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<table>
<thead>
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<th>Abbreviation</th>
<th>Description</th>
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<tr>
<td>Clr</td>
<td>Clear weather conditions</td>
</tr>
<tr>
<td>Cldy</td>
<td>Cloudy weather conditions</td>
</tr>
<tr>
<td>X/Wind</td>
<td>Severe crosswinds</td>
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<td>Daylgt</td>
<td>Daylight</td>
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<tr>
<td>FAT</td>
<td>Fatality</td>
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<tr>
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<td>Injury</td>
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<td>Fatality &amp; Injury</td>
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<td>Property Damage Only</td>
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<td>Angl</td>
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<td>No collision with another vehicle</td>
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<td>Rear end collision</td>
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<td>CTH</td>
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INTRODUCTION

In this evaluation, WisDOT Division of Transportation Investment Management (DTIM) provided the TOPS Laboratory a list of HES/HSIP projects from the FIIPS database completed in SFY 2005. According to the project locations and scheduled start and completion dates, the TOPS Laboratory developed a process to extract appropriate crashes (by location, type and year) from the WisDOT crash database for a before-and-after project-level analysis. A significant amount of crash data, 5 years of “before” and 3 years of “after” data, was retrieved to justify the use of HES/HSIP funds. TOPS Laboratory used the Before-After and Empirical Bayes evaluation methods to assess the HES/HSIP projects from various aspects. Fatal and injury crashes were the focus but the analysis was extended to target crashes based on the nature of the projects. Moreover, a Benefit-Cost ratio analysis was also performed to provide an economic perspective to the evaluation based on both the Before-After and Empirical Bayes analyses.

A total of 17 HSIP projects completed on Wisconsin roads were evaluated in detail. Moreover, 28 projects completed at railroad crossings were also evaluated based on available crash data. The projects crossed a wide spectrum of highway safety improvements and enhancements, such as lane reconfiguration, traffic signal enhancements, addition of turning lanes, pavement friction improvement, and so on. Each project evaluated includes a general description of the project location, the safety issues experienced at that location, the improvements that were implemented, the Before-After and Empirical Bayes crash analysis and respective Benefit-Cost analyses based on Before-After and Empirical Bayes results. The following sections provide complete details of the data collection procedures and sources, methodologies of evaluation techniques, and a brief summary report for each individual project.

DATA COLLECTION

The process of data collection started with obtaining a list of all highway and railroad projects completed in the FY 2005 in Wisconsin. The project list consisted of basic information such as project identification numbers, location, etc., based on which the respective WisDOT regional traffic safety engineers were contacted to obtain detailed information regarding these projects. Detailed evaluation was limited to the constructed highway projects only while railroad and design projects were not evaluated in detail because of lack of crash and detailed improvement data.

The detailed project information, if available, was acquired from traffic safety engineers in the form of original HES/HSIP applications and accompanying submittal information. The HES/HSIP project application forms were completed between the period of 1999 and 2003. The HES/HSIP project application forms provided several useful pieces of information such as preliminary cost estimates, previous year crash numbers, a summary of safety issues and proposed improvements, crash rates, and some form of proposed improvement figures or drawings etc. All this information was made use of in the subsequent analysis and benefit-cost ratio calculations. In addition to this,
project location maps were produced from various other sources and websites to aid in the overall presentation and crash analysis.

Once the detailed project information was collected, the next step was the collection of crash data from the MV4000 database through the WisTransPortal. From the given project information and maps created, crash data were collected for individual projects, before and after the implementation of safety improvements. The before period was defined as five years before the start date of the construction of project. The after period was defined as the time period from one month after the end of construction till December 31, 2007. The start and end construction dates were collected and verified from a number of sources to establish the most accurate account of before and after periods for accurate evaluation of safety improvement projects. Detailed crash characteristics were retrieved from the WisTransPortal database at [http://transportal.cee.wisc.edu/applications/crash-data/](http://transportal.cee.wisc.edu/applications/crash-data/) for subsequent analysis, such as weather conditions, manner of collision, crash severity, and road conditions etc. Traffic volume data were also collected for each project location from WisDOT’s Wisconsin Highway Traffic Volume Data books for various years for the Empirical Bayes analysis.

**METHODOLOGIES**

This section describes the next step after data collection in the evaluation of Highway Safety Improvement Projects for the FY 2005. The methodologies for two main types of analyses used in evaluating individual projects are narrated in detail.

