Measuring Research Benefits

National RAC and TRB Representatives Meeting
Value of Research Task Force
July 23, 2019

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Utah Department of Transportation
Mission Statement

Innovating transportation solutions that strengthen Utah’s economy and enhance quality of life.
Utah Department of Transportation

- 1,650 employees
- Formerly: State Road Commission, Department of Engineering, Utah Highway Department
- 88 maintenance stations
- 4 regions
Utah Department of Transportation

1,237 signals

45,617 lane miles

1,867 bridges

520 snow plows

$35 billion inventory of assets

102,493 signs
I-15 Reconstruction
Geofoam Embankments
Congestion Pricing

Layton City
To
Spanish Fork City

~62 miles
Construction Manager-General Contracting
Diverging Diamond Interchange
ThrU-Turns
INVESTING IN UTAH TRANSPORTATION RESEARCH

Prepared For:
Utah Department of Transportation
Research Division

Submitted By:
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Final Report
July 2016
Approaches to Measure Benefits

- **Surveys to project champions and end-users**
  - Obtain cost savings, project grade, other benefits

- **Interviews to gather detailed data**
  - Refine estimates, maintain conservative values, obtain complete input

- **Allow time for benefits to be realized**
  - 2 to 4 years after project conclusion
  - Implementation completed & concepts adopted
Benefit Types

- Pavement & bridge life extension
- Improved rehab & maintenance methods
- Highway design advancements
- Traffic control enhancements
- More efficient & trained staff
- Reduced materials costs
- More efficient equipment
- Better utilize existing equipment
- Improved management
- Congestion mitigation for commuters
- Crash avoidance
- Crash severity reduction
- Construction zone enhancements
- Noise reduction
- Avoid inefficient highway expenditures
- Modify standards to eliminate poor designs
- Replace specs that are unsuccessful
- Reassign staff where not productive
- Find alternatives to inferior technologies
- Informed staff & stakeholders
- Understanding industry advancements
- Knowledge of future trends & challenges
Projects Often Contribute Multiple Benefit Types

- Increased Safety
- Reduced User Impacts
- Improved Quality of Life
- Enhanced Environmental Stewardship
- Advanced Asset Management
- Informed Administration and Policy Decisions
- Expanded Level of Knowledge
Interview Goals

- **Refine benefit estimates**
  - Department factors (crash costs, congestion costs, employee wages & benefits, material costs, etc.)

- **Calculate ranges in benefits (min – max)**
  - Use lower values to be conservative

- **Discuss how the deliverables could be enhanced** (improved implementation)
**Benefit Calculations**

- Number of items increased, saved, avoided
  - Facility life in years
  - Crashes/severity prevented
  - Person-hours saved
- Value of item
  - Annual cost of facility, crash costs, wages
- Percent attributed to research project
  - Portion of initiative enhanced by research

\[
\text{Benefit} = \text{Number} \times \text{Value} \times \text{Percent}
\]
Cost of Research

- Contract amount
- TAC investment
  - Number of members x TAC meetings x loaded hourly rate
- PM costs
  - 10% to 20% of project contract

Cost = Contract + TAC + PM costs
Benefit/Cost =

Number x Value x Percentage

Contract + TAC + PM costs

Note: Total program B/C includes projects where benefits could not be identified.
## Results of Previous Studies

<table>
<thead>
<tr>
<th>Year Reported</th>
<th>Years Evaluated</th>
<th>Number of Projects</th>
<th>Benefit/Cost Estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>1995-1997</td>
<td>22</td>
<td>12</td>
</tr>
<tr>
<td>2010</td>
<td>2006-2008</td>
<td>41</td>
<td>17</td>
</tr>
<tr>
<td>2016</td>
<td>2009-2012</td>
<td>66</td>
<td>14</td>
</tr>
</tbody>
</table>
Project Benefit Statistics

- 50 to 80% - Quantified
- 10 to 20% - Informational
- 20 to 40% - Undetermined

Percentages are based on number of projects. Quantification categories total 100% for each study.
### Benefit/Cost by Project Type

