Today’s Presentation: Our Work on Scoping Study

- Share with you the insights developed under NCHRP 20-24(79) Specifications for a National Study of the Future 3R, 4R, and Capacity Needs of the Interstate System
  - Describe our charge and approach
  - Explain our technical findings
  - Present the recommendations contained in the report

- Answer your questions as you prepare to undertake the Section 6021 FAST Act Study.
Study Background

- National Cooperative Research Program (NCHRP) 20-24 Series
- AASHTO CEO Sponsored
- Directed by Study Panel
- TRB Staff Andrew Lemer
- Conducted during 2013

<table>
<thead>
<tr>
<th>Project Panel</th>
<th>Project Team</th>
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The 2013 NCHRP Study

Addressed the features of a major National Study which would estimate costs and benefits for:

» 3R – resurfacing, restoration, and rehabilitation as defined in Federal-aid Highway Act of 1976
» 4R – resurfacing, restoration, rehabilitation, and reconstruction as defined in Federal-aid Highway Act of 1981
» New Capacity
  – Lane additions, interchanges and extensions
  – Systems operations, new technology

To provide, in anticipation of a major national study, an understanding of:

» The methodologies for estimating costs and benefits
» How the strategies for maintaining and enhancing the Interstate could be addressed
» The pros and cons of alternative methodologies
Build on best practices, look to the future

 выполнен

A National “needs study” to inform future Interstate investment policy
  » Systematic, credible needs analyses to capture costs and benefits to preserve and improve the Interstate system, in light of potential future demand
  » Rich literature rooted in the Conditions and Performance Reports by FHWA/USDOT, NCHRP Future Options studies, and Commission Transportation for Tomorrow analyses

Technically and methodologically focused – not a ‘visioning” study nor a strategic plan
  » Structured to assess costs and benefits for a wide range of potential future use and facilities
  » Work plan proposed to advance consideration of alternative scenarios and major changes

Identified and recommended approaches to fill methodological gaps and respond to relevant issues
Three Phased Approach (per the RFP)

- Phase I – Critical Review of Data and Assessment Methodologies
- Phase II – Define Approach and Evaluate Alternative Methodologies
- Phase III – Detail the Selected Approach and Final Report
Prior National Studies

- USDOT Conditions and Performance Reports
  - Congressionally mandated; covers highways and transit
  - 2004 edition contained a chapter specifically devoted to the Interstate System

- National Surface Transportation Policy and Revenue Study Commission Report *Transportation for Tomorrow* authorized by S. 1909 SAFETEA-LU

- AASHTO’s and APTA’s “Bottom Line” Series

- NCHRP 20-24(52) Future Options for the National System of Interstate and Defense Highways
Major Considerations Going Forward

- Lessons learned from national studies and application of methodologies
- Look to emerging trends to address the future
- The technical analyses are critical – informed by the study environment
  - Outreach to a wide variety of system users and beneficiaries across modes (particularly important for goods movement, new technologies, multi-modal perspective, impacts)
  - Adopt scenario planning and performance management techniques
  - The long-term future is uncertain – facilitate “what if” analyses through scenarios, sensitivity analyses and risk analysis techniques
Phase I
Critical Review of Data and Methodologies

Primary Data Sources
- Highway Performance Monitoring System
- National Bridge Inventory

Additional Data Sources
- National Household Travel Survey
- Commodity Flow Survey
- Fatality Analysis Reporting Systems and state crash databases
- State unit cost databases
- State pavement management and bridge management systems and inventories

Primary Tools/Models
- Highway Economic Requirements System (HERS)
- National Bridge Inventory Analysis System (NBIAS)

Additional Tools
- Transportation Operations Benefit-Cost (TOPS-BC)?
- ITS Deployment Analysis System (IDAS)?
- Economic models
- Freight models
Key Strengths of Current Methodologies for Interstate Analysis

- Strong history with HERS and NBIAS applications provides practical, available, systematic approach appropriate for National scale

- Reliable and robust basic coverage of Interstate system in national data sets – collaboration with data owners will be key

- Industry experience with outputs of these major models
  - Fosters discussion of ultimate findings on “common ground” – focuses the debate on the assumptions and alternatives investigated, interpretation of their implications
  - Technical experience with data and models can focus attention on overcoming model and data problems
  - Capability to adjust features to address gaps and updates on a limited basis as time allows
Key Limitations of Current Methodologies for Interstate Analysis

- Evaluations by highway segment/bridge are incremental and not by system
- Focus on capital expenditures and user costs – does not address operational costs, costs of planning and design, risk mitigation, administrative costs
- Focus on existing network (mostly defined 60+ years ago) – does not address possible new facilities and new corridors
- Does not address adaptation or resiliency – a “5th R?”
- Data – perception of reliability and consistency, degree of detail, time lags
- Misses needs driven by freight and goods movement and quick moving market forces

These can be addressed
Example of Addressing a Limitation: 

Accounting for Cumulative Deterioration of An Aging System

- Treatment of long-term, evolving, cumulative need for major reconstruction is inconsistent with HERS incremental decision algorithms

- Task 14 of NCHRP 20-24(52) Future Options for the National System of Interstate and Defense Highways was undertaken to investigate concerns and potential adjustments to address:
  - Underestimation of costs to replace aging facilities?
  - Realistic lifetimes for overall pavement structures?
  - Overemphasis on surface conditions as opposed to underlying structural conditions?

