



School of Building Construction

Monday July 15, 2013

Synthesis of Best Practices for Determining Value of Research Results

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**2013 AASHTO-RAC and TRB State Representative Annual Meeting
Value of Research Taskforce**

Overview

- Research Objective
- Research Methodology
- Results of the First Survey
- Results of the Second Survey
- Results of the Third Survey
- Examples of Determining Value of Research
- Summary of Best Practices
 - Methods
 - Measures
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- Conclusions and Research Path Forward

Research Objective

- The overall objective of this project is to synthesize the best practices for determining the value of research results, in order to demonstrate the impact that the research has on transportation system features, such as safety, quality and cost effectiveness.
 - This synthesis presents the critical review of methods used for determining the value of transportation research.
 - Furthermore, it is intended to identify various measures and data sources used for determining value of research.

Research Methodology

- Review literature on determining value of research results
- Conduct three fact-finding surveys
 - Survey 1 was conducted to capture state of knowledge and practice in determining value of research in DOTs
 - Surveys 2 and 3 were conducted to collect best examples for determining value of transportation research
- Perform content analysis on the best examples for determining value of transportation research

First Survey Results – Response Rate

■ Distribution of survey:

- The survey was distributed among representatives from 50 State Departments of Transportation (DOTs), District of Columbia, Federal Highway Administration (FHWA), and Transportation Research Board (TRB) to capture state of knowledge and practice in determining value of research.

■ Response rate:

- 25 individuals replied.
- These individuals represent 20 state DOTs as well as FHWA, and TRB.

Alaska DOT	California DOT	Colorado DOT	Florida DOT
Georgia DOT	Illinois DOT	Iowa DOT (2)	Louisiana DOT
Maine DOT	Maryland DOT	Minnesota DOT (3)	Mississippi DOT
Montana DOT	North Carolina DOT	Ohio DOT	Pennsylvania DOT
South Carolina DOT	Texas DOT	Utah DOT	West Virginia DOT
FHWA	TRB		

Summary of findings of the first survey

- **Several research reports have been collected and analyzed:**
 - Florida DOT (Two research reports)
 - ♦ Review, Analyze and Develop Benefit Cost/Return on Investment Equations, Guidelines and Variables (2003)
 - ♦ Valuing the Benefits of Transportation Research: A Matrix Approach (2002)
 - Ohio DOT (Two research reports)
 - ♦ Evaluation of ODOT Research and Development Implementation Effectiveness (1988)
 - ♦ Benefit-Cost Analysis of Transportation Research Projects (1992)
 - Kentucky DOT (One research report)
 - ♦ Research report: Value of research: SPR projects (2001)
 - Utah DOT (One research report)
 - ♦ Measuring the benefits of transportation research in Utah

Summary of findings of the first survey (Cont'd)

- Minnesota DOT (One research report)
 - ♦ Economic benefits from road research (2008)
 - TRB (One report)
 - ♦ Communication matters: a guidebook published by National Cooperative Highway Research Program (NCHRP), Report 610, Available from Transportation Research Board (TRB) (2009)
 - RPM (One research report, PM 101, and the system)
 - ♦ Performance Measurement Tool Box and Reporting System for Research Programs and Projects, NCHRP Project 20-63
- Most states have future/present plans to quantify the value of research projects.

Summary of findings of the first survey (Cont'd)

- There is not a formal guideline for assessing the benefits of research reports.
 - Although several methods are proposed for quantifying the benefits of research projects in the research reports collected in the first survey, there is not any formal guideline or formal method to evaluate the quantitative and/or qualitative benefits of research projects in state DOTs.
- There are less attempts for quantifying benefits that are hard to put dollar values on.
- Data scarcity for evaluation of research benefits is a significant challenge.

Summary of findings of the first survey (Cont'd)

- The evaluation methodology should not be too long and too complex.
 - It should be easy to follow.
- Based on the survey results, flexibility is the key for designing any guideline to assess research benefits.
 - Several classifications of areas of research projects and the corresponding benefits
 - Several methods for assessing the value of research benefits
 - Several measures for assessing the value of research benefits

Summary of findings of the first survey (Cont'd)

- Developing a training program for researchers and state DOT personnel is vital.
- Communication of research benefits is important.
- Collection and distribution of good evaluation examples can be extremely helpful.
 - AASHTO high value research projects and TRB “Research pays off” documents summarize valuable examples of State DOT’s attempts towards quantifying research benefits.

