Roadway Planning Models for Tribal Planners

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Objectives

- Provide tribal planners with roadway planning tools comparable to those used by federal and state agencies
- Provide tools that consider context of use
- Provide support and training

Mechanisms:
- Collaboration and leveraging
- Developers’ working group
Contributing Organizations

- North Dakota State U.
- University Transportation Centers Program
  - Mountain-Plains Consortium (MPC)
  - NDSU, CSU, UW, SDSU, Utah
  - NDSU match
- TTAP Centers (Colorado, Northern Plains, NW)
- FHWA: Asset Mgmt. Division (Thomas Van)
- Federal Lands Highway
- BIA
- Tribes
History of Work I

- Application of FHWA model—Highway Economic Requirement System (HERS)
  - Benefits of investments
  - Cost to maintain highway system in current condition
- Used HERS to analyze state roads running through reservations and estimated benefits:
  - Safety
  - User costs=$f(\text{roughness, time})$
  - Energy
- Next step: analyze IRR roads
HERS Deficiencies & Correcting Improvements

DEFI CIENCY:

pavement condition

triggering deficiencies

volume/capacity

surface type

lane width

IMPROVEMENT TYPE:

resurfacing

reconstruction

widening lanes

additional lanes

sho ulders

realignment

horizontal alignment

vertical alignment

Resurf. with Shld. Improv.
# Components of HERS Benefits and Costs

<table>
<thead>
<tr>
<th>Benefits</th>
<th>User Benefit</th>
<th>Agency Cost</th>
<th>Externality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Operating Cost Savings</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety Cost Savings</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Travel Time Cost Savings</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incremental Benefits to New Travelers</td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>Highway Maintenance Cost Savings</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Residual Value of Investment</td>
<td></td>
<td>X</td>
<td></td>
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<tr>
<td>Emissions Reductions</td>
<td></td>
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</table>

# Costs

<table>
<thead>
<tr>
<th>Costs</th>
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<tbody>
<tr>
<td>Initial Improvement Cost</td>
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<td>X</td>
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</table>
HERS Rural 2-Lane Non-Intersection Crash Rate Factors

- Lane width & shoulder widths (in feet)
- Roadside hazard rating (e.g., 3.0)
- Driveway density per mile
- Average degree of curvature
- Average percent grade
- Crest vertical curve grade rate
## HERS Rural 2-Lane Highway Crash Model

<table>
<thead>
<tr>
<th>Shoulder Width</th>
<th>Crash Rates (mil. VMT)</th>
<th>Lane Width (Feet)</th>
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<tbody>
<tr>
<td></td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>0</td>
<td>127</td>
<td>117</td>
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<tr>
<td>1</td>
<td>120</td>
<td>110</td>
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<td>2</td>
<td>113</td>
<td>104</td>
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<tr>
<td>3</td>
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<td>4</td>
<td>101</td>
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<td>5</td>
<td>95</td>
<td>87</td>
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<tr>
<td>6</td>
<td>89</td>
<td>82</td>
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</table>
## Changes in Crash Costs (000 VMT)
### 20-Year Period: MT Case Study

<table>
<thead>
<tr>
<th></th>
<th>Beginning of Analysis Period</th>
<th>End of Analysis Period</th>
<th>Changes in Analysis Period</th>
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</thead>
<tbody>
<tr>
<td>Crashes</td>
<td>151.3</td>
<td>120.6</td>
<td>-30.7</td>
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<tr>
<td>Injuries</td>
<td>94.9</td>
<td>75.7</td>
<td>-19.2</td>
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<tr>
<td>Fatalities</td>
<td>2.49</td>
<td>1.98</td>
<td>-0.51</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>--------------------------------</td>
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<tr>
<td>Beginning of Analysis Period</td>
<td>$2,164</td>
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<tr>
<td>End of Analysis Period</td>
<td>$1,157</td>
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<tr>
<td>Changes in Analysis Period</td>
<td>-$1,006</td>
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</table>
## Benefit-Cost Ratios: MT Case Study

<table>
<thead>
<tr>
<th></th>
<th>Improvement Cost (mil $)</th>
<th>Total Benefits (mil $)</th>
<th>BCR</th>
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<tbody>
<tr>
<td>Resurf. + Shld. Imps</td>
<td>63.37</td>
<td>606.47</td>
<td>9.57</td>
</tr>
<tr>
<td>Resurfacing</td>
<td>16.75</td>
<td>311.10</td>
<td>18.57</td>
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<tr>
<td>Major Widening</td>
<td>19.785</td>
<td>50.25</td>
<td>2.54</td>
</tr>
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</table>
Assess Other Models

- World Bank:
  - Highway Design/Maintenance Model
  - Road Economic Decision Model
- MPC gravel road guide
- FHWA: Interactive Highway Safety Design Model (IHSDM)
  - Highway Safety Manual
- Asset mgmt programs (John MacGowan)
Possible Outcomes

- Modify HERS analytical model
  - Include unpaved road and thin asphalt models
  - Gravel road vehicle cost models
  - Include other features—safety improvements
- Adapt other (e.g. World Bank) models
- Build our own models
  - Tailored to specific uses
  - GIS transportation planning
History of Work II

- Converted IRR inventory to HPMS format
  - Allow use of FHWA and state models that use HPMS
  - Running and testing on converted file

- Comparison and analysis of IRR and HPMS databases:
  - Assess what can be directly converted from IRR to HPMS format
  - Examine/determine potential conversion of variables not directly in both databases
  - Investigate converting data ‘codes’ - e.g., matching the IRR/HPMS definitions of functional class
History of Work III

- Roadway Asset Management (John MacGowan)
- Beyond roadway inventory
  - Track asset conditions
  - Optimal timing of improvements (expenditures)
- Workshop (MPC, TTAPs, LTAPs, FHWA Asset Mgmt)
- Phase II
  - Updated local roads asset management guide
  - Workshops
Input from You

- What do want the models to provide?
  - Portray benefits of investments in IRR?
  - Information for selecting among potential projects?
  - Forecasting: road conditions/needs?
  - Safety only?

- How would you use the model and how often?