- Case studies will help conceptually address these methodology issues
  - Identify criteria, validate against sample forensic analyses/case studies
  - Develop restoration cost estimates and incorporate into HERS
Modeled Needs Analyses are not “cookie cutter” nor do they lead to precise answers about the long term future. They can be successfully applied to provide a sense of scale and implications of options.

### Summary of range of “high” average annual capital investment levels analyzed for all modes

<table>
<thead>
<tr>
<th></th>
<th>Currently Sustainable</th>
<th>Range Through 2020</th>
<th>Range Through 2035</th>
<th>Range Through 2055</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>From</td>
<td>To</td>
<td>From</td>
<td>To</td>
</tr>
<tr>
<td>Highway</td>
<td>$68</td>
<td>$207</td>
<td>$240</td>
<td>$182</td>
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<td>Transit</td>
<td>$13</td>
<td>$21</td>
<td>$32</td>
<td>$23</td>
</tr>
<tr>
<td>Freight Rail</td>
<td>$4</td>
<td>$5</td>
<td>$7</td>
<td>$5</td>
</tr>
<tr>
<td>Passenger Rail</td>
<td>$1</td>
<td>$7</td>
<td>$7</td>
<td>$9</td>
</tr>
<tr>
<td>All Modes Combined</td>
<td>$86</td>
<td>$241</td>
<td>$286</td>
<td>$220</td>
</tr>
</tbody>
</table>
Domestic and International Methodologies

- State interviews – Wide diversity in facilities and approaches
  - Kansas: Tiered approach combines “worst first” and optimization tool for pavement preservation. Operations and system management needs derived externally
  - New Jersey: System preservation and reconstruction needs generally based on distress and roughness measurements with a 10-year, performance oriented project selection
  - Utah: Comprehensive pavement condition informs selection of optimization strategies over 7-10 years based on benefit-cost analyses; Capacity needs, operations, and system management needs are derived externally

- International – South Korea, Germany, Japan, China
  - Notable practices were gathered but not directly relevant to needs methodologies
  - Provide context for discussion of enhancements and alternative strategies
Preliminary Methodology Conclusions

- Systematic approach superior to “wish lists” or catalogues
  - Comprehensive, systematic, peer-reviewed; sophisticated methods now incorporate economics
  - HERS and NBIAS models represent a framework that captures the vast majority of needs

- Credibility issues based on lack of understanding of application at national level
  - “Sticker shock” and “skepticism” can undermine
  - Argues for better understanding of methodologies and communication of findings
  - Treatment of variation in regional practices and policy drivers

- A hybrid approach may work best to overcome data and modeling limitations
  - Tap the “best of both worlds” – adopt rigorous, systematic modeling enhanced by case study findings
  - Complimentary and supplemental techniques that time and budget allow
  - Update unit cost inputs
  - Gather cost data based on new technologies
Phase II Explore options and direction

- Proposed Project Framework
  - Modular
  - Performance Based
  - Scalable

- Study Structure
  - Range of Scenarios and Components
  - Determine Treatment of Extent
  - Model Baseline
  - Iterate with Changes

- Work Plan
  - Measures and Targets
  - Input Selection and Gap Identification
  - Case Study Analyses
  - Integrate and Test

Source: NCHRP 20-24(79)
Relationship between Scenarios and Needs

- Investment needs determined by performance targets and evaluated on an economic B/C basis
- Program components for consideration
- Risk assessment and sensitivity to alternative input values can informed by iterative testing

**Needs Estimate**

- **A** Restore and Preserve the Existing Interstate System
- **B** Management & Operational Improvements to Operate Assets Efficiently
- **C** Growing the Interstate: Expansion, Extension, & Interchange Improvements
- **D** Harnessing Technology for 21st Century Enhancements

Growing the Interstate:
- Expansion
- Extension
- Interchange Improvements

Harnessing Technology for 21st Century Enhancements
### A. Restore and Preserve the Existing Interstate System

<table>
<thead>
<tr>
<th>What Improvement Types are Included?</th>
<th>Define the Extent of the Investment</th>
<th>Establish Costs Using a Performance Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Resurfacing</td>
<td>- Existing interstate</td>
<td>- Condition-based performance targets</td>
</tr>
<tr>
<td>- Rehabilitation</td>
<td>- Scale back existing interstate?</td>
<td>- Tiered performance targets</td>
</tr>
<tr>
<td>- Reconstruction</td>
<td>- Expand interstate?</td>
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</table>

**What Improvement Types are Included?**
- Resurfacing
- Rehabilitation
- Reconstruction

**Define the Extent of the Investment**
- Existing interstate
- Scale back existing interstate?
- Expand interstate?

**Establish Costs Using a Performance Approach**
- Condition-based performance targets
- Tiered performance targets
B. Operate Assets Efficiently with Management/Operations

What Improvement Types are Included?
- Geometric improvements
- Customer service-based features
- ITS / system monitoring technologies

Define the Extent of the Investment
- Traffic volume-based?
- Economic analysis-based?
- System wide?