Second Survey for Capturing Best Examples

- We followed up with the responders of the first survey (and contacts from the RAC roster) to collect examples of quantifying research benefits in the following areas:
 - Safety
 - Environmental Sustainability
 - Management and Policy
 - Infrastructure Condition
 - Traffic and Congestion Reduction
 - Quality of life
 - Freight movement and Economic Vitality
 - Customer Satisfaction
 - System Reliability
 - Expedited Project Delivery
 - Engineering Design Improvement
 - Increased service life
 - Improved productivity and work efficiency
 - Reduced User Cost
 - Reduced administrative costs
 - Reduced Construction, Operations and Maintenance Cost
 - Materials and Pavements

Second Survey Results

■ Response rate

- Representatives from 16 state DOTs, FHWA, and TRB replied.
- 9 representatives replied that they do not yet quantified the value of research.
- In several state DOTs, the process of quantification is in progress (e.g., California and Montana)

Third Survey for Capturing Best Examples

- AASHTO documents introducing high value research projects were reviewed.
 - Several high value research projects have also been highlighted in “Research Pay Off” documents.

- 69 projects were selected for further analysis.
 - Based on the AASHTO documents, the value of research in these 69 projects were assessed explicitly and objectively.

- Emails were sent to corresponding agencies to ask for further details on the background calculations for determining the benefits of the research projects.
 - ◆ 9 individuals replied.
 - Note: Some individuals provided multiple examples.

Third Survey (Cont'd)

- The benefits in the identified projects (69 projects) are distributed among the areas:
 - Safety
 - Environmental Sustainability
 - Management and Policy
 - Infrastructure Condition
 - Traffic and Congestion Reduction
 - Quality of life
 - Freight movement and Economic Vitality
 - Customer Satisfaction
 - System Reliability
 - Expedited Project Delivery
 - Engineering Design Improvement
 - Increased service life
 - Improved productivity and work efficiency
 - Reduced User Cost
 - Reduced administrative costs
 - Reduced Construction, Operations and Maintenance Cost
 - Materials and Pavements

Note: We categorized the projects into the benefit areas based on the AASHTO documents and the project reports (if available).

Example of Determining Value of Research Results of Content Analysis

Evaluation of Pollution Levels

■ Research project:

- “Evaluation of Pollution Levels Due to the Use of Consumer Fertilizers under Florida Conditions”
- Sponsored by: Florida DOT
- Local water management district directs FDOT District to reduce nitrogen in surface waters by 18,472 pounds per year.
- FDOT needs to purchase Total Maximum Daily Load credits at a cost of \$500,000-\$1,000,000 per year for 20 years if it is unable to meet the reduction target.

■ Research objective:

- Provide a scientific basis for quantifying the reduction in nutrient losses from highway slopes due to changes in fertilization practices.

Reference: Florida DOT

Evaluation of Pollution Levels (Cont'd)

- **Areas of benefit:**
 - Environmental Sustainability
 - Reduced Construction, Operations, and Maintenance Costs
- **Methods for determining value of research:**
 - Lab experiments using a custom designed field scale test bed and rainfall simulator
 - Benefit (Dollar) Analysis

Reference: Florida DOT

Evaluation of Pollution Levels (Cont'd)

■ Benefit (Dollar) analysis:

- FDOT showed that they could meet 85% of their target reduction by stopping annual fertilizing.
- The amount of nitrogen that was getting out of the turf and into the water was quantified by various tests conducted at the University of Central Florida using field-scale rainfall simulator and test bed.
- FDOT could save \$150,000 per year in fertilizer
- FDOT could save 85% of the anticipated fine (\$1M per year),
 - ◆ This is equivalent to \$850,000 per year.