**Empirical Bayes Analysis**

The Empirical Bayes analysis increases the precision of safety estimates given lack of long term safety data and eliminates the regression to the mean effect. It takes into account the safety of the site being evaluated and conditions at similar sites in order to estimate the best possible safety performance. For example, to estimates the safety of a specific intersection, one should use not only the crash counts for the specific intersection but also the knowledge of typical crash frequencies of similar intersections at other locations. Empirical Bayes analysis uses the joint information from actual location and similar sites based on a weighted average to estimates the “Expected” frequency of crashes at a particular location. This expected safety can then be compared to actual safety of the location to assess the true improvements or otherwise at a site after safety improvements. Detailed information and tutorial on Empirical Bayes analysis and its calculations can be found in the document by Hauer (I).

A comprehensive Empirical Bayes analysis was conducted to analyze the safety improvement projects completed at intersections and road segments in the FY 2005. Crash data were collected for each project location as described in the data collection section. The Empirical Bayes evaluation consisted of estimation of crash benefits in terms of reduction of “Target Crashes” based on the Empirical Bayes methodology followed by Benefit-Cost analysis based on Empirical Bayes estimates. The before and
after periods were identified based on the actual start and end dates of the safety improvements as provided by WisDOT. A grace period of one month was assumed after the end of construction in order to provide a stabilization period for drivers to get used to change in conditions at project locations. In the case where no specific dates were provided, the start date was assumed to be January 1 2005 and the construction period was assumed to be six months. Once the start and end dates for each project were fixed, crash records for the before period were collected for before and after periods as described in the data collection section. The before and after periods were calculated in number of days because of different start and end construction dates.

Empirical Bayes analysis required traffic volume data, safety performance functions, and other ancillary project information such as area type, project length, project cost, growth factor etc. Traffic volume data were collected from the Wisconsin Highway Traffic Volume Data books. The safety performance functions were selected from the database of FHWA’s Safety Analyst software. Equation 1 and 2 below shows a typical Safety Performance Function for a road segment and intersection respectively.

\[ \mu = e^{\alpha} \times ADT^\beta \times L \]

(1)

\[ \mu = e^{\alpha} \times MajADT^{\beta_1} \times MinADT^{\beta_2} \]

(2)

where

\( \mu \) = the number of crashes per km per year expected on similar segments and crashes per year expected for similar intersections
\( \alpha, \beta \) = Coefficients of constant and ADT values
\( ADT \) = Average Daily Traffic
\( MajADT \) = Average Daily Traffic on major road of an intersection
\( MinADT \) = Average Daily Traffic on minor road of an intersection
\( L \) = length of segment

The Safety Performance Functions provided in Safety Analyst have been developed using national data and describe the performance of facilities on nationwide level. Ideally these Safety Performance Functions should be calibrated to Wisconsin conditions but it was impossible to do so due to lack of data. Nevertheless, the results provided comparisons of safety improvements conducted in Wisconsin to the performance of similar countermeasures on nationwide scale. Moreover, the use of Empirical Bayes methodology eliminates the regression to the mean effect to present actual benefits of safety improvements that are overlooked in traditional Before-After analysis. The rest of ancillary project information was obtained from original HSIP project applications and supplementary information provided by the regional safety engineers.
The Empirical Bayes analysis was conducted for each of 17 projects completed in the FY 2005 in Wisconsin. As described above, the results of Empirical Bayes analysis are based on a weighted average of safety performance of observed site and similar sites. General form of the Empirical Bayes result is presented in Equation 3 below.

$$\pi = w \times \eta + (1 - w) \times \lambda$$

(3)

where

$$w = \frac{1}{1 + \left( \frac{\mu \times Y}{\varphi} \right)}$$

(4)

$0 \leq w \leq 1$

$$\eta = \mu \times Y \times L$$

(5)

$\pi$ = Crashes that would have occurred at project location in the entire after period in the absence of safety improvements  
$\lambda$ = Total number of observed crashes in the entire after period at the project location  
$w$ = Weight used in Empirical Bayes calculations where  
$\varphi$ = overdispersion parameter of Safety Performance Function  
$Y$ = Before and After period in number of days  
All other variables are as described previously

The results of Empirical Bayes analysis as described by the equations presented above shows a comparison between observed safety at a particular site after safety treatment was implemented and the expected safety performance had no safety improvement been conducted at that site. Such comparison provides detailed insight into the actual safety benefits at project location which would otherwise be inaccurately estimated by the naïve Before-After analysis due to regression to the mean effect. These results were calculated for total number of crashes.