<table>
<thead>
<tr>
<th>Category</th>
<th>Cost ($k)</th>
<th>Benefits ($k)</th>
<th>Benefit/Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infrastructure</td>
<td>$482</td>
<td>$7,270</td>
<td>15</td>
</tr>
<tr>
<td>Operations</td>
<td>$297</td>
<td>$3,815</td>
<td>13</td>
</tr>
<tr>
<td>Administration</td>
<td>$31</td>
<td>$200</td>
<td>6</td>
</tr>
<tr>
<td>Policy Research</td>
<td>$164</td>
<td>$800</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total 3-year</strong></td>
<td><strong>$974</strong></td>
<td><strong>$12,085</strong></td>
<td><strong>12</strong></td>
</tr>
</tbody>
</table>

Benefits of Research Projects in Utah, May 2000
Management Uses of Benefit Information

- Defend research program budget
- Establish policy & guidelines for use of technologies
- Create B/C library
- Share interesting technologies with the public, Commission & State Legislature
Research Division Uses of Benefits Information

- Identify key areas to focus future projects
  - High B/C project types
  - DOT emphasis areas needing more study
- Identify successfully completed projects that have not been adequately implemented
- Review program balance/priorities
- Improve research project management
- Identify top performing consultants/champions
Movable Barrier Example

- Reconstruction of 3500 South in West Valley, Utah
- Movable barrier was used to change from a 4-lane pattern to a 3-lane construction zone
- Rush hour traffic carried by 2 lanes AM & PM
- Goals:
  - Control congestion
  - Restrict left turns between intersections
  - Open area for construction activities
Movable Barrier Findings

- Lower user delays
- Crash costs reduced
- Business losses reduced
- Travel time impacts reduced
- Congestion level maintained
- Project completed 7 months early
- Worker and commuter safety enhanced
- Movable Barrier could benefit additional future high volume urban projects
Benefit/Cost: Movable Barrier

\[
\text{Number} \times \text{Value} \times \text{Percent} = \text{Contract} + \text{TAC} + \text{PM costs}
\]

- (12 property damage crashes)($3,200)
- + (6 injury crashes)($62,500)
- + (5 serious injury crashes)($122,400)
- + (4 min saved)(7,840 vehicles)(150 days)($12/hr)

\[
= \frac{22,000 + 8,640 + 4,400}{25%} = 14
\]

Research B/C = 14
B/C Applications

Determine the B/C ratio and back-calculate required benefit:

- **Cable Barrier**: Where B/C=15, use if one or more fatal cross-over crashes are expected in barrier lifetime.
- **Fast-Track Construction**: Where B/C=10 and added costs=$400K over traditional; use if congestion and crash mitigation savings exceed $4M.
Innovation & Efficiencies Report

- Region Four Water Truck
- Truck and Trailer Electrical Test Box
- Three-Year Maintenance Planning Tool
- Storm Management Dashboard
- Intelligent Design and Construction
- Real-Time Pavement Smoothness
- Unmanned Aircraft Systems
- Moab Adaptive Signal Control
- Wind Mitigation for Signal Mast Arms
- P+T+Quality Bidding
- Electronic Signature Routing
- Statewide Utility License Agreements
- Statewide Access Management Program
- Transportation and Land Use Connection
- Bicycle & Pedestrian Counts Guidebook
362 IDEAS SUBMITTED

Since Innovation group started June 2017

Implemented Ideas

Implemented 50.3%

In Progress 48.7%

Bar chart showing:
- Tech & Innovation with 65 implemented and 7 submitted ideas
- Region 4 with 98 implemented and 59 submitted ideas
- Region 3 with 34 implemented and 29 submitted ideas
- Region 2 with 54 implemented and 54 submitted ideas
- Region 1 with 33 implemented and 27 submitted ideas
- Project Dev with 18 implemented and 5 submitted ideas
- Other with 2 implemented and 1 submitted idea
- Operations with 15 implemented and 2 submitted ideas

Legend:
- Blue: Implemented Ideas
- Orange: Submitted Ideas

Footer: LTDOT - Keeping Utah Moving
The INNOVATOR
June 2019