Reference: Florida DOT

Evaluation of Pollution Levels (Cont'd)

■ Measures:

- Reduction in anticipated fine
- Reduction in amount of annual fertilizer
- Reduction in the amount of Nitrogen getting out of turf

■ Data sources:

- Outcome of lab experiments using a custom designed field scale test bed and rainfall simulator
- Anticipated fine from the local water management district

Reference: Florida DOT

Summary of Best Practices

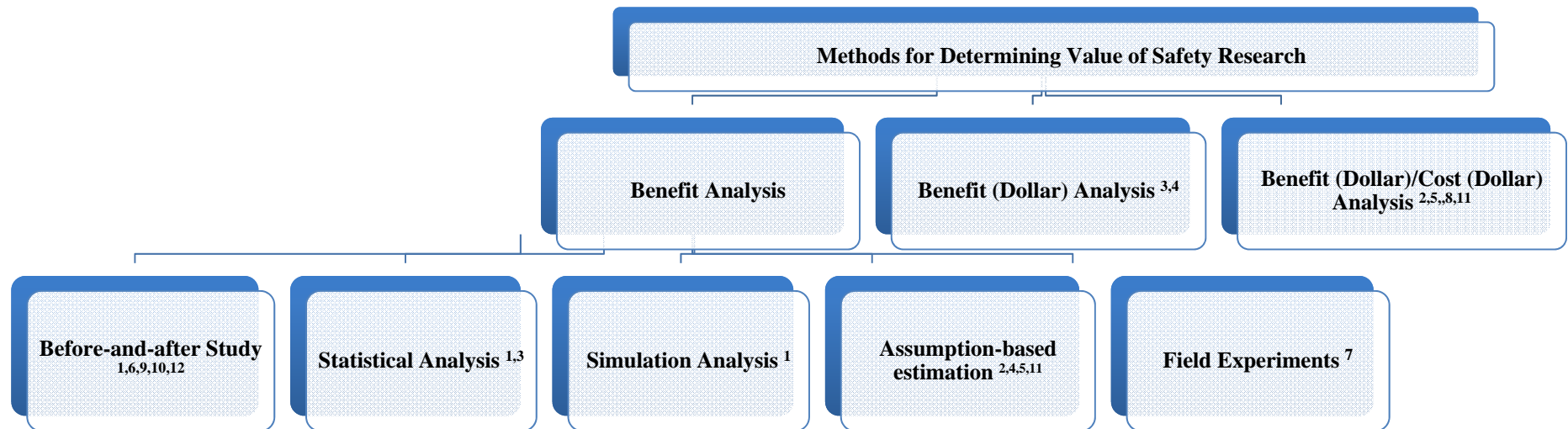
Summary of Best Practices

- Best practices to determine the value of transportation research are summarized for several impact areas, as the following:

- 1 Safety
- 2 Environmental sustainability
- 3 Improved Productivity and Work Efficiency
- 4 Traffic and Congestion Reduction
- 5 Reduced Construction, Operations and Maintenance Costs
- 6 Management and Policy
- 7 Customer Satisfaction
- 8 System Reliability
- 9 Expedited Project Delivery
- 10 Engineering Design Improvement
- 11 Increased Service Life
- 12 Reduced User Cost
- 13 Reduced Administrative Costs
- 14 Materials and Pavements
- 15 Intelligent Transportation Systems

