

Quarterly Progress Report

To the

National Cooperative Highway Research Program
(NCHRP)

On Project 22-27

ROADSIDE SAFETY ANALYSIS PROGRAM (RSAP) UPDATE

Limited Use Document

This Quarterly Progress Report is furnished only for review by members of the NCHRP project panel and is regarded as fully privileged. Dissemination of information included herein must be approved by NCHRP

For period
April 1 through June 30, 2012

From
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Introduction

As stated in the original project solicitation and the research proposal, the objectives of this project are to rewrite the software, update the manuals, improve the user interface, and update the embedded default data tables of the Roadside Safety Analysis Program (RSAP).

This report will describe the progress achieved in this project in the previous quarter with respect to the eight tasks identified in the work plan. The following sections will describe the task-by-task progress identifying work items accomplished and any problems encountered in the research. A section describing the contractual status of the project (i.e., funding, schedule, etc.) appears at the end of the report and the progress summary tables and plots appear in [Attachment A](#).

Comments received regarding the last Quarterly Progress Report are addressed in [Attachment B](#) (there were no comments on the last QPR). This quarterly report and attachments can be found on the World Wide Web at <http://rsap.roadsafellc.com/QPR>.

Task 1: Literature Review

Statement of Work

Conduct a literature review for updating the algorithms, procedures, and built-in data of RSAP, including the severity indices and encroachment rates.

This task is complete.

Task 2. Survey of Practice

Statement of Work

Conduct a survey of users in the United States and Canada, with follow-up interviews as necessary, to identify and catalog problems and perceived shortcomings of RSAP. The survey shall include, as a minimum, user inputs regarding default data values, ease of use, and output formats.

This task is complete.

Task 3. Revised Work Plan

Statement of Work

Develop a revised work plan for updating RSAP, based on the findings of Tasks 1 and 2 and the research agency's experience that will accomplish the subtasks outlined below.

This task is complete.

Task 4. Interim Report

Statement of Work

Submit an interim report that presents the findings of Tasks 1 through 3 with recommendations and estimated costs.

Note: The recommendations of the interim report need not be limited to the available funds. Costs for major tasks associated with updating the software and revising the severity indices shall be broken out separately.

This task is complete.

Task 5. Interim Report Review

Statement of Work

Meet with the NCHRP panel to review the Task 4 interim report approximately 1 month after its submittal. Submit a revised interim report addressing the panel's review comments.

This task is complete.

Task 6. Execute the Plan

Statement of Work

Execute the revised work plan approved by the NCHRP at the interim meeting.

Consistent with the January 26, 2010 Interim Report, this task consists of 14 subtasks which are listed below with a brief description of the work performed in each task this quarter.

Task 6A1 – Program Architecture

Develop a detailed program architecture including flow charts and key software module descriptions.

This task is complete.

Task 6A2 – Develop Data Table Specifications

Identify all the data tables that must be created based on the program architecture developed in Task 6A1. Specify what variables will be used by the program to search the data tables and what values the program will read back from the data tables. Expand the number of adjustment factors to represent a wider range of highway geometries (i.e., lane width, shoulder width and type, rumble strips, horizontal curvature, grade, etc.). Represent all data in the form of external text files that can be easily updated without changes to the computational engine. Allow users to substitute user-defined data tables for any of the data tables and adjustment factors used in RSAP.

This task is complete.

Task 6A3 – Pseudo-Code Documentation

Prior to writing the actual code, write a complete pseudo-code for the computation portion of the program. This will create documentation for the program that will be included in the programmer's Manual that will make de-bugging and maintaining the code in the future much easier.

This task is complete.

Task 6A4 – Re-Write the Software

Re-code RSAP using vb.net and target the application to a Windows user interface. Use vb.net wpf for the user interface and C or C# for the computational engine. Allow for the importation of highway characteristics using the Land XML data exchange language.

This task is complete .

Task 6A5 – Verification

Develop and execute a debugging plan that ensures that the calculations performed by RSAP are correct. The plan should be developed and executed in parallel with the development of the code such that each subroutine and module can be independently validated. The check should include the full range of data input expected as well as erroneous and false input to make sure the program detects incorrect or inconsistent input as well as correctly processes data across the full range of valid input.

Verification exercises were completed with each module as the modules of code were developed. The details for verification are included in the Engineer's Manual and Programmer's Manual in the discussions of each code segment. This task is complete.

Task 6B1 – Convert Existing Data to Conforming Data Tables

Convert the data models and default data in the existing RSAP into data tables conforming to the specifications developed in Task 6A2.

This subtask complete.

Task 6B2 – Encroachment Model Updates

Re-model the Cooper encroachment data using more appropriate and modern statistical techniques to develop a more correct and robust encroachment model. Obtain and assess the data bases used in the development of the HSM AFMs and use these data to model encroachments and lateral extents of encroachments. Use the Washington State cable median barrier data to model encroachments and lateral extent of encroachments.