A number of “Measures of Effectiveness” were also calculated to establish the statistical significance of Empirical Bayes analysis results. These MOE’s describe whether the treatment was effective in reducing the number of crashes at a particular location and whether the results are statistically significant given the number of crashes and reduction in number of crashes.

Along with Empirical Bayes analysis of total number of crashes, the results also present an estimate of actual and expected safety performance by “Crash Severity” and “Manner of Collisions” along with treatment effectiveness and statistical significant in
terms of each severity level and manner of collision. The color green and red represents treatment effectiveness or non-effectiveness and statistical significance or non-significance respectively.

Note that the Empirical Bayes analysis was not conducted for projects that involved the installation of skid resistance surface treatments in icy conditions because the Target Crashes for these projects were only snow and ice-related crashes and there is no Safety Performance Function specific to the estimation of snow or ice-related crashes on bridges. The results of Empirical Bayes analysis provide a difference perspective on safety estimates which is more precise and statistically robust to account of discrepancy in crash data analysis. These results are further used in calculating the Benefit-Cost ratio which is described in subsequent section.

**Before After Crash Analysis**

A comprehensive Before-After crash analysis was conducted to analyze safety improvement projects completed at intersections and road segments in the FY 2005. Crash data were collected for each project location for periods before and after the implementation of safety improvements. The before and after periods were defined as already described in the data collection section. Since the number of days were unequal between “before” and “after” periods, the total number of crashes for each project in the before and after period were normalized by the corresponding number of days. This provided and overall picture of the effects of safety improvements completed at each location. A percent change in the total number of crashes was calculated based on the following equation.

\[
\text{% Change in Crashes} = \left[ \frac{B - A}{B} \right] \times 100
\]

(6)

*where*

A = ratio of number of crashes in the after period to number of days in after period  
B = ratio of number of crashes in the before period to number of days in before period

Crashes in the before and after periods were also compared based on different types or classification of crashes as follows:

1. Road Conditions  
2. Weather Conditions  
3. Manner of Collision  
4. Accident Severity

These analyses provided detailed comparison for different crashes outcomes in different circumstances to assess specific improvement areas. Moreover, these analyses also helped in identifying safety trade-offs due to the implementation of certain types of safety countermeasures, which may result in a shift in other safety issues. For instance,
upgrade a stop-controlled only intersection to a signalized one may eliminate angle crashes but could result in an increase in rear-end crashes. This means that the safety problem has been shifted from one type of crashes to another. Detailed comparison of crashes by different types or conditions helped in the identification of positive effects of safety improvement and possible side impacts as well.

**Target Crash Classification**

In order to gain an economic perspective of the performance of various safety improvement projects, a benefit-cost analysis was conducted. In this case, it was required to classify target crash types for each individual project. Target Crashes stand for the primary crash type or types that the safety improvements were intended to mitigate or eliminate. The process of identifying target crashes was completed in light of information from the HSIP project files and the type of safety improvements suggested for each location. For example, in a project where exclusive left-turn lanes were constructed to eliminate angle crashes at an intersection, the Target Crash type was selected to be angle crashes. Therefore, the Benefit-Cost ratio analysis was conducted based on the reduction in only the angle crashes and changes in other types of crashes were ignored. Note that for intersections which were signalized due to problems with angle crashes, rear-end crashes were also included as “Target Crashes” because it is generally accepted that installation of a traffic signal can result in increased rear-end crashes. Therefore, it was deemed necessary to include these crashes in economic analysis.

**Economic Analysis**

The process of economic analysis was based on a modified form of benefit-cost analysis. Benefit-cost analysis usually consists of comparing the existing cost of a project with expected benefits in the future, which has not been observed yet. This methodology was modified to compare the cost of each project with actual benefits observed in terms of reduction in the number of crashes in the after period. The benefit-cost analysis was completed using the results from Empirical Bayes analysis and Before-After analysis of Target Crashes.