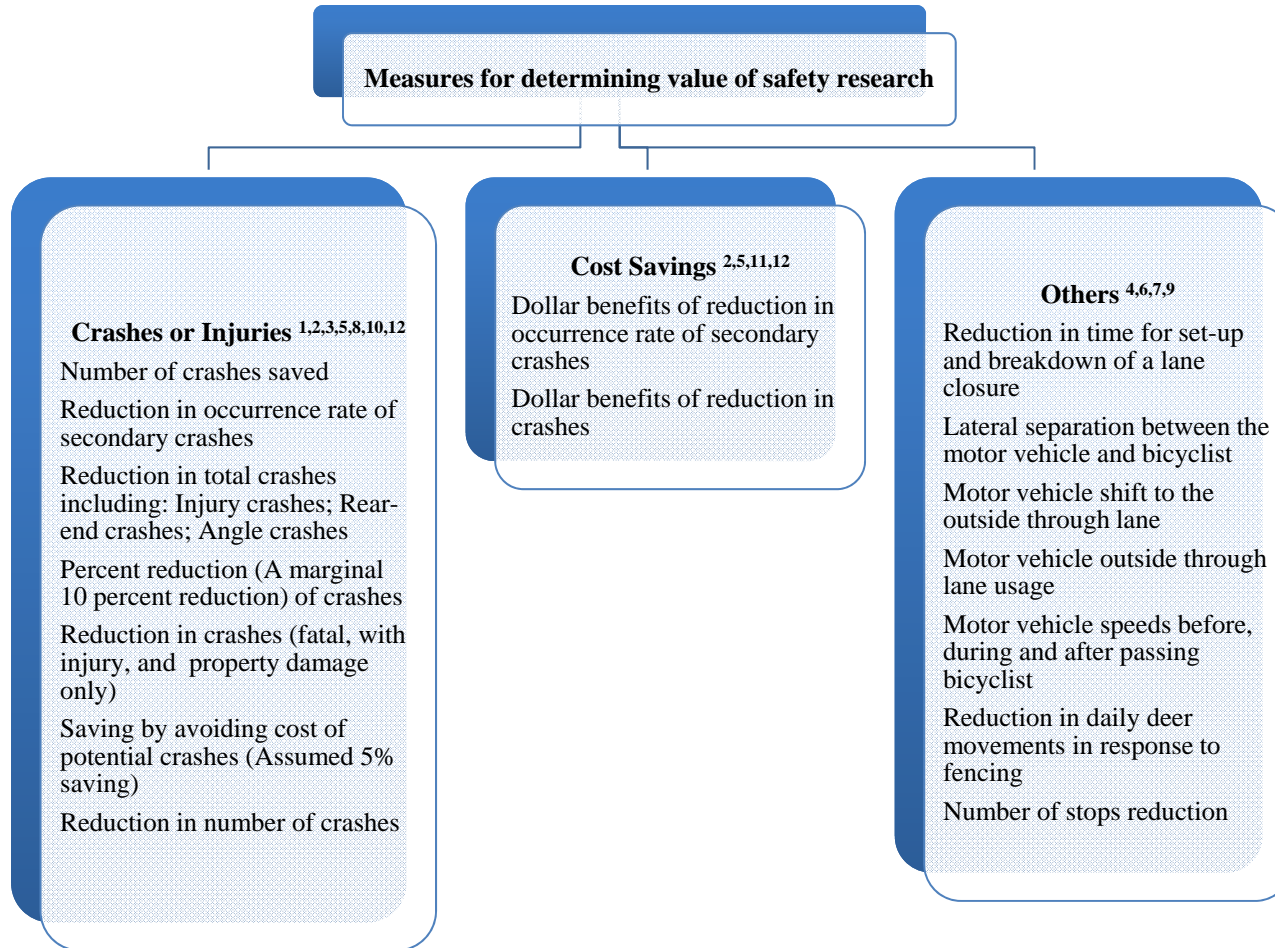
Summary of Best Practices – Safety (Methods)