This sub-task is now complete.

Task 6B3 – Multi-lane Adjustment Factor

Eliminate the lane-by-lane simulation of encroachments and replace it with a multilane adjustment factor that is applied to the base encroachment rate.

This sub-task is complete.

Task 6B4 – Updated Severity Indices

Develop a method for estimating crash severity based on observable crash data consistent with the probability of injury approach suggested in the RSAP EM. Use the new method to develop new severity models for at least the basic eight types of features in RSAP.

This sub-task is complete.

Task 6B5 – Penetration of Features

Replace the method used for determining if a hazard has been penetrated using the impact severity with a probability of penetration based on observable crash data.

This task is complete.

Task 6B6 – Driver Input and Curvilinear Paths

Modify the Monte Carlo method to include driver braking and steering input. Create the facility to pass the driver inputs, terrain geometry and encroachment conditions to a look up table. The lookup table can then return the curvilinear geometry of the trajectory and indicate whether or not a rollover has occurred.

This sub-task is complete.

Task 6C1 – Benchmark Cases

Develop at least five bench mark cases that will be used to validate the program as well as serve as example problems in the Roadside Design Guide.

This subtask is complete.

Task 6C2 – Validation

Validate the updated RSAP code using the benchmarks developed in Task 6C1. Validate the benchmark examples using actual crash data and document the results of the validation effort.

The beta version of the RSAPv3 code was validated using two examples where field data was obtained. A concrete median barrier example based on data collected on the New Jersey Turnpike and cable median barrier cases from the State of Washington were used to compare the RSAPv3b predictions to actual field data. The cases used for validation are also included as examples in the User’s Manual. Details of the validation are included in the final report in the “validation” section. The RSAP models for both cases were validated with observed crash data. This task is now complete.

Task 6C3 – Compare RSAP and HSM

Use the benchmark cases developed in Task 6C1 to compare the updated RSAP to the IHSDM CPM (i.e., the computer implementation of the HSM).

This subtask is complete.

Task 7. Alpha and Beta Testing

Statement of Work

Conduct Alpha and Beta testing to validate the full range of updated RSAP capabilities, and revise/validate software accordingly.

The beta version of the software is now complete and will be posted on the RSAPv3 download webpage (i.e., <http://rsap.roadsafellc.com/>) on Monday, July 23rd. An email will be sent out to the panel, all those who attended the alpha workshop in January and other people that have expressed an interest in RSAPv3. The email will inform the group that the beta version is available for download. As was the case for the alpha test, the download page will have the installation program, the example problem workbooks and the user’s manual available for download.

Rather than attempting to schedule a live webinar the research team is going to develop a podcast or Camtasia presentation that can be run from the download site by users interactively. This method has several advantages including avoiding scheduling issues and making the training presentation available to anyone at any time. Beta users can forward questions and comments to the research team who will resolve any issues as they come up. While it would have been preferable to complete the beta test before the draft final report the research team believes it is more important to finish the project on time. The beta test will run up until the final version of the final report is submitted in October.

Task 8. Final Report

Statement of Work

Submit a final report documenting the entire research effort with appendices that include the user's manual, revised RDG Appendix A, and appropriate sections of RDG Chapter 2. The user's manual shall include several example problems with various levels of complexity. The executable software shall be submitted free of defects and viruses on DVD- or CD-ROM, with documentation and user's manual, and all source code in text file format.

The final report is nearly complete. An electronic version of the final report will be distributed to the panel by July 27th. The official printed version of the draft final report will be delivered to the NCHRP program officer at the same time and panel members will receive their hard-copy versions from NCHRP shortly thereafter. All the project tasks have been documented in the final report. The User's Manual, Engineer's Manual and Programmer's Manual are all part of the final report document.

Contractual

The project was initiated on March 1, 2009, the Interim Report was submitted January 25, 2010 and authorization to proceed into Phase II was received on February 25, 2010. The research team and panel requested an additional \$200,000 from AASHTO SCOR and this request was approved on March 25, 2010. The contract modification was signed on 26 August 2010. A second contract modification was executed in December 2010 making a simple change of contractors from Malcolm H. Ray, P.E., Ph.D. to RoadSafe LLC. A third contract modification was executed on June 23, 2011 extending the project end date to June 30, 2012 and a fourth contract modification was executed extending the project end date to October 31, 2012. This will be the last quarterly progress report on this project since the draft final report is being delivered to NCHRP shortly. The project team expects to complete the project on-time and deliver the final report by October 31, 2012. A summary of the progress and fiscal status of the project is shown in [Attachment A](#).

Sincerely,



Malcolm H. Ray, P.E., Ph.D.

Attachment A: [Progress and Fiscal Summary](#)
Attachment B: [Responses to Panel Comments](#)