Benefit-Cost ratio calculation based on Empirical Bayes analysis results compared the expected number of crashes if no safety treatment had been conducted at a site with observed number of crashes at the same site. Similarly, Benefit-Cost ratio calculations based on Before-After analysis results compared the number of crashes in the before period with number of crashes in the after period normalized by the number of days. The use of both methodologies to conduct Benefit-Cost ratio calculations provided useful insight into comparing the performance of safety improvements in Wisconsin with nationwide results in economic terms. Moreover, the economic analysis was conducted by crash severity levels which provided additional detail in terms of reduction of crash severity at project location. This helped comparing the effects of safety countermeasure on both target crash numbers and severity. Also it provided a comparison between the Empirical Bayes analysis and the naïve Before-After analysis which shows that the
Empirical Bayes analysis rightly reduced the overestimation of safety benefits which it attributes due to the regression to the mean effect. A spreadsheet was developed for calculation of Benefit-Cost ratio results based on both Empirical Bayes analysis and Before-After analysis results, which consisted of the following sections.

**General Project Information**

In the first section, general project information was provided in the form of project location, county, city, street names, intersection control type or corridor location, start and end dates of the before and after periods, and project FOS ID. A brief summary of safety issues and proposed improvements at individual locations was also provided in this section.

**After Period Expected Crashes Estimate (Without Treatment)**

In this section, the results of the Empirical Bayes analysis were entered based on the severity and manner of collision of crashes. These numbers represent the estimated crashes expected at a site in the event of no safety improvement being conducted. Since these numbers are estimates, they are represented in decimal form. The severity of crashes was based on the KABC type scale indicating fatal, incapacitating, non-incapacitating evident, possible injury and property damage only crashes. Therefore, crashes were identified by their types and the scales of severity. As mentioned above, benefit-cost analysis was completed using reduction in target crashes. The target crashes were selected by typing “Target” in the “Target Crash Indicator” row above the different crash type classifications.

**After Period Observed Crashes (With Treatment)**

All the crashes in the after period at the specific site under study were entered in a fashion as described in the previous section.

**Crash Data (Before Period)**

In this section, all the crashes in the before period were entered based on the type of crashes and their severity. The crashes were classified into angle, head-on, rear-end, sideswipe-same direction, sideswipe-opposite direction, and pedestrian type crashes. The severity of crashes was based on the KABC type scale indicating fatal, incapacitating, non-incapacitating evident, possible injury and property damage only crashes. Therefore, crashes were identified by their types and the scales of severity. The target crashes were selected by typing “Target” in the “Target Crash Indicator” row above the different crash type classifications.

**Crash Data (After Period)**
All the crashes in the after period were entered in a fashion as described in the previous section.

**Benefit Cost Analysis (Empirical Bayes and Before-After Based)**

This section was further split into two parts. The first part calculated the “Observed Project Benefits”. This was based on the difference between the number of crashes normalized by the number of days in the before and after periods respectively. The actual monetary benefits were calculated by multiplying the cost of each crash by severity, the per-year target crashes in the before period for each severity type, and crash reduction factor from the difference between the before and after periods. Similarly for Empirical Bayes based Benefit-Cost analysis, the difference was between the expected number of crashes in the absence of safety improvement and observed number of crashes after completion of safety improvements normalized by the number of days. The actual monetary benefits were then calculated by multiplying the cost of each crash by severity, and the difference between expected and actual number of crashes as described previously.

The crash costs used in the detailed benefit-cost analysis for individual projects were based on National Safety Council’s average comprehensive costs of crashes for the year 2005 (2). Note that although all the crash numbers were normalized by number of days in order to compensate for difference in the before and after periods, the final results were calculated based on per-year target crashes. The reason for calculating per year results was to facilitate the comparison between net annual benefit values with annualized costs of the project. The crash reduction factor for each crash by severity in the Before-After analysis was calculated using the following equation.

\[
CRF = \frac{(B - A)}{B}
\]

(7)

where

$CRF$ = crash reduction factor by crash severity type

$A =$ ratio of number of crashes by severity type in the after period to number of days in after period

$B =$ ratio of number of crashes by severity type in the before period to number of days in before period

A positive value of $CRF$ indicates the reduction in a particular type of crash by severity from the before period while a negative value indicates the factor by which a particular type of crash is increased in the after period. For Empirical Bayes based Benefit-Cost analysis, the difference between the expected and observed crashes for the Empirical Bayes based Benefit-Cost analysis can result in negative or positive value, representing respective increase or decrease in crashes after the safety improvement. The calculated “Annual Benefits” shows a positive value which indicates the net monetary
gain in benefits while a negative value indicates the net monetary loss in benefits of each particular crash type by severity.