- Methods for Determining Value of Research on Transportation Safety



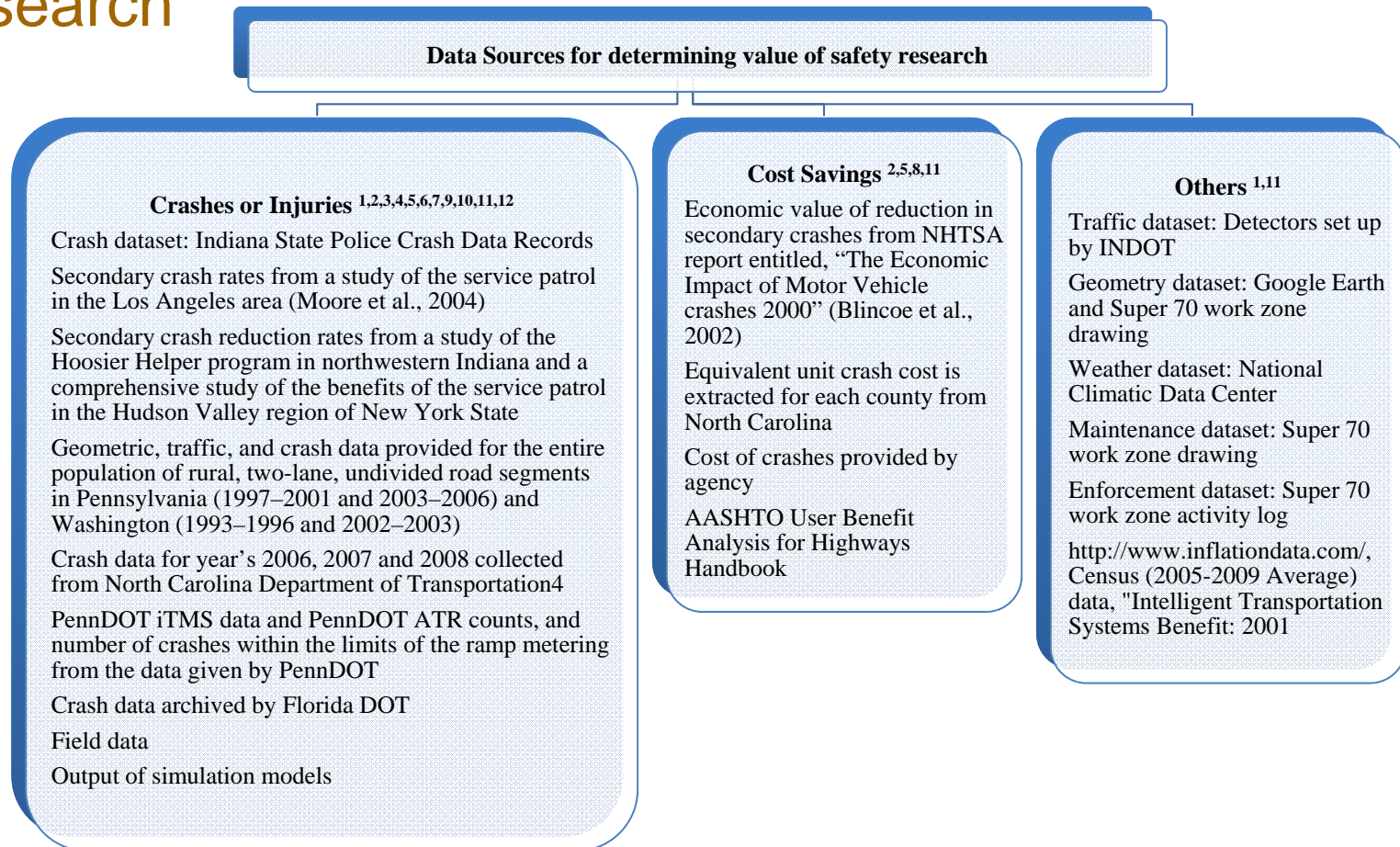
Summary of Best Practices – Safety (Measures)

■ Measures for Determining Value of Safety Research



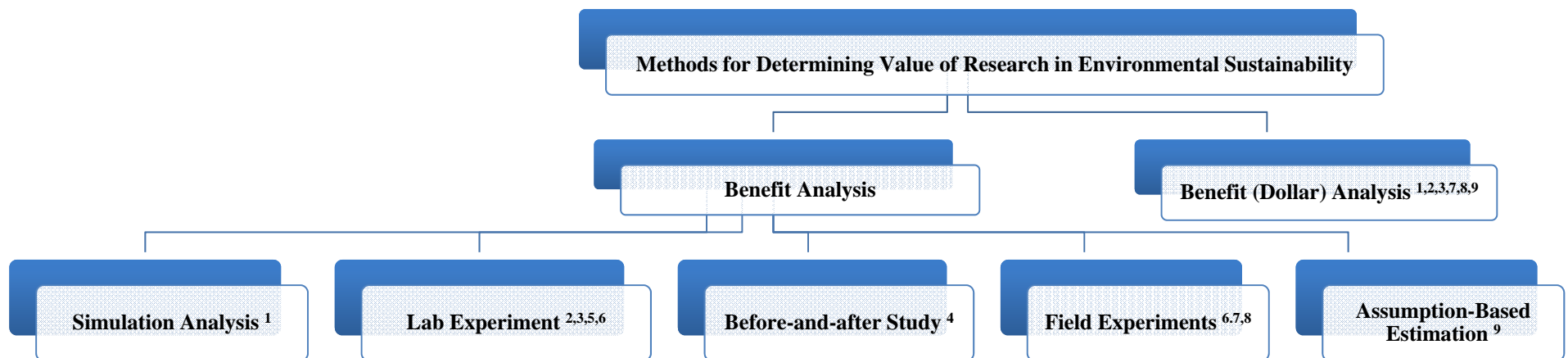
Summary of Best Practices – Safety (Data Sources)

