Benefit-Cost Analysis of Traffic Sign Upgrades

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“The purpose of traffic control devices, ... is to promote highway safety and efficiency…”

“Traffic control devices notify road users of regulations and provide warning and guidance needed for the reasonably safe, and efficient operation of all elements of the traffic stream”.

“The use of brighter retroreflective sheeting material appears to reduce the frequency of both total crashes and right angle crashes.

Goals

- Compare results of various sign upgrade programs.
- Identify a Benefit to Cost Ratio that could be reasonably expected for sign upgrade projects.
- Provide best practices guidance for future upgrade programs.
Study Subjects

- City of Sioux City, IA – Scott Carlson
- Mendocino County, CA – Steve Ford
- ICBC, Vancouver, B.C. – John Pump
- Putnam County, NY – Mike Druckreier

Actual Vs. Controlled Applications
Field Information Vs. Laboratory
Compare and contrast rather than traditional research
Not Reporting on Theory, Reporting on Actual Results

- Four different agencies
- Four different applications
- Four methods
- One Result
Sioux City, IA

- Began Aggressive Upgrade in 1995/1996
- Upgrading all sign series from Type I to Type IX Community Wide*
- Also began durable pavement marking program at same time – Limited locations

“Not only have total accidents gone down but the night/day ratio is a real testament to higher visibility signs and durable/better retro-reflective pavement markings”

- Scott Carlson – Traffic Supervisor

* Began Type III Upgrade in 1995, converted to Type IX, did not include parking series
Sioux City, IA

- 30% reduction in actual number of crashes 1995-1999

- Crash Rate fell from 6.53 crashes per MVMT in 1995 to 4.03 crashes per MVMT in 1998


- Project Cost 1997-1999 $144,925 - Benefits based on reduction in crashes $4,920,900

- Benefit to Cost Ratio $33.95 to $1
Putnam County, NY

- Began sign replacement program in 1993
- Type I signs to Type III and Type IX signs
- Arrows, Chevrons and Warning Signs
- Signing was only significant improvement at sites

<table>
<thead>
<tr>
<th>Year</th>
<th>1992</th>
<th>1995</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fair Street</td>
<td>42</td>
<td>21</td>
<td>-50%</td>
</tr>
<tr>
<td>Croton Falls</td>
<td>39</td>
<td>39</td>
<td>0%</td>
</tr>
<tr>
<td>Stoneleigh Ave</td>
<td>31</td>
<td>23</td>
<td>-35%</td>
</tr>
<tr>
<td>Total</td>
<td>112 Crashes</td>
<td>83 Crashes</td>
<td>-25%</td>
</tr>
</tbody>
</table>

The Croton Falls location did not see a real number decrease in crashes. However, nighttime crashes were reduced by 53% and wet pavement was a contributing factor in 21 of the crashes.
### Contributing Factors

<table>
<thead>
<tr>
<th>Failure to Yield</th>
<th>1992</th>
<th>1995</th>
<th>Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROW</td>
<td>16</td>
<td>2</td>
<td>88%</td>
</tr>
<tr>
<td>Unsafe Speed</td>
<td>23</td>
<td>2</td>
<td>91%</td>
</tr>
<tr>
<td>Slippery Pavement</td>
<td>22</td>
<td>4</td>
<td>82%</td>
</tr>
<tr>
<td>Following Too Close</td>
<td>8</td>
<td>1</td>
<td>88%</td>
</tr>
<tr>
<td>Improper Lane Usage</td>
<td>4</td>
<td>2</td>
<td>50%</td>
</tr>
<tr>
<td>Driver Inattention</td>
<td>1</td>
<td>2</td>
<td>-100%</td>
</tr>
<tr>
<td>Other</td>
<td>24</td>
<td>2</td>
<td>92%</td>
</tr>
</tbody>
</table>
Putnam County, NY