Establish Costs Using a Performance Approach
- Recurring and non-recurring congestion and reliability-based performance targets
- Incident management performance targets
- Safety-based performance targets
C. Growing the Interstate
Expansions, Extensions, and Interchange Improvements

What Improvement Types are Included?
- Expansions / Lane additions
- Extensions
- Interchange improvements and additions

Define the Extent of the Investment
- Existing Interstate
- Interstate plus portions of NHS
- Expand based on criteria (capacity analysis, connecting communities, freight, military, etc.)

Establish Costs Using a Performance Approach
- Economic analysis
- Reliability-based performance targets
- Connectivity-based performance targets
D. Harnessing Technology for 21st Century Enhancements

What Improvement Types are Included?
- Service life improvements
- Changes to speed/throughput
- New technology (connected vehicles, driverless cars)
- Others?

Define the Extent of the Investment
- Entire system
- Population-based / urban only
- VMT-based

Establish Costs Using a Performance Approach
- National congestion and reliability-based performance measures
- Safety-based measures
Four Basic Questions to Translate to Needs

How Do We Define the System Scope?
A. Existing system, condition & performance?
B. Consider modern operational efficiency?
C. Consider growing the Interstate?
D. Harnessing new technology?

What Types of Strategies Would Be Deployed?
- Preservation
- Rehabilitation
- Reconstruction
- Management
- Operations
- Expansion
- Extensions
- New tech features
- New practices

To What Level?
What are the relevant performance targets?

At What Cost?
What unit costs should be used in estimating the cost of improvements?
### Alternative Approaches Were Considered

<table>
<thead>
<tr>
<th></th>
<th>METHOD 1: Model Needs with Existing Analytical Tools</th>
<th>METHOD 2: Case Study approach to develop sample segment cost estimates</th>
<th>METHOD 3: Supplement analytical tools with Case Studies (Hybrid of Methods 1 and 2)</th>
<th>METHOD 4: State-assessed needs combined with unit costs</th>
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<tbody>
<tr>
<td>Strengths</td>
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<tr>
<td>Weaknesses</td>
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<tr>
<td>Effort</td>
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<td>Reliability</td>
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See NCHRP 20-24(79) Appendix A.1 & A.2 report for details)
Hybrid Approach *Strengths and Weaknesses*

<table>
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<th>Overall Strengths</th>
<th>Overall Weaknesses</th>
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<tr>
<td>- Case studies could be used to adjust the models’ parameters and data</td>
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<tr>
<td>- Helps to improve understanding and credibility of national needs</td>
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<tr>
<td>- Extensive and in-depth case studies required to cover range of conditions</td>
<td></td>
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<td>- Variability among state agencies related to cost and data collection</td>
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<td>- Learning curve with any new models may delay their use and acceptance</td>
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Excerpt from Table 3.2 NCHRP 20-24(79)
## Application of Hybrid Approach

<table>
<thead>
<tr>
<th>Description</th>
<th>Level of Effort</th>
<th>Reliability of Estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Restore and Preserve the Existing Interstate System</td>
<td>Moderate to High</td>
<td>High</td>
</tr>
<tr>
<td>B. Operate Assets Efficiently with Management and Operational Improvements</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>C. Growing the Interstate Expansions, Extensions, and Interchange Improvements</td>
<td>Moderate to High</td>
<td>High</td>
</tr>
<tr>
<td>D. Harnessing Technology for 21st Century Enhancements</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
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Phase III Detailed Recommendations

Hybrid approach - leverage strengths, address limitations and gaps

Communications and Participation
» Achieve a common understanding of the approach being adopted in order to bring together the disciplines and perspectives needed to inform the analyses
» Foster broad-based collaboration across wide stakeholder base – but keep it real.

Cost -- $3-4 Million minimum
» Based on C&P budgets, $2-$3 M of contract support for modeling over 2 years
» Additional costs for case study research, communications, collaboration

Time – highly dependent upon scale of case studies and scenarios
» 2-3 months to refine workplan including adopting scenarios
» 9 months to conduct case studies in parallel with baseline modeling
» 2 months of adaptation of models/6 months of model simulation
» 6 months report writing and ground testing
Conclusions

NCHRP 20-24(79) provided a methodological “springboard” to hit the ground running for the Section 6021 Future Interstate study

Methodology can respond to a variety of scenarios and policy options

» Treat a range of travel demand and modal share forecasts

» Preservation and safety investment needs for existing system under alternative performance goals

» Capacity and operations investment needs for existing/potentially expanded system under alternative goals for mobility and reliability

» Incorporate resilience and adaptation goals to recognize climate change/ extreme weather events.

» Implications of short-term as well as far-reaching technology innovations

While recommended schedules and budgets will need to be trimmed, the recommended approach is still the best of the options
We are happy to take questions.

Susan Binder
Hal Kassoff