■ Data Sources for Determining Value of Safety Research



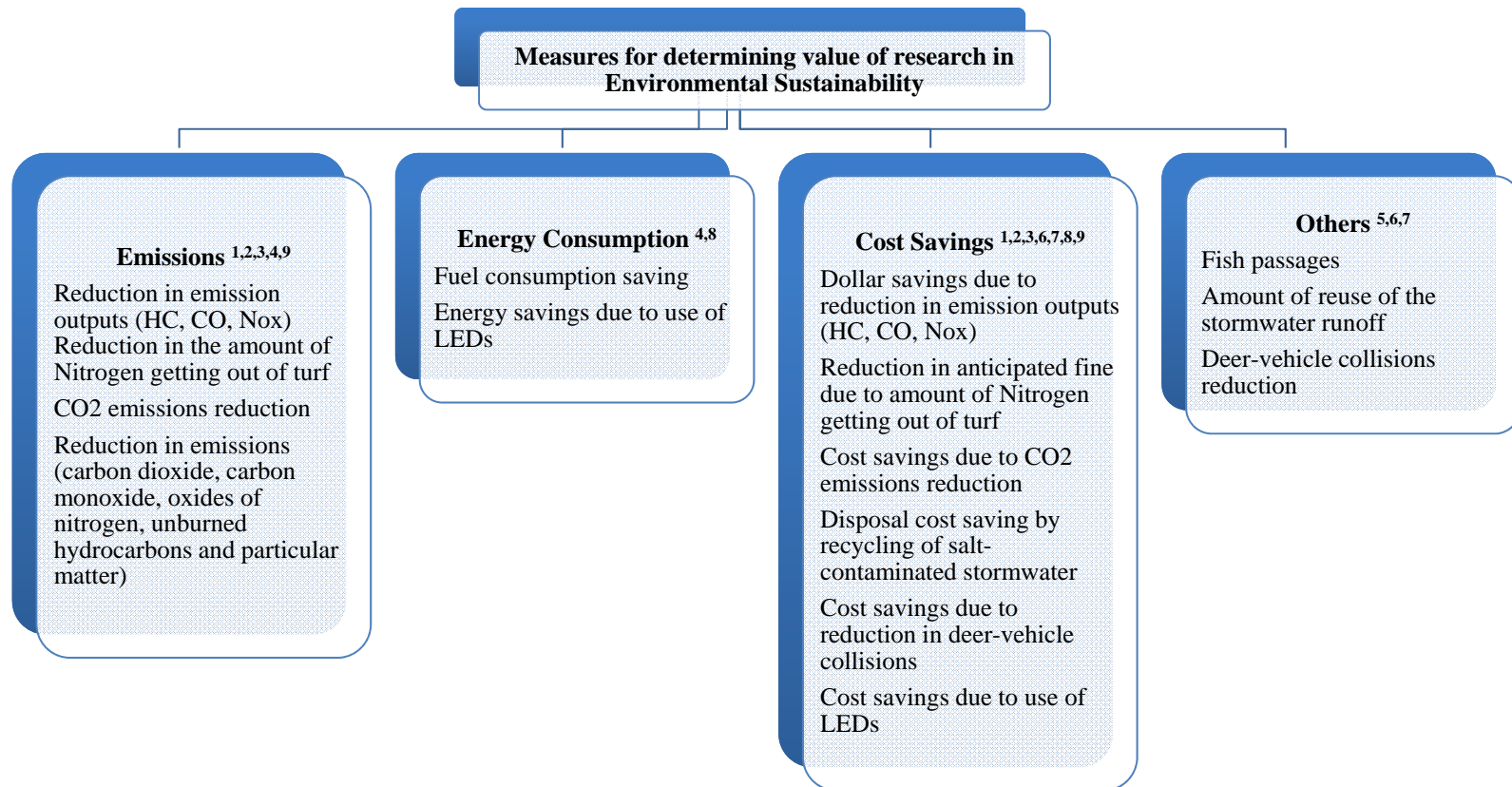
Summary of Best Practices - Env. Sustainability (Methods)