- Reduction of 18 injury crashes to 6
- Total cost of installations $160,000
- Estimated savings from reduced crashes $185,000
- Benefit to cost 1.16 to 1
- Cost of program recouped in first year with expected minimum life of 7-10 years.
“The benefits to the county appear to be phenomenal. By taking an active role in roadway safety, the Putnam County Highway Department offers its customer – the vehicular and pedestrian traffic on county roads – a much safer environment. This improvement will continue to yield positive results as the county population grows and ADT’s continue to rise.”
Mendocino County, CA

- Completed a review of select roadways, identified deficiencies such as obsolete or inconsistent signs, poor sign locations or unmarked hazards, recommending corrective actions and reviewed the results
- Type I signs replaced with Type III Signs
- Compared results to control groups

<table>
<thead>
<tr>
<th>Study Group</th>
<th>Change in Crashes over 6 year study period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roadways with improved signing</td>
<td>-42%</td>
</tr>
<tr>
<td>Control Group 1- No Improvements</td>
<td>26%</td>
</tr>
<tr>
<td>Control Group 2- No Improvements</td>
<td>-3%</td>
</tr>
</tbody>
</table>
Results

The cost to complete the work was approximately $79,000. Based on average crash costs and the actual reduction in crashes, it is estimated that the program saved between $12.5 Million and $23.7 Million with a benefit to cost ratio between 1:159 and 1:299.

- Since the original results were so positive, the program was expanded in 1996 to include local streets with some crash history and continues today.
- Since 2000 some of the signs are being converted to more reflective Diamond Grade™ (ASTM Type IX).
Insurance Corporation of British Columbia

- Began program in 1996
- Upgraded Type I Signs to Type IX
- Only included safety related signs such as regulatory and warning signs
- Various locations throughout British Columbia
Results

Implementation of highly reflective signs and pavement markings has the potential to reduce night-time collisions by increasing sign conspicuity, sign legibility, and consequently driver perception time.

Source - G.D. Hamilton Associates Consulting Ltd
Not Reporting on Theory, Reporting on Actual Results

Details of each case can be debated to minutia but the results are:

- Upgrades result in safer roads
- Sign upgrades are a low cost safety solution
- Upgrades show results
- Program costs recovered in first few years
- One Consistent Result = Improved Safety
<table>
<thead>
<tr>
<th>Location</th>
<th>Years</th>
<th>Savings*</th>
<th>Savings Adjusted*</th>
<th>Costs</th>
<th>B/C Ratio</th>
<th>B/ C Ratio Adjusted for 10 Years**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sioux City</td>
<td>3</td>
<td>$4.92M</td>
<td>$11.6M</td>
<td>$144,925</td>
<td>33.95:1</td>
<td>267:1</td>
</tr>
<tr>
<td>Putnam County</td>
<td>1</td>
<td>$185,600</td>
<td>$185,600</td>
<td>$160,000</td>
<td>1.16:1</td>
<td>11.6:1</td>
</tr>
<tr>
<td>Mendocino County</td>
<td>6</td>
<td>$12.5M - $23.7M</td>
<td>$2.4M - $4.5M</td>
<td>$79,000</td>
<td>159:1 - 299:1</td>
<td>50.6:1 to 94.9:1</td>
</tr>
<tr>
<td>ICBC</td>
<td>3</td>
<td>NA</td>
<td>NA</td>
<td>$1.5 M</td>
<td>&gt; 10:1</td>
<td>NA</td>
</tr>
</tbody>
</table>

*Savings based on local data

** Crashes adjusted to an 1997 NSC Estimate of $ 6,400 - Signs adjusted for 10 Year Life
Goals

- Compare results of various sign upgrade programs. Results Different-Results Positive

- Identify a Benefit to Cost Ratio that could be reasonably expected for sign upgrade projects. Between 11 and 267 to 1

- Provide best practices guidance for future upgrade programs. Begin upgrades
Thank You!

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