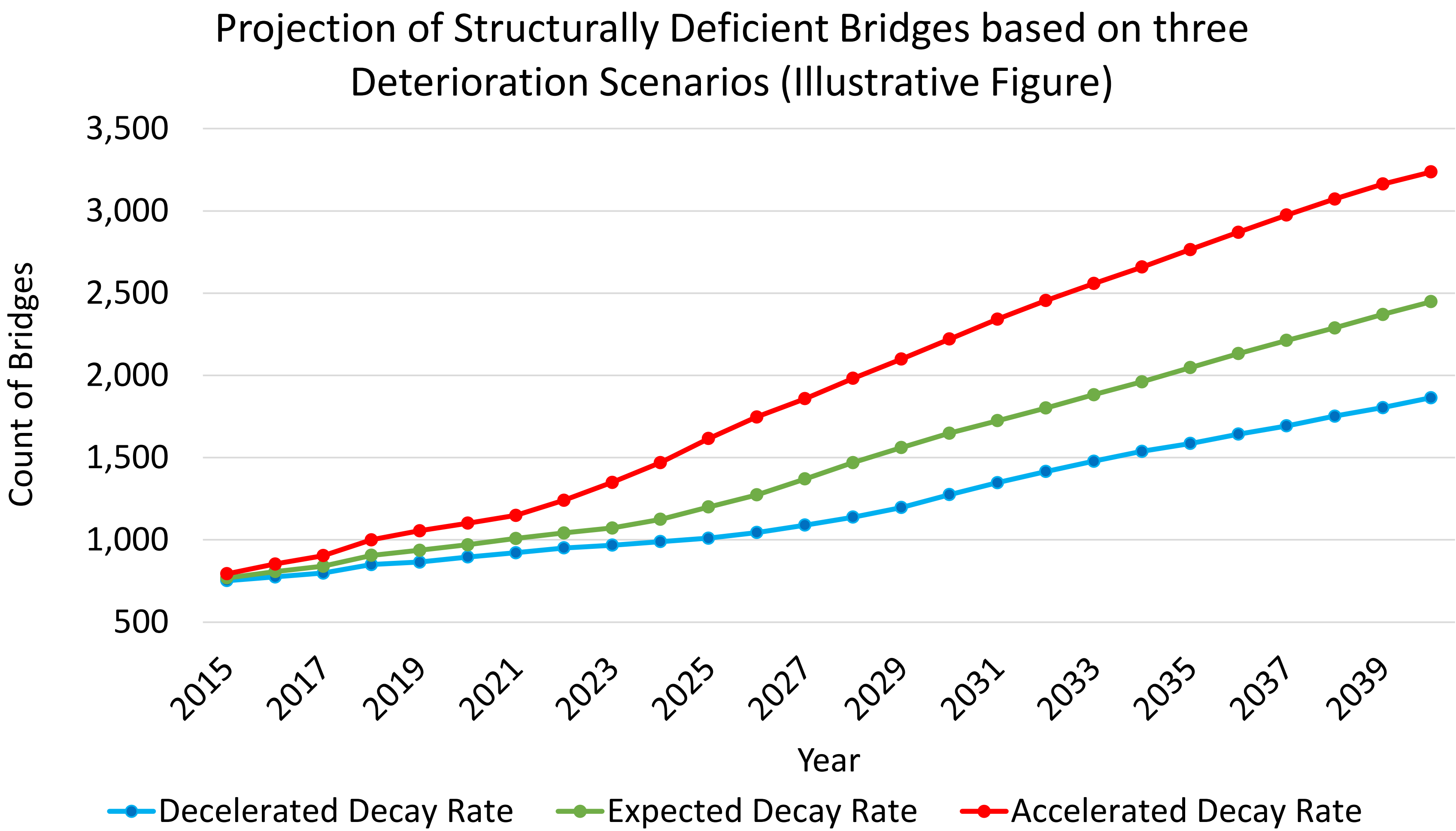
# Risk-based Decision Making

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# Summary

- ✓ Current method can be used by any transportation agency that collects bridge condition data
- ✓ Easily repeatable and the results can be easily updated with new inspection data
- ✓ Incorporates deterioration uncertainties with standard deviations
- ✓ Agencies are able to define multiple forecasting and financial planning scenarios to consider risk

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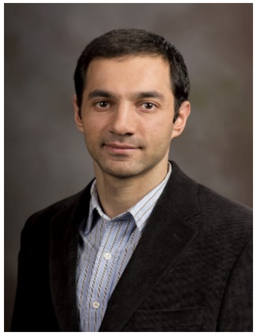
# Questions



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