- Methods for Determining Value of Research on Environmental Sustainability



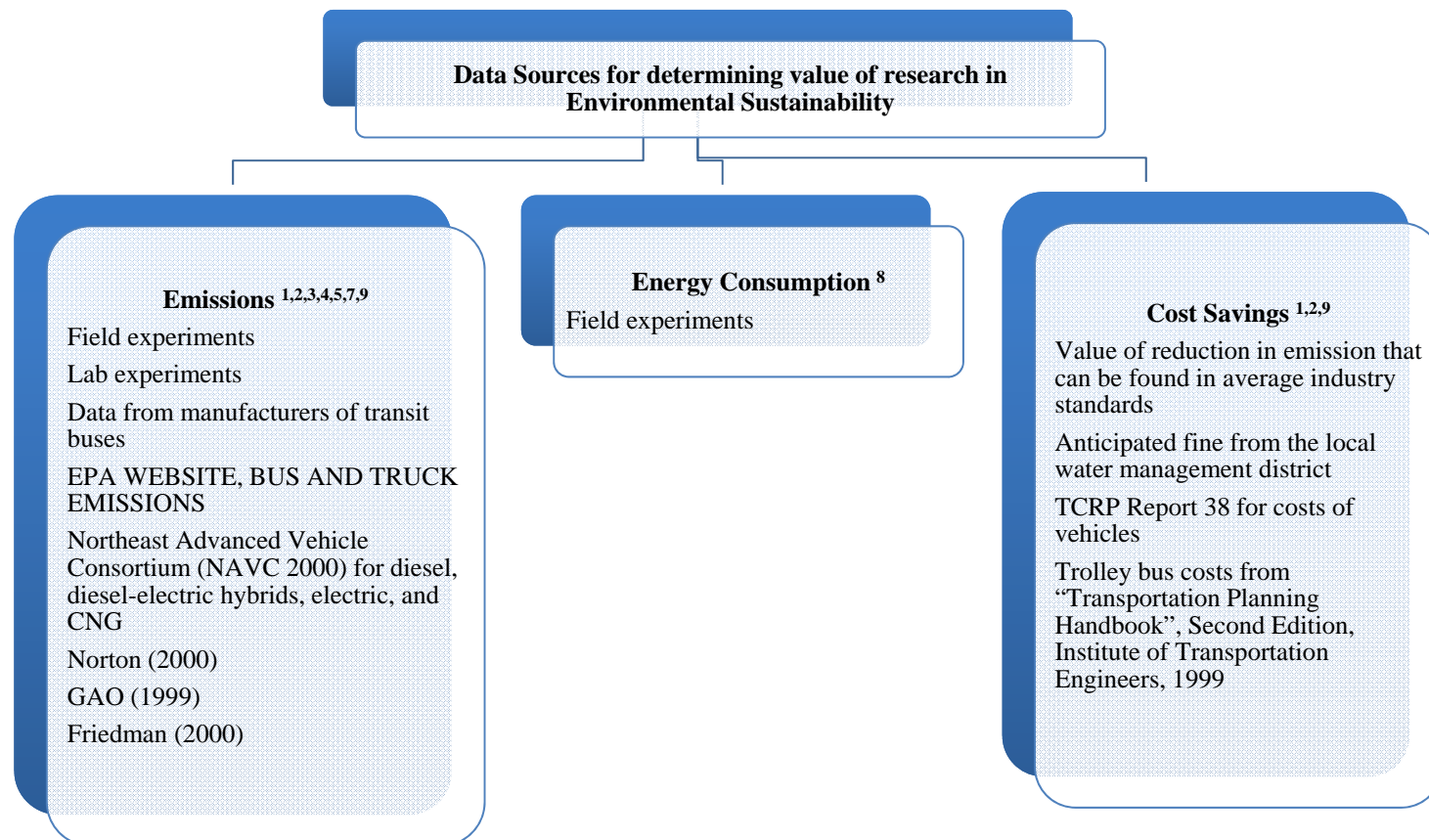
Summary of Best Practices - Env. Sustainability (Measures)