The monetary benefits for each crash type by all severity levels were added together to give “Total Annualized Benefits”, which was multiplied by a traffic growth factor (TGF) in order to allow for increased benefits due to increasing traffic in the after period with the premise that the number of crashes is proportional to traffic growth. The TGF was calculated using the following equation.

\[
TGF = (1 + g)\frac{(1 + g)^n - 1}{(g * n)}
\]

(8)

where

TGF = traffic growth factor
\(g\) = annual traffic growth rate in percentage
\(n\) = service life of the safety improvements

The values for “\(g\)” and “\(n\)” were input from the actual project files. In the case where these values were not provided, a growth rate of 2% and service life of 10 years were assumed. The product of “Total Annualized Benefit” and TGF offered the “Total Benefit” of the project.

The other part of this section calculated the “Total Cost” by applying standard economic procedures to the total project and maintenance costs as given in the project files. The total project and maintenance cost was input from the project files. In the case where maintenance costs were missing, it was assumed to be $500 per year. A discount rate of 5% was used for all the projects. The Total Annualized Project Cost (TAPC) of the project considering discount rate and other factors was calculated using the following equation.

\[
TAPC = P * \left[ \frac{i(1 + i)^n}{(1 + i)^n - 1} \right]
\]

(9)

where

TAPC = total annualized project cost
\(P\) = total project cost
\(i\) = discount rate
\(n\) = service life

The TAPC added to the maintenance cost per year provides the “Total Cost” per year corresponding to each project. The ratio of “Total Benefit” to “Total Cost” was the benefit-cost ratio for each project.
HSIP PROJECT EVALUATION SUMMARY RESULTS

This section provides summary results of the FY 2005 HSIP project evaluations. Table 1 below presents an overall summary of the projects completed in FY 2005. Table 2 provides summary results for the project evaluations. It provides the start and end dates, the number of days in the before and after periods, and the ratios of crashes per day in the before and after periods along with percentage difference in crashes between the two periods for each project. Categorized crashes per day in the before and after period by various types such as accident severity, injury severity, and manner of collision are also provided. Table 2 clearly shows that out of 17 projects, the number of crashes have been reduced in all but 4 cases. Two of these projects involved installation of anti-skid surface materials while the other two projects were related to intersection modifications.
Table 1 Comprehensive Before-After Crash Analysis for FY 2004 HSIP Projects

(Add Table from Excel printout here)
Table 1 Comprehensive Before-After Crash Analysis for FY 2004 HSIP Projects

(Add Table from Excel printout here)
Table 3 presents summary results of the benefit-cost analysis for the HSIP projects completed in the FY 2005. Detailed calculations for each individual project were provided in the next section where each project was evaluated separately. A comparison between the benefit-cost ratios calculated using Empirical Bayes estimates and Before-After data difference is provided using national average comprehensive crash costs from National Safety Council. The Benefit/Cost analysis was conducted for all 17 projects using Before-After data but for only 12 projects using Empirical Bayes estimates because of the absence of Safety Performance Functions for these projects. The results of Table 3 also shows the general trend where the Benefit-Cost values calculated using Before/After data are higher than those calculated using Empirical Bayes estimates. This is inline with literature in the sense that naïve Before/After analysis tend to overestimate safety benefits where as Empirical Bayes analysis accounts for that overestimation by taking into account the regression to the mean effect.

Table 3 Comparison of Different Types of Benefit-Cost Ratio Analyses

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National Safety Council national average comprehensive crash cost values
*Safety performance was not available for the project type and location
HSIP INDIVIDUAL PROJECT LEVEL EVALUATION RESULTS

The sections below present a one page summary of the results of the individual project evaluations for HSIP projects completed in the FY 2005. The details include summary information on project information, safety issues, countermeasures implemented, and the results of different types of evaluations. Subsequent tables include detailed information on the Empirical Bayes analysis, Before/After analysis results, and corresponding Benefit-Cost results.
HIGHWAY-RAILROAD GRADE CROSSING PROJECTS EVALUATION

Background

The initial study for FY 2005 consisted of a list containing 28 different railroad grade crossing improvement projects, referred to in this document by their FOS ID identification number. FOS IDs could contain either one project for a single grade crossing, or multiple projects, spread over a region (usually a town, village, or city). Using the given grade crossing DOT identification numbers, the Federal Railroad Administration website (http://safetydata.fra.dot.gov/OfficeofSafety/Default.asp) was used to find any and all crash events at the grade crossing. As shown in Table 5, many of the projects had no crash events at the particular grade crossing to use for a conclusive safety improvement analysis. Those projects which had crashes were very few and are also provided in the table below along with project improvements and cost information.
Table 4 Wisconsin Railroad Crossing Improvement Projects Summary
Analysis and Discussion