Measures for Determining Value of Research on Environmental sustainability



Summary of Best Practices - Env. Sustainability (Data Sources)

■ Data Sources for Determining Value of Research on Environmental Sustainability



Summary of Best Practices (Methods)

- Several methods have been used to determine the value of research:
 - Benefit Analysis
 - ◆ Before and After Study
 - ◆ Statistical Analysis
 - ◆ Simulation Analysis
 - ◆ Assumption-Based Estimation
 - ◆ Field Experiment
 - ◆ Lab Experiment
 - ◆ Revenue Estimation Modeling
 - ◆ Surveys
 - ◆ Assessment of Benefits in Other Areas
 - Benefit (Dollar Analysis)
 - Benefit (Dollar)/Cost (Dollar) Analysis
 - Life Cycle Cost Analysis
 - Analysis of Dissemination of Research Output

Summary of Best Practices (Measures)

- Several measures have been used for determining value of research.
 - Measure categories specific to areas of benefits
 - ♦ For instance, “An Evaluation of the Benefits of the Alabama Service and Assistance Patrol” research project used the reduction in occurrence rate of secondary crashes to determine value of safety research.
 - “Cost Savings” measures
 - ♦ For instance, “An Evaluation of the Benefits of the Alabama Service and Assistance Patrol” research project used dollar benefits of the reduction in occurrence rate of secondary crashes to determine value of safety research.
 - “Others” measures
 - ♦ For instance, “An Evaluation of the Benefits of the Alabama Service and Assistance Patrol” research project used “motor vehicle shift to the outside through lane” to characterize the value of safety research.

Summary of Best Practices (Data Sources)

- Several data sources have been used for determining value of research:
 - Literature (Scholarly papers, databases, reports, etc.)
 - Data provided by DOTs, FHWA, TRB, AASHTO (Performance records, etc.)
 - Data provided by manufacturers
 - Outcomes of surveys
 - Outcomes of lab experiments
 - Outcomes of field experiments
 - Outcomes of simulation studies
 - Assumptions (Based on judgment, experience, literature, etc.)

Conclusions and Research Path Forward

Conclusions

- There is not a formal guideline for assessing the benefits of research reports.
- There are less attempts for quantifying benefits that are hard to put dollar values on.
- A broad range of approaches (in terms of methods, benefit measures, and data sources) have been used for quantifying the value of research.
 - Data scarcity for evaluation of research benefits is a significant challenge.

Conclusions (Cont'd)

- Communication of research benefits is important.
- Collection and distribution of good evaluation examples of determining value of research can be extremely helpful.
 - AASHTO high value research projects and TRB “Research pays off” documents summarize valuable examples of State DOT’s attempts towards quantifying research benefits.
- Developing a training program for researchers and state DOT personnel is vital.

Research path forward

- An evaluation method should not be too long and too complex.
- There is a need to conduct research to develop a systematic and transparent approach to determine value of transportation research.
 - The proposed approach should be both scalable and flexible.
 - The proposed approach should be easy to understand and follow.
 - The proposed methods and measures should not prohibit innovative ways to objectively determine value of research.

Research path forward (Cont'd)

- **There is a need to develop a guidebook that**
 - Classifies types of research projects
 - Recognizes potential areas of impact;
 - Recommends appropriate methods based on research types and areas of impact;
 - Recommends proper measures to determine value of research;
 - Describes required data for determining value of research; and
 - Recommends appropriate data collection process throughout research development and implementation.
- **Flexibility is the key to create such a guidebook**
 - A proper guidebook should facilitate communicating value of research.
 - ♦ Current practices and research reports collected here can be a good starting point to develop such a guidebook.

Thanks!

Discussions about next steps Questions & Comments

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