The biggest “problem” in attempting to analyze railroad improvement projects was lack of crash events. A significant number of projects had no crash events occurring even years before and after the completion of the projects. Since railroad companies are under pressure to improve the safety and upgrade all sub-standard grade-crossings, it is hard to tell which of these crossings were upgraded simply because they were on a pre-determined list for improvements or if they were upgraded due to its (in most cases, limited) crash history.

Also unknown, are the AADTs for the highways that the listed rail lines cross. Using basic mapping software, many crossings were found to be on fairly minor highways, CTH or lower designation. The amount of exposure to vehicular traffic will make a significant impact in the amount of risk and possibility of a train vs. vehicle crash.

Because of the preceding, a firm conclusion regarding any safety benefits of the given projects cannot be made for any of the projects. Not enough consistent and/or complete data exists, crash or equipment-wise to make a solid conclusion on any safety improvement.

CONCLUSIONS AND RECOMMENDATIONS

This report presents a detailed and comprehensive evaluation of the HSIP projects completed in Wisconsin in the FY 2005. A total of 17 projects were evaluated that were completed in the FY 2005. Majority of the safety improvement projects were conducted in urban areas although there were a few rural locations also. The range of safety improvements at these project locations varied from intersection reconstruction, realignment, redesign, addition of turn lanes (left or right), installation and improvement of traffic control devices (traffic signals, signs, and pavement markings), and so on. A great number of these safety improvements were geared towards the elimination or reduction of angle and/or rear end crashes which were the predominant types of crashes at most intersections.

Each project evaluation includes the analysis of both general crash patterns based on state-of-the-art Empirical Bayes analysis and Before/After data analysis. A few projects were implemented at non-intersection locations, i.e. corridor or segment type of improvements, which have been analyzed differently due to the lack of specific information. It should be kept in mind that the before and after time period is not always the same because of the nature of the projects and different project schedules. It should be noted that in deciding the before and after periods, the construction end dates were extended by 1 month to provide a buffer zone where drivers get used to the changed conditions after the completion of projects, especially construction projects which significantly changed the geometry of roads at that particular location. The crashes occurring during the construction period were excluded in the evaluation.
A detailed benefit-cost ratio analysis was completed for the projects based on the Empirical Bayes estimates and Before/After estimates. For most of the projects, the use of Before-After estimates resulted in a higher benefit-cost ratio value, which is inline with the norm. Overall, the results present a mixed picture with some projects having very high benefit-cost ratio and vice versa. Meanwhile, the benefit-cost analysis raises questions about the justification of a couple highly-priced projects with relative low number of “before” crashes.

The results of the crash and benefit-cost analysis indicate that although crashes were reduced at almost all the project locations, the cost of reducing these crashes at some locations was much higher than at others. It is recommended that a database of such evaluations be created and be used as a future reference to compare the performance of safety improvements and their related costs in Wisconsin.

The amount of detail and accuracy of reporting information varies significantly from event to event for the grade crossing project. The analysis results of the railroad grade crossing projects were inconclusive due to lack of detailed information. These projects were not adequately described to aide in making any conclusions. The vast majority of crossings that received improvements did not show the urgent need from an incident/crash-related perspective or evidence. However, it is understood that in most cases, these improvements were the result of either public pressure, governmental influence or proactive safety countermeasures due to the grizzly nature of railroad related highway crashes.

The evaluation of HSIP projects for FY 2005 in Wisconsin was completed with the help of data collected from various sources. While going through the data collection and analysis process, one of the issues was with the use of Safety Performance Functions for Empirical Bayes analysis. The Safety Performance Functions used in this analysis were taken from the national database of safety performance functions. Ideally, these safety performance functions should be calibrated for Wisconsin data but given the lack of specific information, this could not be achieved. It is recommended that for future analysis, safety performance functions specific to the state of Wisconsin should be used for ideal results. The implementation of these recommendations will greatly improve the accuracy of future evaluation and substantially reduce the time required to complete such analyses. More accurate data alone would allow for the analysis to be completed in less time, while increasing the reliability of conclusions.
REFERENCES